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POPULAR MECHANICS

DEC. 1964
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Speed Carnival at Bonneville

Buyer's Guide to
Household Batteries

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New Christmas
Project-a-Plans



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Most men think this GMC pickup costs a lot more than it really does. Can you blame them?



A printed circuit replaces the tangle of wires behind the instrument panel. It's a GMC exclusive.

A double-roofed steel cab. Others? A single steel roof.

A husky wood floor that is quiet and long lasting. None of that annoying drumming and rusting.

In-line six engine. More torque, more cooling and lubricating capacity than most competitive engines.

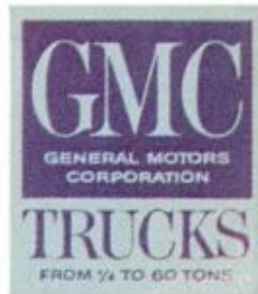
Progressive leaf rear springs that automatically adjust to the load.

*Based on manufacturers' suggested retail prices, the GMC in-line six model pictured above is never priced more than \$49 over comparable competitive base models. Often the difference is less.

Three letters that stand for three important things. Built by truck people. Sold by truck people. Serviced by truck people.

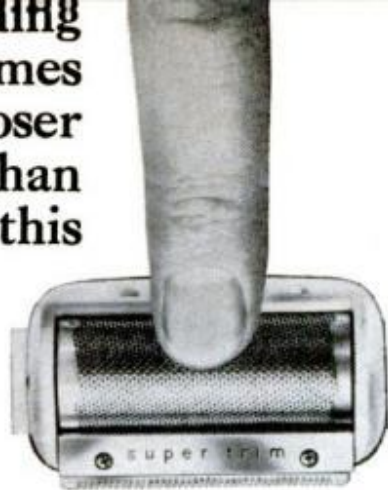
Four headlamps. Most other pickups have just two.

Only GMC offers a proven total suspension system that always gives a smooth ride even with maximum loads.



The truth is its price is only \$49* more than others.

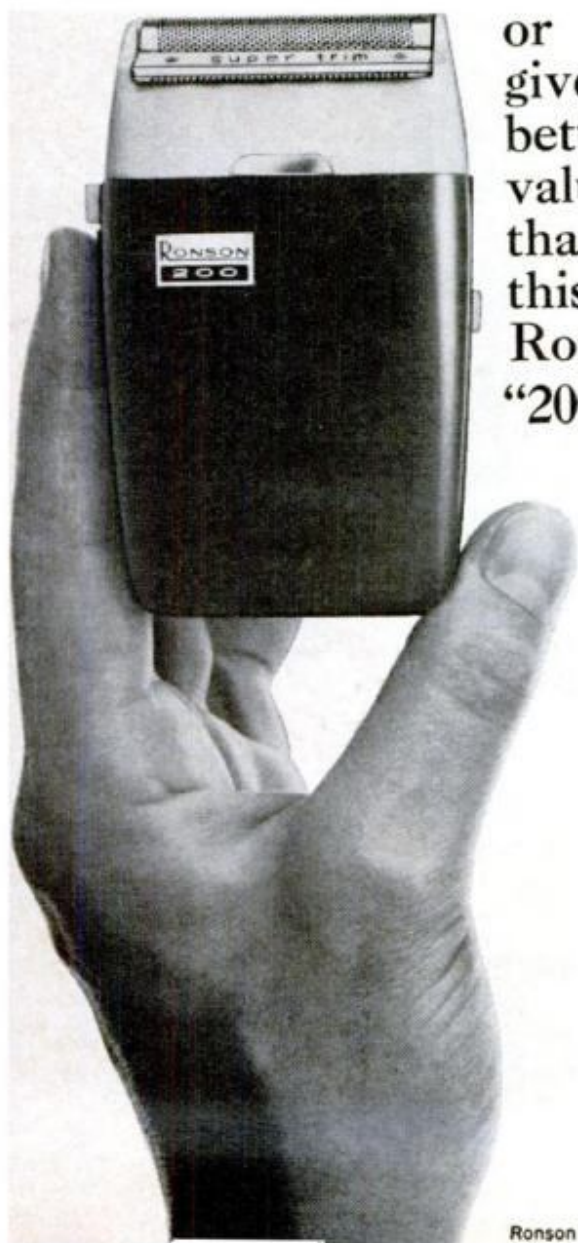
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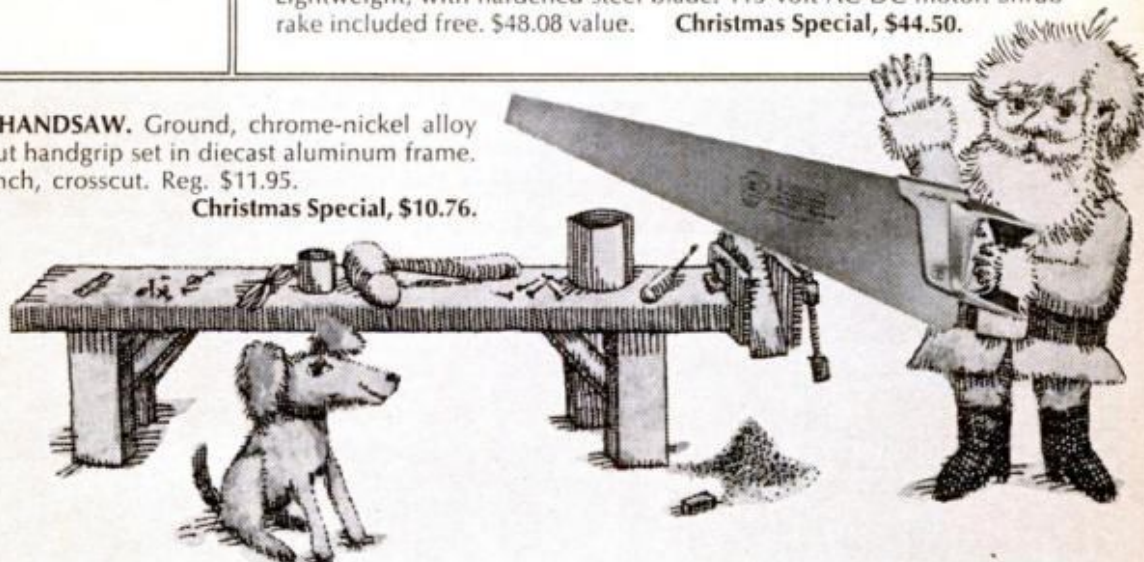


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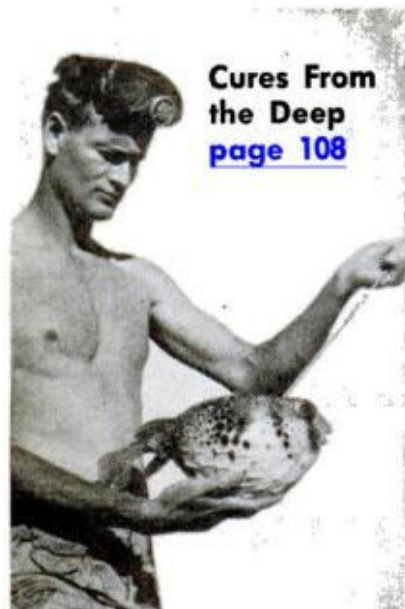
POPULAR MECHANICS®

DECEMBER 1964
VOL. 122 NO. 6

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INTERNATIONAL EDITIONS • AUSTRALIAN • SPANISH • CARIBBEAN • FRENCH • DUTCH

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NEXT MONTH: 1965's snazzy cars are taken apart and put together by an expert mechanic who analyses their faults and virtues. January PM also carries a hot report on a new whispering engine, a rundown on latest ice fishing gadgets, an adventure with a frost-fractured airline, plus does and don'ts for hanging your own wallpaper.

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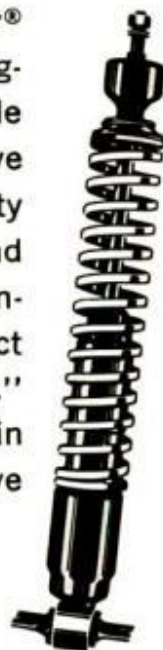
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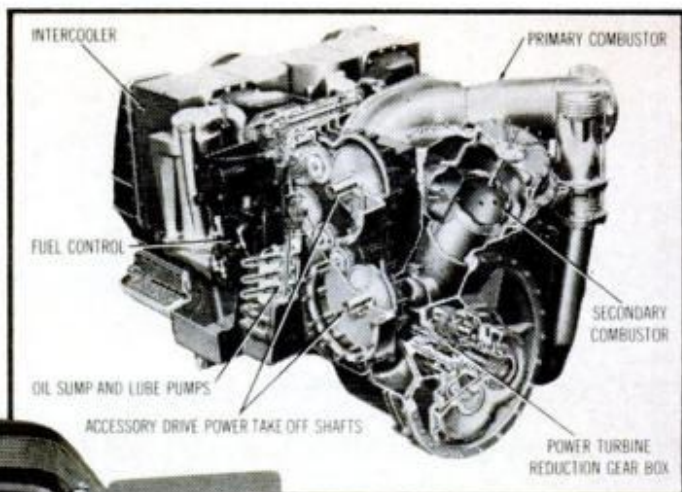
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Over the Editor's Desk

Stair Chair

I built the *Chair That Climbs the Stairs* (page 119, August PM) and it works very well.

When I built this one, I put a 12-volt solenoid and ignition switch in the system so one must have a key to operate it. Otherwise, it would be easy for a child to



move the lever and get into the cable. I also put a guard over the spool to protect anyone from becoming caught in the cable.

Thank you for the very excellent plans. I have had PM every month for over 25 years.

Grantsburg, Wis.

CLAYTON G. RETZER

Rough, Too, in the Good Old Days

In your article *Shin-Bustin' Polo* (page 108, July PM), the authors state, "Cycle polo, unknown a short time ago, is catching on."

I beg to differ; back in 1929 my brother was considered the champion motorcycle poloist of the United States.

Lansdale, Pa.

FRANK E. MANSON

And it was a rough sport then, too, according to a clipping Reader Manson enclosed from the July 5, 1929, Philadelphia Public Ledger. The article tells how Harry Manson, captain of the Philadelphia Ramblers motorcycle team, was seriously burned when a gasoline leak set his clothing afire.

Marine Listener

After I had bought parts and put them in my radio (\$5 Conversion Puts AM Radio on Marine Band, page 172, July PM), I was pleased very much by the way the additional circuit works.

I have been receiving many radiotelephone conversations from the San Francisco area. Five dollars is little for the pleasure I have had.

Big Basin, Calif.

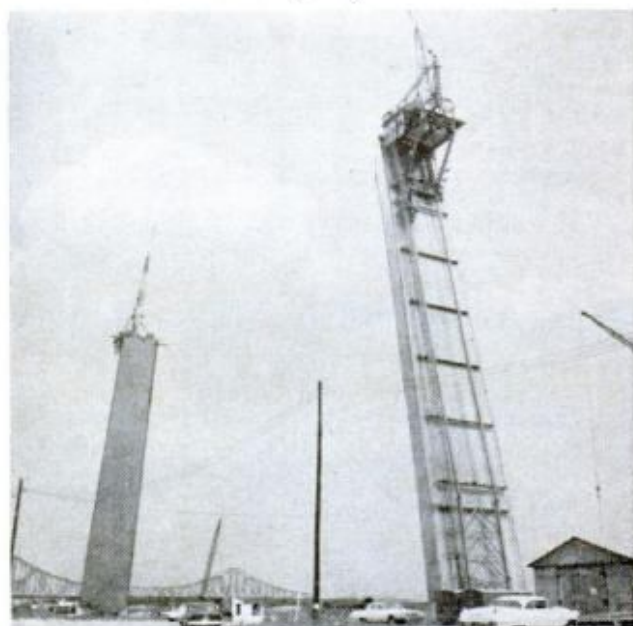
BARNEY TRIGEIRO

St. Louis Revisited

In the December, 1963 issue, Midwest Editor Cliff Hicks reported on the construction of "The Incredible Gateway Arch," America's mightiest national monument. The 630-foot Arch is under construction in St. Louis.

The article pointed out that if construction crews made an error of just $\frac{1}{64}$ inch in pouring the foundation of either of the two mighty legs of the Arch, the legs would fail to meet high in the sky when it was time to slip the keystone section into place.

Editor Hicks recently returned to check on the progress—particularly that $\frac{1}{64}$ -inch. The legs now are more than halfway to their meeting point 630 feet in the air. Construction is slightly behind schedule



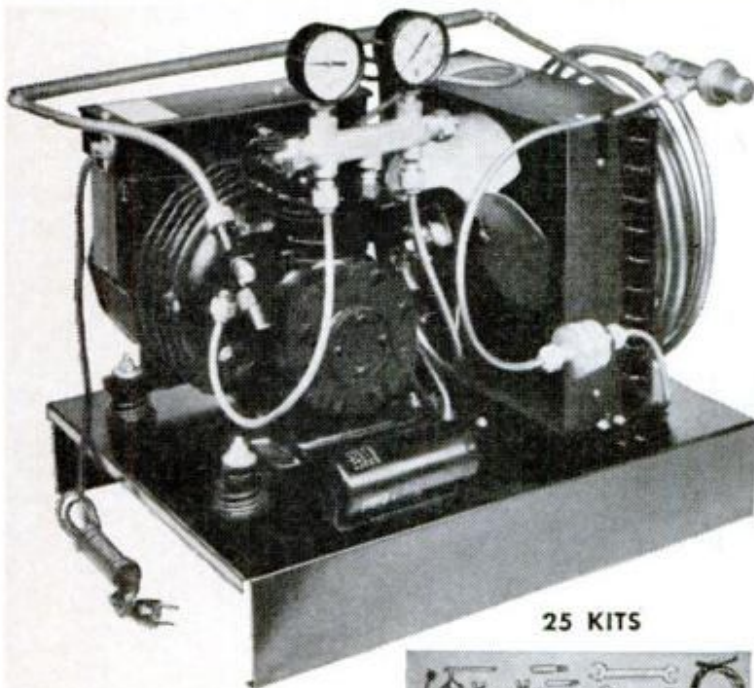
because work was stopped for a few weeks while engineers checked on that $\frac{1}{64}$ -inch, along with every other factor involved, to make sure that one of the tallest and most unique of all man-made structures will be absolutely safe. As a result of this re-evaluation, only a few minor changes were made in construction plans, and there is every indication that if you visit St. Louis on an as-yet undetermined date in the summer of 1965 you can see the mighty derricks hoist the keystone into place.

The Editor

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Sidelights from the SERVICES

By William R. Kreh

Ever wonder if a pilot really can "fly by the seat of his pants," as the old saying goes? Well, apparently he can, according to Dr. H. Strughold, a specialist in aeromedicine. He decided to find out if a pilot really does receive aid in the form of "gravity reports" from nerve impulses transmitted through his posterior. Dr. Strughold injected his backside with novocaine and when said sitter was completely anesthetized, he went aboard an airplane.

The pilot took off and performed a number of slow rolls, loops and other aerobatics. As the doctor sat on his frozen posterior and rolled around the sky, he discovered he had lost all ability to orient himself. Even though, in the course of other medical experiments, he had piled up many hours of aerobatic flying without undue discomfort, Dr. Strughold proved that when he lost his anchor of gravity, i.e., the seat of his britches, the psychological effect produced was one of fear, nausea and absolute disorientation.

Lead bricks—5000 of them—were flown recently to the Navy's Arctic Research Laboratory as part of a federal study to determine how much nuclear fallout has contaminated the food of Alaskan Eskimos and Indians.

The bricks are being used to shield the natives from outside radiation—particularly cosmic rays—while a sensing device measures the radioactive materials that have been absorbed into their bodies over a period of time.

Are birds the answer to ambush detection problems in Vietnam? Apparently the Army's Limited Warfare Laboratory thinks they could be. Pentagon officials have confirmed that a commercial firm has been awarded a \$175,000 contract to study Army findings that birds are able to detect the presence of humans and signal this recognition to other humans. Further details are classified, the Pentagon says.

A revolutionary electric generator has been developed by the Army. The device converts the heat of a gasoline flame directly to 150 watts of electricity. The silent generator has no moving parts, can operate four hours on less than a gallon of gasoline and weighs only 30 pounds.

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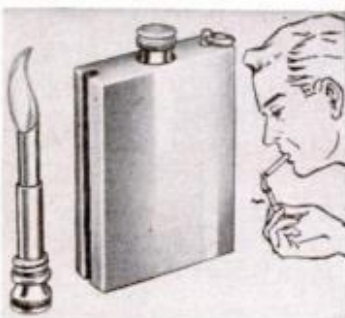


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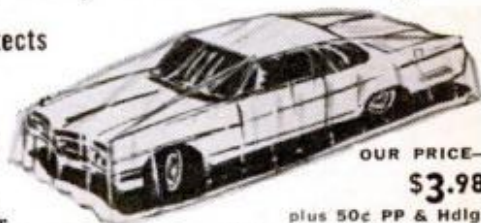
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Christmas trees from the freezer. If you bought your tree at a supermarket and it's between three and four feet high, chances are it came from the freezer vaults of Roy Halvorson in Duluth, Minn. His company ships to cities throughout the country and exports to Central and South America.

The trees are black spruce, which grow in northern Minnesota, Halvorson told *Popular Mechanics*. They're cut in the spring and fall, then coated with a preservative and frozen.

Fish are built all wrong for fast swimming, according to some scientists, and supposedly can't do any better than 25 to 30 m.p.h. But a Los Angeles zoologist, Dr. Vladimir Walters, has clocked a hooked tuna at 46 m.p.h. He read the speed from a simple rig that recorded how fast the line was coming off the reel.

Discovery of a new nuclear fragment was recently credited to an international team of physicists and engineers working at the European Center for Nuclear Research in Switzerland. Named the *epsilon* particle, the fragment has a mass approximately four-fifths that of the nuclear building blocks, protons and neutrons, and is the sixteenth member of the family of nuclear particles called mesons to be identified.

Mystery in the Indian Ocean. Russian and British research vessels report finding huge areas—as large as 75,000 square miles—covered by millions of dead fish. Scientists have arrived at this explanation: Mineral-rich but oxygen-poor deep water rises and promotes the growth of plankton (minute organisms). As the plankton dies and decomposes, it uses up more oxygen, causing fish to asphyxiate.

Scientists at Cornell University report that they've been able to keep whole eggs fresh for more than two years. Their method: pack the eggs under high vacuum and store them at 40 degrees F.

For a lot of guests, or for someone with a real yen for hard-boiled egg, British food experts have produced a composite egg a foot long. The yellows of eight eggs are boiled in a 12-inch-long cylinder. The resulting stick of yellow is placed on end in another cylinder and the whites are poured around it. Another boiling and you have a big sausage-shaped egg that's handy for slicing.

An antenna described as the "free world's most advanced radio communications instrument of its kind" has been installed at Tyngsboro, Mass. The 120-foot aluminum saucer is said to be capable of detecting a quarter-inch metal sphere 1000 miles in space.

Super snooper. It's now possible to measure TV audiences without contacting a single viewer. A California firm has developed an electronic device that can detect the tiny signals that are emitted by television receivers. Installed in a truck, the device can quickly tell which houses have TV turned on and which channels are being watched.

Doctors at New York's Albert Einstein College of Medicine are doing research on the feathers of a rare African bird, the loerie. It seems that the loerie is not "color fast"—the red in its feathers washes off. After a rain, it takes several days for the bird to get his color back.

The red pigment is closely related to the red of hemoglobin, which gives color to human blood. Experiments with the loerie red may help explain the nature of nutritional blood ailments.

Sign of the times. One *PM* editor recently renewed an accident insurance policy that provides coverage for air travel. In addition to the usual exclusions involving such things as suicide and war, he noted a new one: "This policy does not cover loss caused by or resulting from travel or flight in any vehicle or device for navigation beyond the earth's atmosphere."

By adding a TV attachment to an electron microscope, engineers at RCA have developed an instrument capable of magnifying an image two million times. Under such magnification, a one-inch paper clip would appear 32 miles long. Standard electron microscopes can magnify objects 200,000 times.

John F. Pearson
Science Editor
POPULAR MECHANICS

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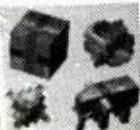
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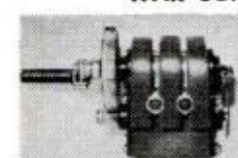
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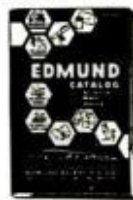
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Noteworthy New INVENTIONS

By M. J. Pedersen

A ship on a collision course with another moving object, can be warned automatically by a relatively inexpensive radar modification which was awarded patent 3,149,325 for John F. Kellogg of Bethesda, Md. When two objects are moving in straight lines so as to reach the same point at the same time, the angles between the paths of the objects and a line joining the objects remain constant, regardless of the relative speeds and directions as long as these do not change. In such an event, an alarm is tripped by the new device.

Space vehicle changes its shape so it can travel at the high speeds necessary to reach orbit or at the much slower speeds for controlled flight and landing. It unfolds sections into a winged configuration. The vehicle earned patent 3,147,936 for Earl J. Mercille, Creve Coeur, Mo.

A free-piston hydraulic pump that could be used to power automobiles is not mechanically connected to convert the power it generates into useful work, as in the transmission of most automobiles. Its power is used directly; the free piston engine is linked to a hydraulic pump in a single interacting unit. Receiving patent 3,145,660 on his invention, Dr. Vannevar Bush of Belmont, Mass., says that a free piston is more efficient than conventional engines and operates on cheaper fuel.

Spotting decoys surrounding a bomb-carrying missile to confuse detection and tracking instruments can be accomplished by a laser light beam. The usual decoy being an inflatable balloon with a reflective coating, the intense coherent light from a laser has sufficient energy to knock it off course. This deflection can be detected by noting the changes in frequency of the reflected light beam. Rodger C. Finvold of San Diego, Calif., received patent 3,150,363 for the system.

A hydrofoil attachment for boats, comprised of a frame with a pair of side rails extending parallel to the sides of the boat hull and a means for connecting it to the hull, was awarded patent 3,150,626 for Finn T. Irgens, Milwaukee, Wis.

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Assure easy starts, optimum performance and maximum gas economy with Model BT-162.

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

- Assure precise adjustments of points that are slightly worn or pitted.
- Indicate the most effective point setting without removing the distributor cap.
- Indicate the correct settings for external adjustment type distributors. (A feeler gauge cannot be used for making correct adjustments on this type of distributor since many manufacturers' specifications do not list the point gap in inches. They list only the dwell angle in degrees.)
- Insure maximum gas economy and quiet engine running. Read the exact RPM while the engine is in neutral position. Then adjust the carburetor in conformity with the car manufacturer's recommendations.
- To locate a "miss" you need only disconnect or "short" the spark plugs one at a time with the Model BT-162 switched to the Tachometer position.
- Cars with automatic transmissions function efficiently only if the fluid pressures are correctly maintained and since manufacturer's instructions always refer to RPM, the Model BT-162 (or an equivalent tachometer) is required to properly service automatic transmissions.

The Model BT-162 is the most complete unit in its price range ever produced. It comes absolutely complete, ready to use. Only

\$29⁹⁵

Specifications

The Model BT-162 provides three dwell angle scales; 0 to 45 degrees, 0 to 60 degrees, and 0 to 90 degrees. The three dwell angle ranges specified above make this instrument suitable for making accurate dwell angle adjustments on all 4 cylinder, 6 cylinder, and 8 cylinder cars, both foreign and domestic.

The dual range tachometer is extremely versatile since it provides both a low range of 0 to 1000 RPM, necessary for making precise carburetor adjustments and the high range tachometer, 0 to 5000 RPM suitable for making all other tests at high engine speeds.

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Sidelights on

AVIATION

The build-it-yourself airplane described in the story beginning on page 80 was designed by John Thorp who, if nothing else, is an honest man—blunt, but honest. He claims a maximum of nine Gs for his all-metal T-18 monoplane, but hastens to point out that this means a six-G limit load. Most designers and/or manufacturers of new airplanes would simply say "it's aerobatic up to nine Gs" and stop.

Thorp, in his blunt but honest way, plows right ahead. (His blunt letter to us started out, "Apparently no one has explained to you the significance of six-G limit load and nine-G ultimate . . .")

Well, now that you mention it . . .

Here's Thorp's explanation: "Theoretically, a structure . . . which was designed to carry nine Gs without breaking would start showing permanent deformation at two-thirds of its breaking strength (six Gs). Hence, if we design for six Gs limit . . . we could theoretically pull six Gs as many times as we want without hurting the structure. If we exceed six Gs (say seven) in some maneuver . . . we would not expect the structure to break, but we would expect to find permanent deformation in the structure when we got down. Maybe the structure would be repairable—maybe not.

"If, in a pinch, we were called upon to pull nine Gs under the same conditions we would expect the airplane to stay together, but we would know for sure that when we got down it would be so bent up that it probably would not be worth repairing. If we exceeded nine Gs, the structure would have every right to a catastrophic in-flight failure.

"Hence, we can maneuver as much as we want up to six Gs without hurting anything. The ultimate strength of the same structure would be nine Gs."

Any questions?

Incidentally, as the story indicates, only one T-18 had been completed at the time of writing, but by the time this issue hits the mails and the newsstands a few more may be flying. We expect to have a follow-up report on these other planes—each one built by a different maker—to see how closely their performances match the first completed version.

Kevin V. Brown
Aviation Editor

POPULAR MECHANICS

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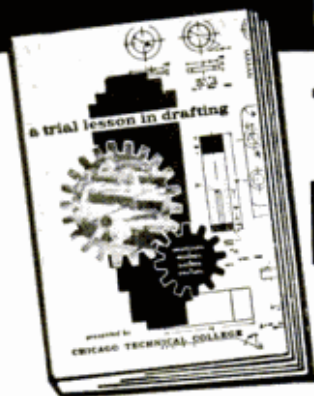
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CLINIC FOR HOMEOWNERS

Q I have fairly long runs of cold-water pipe in my basement. The pipe sweats badly during the warmer months. It's installed in such a way that it would be difficult or impossible to use a wrapping material. Is there any other way of coating the pipes or any material that can be applied like paint?—N.R., W.Va.

A There are materials that can be applied in a manner similar to painting to prevent the condensation that is causing the trouble. Inquire of your local hardware or building materials dealer. If they do not stock the item they can order for you. There also is a relatively new foam-like material that comes in an aerosol (pressurized) container which is said to be quite effective. Be sure to follow manufacturer's instructions when applying any of these products.

Q I have acoustical tile ceilings in two small rooms. I have warm air heating and directly over the registers the tiles are discolored with what I suppose is dust and grime. How does one clean them? Also, can the tiles be painted?—R.G., Mo.

A In general, acoustical tiles can be cleaned by sponging with a mild soap solution. This should remove any discoloration from the sources you mention. Be careful not to get the surface of the tiles too wet and rub only lightly, using a large artificial sponge with a flat face. The tiles can be repainted with any of the common inside paints without appreciably affecting the acoustical properties. Thin the paint to an easy brushing consistency and be careful to apply evenly and without filling any of the holes in the tiles.

Q In my older home a partition has been removed to make a larger living room. The ceiling is sagging rather badly where this partition was taken out. How can I un-sag it?—G.N., N.Mex.

A Ordinarily, such a condition calls for a major repair job, but it may be possible to level the ceiling with jacks and install a large beam to carry the weight. The beam must be of adequate size and

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must be solidly supported at each end. After installation it can be boxed with clear material to make it more attractive and finished to match the woodwork in the room. If you proceed in this fashion, support the jacks on a beam at the first floor and then use 4 x 4 extenders from each jack to another 4 x 4 beam at the ceiling. This setup should be placed so that it does not interfere with installation of the permanent beam. When raising the ceiling turn the jacks up uniformly and only a fraction of an inch of lift at a time.

Q I have an old piano I'd like to refinish. I think the wood is mahogany as what appears to be veneer is chipped in one or two inconspicuous places and the chips appear to be mahogany. Shall I spray-paint it or take the old finish off and refinish in natural color?—O.F., La.

A It should prove attractive either way. We would take off the old finish first, as some old pianos were made up in very beautiful woods on all exposed parts. Take off all the removable panels and use a paste-type paint remover on all fixed vertical surfaces. Remove all the piano hinges and be especially careful not to get any of the remover on the strings, mechanism or keys. Then sand and refinish all exposed parts with a sealer and two coats of semi-flat varnish, rubbing down between coats with very fine steel wool. Rub the last coat glass-smooth. If the wood is not especially attractive in the grain, then you can refinish with any of the newer multicolored finishes of the brush-on type, or those supplied in aerosol (pressurized) containers. When using any of these finishing materials be sure to provide adequate ventilation. Also, read and follow all instructions for use.

Q I have some fairly old books I'd like to make more presentable. The covers are worn and rather shoddy but are not yet "dog-eared". Is there any way I can brighten them up a bit, using enamels, or what?—R. P., N. H.

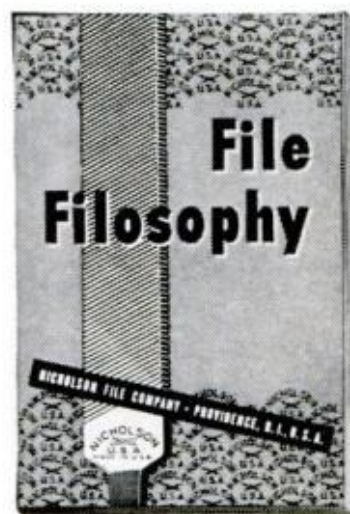
A You do not mention the bindings so we assume they are still in reasonably good condition. If the bindings are loose, broken or otherwise damaged, you have a job for the bookbindery. Otherwise you can do a fair job of renewal by going over the books with a damp cloth dipped in soapy water to remove grime. Allow to dry and apply a light coating of a quick drying clear finish, such as fixative which comes in a spray can.

DECEMBER 1964

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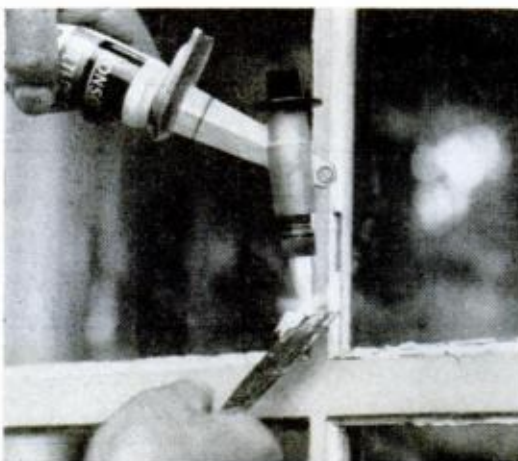
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Or are you?

Ever try to thaw a frozen water pipe with that hammer? Or unstick a cracked floor tile with that screwdriver?

Or chip ice off the front steps with that chisel?

Humiliating, isn't it?

(Not having the right tool at the right time can make you feel about as self-sufficient as an old-maid schoolteacher fixing her first flat tire.)

But now Ronson has a new torch that can do all those

things. And more.

You don't have to be a handyman to put it to work. It starts charcoal and log fires quickly. It burns leaves and caterpillar nests. You can even use it to put a nice brown meringue on Baked Alaska!

It weighs less than 13 ounces. Much smaller than other leading torches, it takes very little storage space. It's as compact and easy to handle as a flashlight.

A blast from this torch can spot-kill a weed faster than you can yell "Crabgrass!"

A broken wire fence needs mending?

This torch can do a perfect soft-solder job in less than a minute.

It can hard-solder a 1/2" copper tube to a brass elbow in just a few minutes.

It can help remove old paint.

Soften old putty.

Fix a kid's toy.

Help refinish furniture.

Sweat copper tubing.

(Whew!)

Loosen rusted pipe fittings and connectors. (Just try to get in and around pipes and fittings with a larger torch.)

Free frozen nuts and bolts.

And even stand up like a laboratory burner.

(This comes in handy when you need both hands free.)

How did Ronson put this new torch together?

We used butane gas, and the

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(size butane Multi-Fill.)

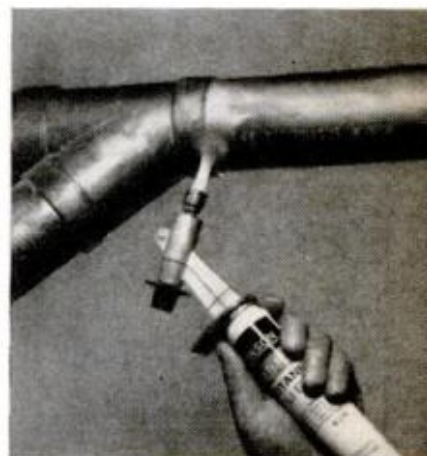
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And you won't have to take this torch apart to clean it between jobs. It's completely self-

cleaning. It just won't clog.

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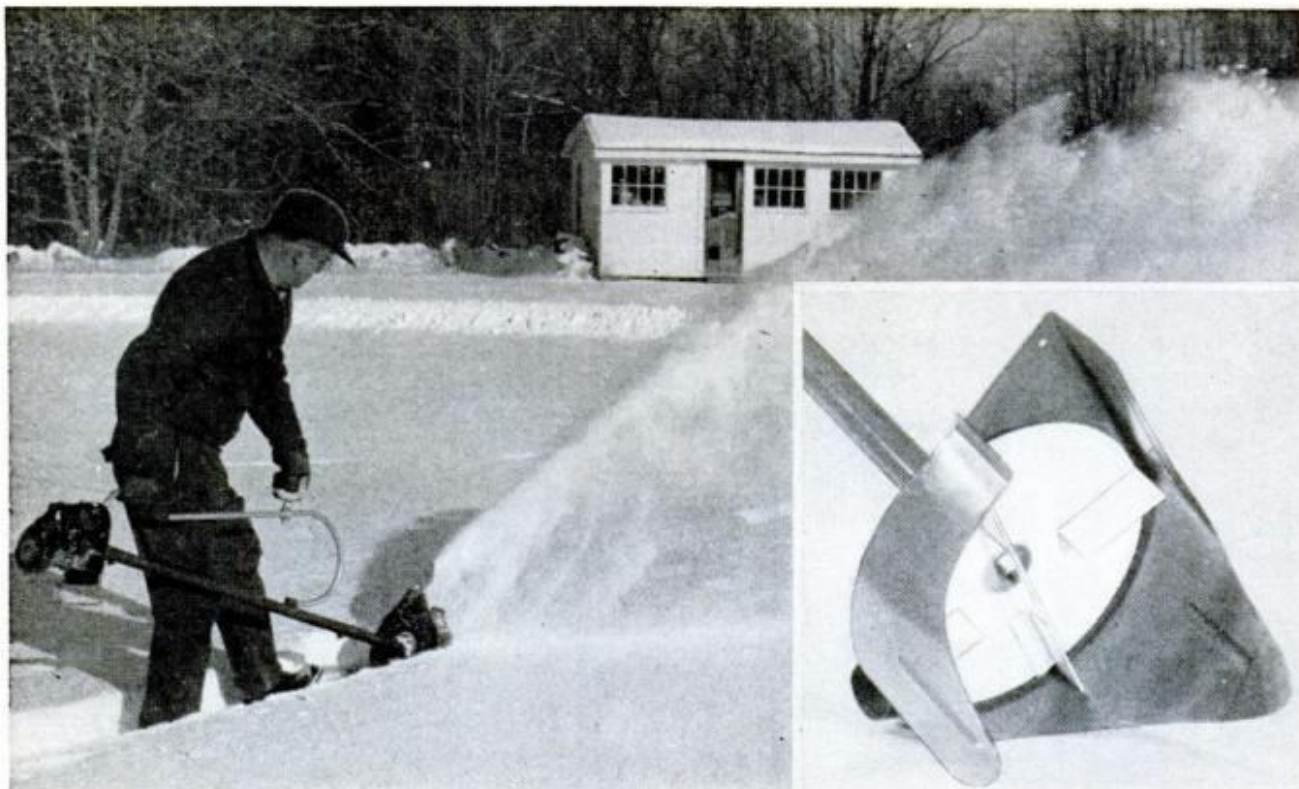
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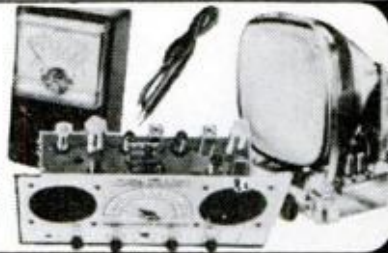
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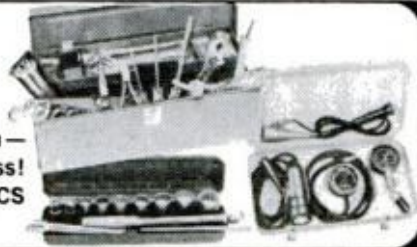
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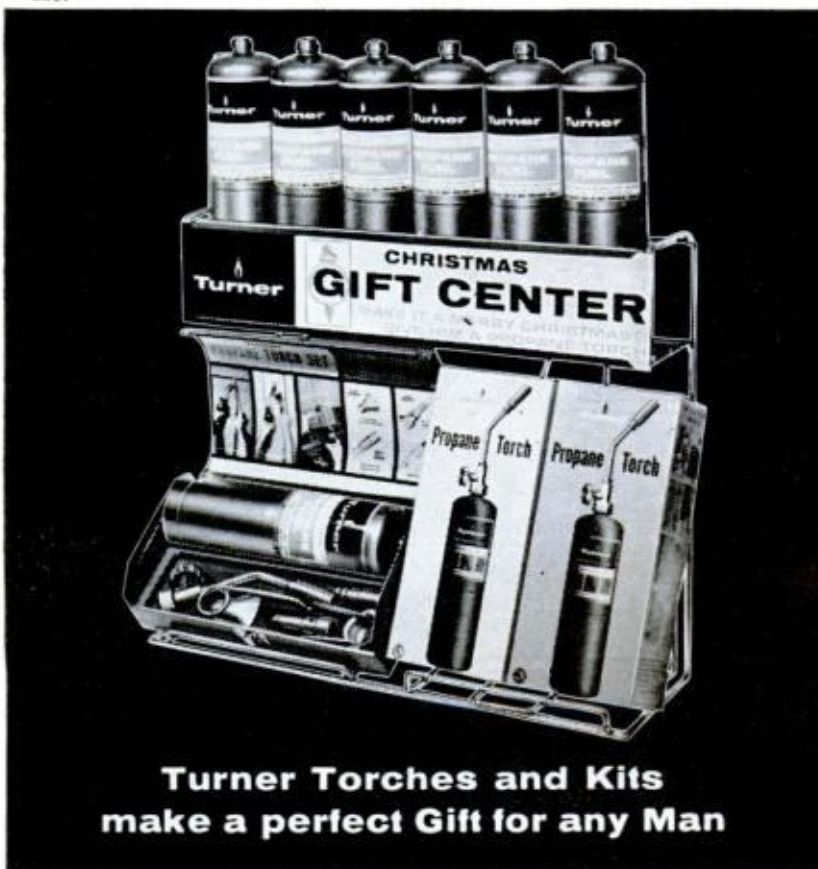
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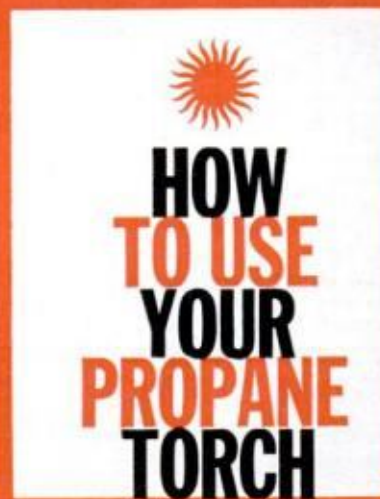
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Computers' Computer Secretary

Computers are behaving more like human beings every day. In related developments at Purdue University:

- One computer has "hired" another computer as its personal secretary.

- Computers across the country soon may be linked into a network that will enable any one of the machines to pick the brains of all other computers in the net.

The "secretarial computer" schedules appointments for the biggest computer on the Purdue campus. The "secretary" collects problems from human researchers, and discreetly asks its "boss" every few minutes if it is prepared to take on some outside work. If the answer is affirmative, the master computer accepts the problems, makes its computations, and feeds the answers back to its "secretary." The smaller computer then sorts out the answers and routes them to printout typewriters located in various departments on campus.

By efficiently scheduling the big computer's operations, the smaller one permits its "boss" to perform several times as much work. It interrupts the master's electronic cerebrations about once every three minutes to ask whether it is prepared to accept and solve new problems before going on with the work it then has in progress.

Eventually the master computer at Purdue will be linked to another at Indiana University 100 miles away; if this experiment proves satisfactory, these two masters then may be linked to other computers in laboratories all across the country. The computers then can talk to each other, drawing on memory systems anywhere in the computer network for facts and figures needed for computations. In such a case "secretarial" computers will schedule questions so the master computers will not be interrupted during long-distance "conferences" or other important work.

Mountain Haze Caused by Plants

That blue haze of the Blue Ridge Mountains and the hazy days of summer are caused partly by the fragrance of plants, according to Drs. R. Rasmussen and F. W. Went of Washington University, St. Louis.

Although the blue-gray haze hanging over cities may be largely gasoline vapors, the scientists found that most of the common volatile substances in the air (isoprene, alpha-pinene, beta-pinene, limonene and myrcene) derive from the odors which make plants smell. Man uses them as turpentine and in perfumes. Concentrations of these volatiles vary, rising during the day and decreasing during night.

DECEMBER 1964

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United Hdw.

Pikesville

Pikesville Hdw.
Akehurst Hdw.

Pimlico

Pimlico Hdw.

MASSACHUSETTS

Boston

Reliable Hdw.

Brookline

Highland Hdw.

Falls River

J. O. Neill Co.

Greenfield

Prestige Lmbr.

Framingham

White Hdw.

Keene

Spencer Hdw.

East Longmeadow

Kelly-Fradit Lmbr.

N. Andover

Roberts Hdw.

Norwood

Norwood Hdw.

Northampton

Hampshire Supply

Salem

Zina Goodell

Springfield

Vadnair

Wilbraham

Hdw. Center

Wollaston

J. MacFarland & Son

Ware

Green Acres Supply

Worcester

Stone & Berg Lmbr.

NEW HAMPSHIRE

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Dover Hdw.

Keene

Spencer Hdw. Co.

Lebanon

Dulac's

Manchester

J. J. Moreau & Son

NEW JERSEY

Glassboro

Glassboro Hdw.

PENNSYLVANIA

All Moores Auto Stores

Chester

Marchliks Hdw.

Conshohocken

Conshohocken Variety

Germantown Pike

Fairview Village
Fairview Bldg. Supply

Norristown

Cottonaro Hdw.

Philadelphia

Blumberg Hdw.
Bridge Hdw.
Ce Mar Hdw.
P. Cohen Hdw.
E. C. Fisher Hdw.
C. Hughes Hdw.
Jacobs Hdw.
S. Jacobs Supply
Katzen Hdw.
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Upper Darby

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Upper Darby Boat Hdw.

RHODE ISLAND

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J. O'Connell

Providence

City Hall Hdw.
Harris Lmbr. Co.

VIRGINIA

All Moores Auto Stores

Hampton

J. P. Blythe, Inc.



Coming: A Brand-New Suspension for Mustang, and a Long, Long Wait for a Chrysler Turbine

Ford's Total Performance program will include a new goody for the '66 Mustang—an optional independent rear suspension. This will give a more comfortable ride and better cornering on rough road surfaces. Cost: about \$200.

Our don't-believe-everything-you-hear department will now explode two rumors circulating in Auto Land:

- **Chrysler** is *not* building hundreds of gas-turbine cars for sale to the public. A total of 50 has been made. So far, 34 have been lent to 97 private individuals for three months at a time, to test public reaction. The remaining 16 are used for promotional purposes. There are no marketing plans.

- **Chrysler** won't have an entry in the next Indy 500 race. A new engine formula is due in '66, and it wouldn't pay Chrysler to develop an engine that would be obsolete after a year.

Speaking of Indianapolis, Ford will soon sell its 255-cube Indy racing engine to all comers. This hairy V8 has dual overhead cams, injection and a set of headers that looks like Medusa's hairdo. Before you run to order one, stop at the bank and withdraw a cool 15 gees.

Smarting from many oval-track and drag-strip defeats at the hands of the **Dodge and Plymouth** hemispherical-head V8s, **Ford** has been developing its own hemi. But now it turns out this engine will not be legal in **NASCAR** (National Association for Stock Car Auto Racing) events next year. NASCAR president Bill France recently ruled that engines must be of production design, thus eliminating hemi heads, high risers and overhead cams. They're so expensive that only factory teams could afford to compete. And squeezing out the private owner would hurt the sport. Wheelbase and displacement specs remain the same. Any internal modifications may be made.

Ford and Chrysler are dropping their rally activities abroad. Though Ford has been moderately successful, and Chrysler somewhat less so, the cost is staggering and the amount of publicity in this country practically nil. What's more, Ford was competing with its own English-made

Ford Cortina in the foreign contests.

A dual-gap spark plug for auto engines has been proposed by a Stanford University electrical engineer. The conventional spark plug, explains Dr. George H. Barry, is a compromise between high- and low-speed efficiency. "Rich fuel mixtures, as in full-throttle operation, ignite with any spark, however small," he said. "Lean mixtures, under part throttle, demand a bigger spark and wider gap." His plug would have two spark gaps—designed so the spark always jumps the wide gap if possible. If it can't, then it jumps the narrow gap.

A production goof has resulted in at least 100,000 new '64 and '65 cars collecting dust in lots. They can't be sold because they have no seats! The primary seat supplier to Detroit miscalculated. Now they're working three shifts a day, seven days a week to catch up.

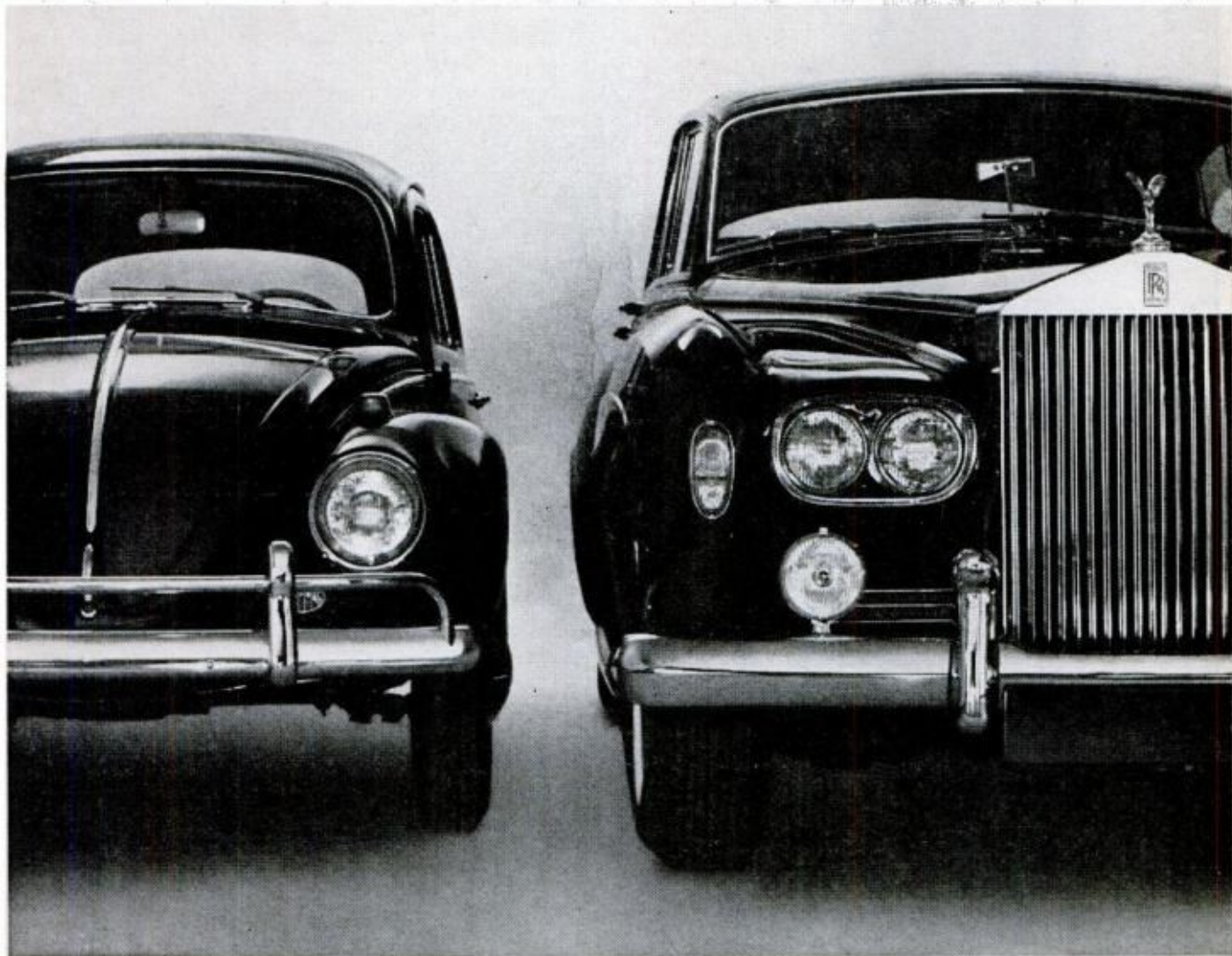
Is overdrive worthwhile? A Californian writes us complaining that the economy benefits of overdrive are lost when manufacturers automatically include a lower axle ratio. But it's not that bad. This year's **Chevy Biscayne** and **Bel Air** sedans are typical examples. With a three-speed manual box, the rear-axle ratio is 3.07. With overdrive it's 3.70. But in overdrive, the transmission ratio drops to 0.7, giving the same effect as running in non-overdrive high with a 2.59 axle—certainly an economy ratio.

Speaking of axle ratios, **Mercedes-Benz** says the sluggishness I complained of (*Spotlight on Mercedes-Benz 190 Diesel*, p. 32, Sept. PM) is gone. The 3.9 axle has been replaced by a 4.1 unit.

The Defense Dept. keeps trying to warn us about "surplus" Jeep bargains. "Chances are," said one colonel, "that anyone who collects cash in advance for \$35 bargains in unused surplus Jeeps is a swindler or swindler's victim."

Department catalogs say candidly that many Jeeps for sale seem in poor condition. Often major parts are missing.

Automotive Editor

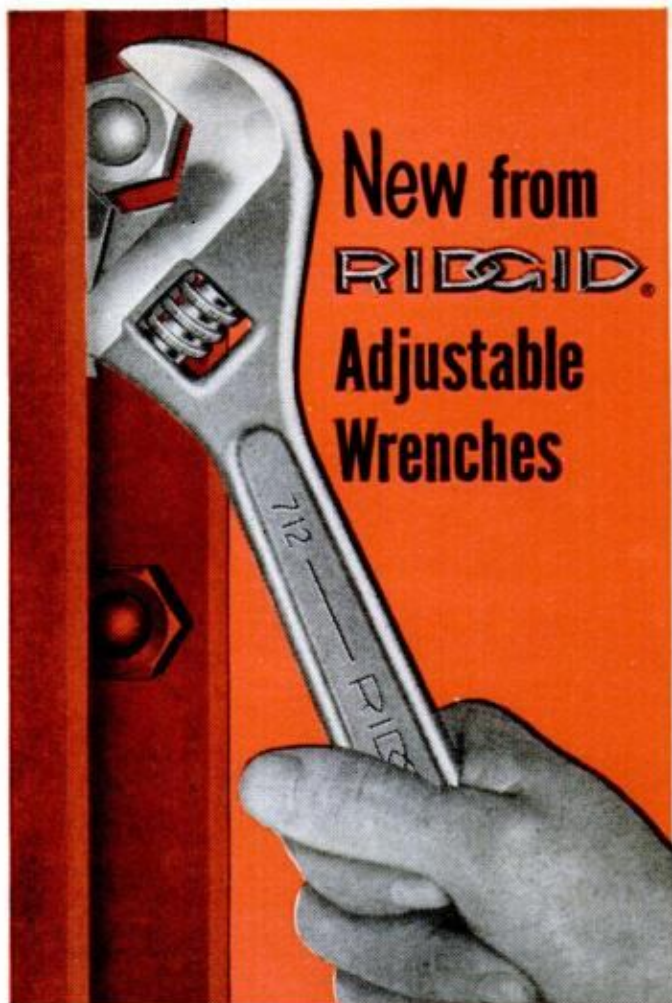


Millions of cars the world over, including Volkswagens and Rolls-Royces, come equipped with silvery-plated Champions

Again in 1965, Champions will be installed by more of the world's car makers than the next two brands of spark plugs combined—because Champions have no equal for all-around performance. Why settle for less in your car?

P.S. For dependable power all winter, install new silvery-plated Champions now!





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The Ridge Tool Company, Elyria, Ohio, U.S.A.

Items from All Outdoors

Learning to ski in a week is possible by a new teaching method described in an article on page 100. Walter Foeger, the man who devised the system, has written a book about it: *Skiing for Beginners*. It is published by Ronald Press. For more detailed information about where the system is taught, write to: Walter Foeger, Jay Peak, North Troy, Vt.

Ice fishing, a growing mania in the U.S., will be the subject of an article in next month's *PM*. While gathering material for the article I was in Winona, Wisconsin, a small town that bills itself as the Ice Fishing Capital of the World. In particular, I was interviewing Ronnie McKee, veteran ice fisherman, raconteur and saloon keeper, and it was Ronnie who introduced me to Mrs. Marie Aska of Rockford, Ill. and her recipe for barbecuing fish on a spit. This recipe, alone, was worth the trip. It is best with a large-size bass or lake trout. When the fish is cleaned, you wrap it with cheesecloth and bind it with cord. It is put on the spit, and while it is turning, it is *liberally* basted with melted butter. When the flesh flakes at the touch of a fork it is done. The cheesecloth is a charred coating that is easily peeled away.

What's new for outdoors is a folding saw for campers with a 21-inch blade that goes through eight-inch logs with ease. I used it last summer and found it extremely stable, and easy to fold and unfold. It sells for \$5.95 from Savage, Inc., Elverson, Pa. . . . And also for campers is a unique can of aerosol cooking fuel that contains its own stove. The cap on the can is inverted, wire legs are pulled out, and it becomes a single-burner stove that will hold a coffee pot or medium-sized pan. It is called Redi-fire. A 10-ounce can sells for \$1.69, and it is made by Turtle Wax, Inc., 1800 No. Clybourn Ave., Chicago, Ill. . . . For shooting enthusiasts with a child ready for his first shotgun, the Ithaca Gun Co. of Ithaca, N.Y. is offering an excellent booklet on basic gun training for \$1. The author is Gerald A. Stoltenberg, and he writes about his own son's initiation to shotgun shooting.

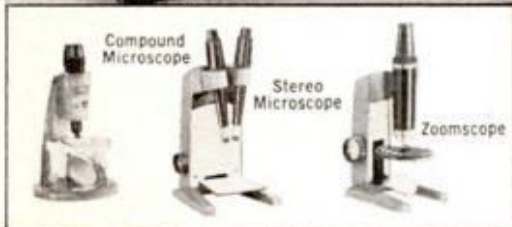
STUART JAMES

Outdoors Editor

POPULAR MECHANICS

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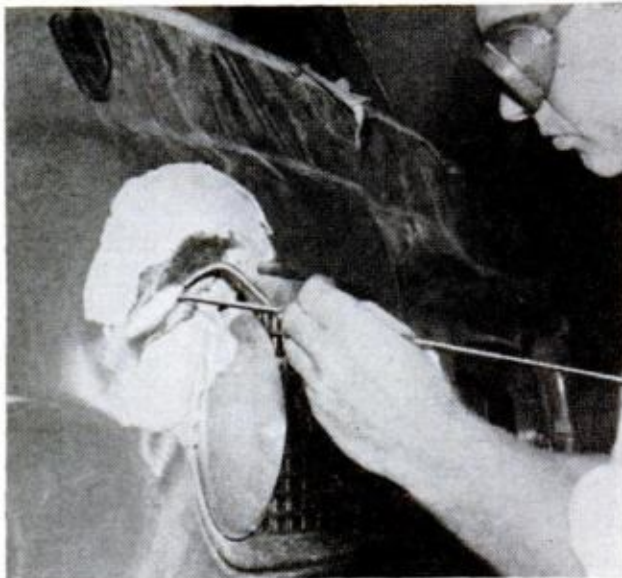
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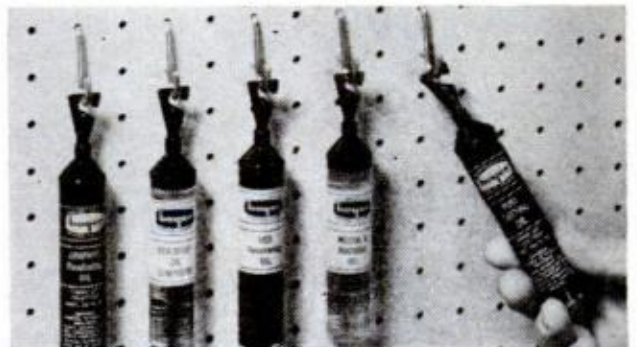
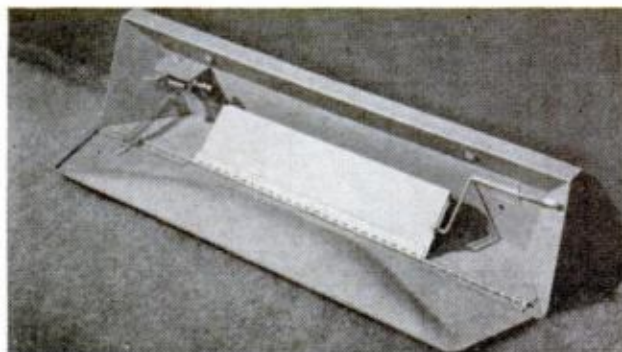
New on the Market

LONG-LIVED SNOW TOOLS: Ace snow pusher and snow shovel (inset) are made of stainless steel with specially heat-treated wear strips. Manufacturer says the working edges of these tools outlast those of competitive tools. Pusher sells for \$6, shovel for \$5. Made by the Union Fork & Hoe Co., Columbus, Ohio



PROTECT FINISHES, GLASS, rubber, etc. from welding heat. Weld-Dun is a foamy paste made by mixing two compounds. You spread this paste around the area to be welded. Said to confine heat no matter how hot welding becomes. Costs \$3 for trial kit. Aceto Chemical Co., 40-40 Lawrence St., Flushing 54, N.Y.

AUTOMATIC REGISTER, the Homart 600, has a sensing element (bottom photo) that reacts to temperature of the air passing through it. For cooling, it opens wide. For heating, it closes, sending air in a wide pattern over the walls (top photo). Costs \$6.50, from Sears, Roebuck & Co., 925 South Homan Ave., Chicago, Ill.



OIL AT YOUR FINGERTIPS: Clear plastic tubes containing various types of oil—general purpose, penetrating, rust cutting, graphited penetrating and neatsfoot—have hook-like tops to permit hanging on nails or hardboard hooks. Hang-Up Oilettes cost 29¢ each. Boyer Chemical, Box 1279, Evanston, Ill.



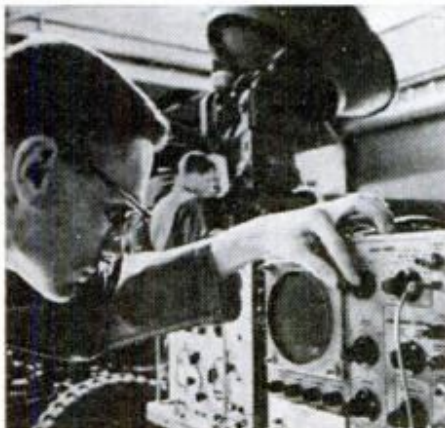
ADHESIVE TAPES perform many repair jobs around the house. No. 357 plastic-coated tape (\$1.98 for 60 ft. roll) seals ducts, patches dryer exhausts, repairs auto seats. No. 330 aluminum foil tape (\$2.98) seals gutter leaks, repairs garbage cans and car bodies. Johns-Manville, 22 E. 40 St., New York 16, N.Y.

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You're not alone in today's action Army. Every experience you have is shared with other great guys. Regular guys who are learning, earning, growing, going, serving our Country, developing themselves. Just as you are.

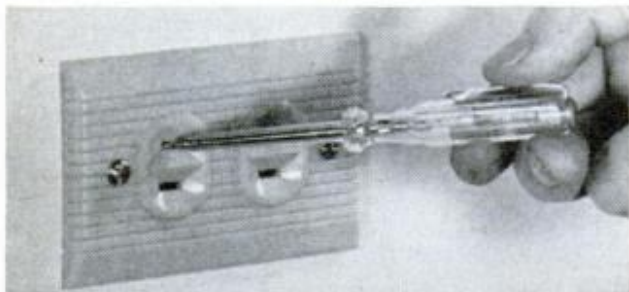
But the wonder of these experiences is yours alone. No one can tell you how great it feels to master a difficult specialty like computer programming, missile repair, electronics, or construction. No one can live the excitement of landing in a foreign country for you. No one can know what *your* great moments in the Army will be. But you can be sure your life in today's Army will be full of great moments. Enough to add up to a great life.

Talk to your local Army recruiter. Let him tell you what the Army can do for you... and what you can do for the Army. Let him help you to that great moment, the moment you realize that...if you're good enough to get in, a proud future can be yours in today's *action*

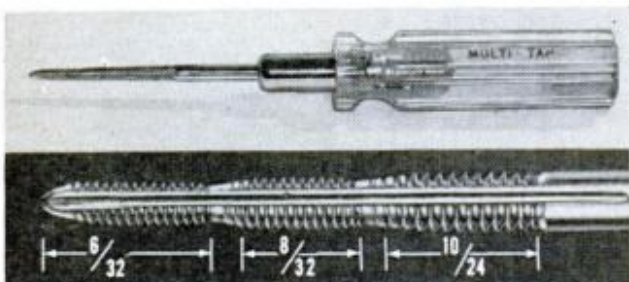
Army

Shopping for Tools

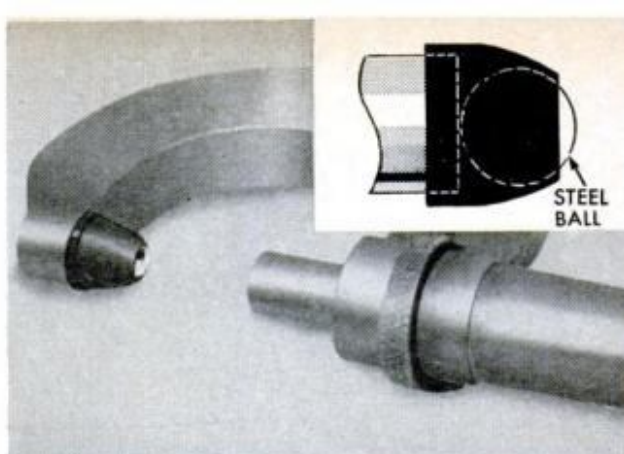
WIRELESS VOLTAGE TESTER tells you if electricity is present in an outlet, plug, etc. You insert the tip into the plug and press the pocket clip on the tool's handle. If the line is hot, a tube inside the transparent handle lights up. Priced at \$1.29 to \$1.98. Marfree, Inc., 17620 James Cousin St., Detroit, Mich.



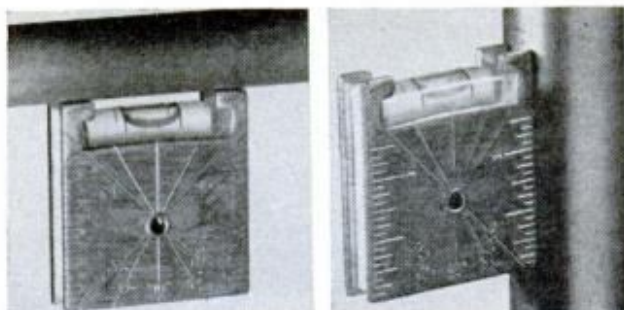
THREE TAPS IN ONE: The Multi-Tap is a screwdriver-type tool which cleans or cuts any of three thread sizes most commonly found in gutters, electrical fixtures, junction boxes. Removable shank can also be used with tap wrench. Costs \$2.25. North County Mfg. Co., 2175 Canyon Drive, Ocean Side, Calif.



FASTEST ORBITAL SANDER on the market, according to the manufacturer, is the No. 330 Speed-Bloc. Its 12,000 5/64-in. orbits per minute give a smooth, swirl-free surface, and its 4 1/8 x 4 1/2-in. pad fits into corners that would be too tight for other sanders. PM editors found the shape and balance of this tool ideal for easy one-hand operation. Costs \$55. Rockwell Mfg., 400 N. Lexington Ave., Pittsburgh, Pa.

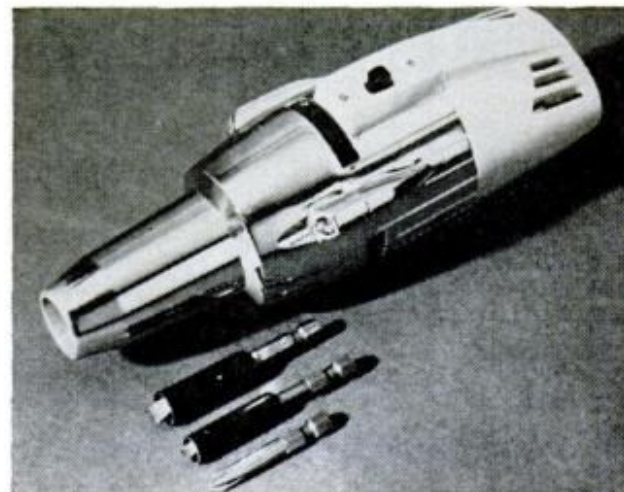


MEASURE THICKNESSES of tube walls and other curved surfaces by placing the Neo Ball Adapter on the anvil of your micrometer. Consists of a steel ball of known diameter in a neoprene socket. To measure, you hold ball against inside of tube wall, then read micrometer as usual. Subtract ball diameter from reading for final result. Price is \$1.50. Neo Ball Co., 669 MacArthur Avenue, Redwood City, California



MAGNETIC LEVEL, Model A 23, holds itself on any horizontal or vertical iron or steel pipe for fast checking of levelness or plumb. Particularly handy when a pipe line is very close to ceiling, as it will cling to the pipe's underside. Retail for \$1.25. Made by Piggyback Level Company, Jutland, New Jersey

ELECTRIC-ZIP SCREW DRIVER drives and removes right- or left-hand screws with slotted or Phillips heads. You place tip of tool on screw, and, with motor turned on, press downward. The driving bit engages screw head. Whole operation takes seconds. In trying this tool, we found its 100-1 reduction gears delivered an impressive amount of torque. \$29.95. Portable Electric Tools, 1200 E. State St., Geneva, Ill.



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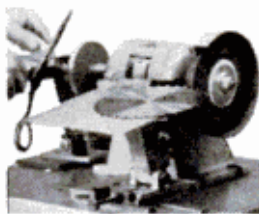
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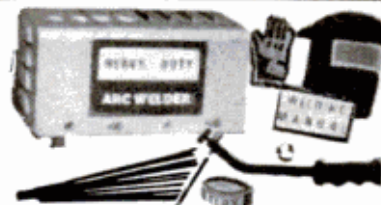
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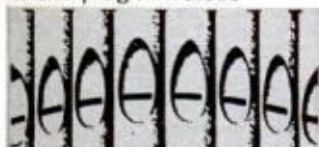
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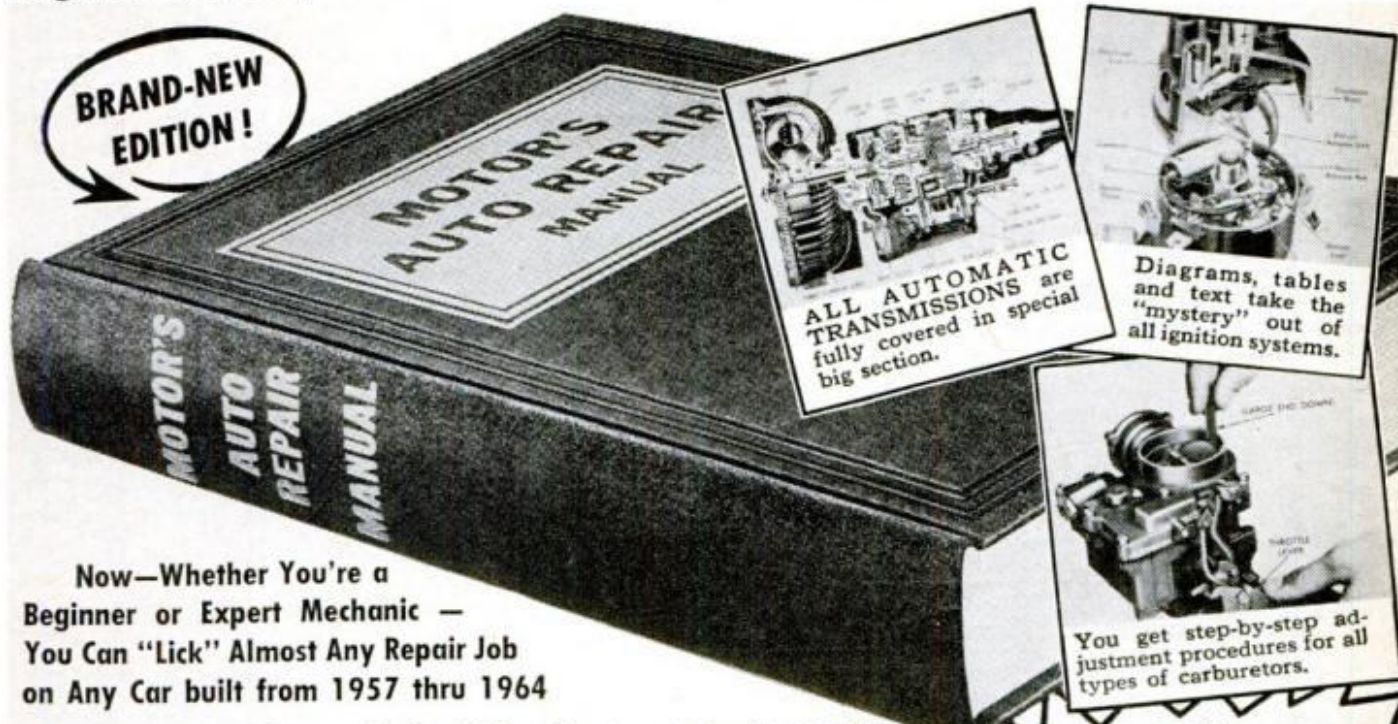
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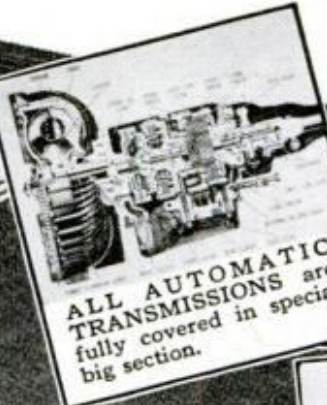
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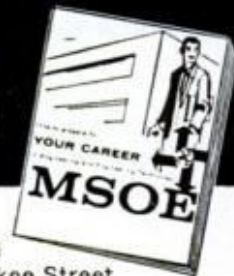
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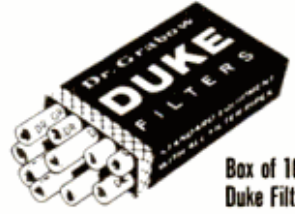
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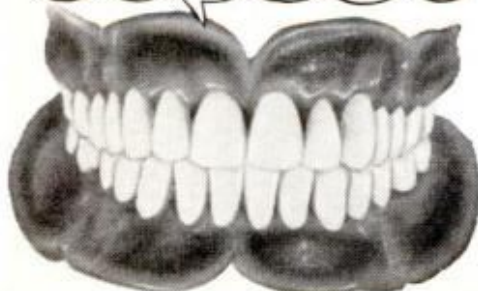
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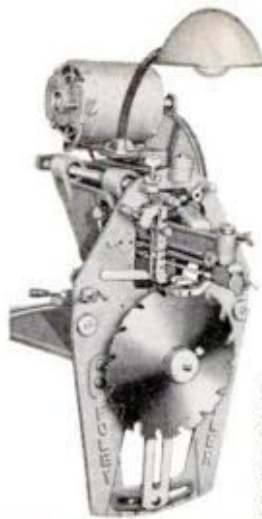
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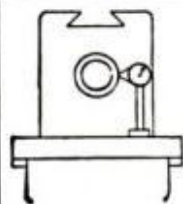
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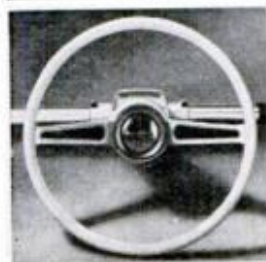
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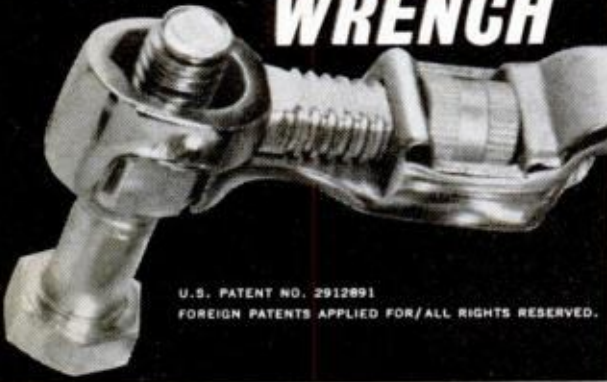
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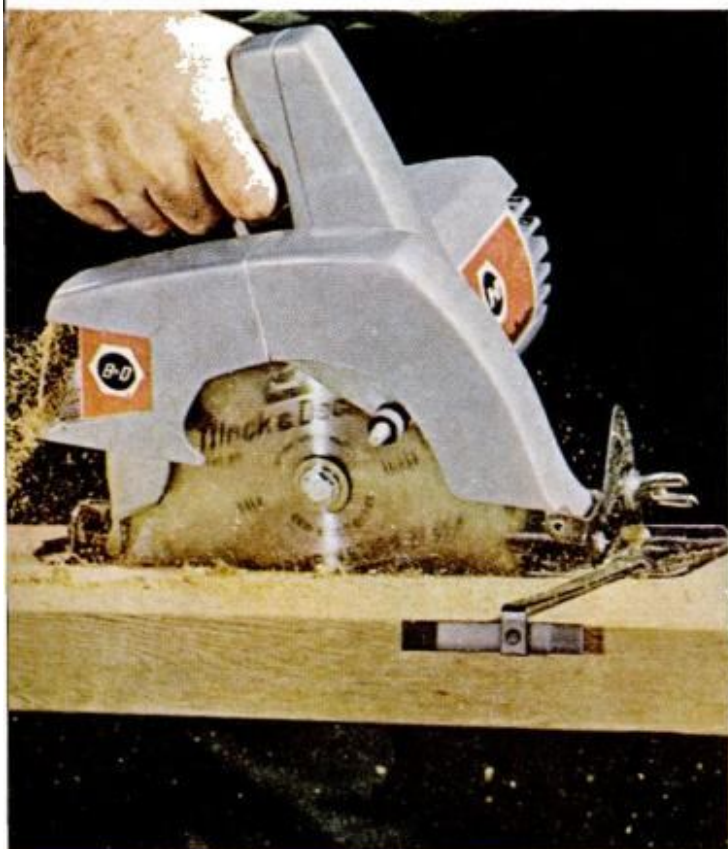
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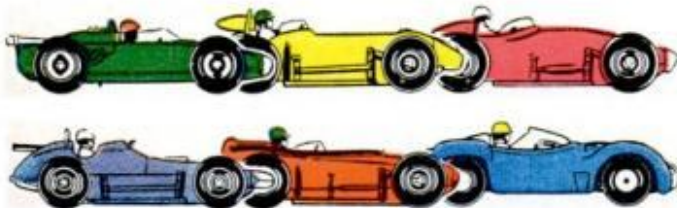
ZAZOOM™
THE SOUND OF POWER



Now the Road Race Sets That Look Like Real,
Race Like Real . . .

SOUND LIKE REAL!

Control the sounds with your Marx pistol grip throttle. Make your racers idle, rev, go full blast. That's only one of 25 new, real-life features from Marx. There are brand-new cars with authentic styling, sleek lacquered finish and real-looking drivers; cars with operating headlights and Ackerman Steering. There are eight kinds of special track: Jump Chicane, Turnout 1/32nd, Turnaround Drag Strip 1/32nd, HO Wiggle Obstacle, 90-degree Crossover 1/32nd Tracks. Marx has built dozens of engineering improvements into the world's biggest Road Racing line.



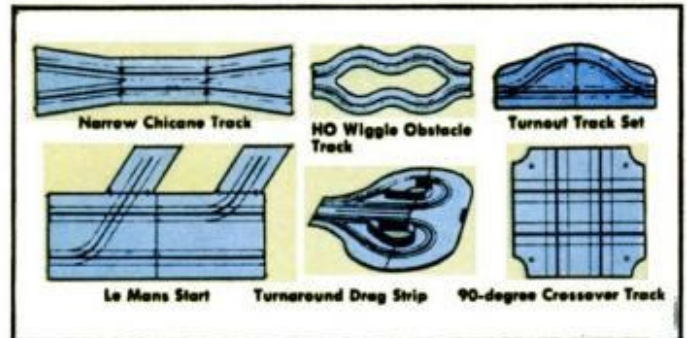
MARX OFFERS BIGGEST SELECTION OF HO AND 1/32nd RACING CARS

All the greatest racers on the road are available in Marx Road Racing Sets. The list includes Wilard Battery Special 1/32nd, Watson Special 1/32nd, Birdcage Maserati 1/32nd, Ferrari GT 1/32nd, Thunderbird HO, Sting Ray HO, Harvey Aluminum Special HO and many more.

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- Real Ackerman Steering for better, more accurate handling
- 5 geared power train for smoother, more realistic operation
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Every Marx car is solidly built to take a real beating and go back for more. And it's road-tested before it's packed.



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Big Feature of Marx Road Racing

Re-create famous courses like Le Mans, Indianapolis, Monza, Watkins Glen, Sebring with Marx track. All track has a special high-traction finish and quality screw-down terminals. Just look at the special feature track you can choose from.



Hi-Voltage Power Pack included in every set

Every power pack is UL Approved

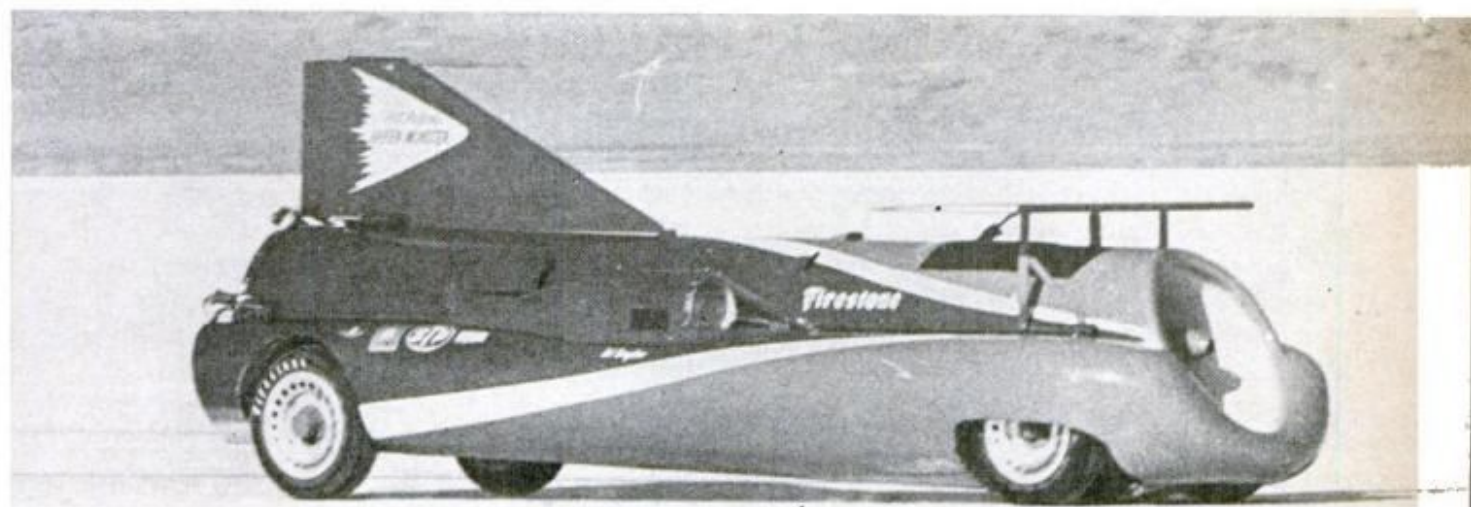
New Calibrated Pistol Grip Throttle for more positive control
Throttle down from 500 scale miles per hour with smooth, realistic action.

Marx adds to your racing fun with a full line of accessories
• figures • bridges • trestles • guard rails

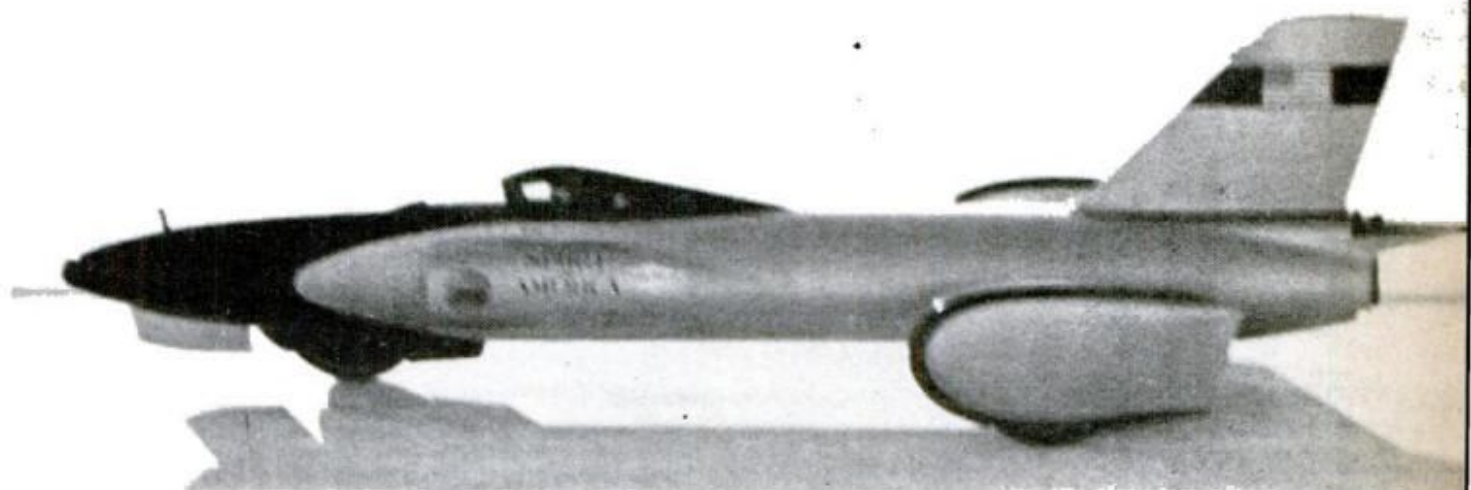
YOU GET MORE FROM **MARX**... WORLD LEADER IN ELECTRIC ROAD RACING AND SPEEDWAYS

Here's the story on the racing weeks that really were—when world land speed records fell like rain in history's wildest, hairiest . . .

SPEED CARNIVAL AT...



BONNEVILLE



TOP, ART ARFONS' *Green Monster* setting a new world land speed record of 536.71 m.p.h. Below, Breedlove's *Spirit of America* on its way to a record of 526.28 m.p.h., which Arfons later broke. At one point, Arfons topped 610 m.p.h.

By
C. P. Gilmore

THEY WERE THE WILDEST WEEKS in racing history. The big jets roaring across the salt at Bonneville broke the world's land speed record so many times they're still picking up the pieces.

First out of the box was the *Wingfoot Express* driven by Tom Green of Wheaton, Illinois, and built by Green and Walt Arfons of Akron. On Friday, October 2, *Wingfoot* smashed Craig Breedlove's 1963 record—407 miles per hour—with an average two-trip speed of 413 m.p.h. But Tom and Walt held the record for just three days. The following Monday, Art Arfons, Walt's brother, hurtled across the salt in his snub-

nosed *Green Monster* to peg the record at 434. That record lasted ten days. Then Craig Breedlove of Los Angeles, smoking across the Utah desert in his sleek *Spirit of America*, lost his steering and both braking parachutes, plowed across a quarter mile of mud and shallow water, smashed a telephone pole into kindling, climbed a 12-foot embankment, and flew through the air 50 feet before coming to rest under 18 feet of water. But he walked—or swam, to be more accurate—away unscratched.

The ride was spectacular in more ways than one. Flashing across the salt with only partial control, Breedlove managed to clock a record 538.89 miles an hour through the measured mile. With the 513 he had chalked up on his previous run, his average was 526.28. (Timers get the official speed by averaging elapsed time through the mile on two runs, then calculating speed from average time. It gives a slightly different answer than averaging the speeds directly.)

Arfons Comes Back

The climax came on Tuesday, October 27, when Art Arfons set out to beat Breedlove again. The salt was rough—still chewed up by Breedlove's wild ride. To cut down on the amount of rough salt he would have to navigate, Art decided to limit his acceleration to a two-mile stretch before entering the measured mile. A warmup run of 462 Tuesday morning convinced Art the *Monster* would handle on the rough salt.

The first record-assaulting run began at 1:07 p.m. as the big car started with a roar. "Then," said Humpy Wheeler, Firestone's representative at the trials, "there was a tremendous boom, like a jet going through the sound barrier. A huge tongue of flame shot out of the tailpipe. We thought the car had exploded."

It had. But not the way they feared. To get up to speed in the two miles he had allowed himself, Art had fired the first stage of his four-stage afterburner. (He never used the other three.)

A camera had been rigged in the right cockpit (Art drives from the left) and a small wire came out under the canopy. Air got under the slit caused by the wire and ripped the canopy off. With no other troubles on the run, official time was 515.98.

The gaping hole left where the canopy had been had to be covered before the re-

turn run. But the canopy was shattered. And the return run, to be official, had to start within one hour. Frantic crew members bolted an aluminum plate over the hole. When it was in place, Art still had 12 minutes.

Again, the big jet roared, and Art laid a heavy foot on the throttle. "I just made up my mind I wasn't going to make another run," he said. "This would be the one."

It was a hairy ride. "When I slipped it into burner," says Art, "it literally picked the car off the ground. It felt like I was in a tornado." Crew members nearest the track said they saw daylight under all four wheels as the *Monster* slammed over the rough salt.

Art went into the measured mile at about 500, accelerated all the way through, and estimates he came out doing a fantastic 610. That's when the right rear tire blew.

Art's tires, especially designed for his car by Firestone, were tested only up to 600 miles an hour. He went faster.

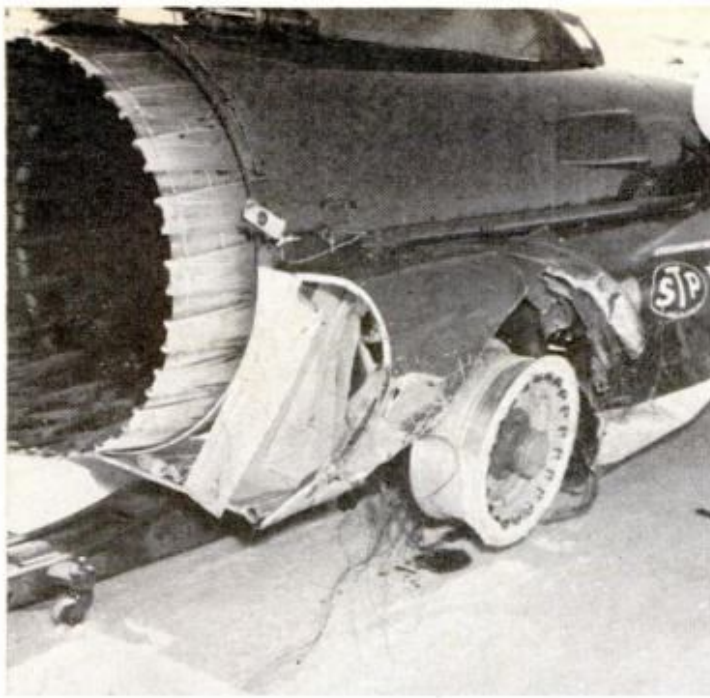
"I let one chute go right away," says Art, "and it ripped off. Then I waited until I slowed down to 400 to let the other one go. I lost about half of it, but it slowed me OK."

Some 4½ miles from the point where he lost the tire, the new world's champion rolled to a stop. He had no trouble controlling the car after the world's first 600-m.p.h. blowout. "She was just right," said Art. "She rolled in a straight line. When the tire blew, it bent the axle, and the wheel started dragging on the frame when the car slowed down to around 200. But it held straight."

"I knew I had it after the run," says Art. So we just waited for the official time. It was worth waiting for. Time on the run was a staggering 559.18 through the measured mile. With the first run, Art's average time—and the new world's record—was 536.71 miles an hour.

The tremendous carnival of speed this year at Bonneville is all the more remarkable in view of the fact that record-breaking runs have been few and far between in the past. The late John Cobb's record 394, set in 1947, stood for 17 years. Finally, just over a year ago, Breedlove squeaked out a 407 average to take the crown. Then suddenly this year, the salt was crowded with record breakers. In 25 days, the world's record changed hands four times

[\(Please turn to page 72\)](#)

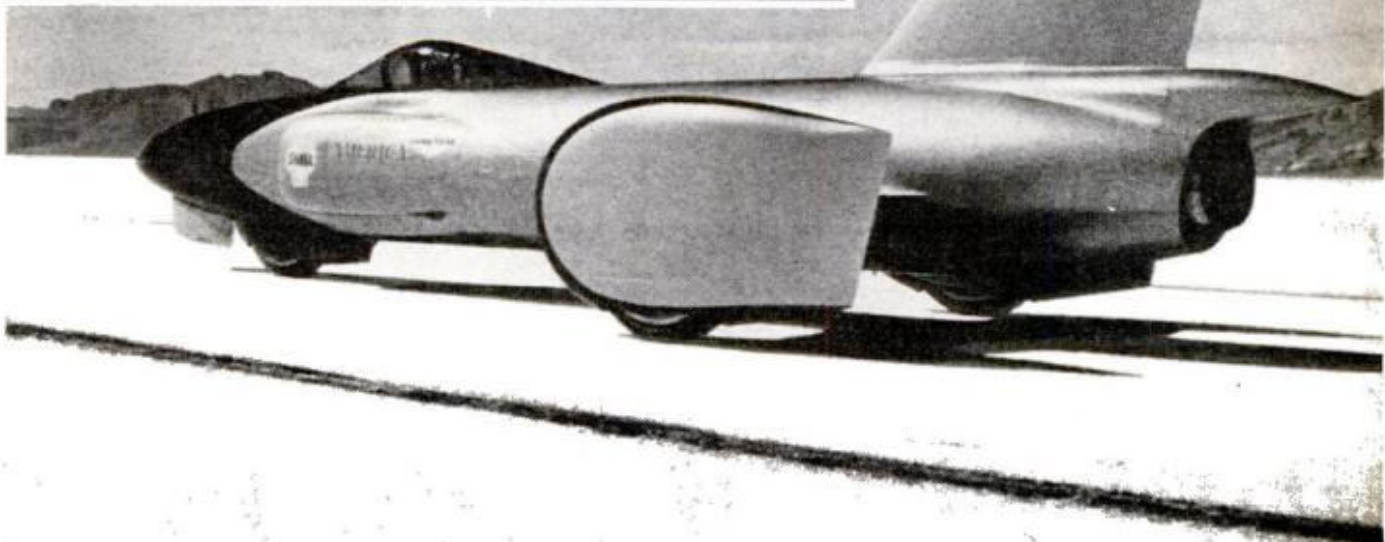


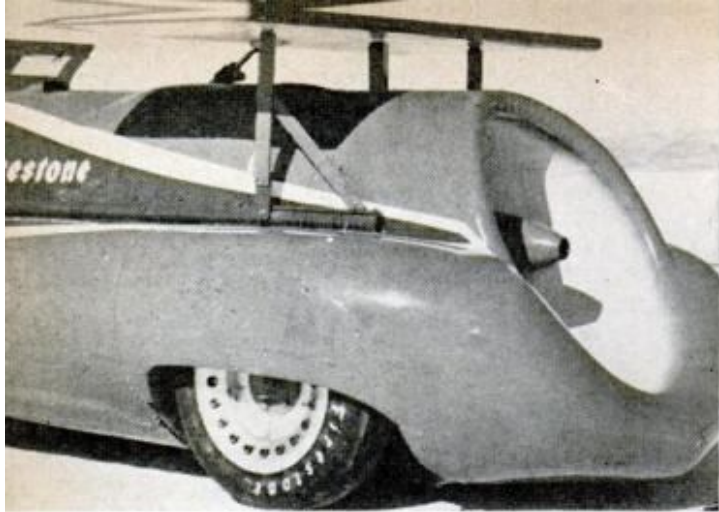
LIKE A BULLET, 3-inch bolt left on salt blew Arfons' tire at 500 m.p.h., causing this damage. Art kept the power on for control, then halted the car safely



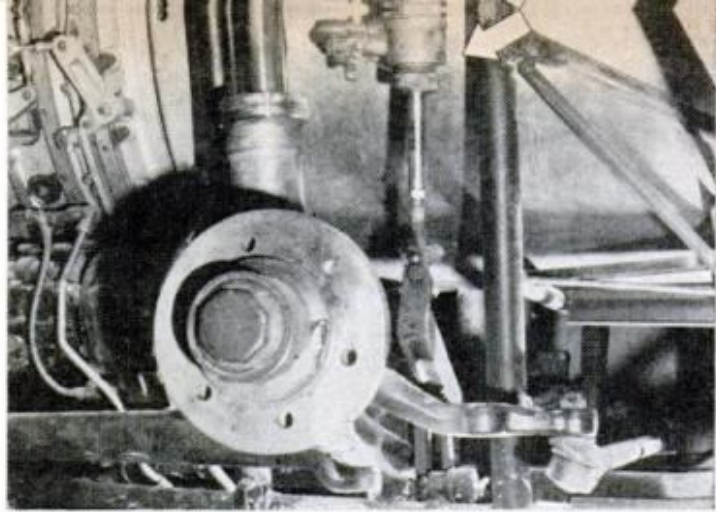
ARFONS gets tucked in for record run. His Green Monster with afterburners can put out 17,500 pounds of thrust, compared to Breedlove's 5700 pounds

THE DRINK BREEDLOVE HIT at 160 m.p.h. Note tail of racer protruding from water at left. This year Breedlove's three-wheeler had smaller nose fin. Engine was the same, but it had been tuned for about 500 more pounds of thrust





TOO MUCH WEIGHT on front end and small wing on Arfons' racer supplies lift; if nose rises, suspension link makes wing supply aerodynamic down pressure



HOW SUSPENSION links to Arfons' wing, keeping front tire loading relatively constant at all speeds. Hydraulic cylinder moves wing when front end lifts

and was shoved upward a staggering 129 miles an hour.

Art, the final winner, paradoxically, was plagued with tire trouble on both of his record assaults. First trouble came on October 7. Art had set a new record with his 434 run two days earlier, and was now out to beat his own record. The airspeed indicator was sitting on 500 m.p.h. when the *Monster's* right rear tire exploded. Later, engineers found a three-inch long bolt near the blowout spot which, they reasoned, the tire had hit. "Hitting a piece of metal at that speed," said Firestone engineer Bob Martin "is just like firing a bullet into the tire."

The tire, with more than 250 pounds of pressure and thousands of pounds of centrifugal force straining to tear it apart, blew up as though it were packed with dynamite. In the process, it ripped a gaping hole in the car's sheet metal skin and put Art on the sidelines for major repairs.

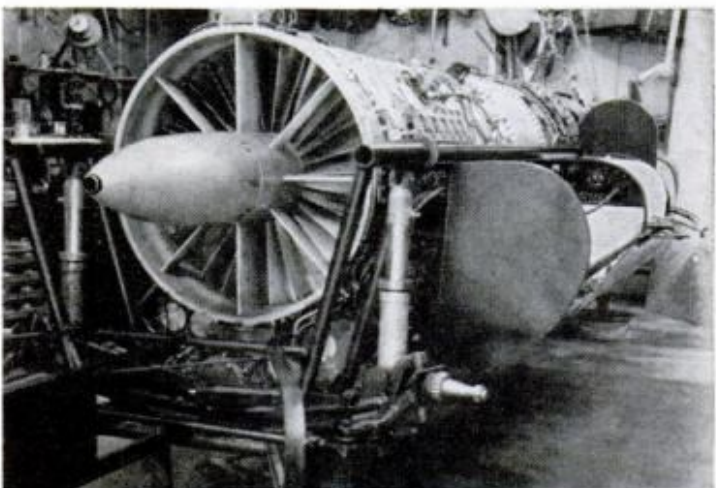
I was watching the *Monster* from a plane above the track when the tire let go. Art said he felt a lurch. But from the air, the car didn't appear to waver. "It dropped on the right rear corner and started wandering to the right," Art told me. "I left the power on long enough to get things straightened out. I eased out of the power then, and I corrected and started back to the left. Then I knew I had control, so I put out the second chute." (The first one had been kicked out of its compartment by the force of the exploding tire, and had shredded in the 500-m.p.h. slipstream.)

When my plane landed minutes later, I drove back along the salt and inspected the three-and-a-half mile furrow Art's naked wheel had plowed in the salt be-

fore he could get the car stopped. For the most part, it was as straight as the black guide lines laid out by surveyors to keep cars on course. Since the tire blew just as the car entered the measured mile, speed dropped rapidly and official time was a relatively slow 331.

Breedlove's out-of-control run—packed with enough close calls to raise hackles on

MONSTROUS J-79 JET used by Art Arfons is the only one in civilian use. Movable vanes circling inside of tailpipe automatically adjust for optimum thrust



a brass statue—also ended without injury. But it was rugged while it lasted.

"I was just two miles off the starting line when I lost my steering," says Craig, "and the car started to pull very hard to the right. I think something broke in the steering linkage to the front wheel, although we haven't found out for sure what. I kept my foot on it, and I had the wheel as hard as I could turn it to the left. It's a butterfly type, and it was almost upside down. I think I was still getting some steering from the fin on the nose, and that's probably what held it.

"Anyhow, the car was holding, and I just kept thinking to myself 'Stay with it, stay with it.' I wanted that 500 bad. When I got into the mile it started pulling out to the right again and the fin wasn't holding it. I backed my foot off the throttle until I cleared the mile.

Chutes Gone, Brakes Fail

"I came out going about 550. I hit the parachute button and the chute tore loose from the car. The thing I didn't know was

that both chutes had come out and torn off. I let the car slow down for another two miles—about 13 seconds—and then I punched the emergency button. Nothing happened. I was in trouble.

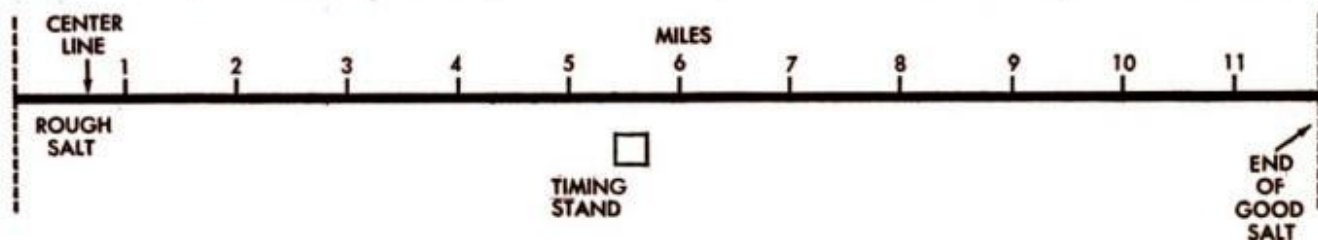
"I looked at the brake pedal and I knew it wouldn't work. I said, 'Well, that's all you've got, go ahead and punch on it.' I stepped down and it went right to the floor. Even if they'd worked, the brakes would have burned up in seconds. They are designed for 30,000 foot-pounds torque. At my speed I was developing about 10,000,000 foot-pounds. But we found out later that the brake pucks never touched the discs.

"I thought about getting out of the car, but I was going 480 miles an hour. I thought to myself, 'Don't be ridiculous. You get out there and you'll lose your balance.'

"I thought the dip at the end of the course would flip me. And I was trying to get lined up so I wouldn't hit any of the telephone poles in the first row. When I

[\(Please turn to page 190\)](#)

BREEDLOVE USES LONG BUILDUP to reach measured mile between 5 and 6-mile markers. When chutes failed, he was still going 488 m.p.h. at 8-mile marker. Arfons, with more power, reaches top speed in about 3½ miles



AS HE TOLD PM READERS he would last June, Tom Green did break the 1963 record of 407 with a new 413 m.p.h. record October 2, in this *Wingfoot Express*. But Art Arfons and Breedlove promptly topped Tom with four new records



Some Choice New TOYS FOR CHRISTMAS

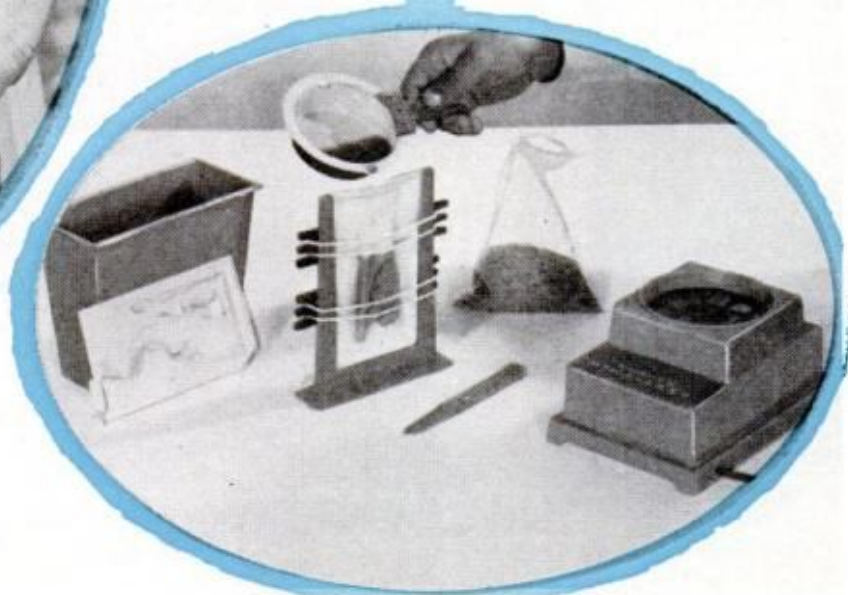
Santa's toy shelf was handy so we took a quick look around. Here's a glimpse of some of its contents

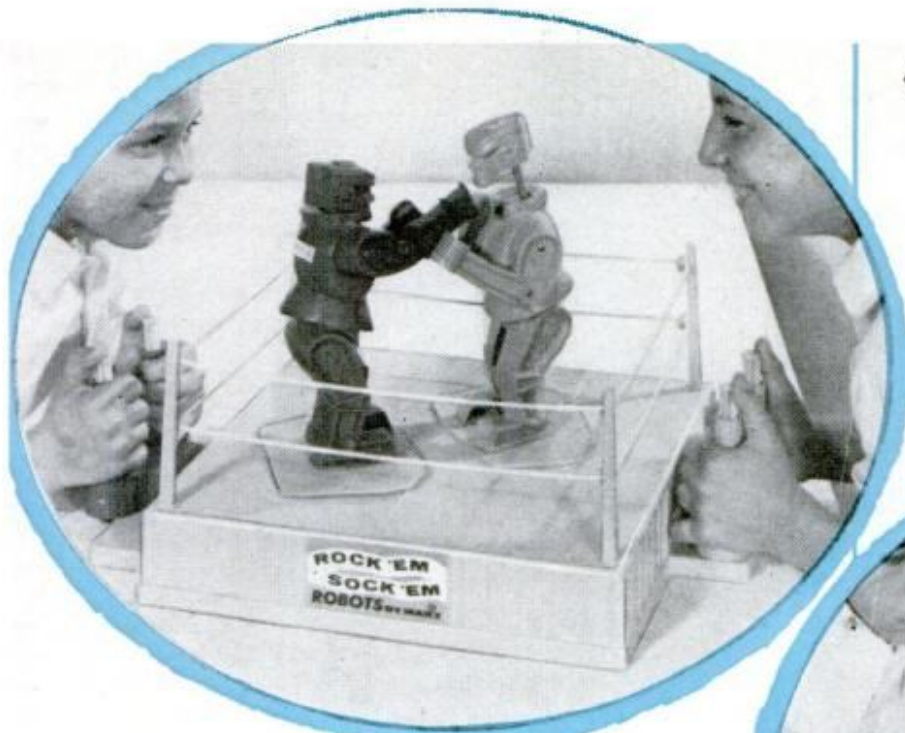
There we were in Santa's workshop surrounded by toys. Big ones, small ones, short ones, tall ones—and we had to make a decision. Which ones did we think were best? We tried them out and learned what made them tick. Finally we made our selection. Here are nine toys, new this year, that we judged best—best to play with, best to have fun with, best to learn from. No doubt your youngsters will be as delighted as the children in these pictures.

FIRE CHIEF HELMET has a built-in transistorized sound amplifier, turns any youngster into a volunteer fireman. Amplifier and speaker are hidden behind shield. Hand mike is attached to the brim. Price is \$3.98 at Texaco stations



MOLD AN ARMY with Formex 7 Military Casting Set. Ordinary light bulb melts plastic. Pour into molds and dip into cooling tank to harden. The finished toys can be recast if desired. Extra kits offer other molds and additional plastic for casting. Priced at \$8 from Emenee Industries



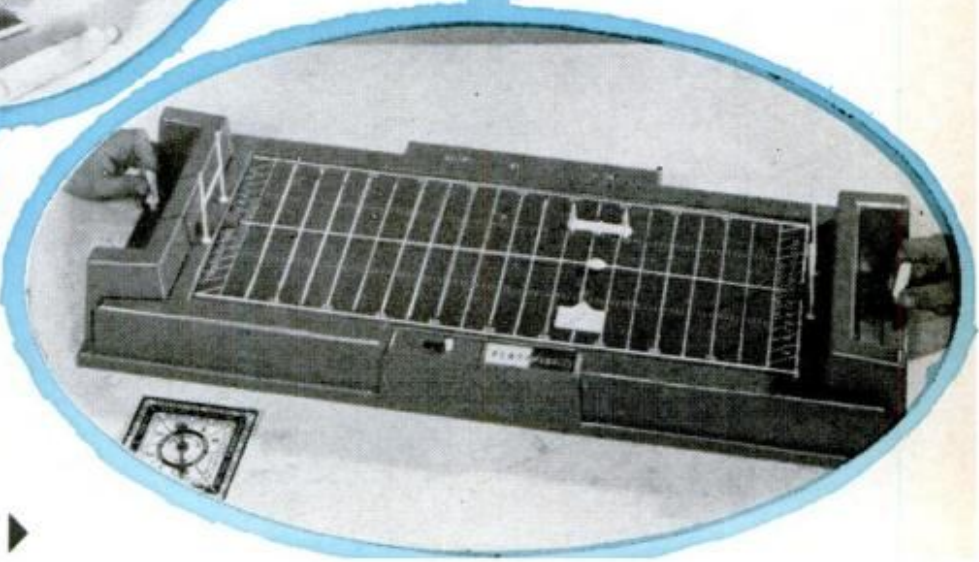


ROCK-EM SOCK-EM ROBOTS toy lets kids spar without hurting anything but the plastic jaws of the two boxers. Hand operated controls move boxers around ring and trigger rights and lefts to the jaw. It takes a good clout to knock a head loose and win. \$12.98 by Marx

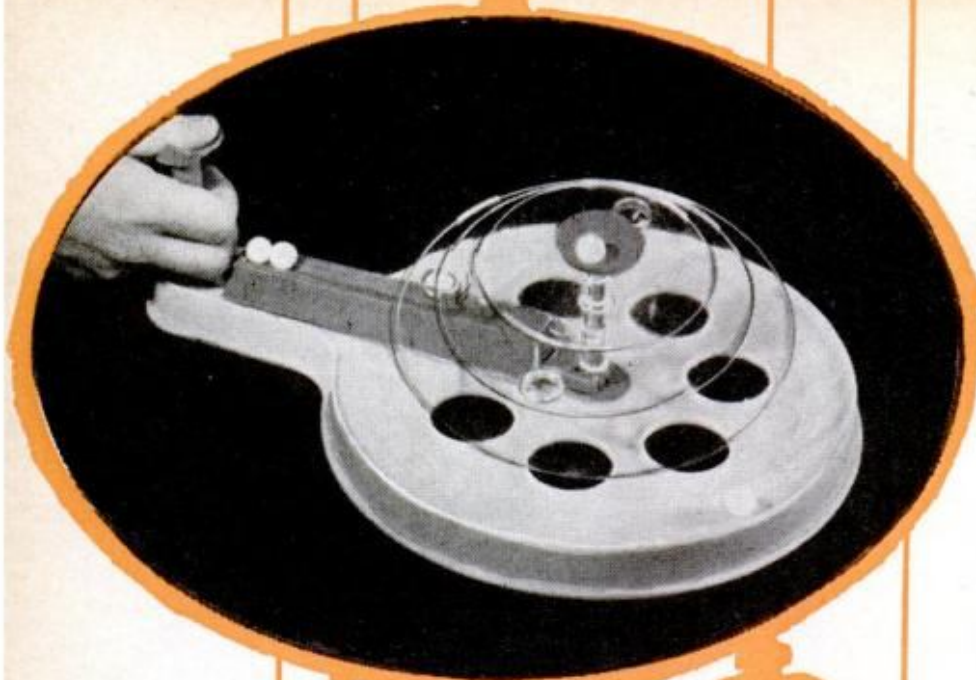
YOUNG PRINTERS will while away the hours with the Big Press flatbed printer. It turns out anything from business cards to novelty sayings and slogans and letterheads. Complete with all accessories. \$18 by Ideal Toy



LITTLE GIRLS CAN BAKE delicious pies, cakes, biscuits, pizza and pretzels with the Easy Bake Oven. Cooking heat provided by two 100-watt light bulbs. Cooks in 6 to 16 minutes. \$15.95 by Kenner



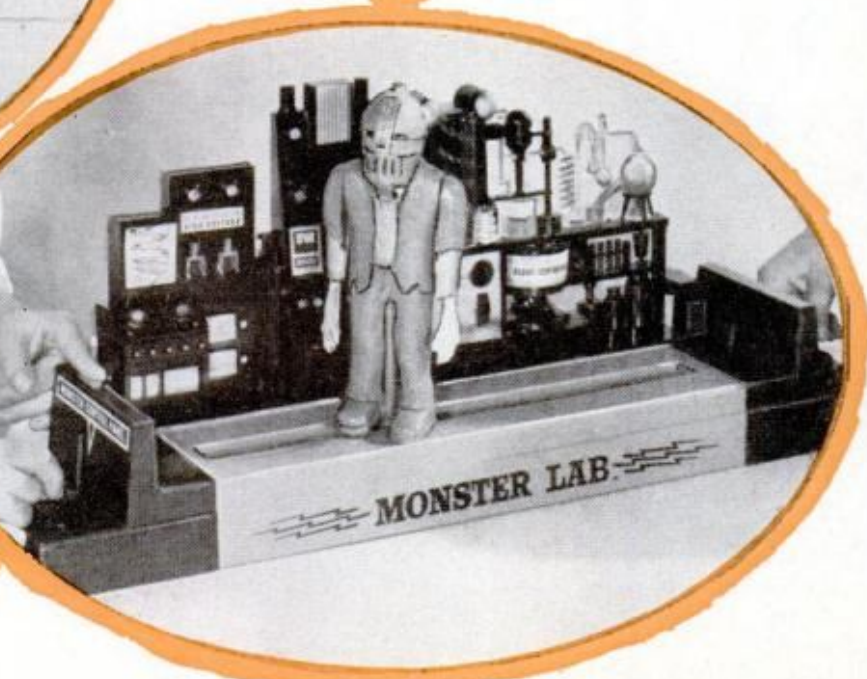
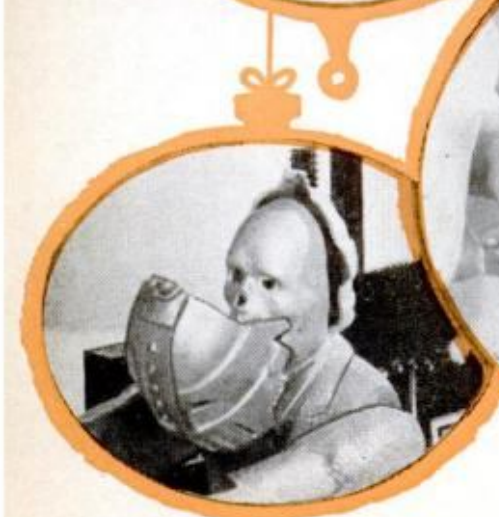
ELECTRIFYING football action: Spin for kickoff and runback, then electric power takes over as teams run ball back and forth to a touchdown. Players try various plays to win. Two batteries required. \$14 from Kenner



ASTRO TRAINER puts a fine edge on reflexes and coordination as you try to maneuver the marble from the top platform to a safe landing on the base. If one marble becomes easy, try two at a time. \$4 from Emenee, Ind.



PUSHBUTTON MARIONETTE takes the kinks out of the strings. Piano-key type operation makes it easy for children to animate marionettes. Eight different puppets for girls and boys. \$3.98 by Knickerbocker Toy Co.



OPPONENTS try to keep the monster away from their end of the Monster Lab as button controls make him walk back and forth. If he reaches either end of lab, he raises his arms, emits a growl and mask over his face drops off. \$16, by Ideal

Spotlight on a New Wanderlust Bus

Are you itching to travel? This all-season cruiser lets you bring your home along with you

By Ed Nelson

THERE'S A TOUCH OF WANDERLUST in most of us, a dream of roaming aimlessly with family or friend. More and more, this vagabond life is becoming available—comfortably—through the many new self-propelled homes on wheels.

I tried a long weekend in the Clark Cortez, one of the finest. It's by no means the biggest; it has only a 120-inch wheelbase and a Chrysler Corp. 225-cube Six. But neither my friend nor I found any important areas in which it was short-changed. There's ample room for two, adequate room for two adults and two or three kids. And one long weekend is not enough vagabonding, you'll find. I'm ready to go again.

Cortez equipment includes a refrigerator, water heater, double sink, stove, toilet and shower. It's a year-round camper. In winter, the regular car heater is more than adequate while you're driving. Overnight, a 17,000-B.T.U. rear heater keeps

OVER-ALL LENGTH is only 225 inches—shorter than that of several large passenger cars. The 140-hp. Six allows 70-plus m.p.h. Sitting directly over the front wheels, driver has an excellent view through panoramic windshield



your family warm as toast.

The drawers under the kitchen counter have flush pushbuttons instead of handles, so your helpmate isn't clipped around the hips while you roll along. My companion wasn't a versatile cook, so I can't report on the oven and broiler. But the bacon and eggs were tasty.

Two rubber-covered wire racks holds dishes and pots neatly on edge. A chromed framework above the three stove burners keeps pots from sliding. It's hinged to swing out of the way for oversized pans, but when we camped on an incline we found it wouldn't stay up. The incline also frustrated the gravity operation of the refrigerator, so the morning juice was warm.

Our Cortez had nine individually controlled, recessed ceiling lights, and two gas lamps (replaced with electric dittos in later models). I prefer the gas; the electrical system carries a heavy load as it is—lights, a good radio and a water pump. Every morning I had ample starting current, but the situation might have been different in the dead of winter.

If you're where the auxiliary 110-volt system can be hooked up, two double outlets are activated, one in the washroom and one over the dining-room table.

The shower, toilet and washroom are all in a closet-sized area. The first use of the shower is an eerie experience. The entire room becomes the shower stall. After your shower, you can swing the door open until it latches across the hall to form a screen, for privacy when the whole family is along. Gals will appreciate the large mirror in this area, which is also a sliding closet door. But I wonder how long the thin plastic bathroom floor will hold up.

For rough roads, foam rubber is called for in the refrigerator. Our eggs suffered a 50-percent mortality rate.

Some foam stripping would be handy along the edges of the sliding closet doors to provide tension. The lock pin tends to vibrate out of place, allowing the doors to bang back and forth. We improvised with a scrap of old inner tube.

The Cortez' eight-foot width takes getting used to. The two outboard mirrors help. At 70 (a practical cruising speed), handling is stable and solid—the result of 3½ tons of body and frame. I'm still amazed that the little Six handled that weight so well. Much of the credit belongs



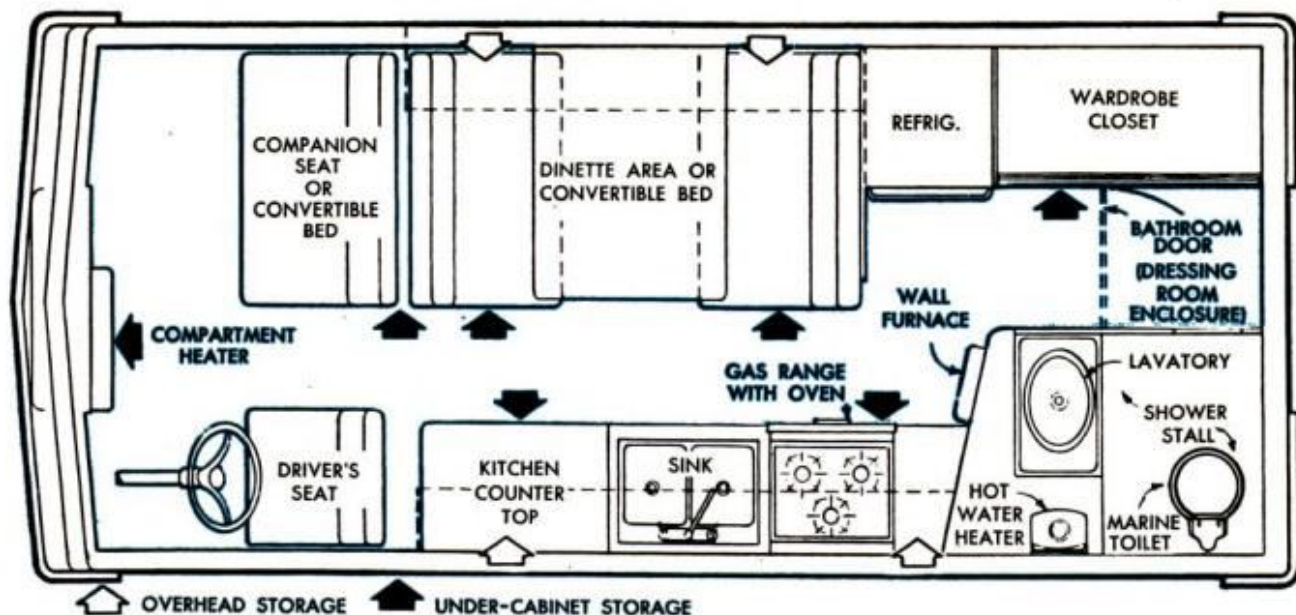
CORTEZ is sure-footed even on poor back roads. Well-controlled ride lets your wife cook while you are driving. Suspension is independent all around



WHILE MY FRIEND peeled onions for a disreputable-looking stew, I was enjoying the radio up front. There's plenty of upper and lower storage space

to the Clark four-speed transaxle. Its gear ratios are 23.80, 12.84, 7.48 and 4.44 to one—equivalent to transmission ratios of 5.36, 2.86, 1.71 and 1.00 to one with 4.44 conventional rear axle. All forward gears are synched, but linkage is mushy. Shifting up to third, I often overshot the wide gate. There was no gear clashing, because reverse is far to the right and down, but a heavier spring in the gate would help.

Front-wheel drive allows a low, flat floor and low center of gravity—which means little lean on corners. Power brakes are standard. So is power steering; with



INTERIOR IS FUNCTIONALLY DESIGNED to squeeze maximum convenience into a minimum of space. Kitchen facilities are grouped directly behind the driver's seat. Behind them is bathroom. All windows are fitted with curtains



TWO DOUBLE BEDS fold out in ingenious over-under fashion. Interior lights are individually controlled so you can work or read while the kids sleep



FOR DINING, beds turn into benches and companion seat, and hinged table is raised. Trouble is, stopping for groceries means less mileage covered

4000 pounds on the front axle, you'd have a merry time without it.

The driver's seat proved amazingly comfortable. The seat back has a firm lower section that gives excellent support—something like the seats in the Volvo 1800S, the best ones I know of.

The gas tank holds 25 gallons of regular. With something this massive you can't expect great fuel economy; we got 10.14 m.p.g. over 554.4 miles of turnpike and back-road driving. The 30-gallon water tank drains into a holding tank of the same size, which is easy to empty.

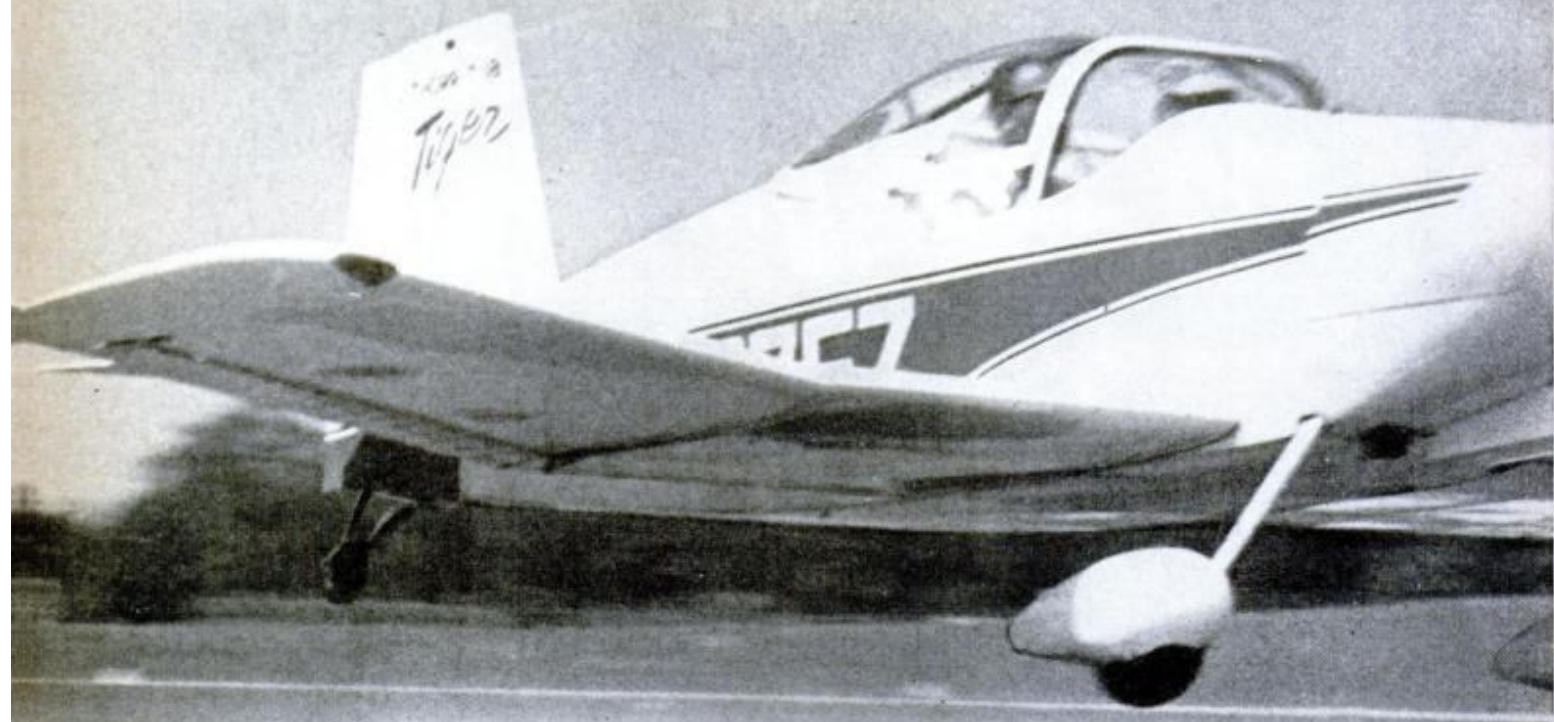
What are the chances of running out of water? I found out, after thoroughly soaping up in the shower—and before rinsing off. I had to dress and drive off to find a well. A water-level gauge would be handy.

All in all, the Cortez adds up to real quality. There's handsome paneling, excellent fittings, wall-to-wall carpeting and much more. If I had \$8619 to spend, this would be a fine place for it.

In some places you can rent one for about \$150 a week and 12 cents a mile. Sure, that's expensive, but who wants to be a cut-rate vagabond? ★★★

FLIGHT TESTING THE ...

First All-Metal Plane



FIRST T-18 built is a swifty. Bill Warwick cruises above Rockford, Ill., indicating 167 m.p.h. straight and level at 75-percent power. Warwick, who had never built a metal airplane before, completed the craft in one year



Anyone Can Build

- A beginner can do it
- Needs only simple tools
- Speeds up to 200 m.p.h.
- Costs less than \$3000

By Kevin V. Brown

LETTERS TO THE EDITOR follow definite patterns. Most respond to stories that have appeared in the magazine, offering additional information, asking for additional information or rebutting information contained in a story.

Some letters, however, come in "from left field." Completely unsolicited, they ask about subjects that have never been covered by any magazine, and often about things that don't even exist. A few, of course, come from crackpots—"Why don't you do a story on a fur-lined gizmo?" Most do not.

One of the most consistent of the sensible requests we've had "from left field"

T-18 TAKES OFF in less than 1500 feet, climbs at 1500 feet per minute. Note distinctive gull outer-wing sections and craft's tubular-steel landing gear

COMPLETELY AEROBATIC, T-18 probably will outperform most amateur-built planes, and open new era of all-metal aircraft constructed in workshops



in recent years is to do a story on a small airplane that a beginner could build in his workshop, easily and inexpensively, and fly just for fun. And, as all editors know, for every man who writes, there are hundreds more who only think about it.

Well, for all those who wrote and for those who only thought about it, we believe we've found what you've been looking for. It's called the T-18—"T" for John Thorp who designed it, and 18 for his eighteenth model. It's a two-place, low-wing, all-metal plane that anyone can build, with simple tools, for less than \$3000. And it's a real speedster.

These are its features:

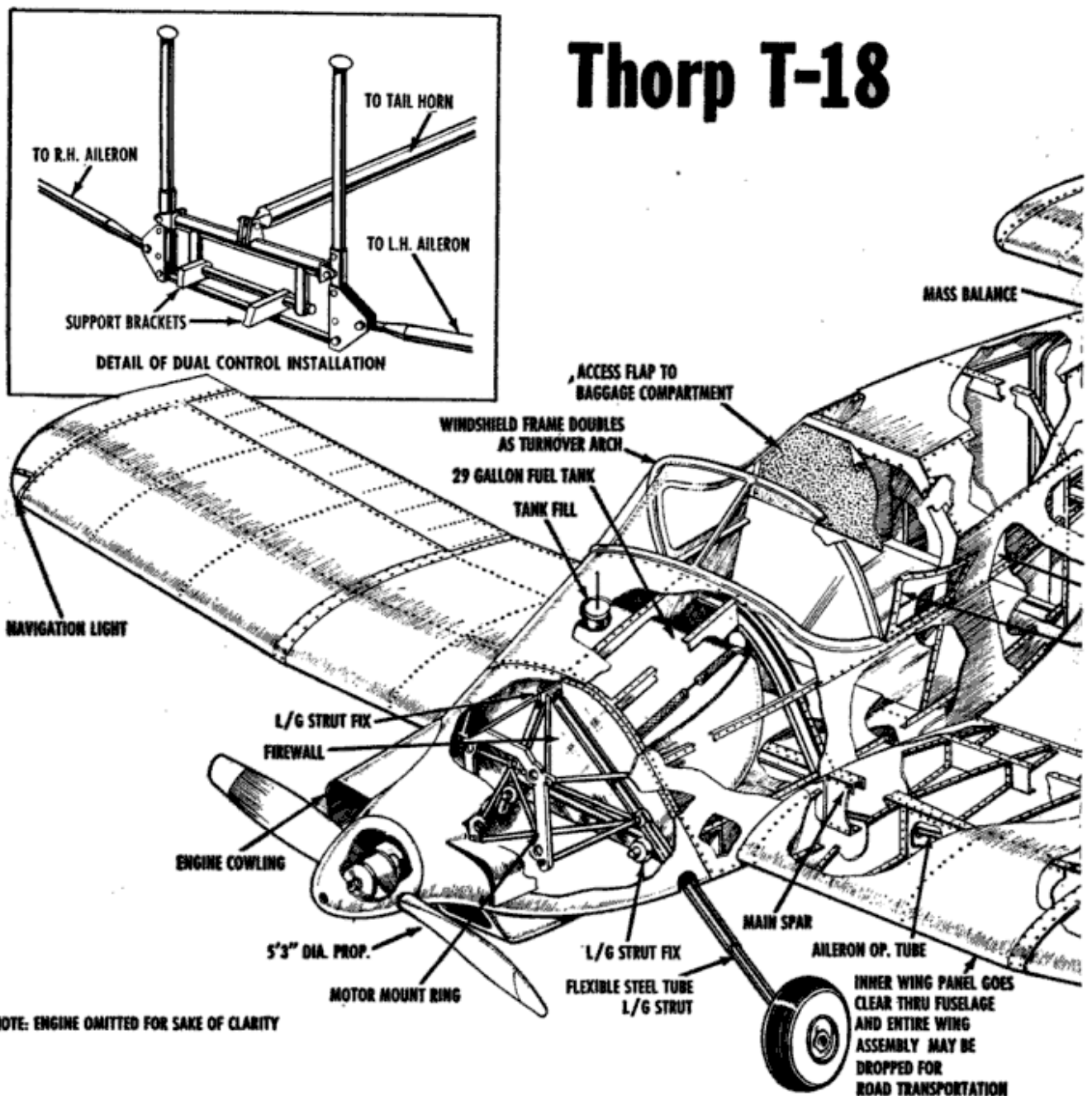
—It's all-metal. Most amateur-built

planes are wood-and-fabric which, without exceptional care (including hangar parking), have limited life spans. Some say about three years. Theoretically, an all-metal plane should last forever.

—It has a simple design. Thorp calls it "irreducibly simple." The number of parts have been held to a minimum, and are designed to be made with minimum shop equipment. Everything that could be eliminated, without sacrificing structural integrity, was left off for easier building.

—It can be made with simple tools. A major reason most amateurs build wood-and-fabric planes is that they can't handle metal, or afford the necessary jigs and riveting equipment. The T-18 needs no

Thorp T-18



jigs and can be put together with a hand-held "pop" riveter.

—It's aerobatic. At gross weight it is stressed to six Gs (nine Gs maximum).

—The wing is removable. It can be unbolted and dropped off whole (it takes about 30 minutes), then the plane can be towed home and stored for the winter.

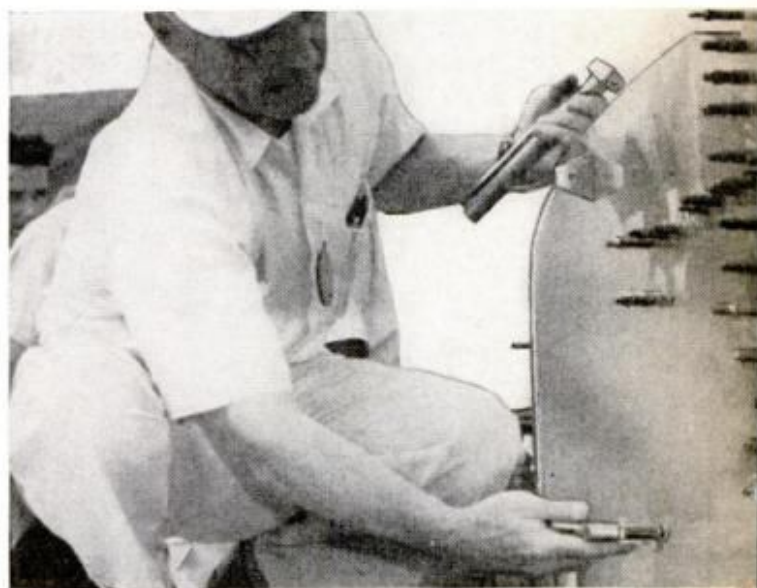
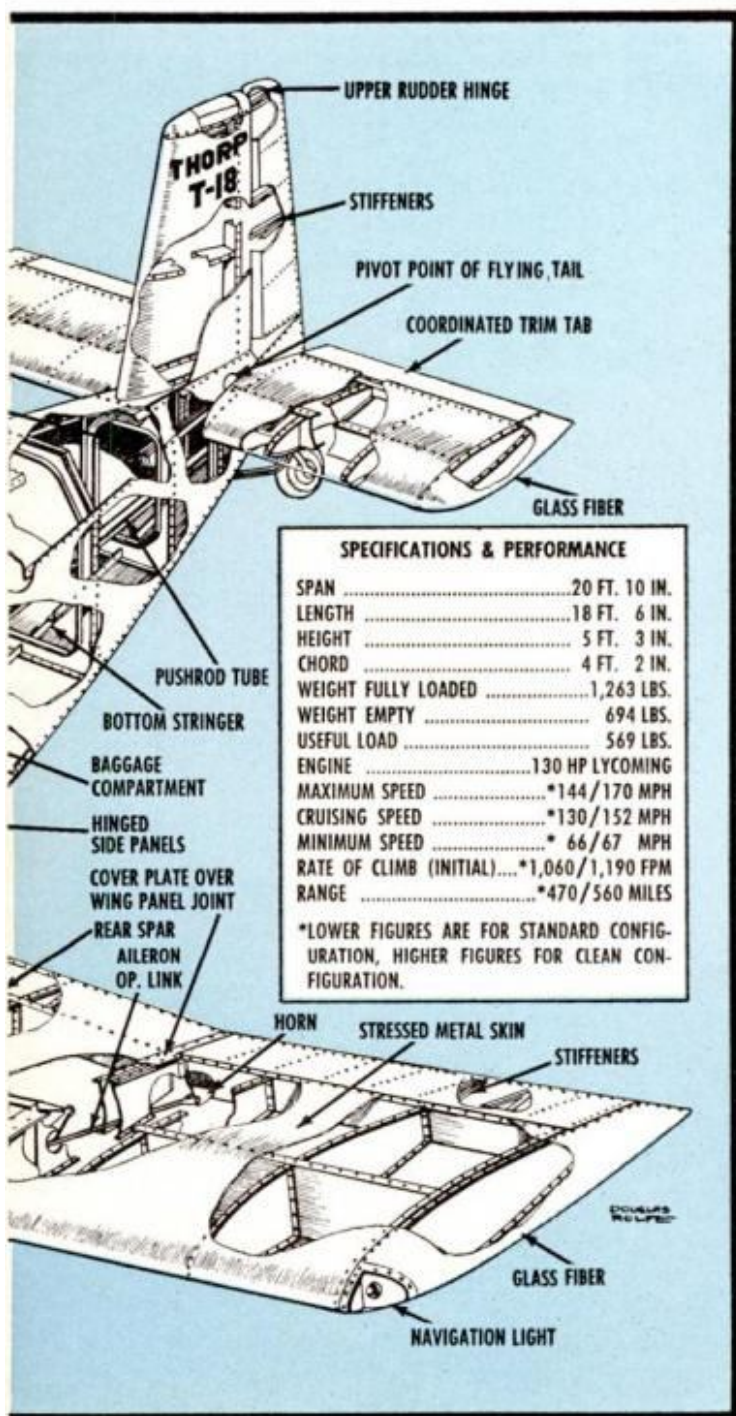
—Its performance is outstanding. Highly maneuverable, its specifications call for speeds from 130 m.p.h. to 200 m.p.h., depending on engine size and refinements in configuration. Its basic design can accommodate engines up to 205 horsepower.

—Its cost is comparable to wood-and-fabric homebuilts. Thorp estimates an average of \$3000, although at least one has

been built for \$2000. Some wood-and-fabric planes have been brought in for less, but all-metal planes run considerably more, as much as \$10,000.

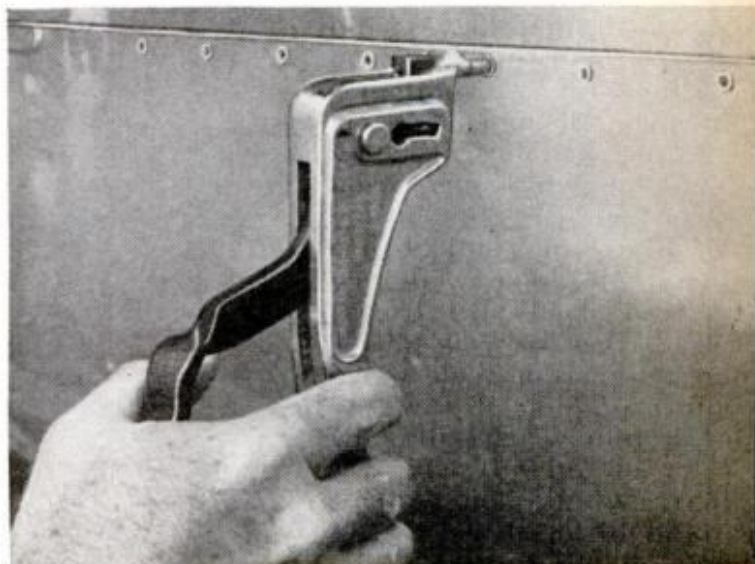
Thorp's basic claims are that the T-18 will be "simpler and cheaper to build than any other airplane," and that it may "open up a whole new era of useful homebuilt transportation." Wood-and-fabric devotees have already challenged the simplicity, and the expense is still to be proved. But he may be right about its usefulness as transportation. Most homebuilts are one-place runabouts in the 100-m.p.h. class. The T-18 is a two-place, all-metal swifty that can easily hack it cross-country.

In any case, it's the first all-metal plane



JOHN THORP demonstrates Cleco method of holding parts in place, eliminating jigs usually used in metal work. Parts are then fastened with pop rivets

POP RIVETER secures parts together permanently. T-18 is so designed that holes are drilled together so they will match up even if slightly off center





'FLYING TAIL', designed by Thorp, is all elevator without usual horizontal stabilizer. Bill Warwick was first of 150 T-18 builders to finish his plane



LANDING GEAR, another innovation, is shaped like an "A" and secured to fuselage behind the engine. This part, and others, can be purchased by beginners

being built on a mass basis by amateurs. Even at this writing, Thorp has not completed the blueprints, yet nearly 150 home-builders had enough faith in him as a designer to buy plans (at \$125 per set) before a T-18 had ever flown. In fact, one of these men was the first to finish and fly a T-18, and this is the plane we tested.

Our verdict: Whether or not it's as simple to build as some men might prefer, it is being done and by beginners. And, once in the air, it's a hot little airplane.

Just who is John Thorp and what are the theories behind this "irreducibly simple" airplane? Well, he lives in Burbank,

FAA INSPECTOR checks another T-18 before approving it for flight. All amateur builders must contact Federal Aviation Agency when building planes



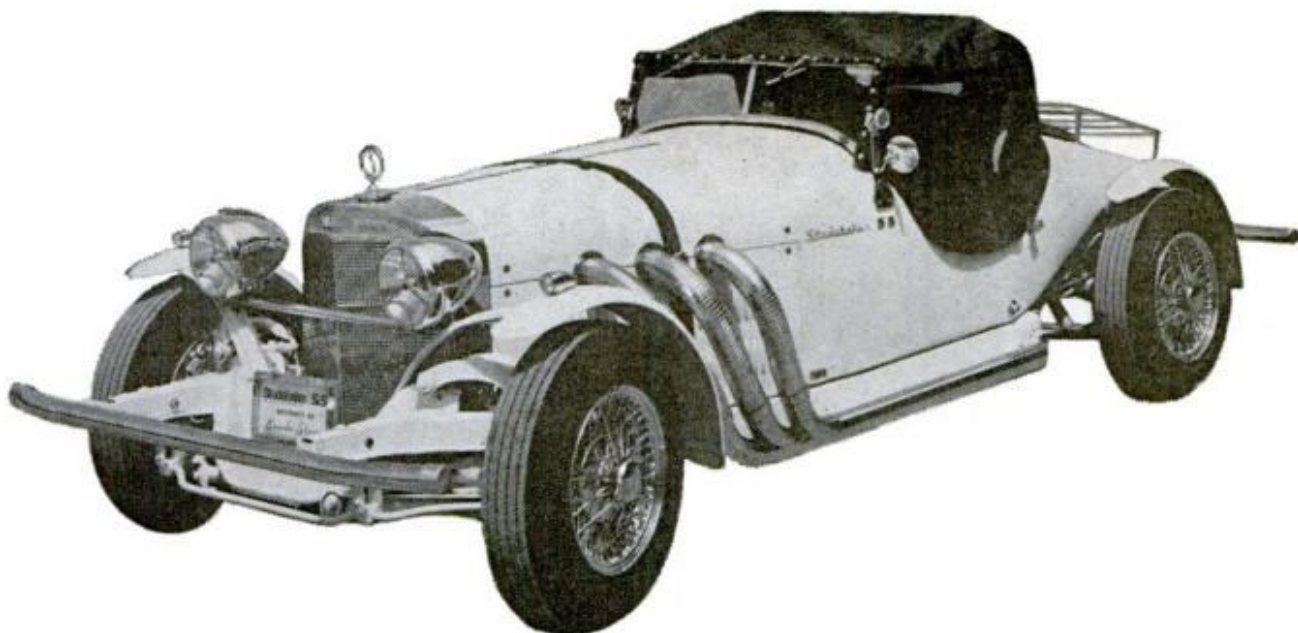
Calif., and he has been designing aircraft since 1932. He's up to number 18 now and, along the way, amateurs may remember his *Little Dipper* and *Sky Scooter* (*PM*, October, 1964). Commercially, he was involved in the preliminary designs of the Lockheed-Vega PV-2 and Piper *Cherokee*, among others. He also designed what he calls the "flying tail" and what Piper calls a "stabilator"—an elevator without a horizontal stabilizer. There's one on the T-18.

This starkly simple do-it-yourself plane is based on several innovations. All of the parts that are made from flat sheets—the skin, ribs and bulkheads, for instance—are completed while flat, cut to size and the holes drilled before flanging the edges, wherever necessary.

Further, Thorp uses "matched hole" tooling in which parts that will be riveted together, or have identical rivet patterns (like the two sides of the fuselage), have their holes drilled together, two or more parts at a time. So patterns are laid out only once. Not only does this speed up the work, but it insures that the holes will match up even if slightly off-center. If they were drilled together, they will be off-center together, so perfectly aligned.

Then, when all the parts are finished, they can be put together "like an Erector set," sub-assemblies first, followed by whole assemblies. The parts are held in place with Cleco fasteners, then riveted with a hand-held "Pop" riveter. No jigs, no heavy riveting equipment. Best of all,

[\(Please turn to page 198\)](#)



If the '65s Don't Suit You, Try This

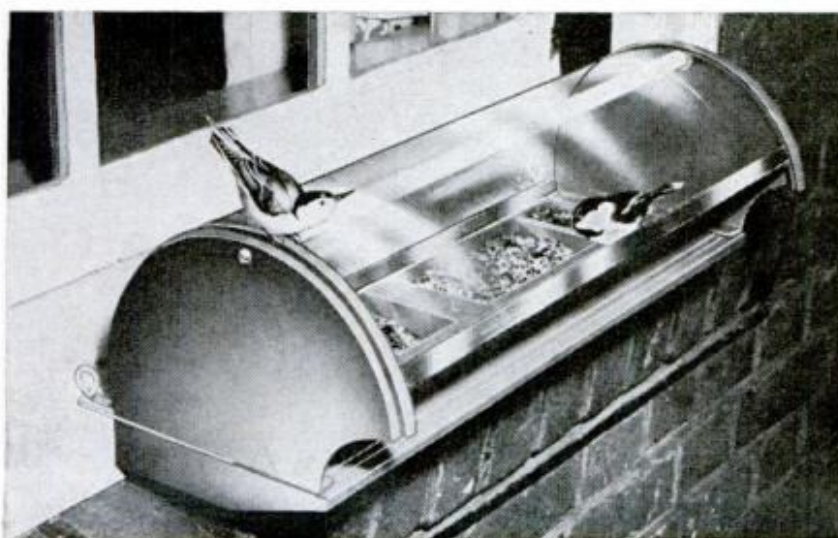
Out of the past comes today's version of one of the hairiest sports cars ever built, the Mercedes SSK. But this is no \$30,000 restoration job; it's the \$6000-plus SS Excalibur, redesigned and built by

Brooks Stevens. It's more than a dream, too. They're available for purchase as what Stevens calls "contemporary classics." The engine is Corvette's and the chassis is Studebaker's.

An Inside Job

Tagging lobsters to study their migratory habits has been impossible in the past, because a lobster sheds its skin as it grows.

But now a University of Rhode Island professor is placing a plastic-covered metal tag behind the lobster's eye. It stays in place after molting, and is detected in the recaptured lobster by an electronic tunnel.



Snack Bar for Birds

A new wild-bird feeder features a transparent roll-top roof over a partitioned tray and landing platform. It measures 8 by 18½ inches and attaches to window sill or can be hung. It is designed to discourage the patronage of free-loading pigeons.

The feeder is made by Duncraft, Penacook, N.H., and costs \$7.95.

Driving Ford's FABULOUS TURNPIKE TRUCK

A gas turbine cruises this brute at 70 m.p.h., and the driver can enjoy all the comforts of home

By Alex Markovich

THE MONSTER was straight ahead of us, stretched out to its full length—an awesome 95 feet. As we drove closer, I watched Everal Kirby's face. His rugged, craggy features were frozen in disbelief.

It isn't easy to surprise Kirby with a new truck; a driver for Consolidated Freightways, he's been pushing trucks of all kinds for 41 years. Since starting at 15 in a four-cylinder, chain-driven White with solid tires, he's logged three million truck miles. Among his many awards, this brawny 240-pounder was Ohio champ at the annual American Trucking Association Roadeo from 1953-1957 and in 1962 and 1963—and national champ in 1956.

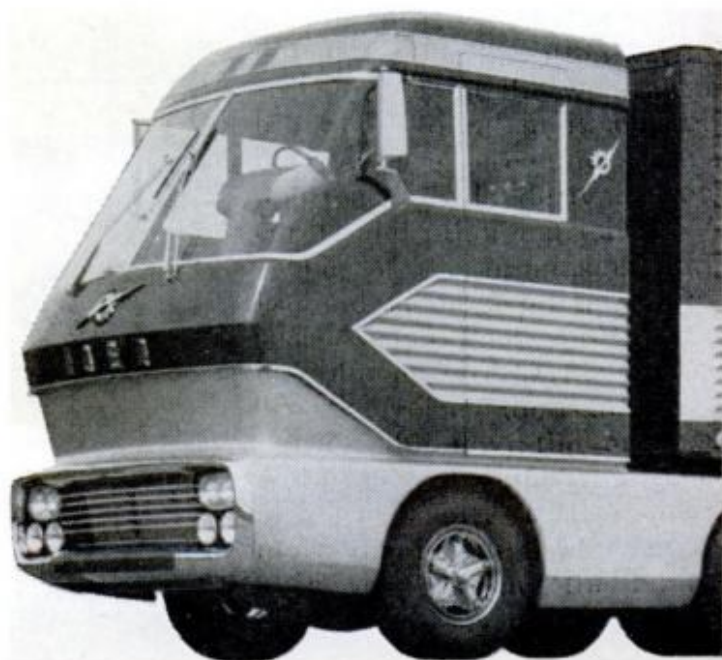
Kirby shook his head, still staring at the truck. "I don't believe it," he said slowly, a trace of a drawl lingering from his West Virginia boyhood.

Before going to the Ford test track, we were briefed by engineers. The truck wasn't a production prototype. It was more Ford's working prediction of what trucks would be like in the 1970s, when more than 40,000 miles of superhighways would link 90 per cent of our cities with more than 50,000 population. With terminals near the exits, a double-bottom or twin-trailer truck would never leave the turnpike except to pick up or drop trailers. At the terminals, trailers would be hitched to small tractors for local delivery.

On such super roads, a modern truck could safely do 70 m.p.h.—which would make a gas turbine the ideal power plant.



AIR-CYLINDER-OPERATED DOOR opens and electrically powered ladder swings down for easy entry. Cab is slightly pressurized and free of engine fumes

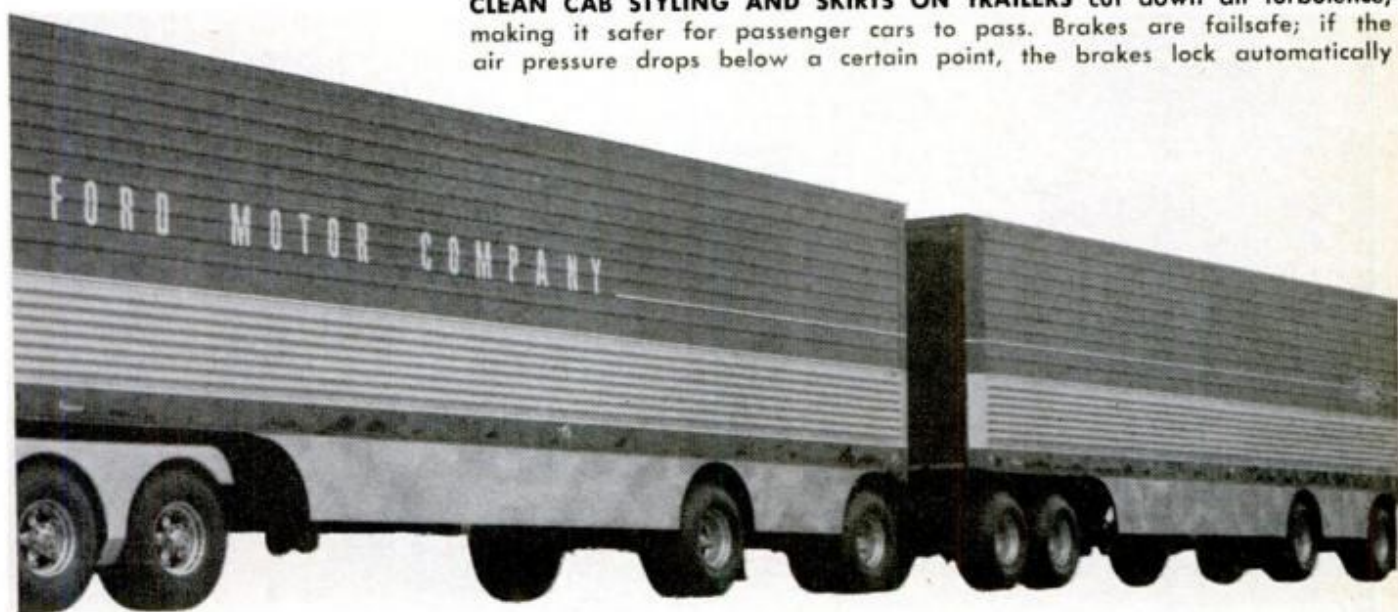


POPULAR MECHANICS



TURBINE TRUCK DWARFS FORD'S BIGGEST DIESEL. Fiberglass cab was built in two sections because of low ceiling. On today's roads, clearances are a problem. In some states, special permit is needed before driving through

CLEAN CAB STYLING AND SKIRTS ON TRAILERS cut down air turbulence, making it safer for passenger cars to pass. Brakes are failsafe; if the air pressure drops below a certain point, the brakes lock automatically





TV SET IN FRONT OF CO-DRIVER has vertical slats so driver's attention isn't distracted. Separate co-driver's air-conditioning control is at the right



KIRBY CHECKED OUT REFRIGERATOR, found it empty as Mother Hubbard's. Three spiggots serve refreshments. Stylists had field day with decorative map

DRIVER CAN SHIFT MANUALLY WITH DASH SWITCH or let Allison five-speed box work automatically. Turbine tachs are above windshield. Immense tinted windshield had slight distortion at bends, but provided a panoramic view





CONTOURED LOUNGE FOR CO-DRIVER proved very comfortable. It was built to recline, but later welded in fixed position because of elusive prototype rattle



FORD'S TURBINE is virtually two engines in one, producing 45 hp. for running accessories or, with supercharging section triggered, the full 600 hp.

The turbine is inefficient at low speeds, but at high speeds efficiency approaches a diesel's. Further, a turbine weighs only about a third as much, which means the truck can haul about 2000 pounds more pay load. At 70, the Ford truck can pull a gross combined weight of 170,000 pounds.

We pulled up near the monster and got out of the car. One of the engineers pulled a switch on the cab; the door swung open and a ladder slid down. We climbed up.

The cab is immense. It has a wide, flat, carpeted floor and enough headroom for Kirby to uncoil to his full six-foot-six-inch height. In fact, the cab, towering 13 feet above the ground, resembles a loaf of bread standing on end. It's mounted over the 600-hp. engine and is independently suspended on four leaf springs.

After watching a quick demonstration of the controls, Kirby slid into the driver's seat and pulled the adjusting lever. The seat glided back—a little too far even for Kirby. He moved it slightly forward again. "You know," he said, "none of the truck manufacturers ever think of the tall driver's comfort. All my life I've been sitting in a cramp. And on the run from Richfield, Ohio, to St. Louis I drive 530 miles at a stretch. This is the first truck I've ever been in where I have *more* than enough legroom."

He glanced approvingly at the futuristic instrument console sprouting from the floorboards, then looked out through the vast expanse of windshield. "Isn't that

view lovely," he said. "When you're driving you can never see too much. But with all this glass, isn't heat a problem?"

"Wait'll the air conditioning is on," the engineer volunteered. "You can make it as cold in here as you want."

Kirby flicked the master switch. The burners went on and the turbine wheels began spinning with a soft, high-pitched whistle that gradually reached a muted peak. The needles on the tachs above the windshield climbed quickly. At the same time, cool air flooded the cabin.

Kirby twisted the electric shift knob to Low and stepped on the large, treadle-like accelerator. There was a lag of a couple of seconds, then the mammoth was rolling. It gathered speed quickly.

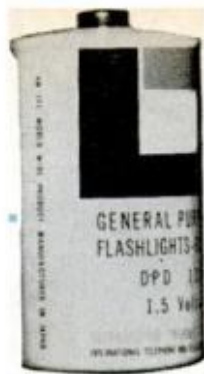
I asked Kirby about that lag. "With a full load, you get that in any truck," he answered. "In fact, this job gets rolling faster, it seems to me."

We felt an upshift to Second. Then Kirby twisted the shift knob to "4," which allows shifts to Third, Fourth and Fifth. "This sure beats my 15-speed gearbox," he said. "You've got to double clutch, and every time you shift the revs drop way down. Here you don't even let up on the gas."

The speedometer was registering 40. "The speedo is slow," the engineer said. "We're doing about 50." From our height, it seemed more like 30.

Engine noise was hardly louder than at

[\(Please turn to page 197\)](#)



PM SHOPPING GUIDE

Which Battery Is Best

Flashlight dead? Transistor radio "motorboating?" Toys won't work? Here's how to match new dry cells to the job.

By Larry Steckler

BATTERIES have become an important part of everyday life. You'll find them in your electric toothbrush, the emergency flashlight in the car, powering the motor in your movie camera, giving life to your transistor radio or portable TV, and keeping the kids' toys going. But when it's time to replace a set of run-down batteries, your problems are just beginning.

Take the "standard" D cells that fit your flashlight—there are endless types to choose from. There are high, low and medium output zinc-carbon cells. There are steel-jacketed leakproof types, cardboard-jacketed leakproof types and no-jacket, not-leakproof types. Then there are alkaline, mercury and rechargeable nickel-cadmium batteries. Prices in this assortment of types vary from a low of seven cents for the imported, not-leakproof battery to six dollars for the rechargeable ones.

There are three basic demands we make on batteries: The amount of power needed, the length of time the power is required and the storage life of the battery. For example; we may want a little power for a prolonged period of time as in transistor radios. We may need medium power for continuous use in toys, movie cameras or other motor-driven devices. Or we may require high power for short intervals, as for firing flashbulbs. We also want standby

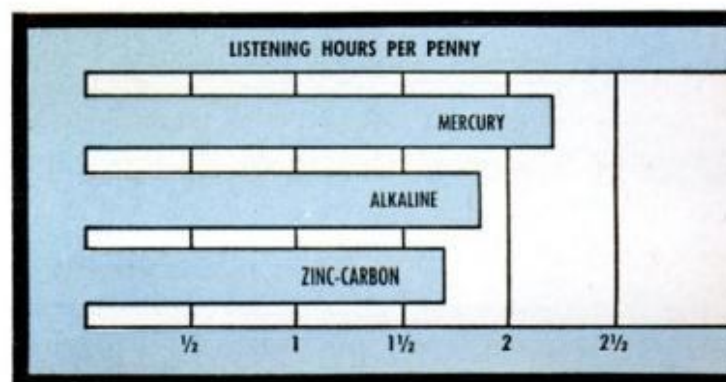
time. We want to be able to store batteries, leave them standing idle, and still have them deliver full power on demand.

These are factors that determine the best battery for a particular job. Figure 1 shows what happens in a transistor radio. You'll note that the mercury battery gives the lowest cost of operation. And this is true even though the mercury type costs as much as an alkaline dry cell and three times as much as a zinc-carbon dry cell.

However, if the same chart were drawn for a flashlight that is used every day, the zinc carbon cell would come out ahead. Draw a similar chart for flashguns and the alkaline cell would lead.

As a general rule, mercury batteries are excellent where low power is required for prolonged periods of time. This is why mercury types are found in hearing aids, electric watches and transistor radios. They also have the ability to pack a lot of electricity into a small package and are used in almost all subminiature electronic devices. For extra power capacity, special silver-mercury cells are made.

Fig. 1—Despite their higher initial cost, mercury batteries give the lowest operating cost when they're used in a low-power drain transistor radio circuit



POPULAR MECHANICS

for You...

Alkaline cells are at their best where high power is required for intermittent short periods of time. The cell recuperates rapidly. This makes them extremely useful in motorized devices or for firing flashbulbs or strobe lights.

Zinc carbon cells have a moderate life, but are available almost anywhere. They are made in three basic categories—general purpose, photoflash and transistor applications. Each should be used for the purpose specified. Do otherwise and you shorten their life.

In Fig. 2, we compare the hours of service various types of batteries can be expected to deliver. Again the application illustrated is a transistor radio. Obviously, if long life in a low-power circuit is required, mercury batteries are best.

If we change the application and draw this same chart for a high-current motor, the alkaline cell would take the lead.

Try to draw high current from a mercury cell and you shorten its life drastically. Zinc-carbon cells don't stand a chance here—the high power drain kills

Fig. 2—Measure hours of service and you'll find that both mercury and alkaline types come out ahead of zinc-carbon batteries when used in a transistor radio

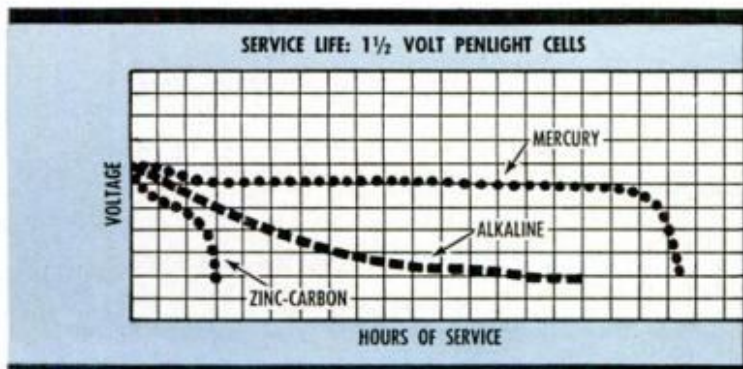
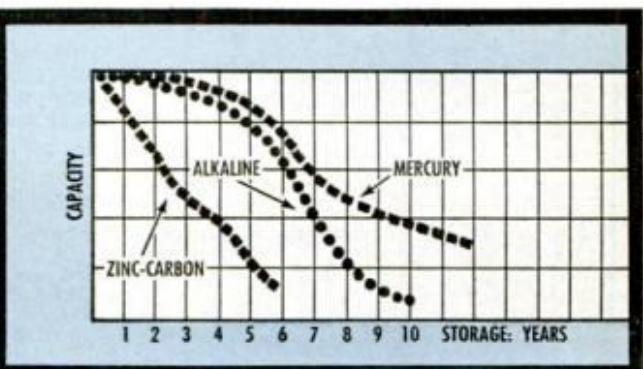


Fig. 3—Shelf life is an important characteristic. It tells you how long you can store idle batteries and still have them work when they are needed



them fast. They may be inexpensive and readily available, but for high power use, alkaline is best.






Figure 3 compares the shelf or standby life of various batteries. Again the mercury cell comes out on top. It can stand idle up to eight years and still deliver 50% of its original power. In less than two years a zinc carbon cell is almost dead. So, if standby power in an emergency radio is required, mercury is best. Note too that alkaline cells have a good shelf life. For this reason they make good standby power for the flashlight in your car.

Going back to Fig. 2 for a moment, notice that this chart also shows the comparative voltage stability of the battery

over its useful life. Both the zinc-carbon and the alkaline drop steadily. However, mercury cell voltage remains relatively constant until it reaches its final hours. Here's another reason why mercury batteries are used in watches and clocks and in the new cadmium-sulfide light meters.

What about leakage? We've all seen what happens when an over aged zinc carbon cell splits and corrosive electrolyte oozes out all over the inside of a flashlight. You usually end up throwing out the flashlight. Leakproof cells help, but I can show you many a leakproof cell that has split and oozed. In a transistor radio this can be fatal; electrolyte can ruin the copper-printed circuit board.

Alkaline cells are much more resistant

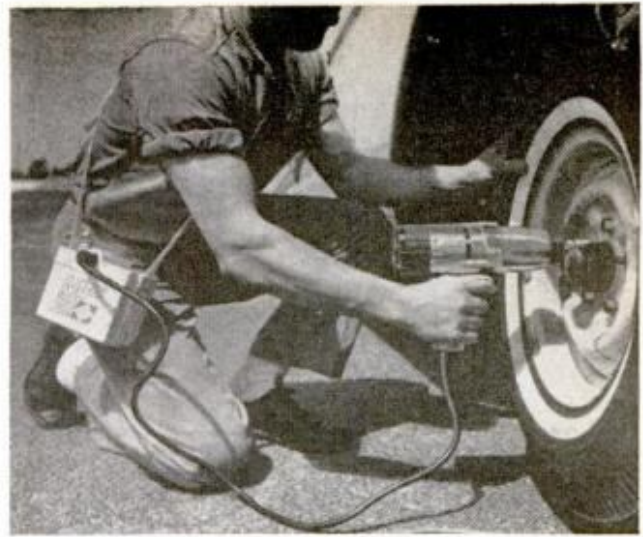
WHERE TO USE THEM		
Use	Battery Type	Pros and Cons
Clocks, Watches 	Mercury	Long, constant-voltage life gives accurate timekeeping with minimum of battery changing. Excellent resistance to leakage
	Alkaline	Voltage curve not constant, could affect timekeeping accuracy. Not available in subminiature sizes used in watches
	Zinc-carbon	Voltage curve not constant. Not available in subminiature sizes. Tendency to leak which could damage mechanism
	Nickel-cadmium	Not suitable. Life too short before recharging
Flashlights 	Zinc-carbon	Excellent for everyday watchman-type service where it can give lowest-cost operation. Replacements are readily available
	Alkaline	Good for rarely-used emergency flashlight in car or home. Long shelf life (see Fig. 3). High current output. Little chance of leakage
	Nickel-cadmium	Very useful around the house where a.c. line voltage available for recharging. Needs recharge after using
	Mercury	Use when long standby life is mandatory. Comparatively high current drain of flashlight will rapidly run down battery
Hearing Aids 	Mercury	Best bet. Provides long-term power in these low-current circuits. Minimum replacement
	Alkaline	Not available in subminiature button-type sizes often used
	Zinc-carbon	Not available in subminiature sizes. Short useful life. Leakage may damage device
	Nickel-cadmium	Not practical. Short useful life before recharging. Might not last eight hours
Cadmium-sulphide light meters 	Mercury	Long, constant-voltage characteristic with minimum battery changing makes this best
	Alkaline	Voltage does not remain constant. Not available in sub-miniature sizes
	Zinc-carbon	Not available in subminiature sizes. Voltage does not remain constant. Tends to leak
	Nickel-cadmium	Voltage does not remain constant. Short useful life before recharging
Flashbulbs 	Alkaline	High power keeps firing bulbs in sync. Long shelf life ideal. Leakage not a problem
	Zinc-carbon	Shorter life but readily available. Change every eight months no matter how much or how little used. Leakage can damage equipment
	Nickel-cadmium	Short life before recharging
	Mercury	Not recommended. Lacks high-current capability. Life short and erratic in this application
Movie camera	Alkaline	Excellent choice. Provides high, fairly constant power. Good storage life. Little leakage

to leakage and mercury cells almost never leak. However, it's a good policy to remove the batteries from any equipment that will stand idle for any length of time.

The rechargeable nickel-cadmium cells are a world to themselves. They keep you tied to an a.c. outlet for recharging, but if you recharge after each use, they last indefinitely. Be sure not to let the battery go completely dead. If it does, it can never be fully charged again.







Zinc-carbon, alkaline and mercury batteries are rechargeable, too. Several rechargers for these units are on the market. Also a new rechargeable alkaline battery has been announced by Eveready.

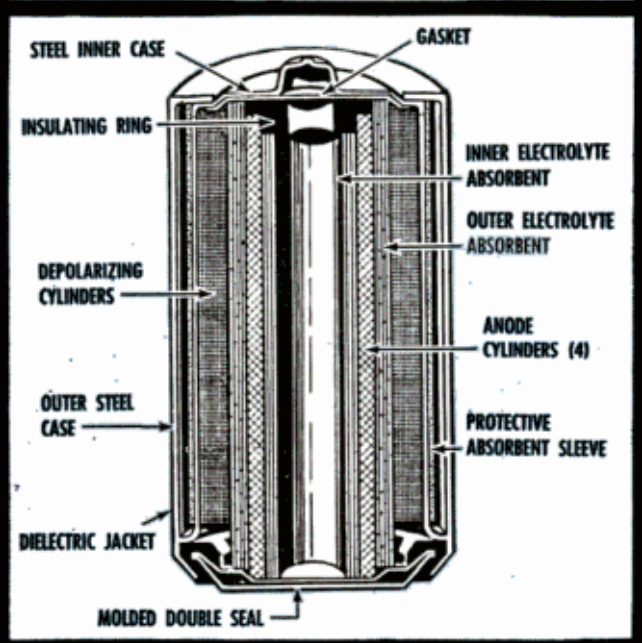
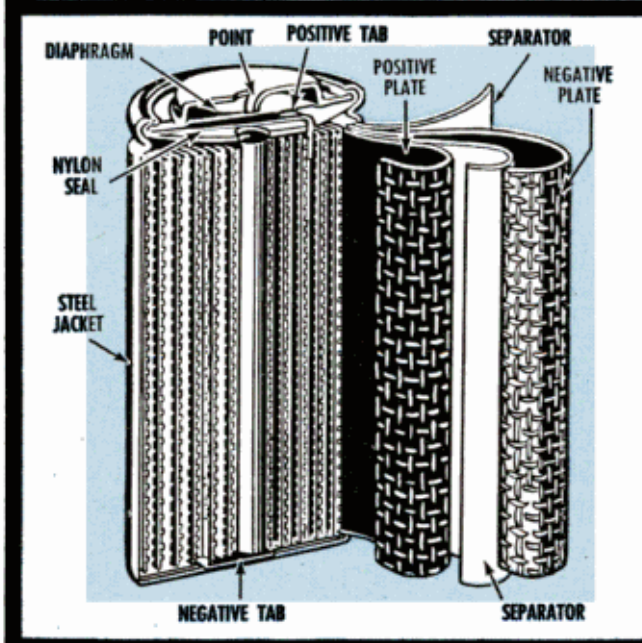
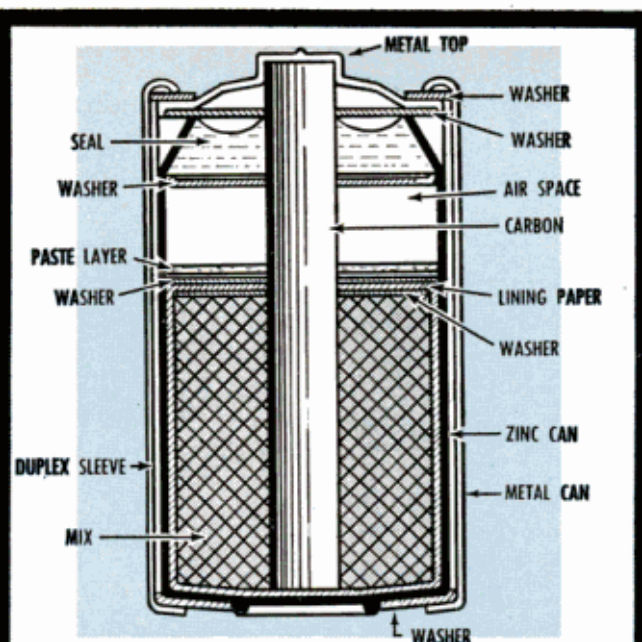
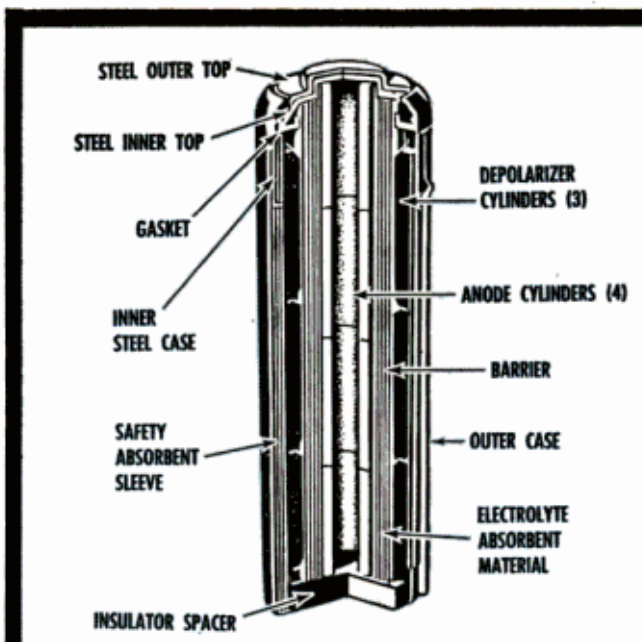
When recharging these batteries, remember that a battery that has gone dead from



NEW SEALED EXIDE lead-acid wet-cell may soon replace more costly nickel-cadmium types. The new rechargeable device holds more power and is less expensive

WHERE TO USE THEM

Use	Battery Type	Pros and Cons
Movie camera (cont.) 	Mercury	Second choice. High current required by some motors can reduce life. Much better voltage stability than alkaline (see Fig. 3). Practically no leakage
	Zinc-carbon	Can be used, but leakage can damage camera. Short life, rapid voltage drop, readily available
	Nickel-cadmium	Short life before recharging needed. Rapid voltage drop. Ties user to a.c. outlet
Strobe 	Nickel-cadmium	Permits a.c. and battery operation. Indefinite life if recharged after each use
	Alkaline	High power. Little leakage possibility. Rapid recycling. Long storage life
	Zinc-carbon	Short life. Leakage may damage equipment. Readily available in emergency
	Mercury	Not recommended. High power drains can reduce life of battery
Tape recorder 	Alkaline	High current for motors. Fairly stable voltage output. Reasonably long shelf life
	Mercury	Long flat voltage output means better speed regulation. However, high current drain from motor may shorten life
	Zinc-carbon	Short life. Leakage may damage recorder. Rapid voltage drop. Easily available
	Nickel-cadmium	Good only for short periods of operation before recharging
Toys 	Alkaline	Longer life and better performance because of high-current potential
	Zinc-carbon	Low cost per unit, but life can be very short. Leakage can damage toy. Readily available
	Mercury	Not recommended. High current drain can shorten battery life
	Nickel-cadmium	High cost can be prohibitive in this use
Transistor radios 	Mercury	Longest life, best performance and lowest end cost. (see Fig. 1)
	Alkaline	Good in sets requiring high power (e.g. table models). In pocket sets won't last as long as mercury, but costs as much
	Zinc-carbon	Readily available, but life is short and end cost high. Leakage can damage receiver
	Nickel-cadmium	Very costly. Practical if only short periods of operation are required before recharging
Transistor portable TV 	Nickel-cadmium	Permits battery or a.c. operation. Indefinite life if recharged after each use. Usable life after recharging may be as little as 2 or 3 hours. Light weight for size
	Mercury	All three expensive, non-chargeable and heavy for this application
	Alkaline Zinc-carbon	



CUTAWAY VIEWS of the four major battery types showing their internal structure. Cylindrical mercury cell is in the upper left. To its right is a standard zinc-carbon battery. On the lower left is a rechargeable nickel-cadmium type and to its right an alkaline battery. All Four types are dry cells

sitting around cannot be recharged and you shouldn't let a battery go completely dead before recharging. When recharging you'll be able to use that zinc-carbon cell about two more lifetimes, the alkaline five to ten lifetimes and the mercury 50 lifetimes. Charging must be slow and steady (usually overnight). A fast or overlong charge may cause the cell to explode.

Now for some final tips. If you want to extend the life of zinc-carbon batteries during storage, keep them cold. The colder the better. This slows down the electrochemical action, prolonging shelf life.

Wherever you keep or use zinc-carbon cells, replace them every eight months whether they have been used or not. This

will insure you against dead or weak batteries when you need them. This is especially true for your flashgun. Weak batteries may fire the flash, but the firing time may be late and the bulb won't sync with the shutter.

Looking into the future, there's a new Mallory battery coming that won't have a storage problem. It is not even charged until you are ready to use it. You'll turn a thumbscrew before use to release the electrolyte and activate the cell. But it's experimental and won't appear on the market for some time.

For more battery data, you can purchase detailed manuals from Burgess, Mallory, RCA, and Union Carbide (Eveready). ★★



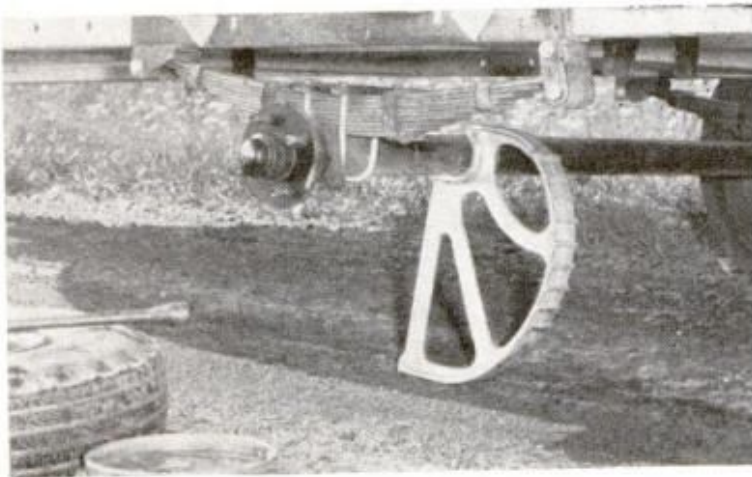
Coffee—Anywhere

Supplying hot coffee any time and any place, a new coffee pot carries its own heating fuel.

Porta-Perk is distributed by Teeco Products, Inc., Anaheim, Calif. Retail price is \$13.95; extra fuel cans cost 69 cents apiece.

Two endless rubber-belt sidewalks at the San Francisco International Airport carry passengers from the United Air Lines ticket area to the flight gate, a distance of 450 feet.

The electrically driven Speedwalk Passenger Conveyors were developed by Stephens-Adamson Manufacturing Co., Aurora, Ill.



Roll-On Trailer Jack

The ingenious design of a new trailer jack makes it possible to elevate a wheel by just pulling the trailer forward on it. Called Kwik Lift, it's available in a two-ton \$9.95 model which fits wheels from 8 to 16 inches and a four-ton \$19.95 size for wheels from 12 to 16 inches, f.o.b. Conlan-Sieloff Industries, Box 372, Bloomfield Hills, Michigan.



Steam Cycle

A loud hiss, a cloud of vapor, and Lenord Washburn is off on his steam-powered motorcycle.

The frame and wheels are Harley Davidson. A butane-burning 1902 Toledo automobile steam engine, running at a normal pressure of 180 pounds, supplies the power—far more than that of a conventional cycle engine. Gobs of torque make a clutch and transmission unnecessary. A droll touch is a valve-operated steam whistle.

Washburn, who lives in Rubidoux, Calif., spent \$650 and 14 months building the hefty 850-pound machine, which is about 250 pounds lighter than a conventional machine.

The photo shows Washburn "fueling up" with water.

Double-Decker Station Wagon

This split-level sleeper, once a Detroit stocker, provides a lofty outlook to highway cruising

By Alex Markovich

THE CLOSEST THING on wheels to John Swanberg's zany split-level sleeper is a transcontinental Sceni-Cruiser bus.

A Minneapolis trucking firm employee, Swanberg made his first sleeper conversion five years ago on a Dodge sedan. He was so pleased with the results that as soon as he got his next car—the six-cylinder Chevrolet sedan shown here—he went to work chopping off the roof, rear window and rear deck lid. He added a second, raised floor pan, an all-steel superstructure and three seats—one facing backward—that fold into two full-length beds. Finally came matching carpeting, upholstery and the wraparound windshield and tinted side windows that curve up over the top.

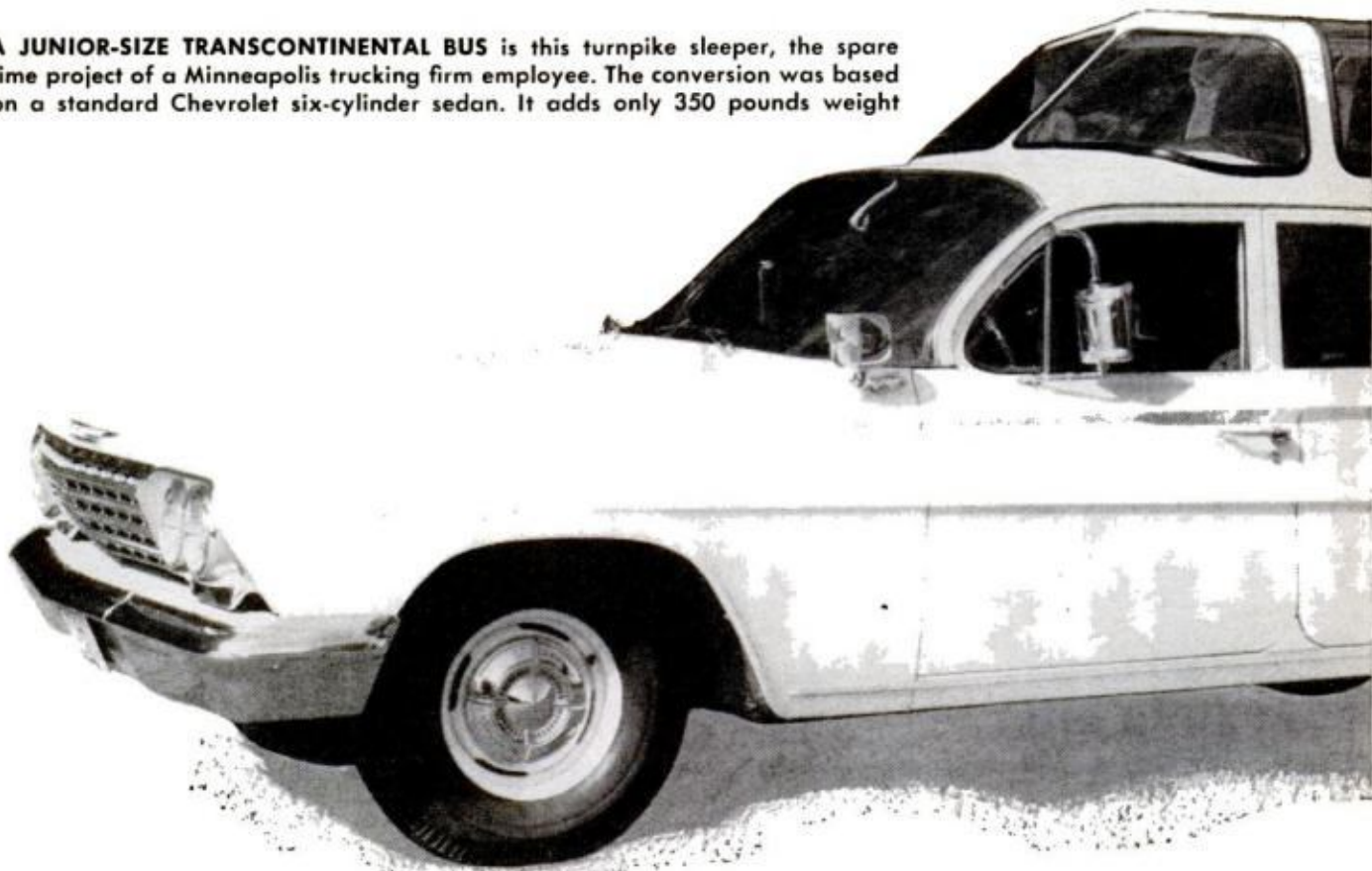
With help from Minneapolis Honeywell engineers, Swanberg designed a micro-

switch system with lighted pushbuttons in the upstairs areas. A touch of the proper button turns on a rear radio speaker, reading or indirect floor lights, an exhaust fan or windshield wipers.

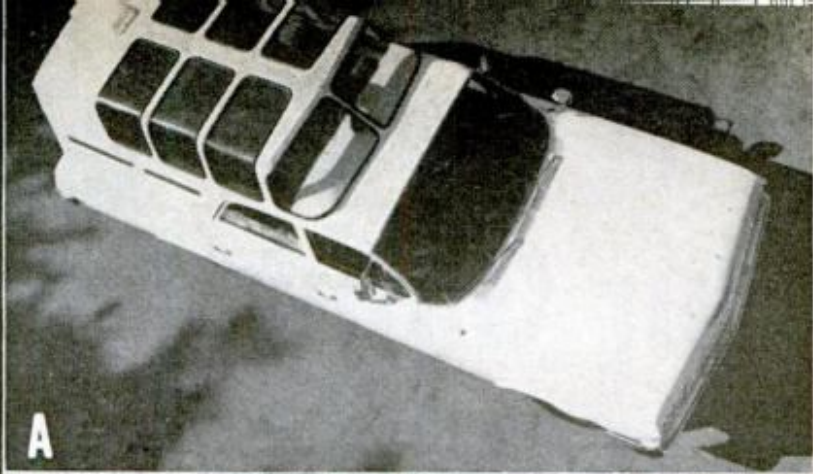
There's been only one mechanical change to Swanberg's rig: He installed station wagon springs to compensate for the 350 pounds of added 16-gauge steel and glass. While his sleeper may look top heavy, he claims its handling isn't noticeably different from a regular Chevrolet Six sedan. Acceleration is, of course, somewhat slower. The only dimensional change is in the increased height—about 14 inches.

Swanberg says the conversion is possible on any full-size car since each one is a custom job. With his son's help, this one took a summer's spare time. Cost: \$1500 over the original price of the car.

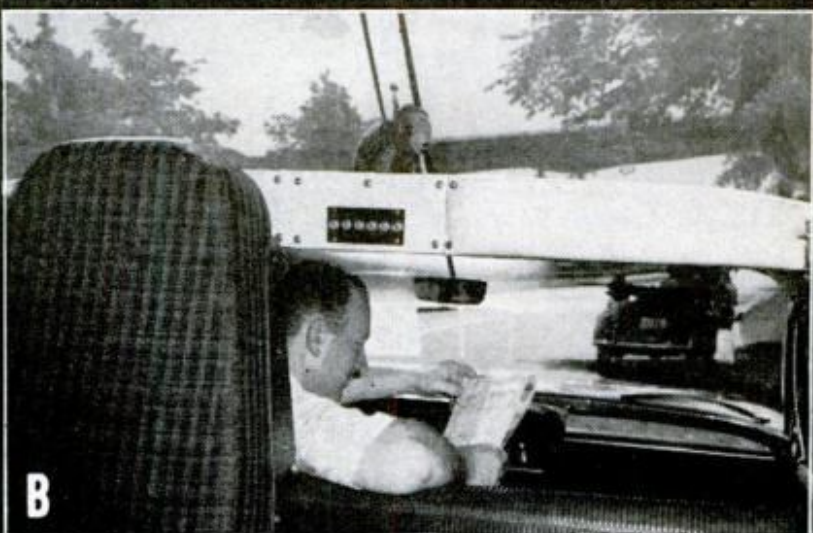
A JUNIOR-SIZE TRANSCONTINENTAL BUS is this turnpike sleeper, the spare time project of a Minneapolis trucking firm employee. The conversion was based on a standard Chevrolet six-cylinder sedan. It adds only 350 pounds weight



A. TINTED WINDOWS of the split-level sleeper curve up and nearly meet at the top. Occupants of the full-length beds sleep under the stars. For day-time travel, the two beds become comfortable reclining seats



B. HALF OF THE TEAM that built the turnpike sleeper, Roy Swanberg, is shown checking his route from the driver's seat. View is from the upper level. The Swanbergs report there's no change in handling characteristics



C. A LIGHT TOUCH ON one of a bank of micro-switches controls overhead reading or indirect floor lights, an exhaust fan, special windshield wipers, even a remote speaker for the radio. It lets owners camp "in transit"



D. GLASS EXPANSE atop the "upstairs" section of the sleeper, although tinted, can let in lots of sun—and heat. But curtains snap in place easily. Removing them at night gives illusion that you're bedding down outdoors



X Raying Our Giant Missiles

By Frank Tinker

A MISSILE is of no value if it's not ready to go. To guard against possible failure, our ICBMs are put through regular countdowns as they stand in their concrete silos. The countdowns stop just short of actual launch.

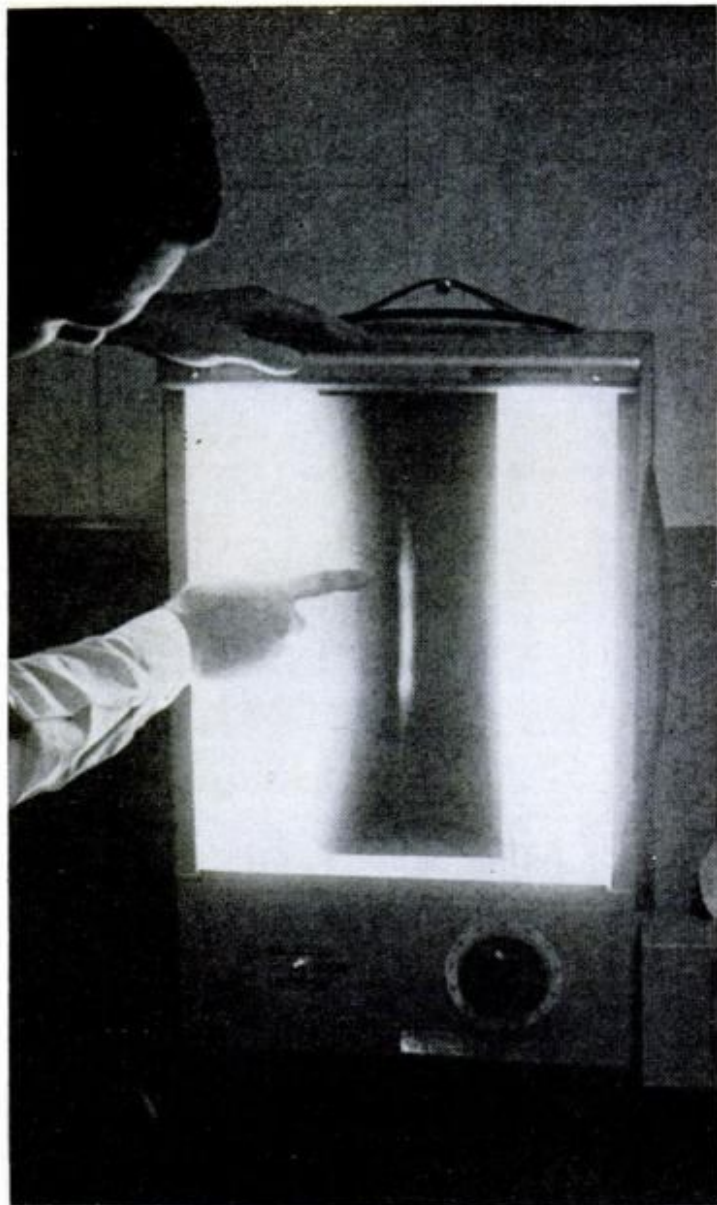
Another check is a constant monitoring system. If a red light shows on a control panel in the underground launch center, the particular weapon is immediately taken out of service. If the trouble is too complex for local repair, the missile is shipped to a central maintenance shop.

One such center is at Hill Air Force Base in Utah. Minuteman missiles from sites in Montana, Wyoming and North Dakota are flown intact to Hill in huge C-130 cargo planes.

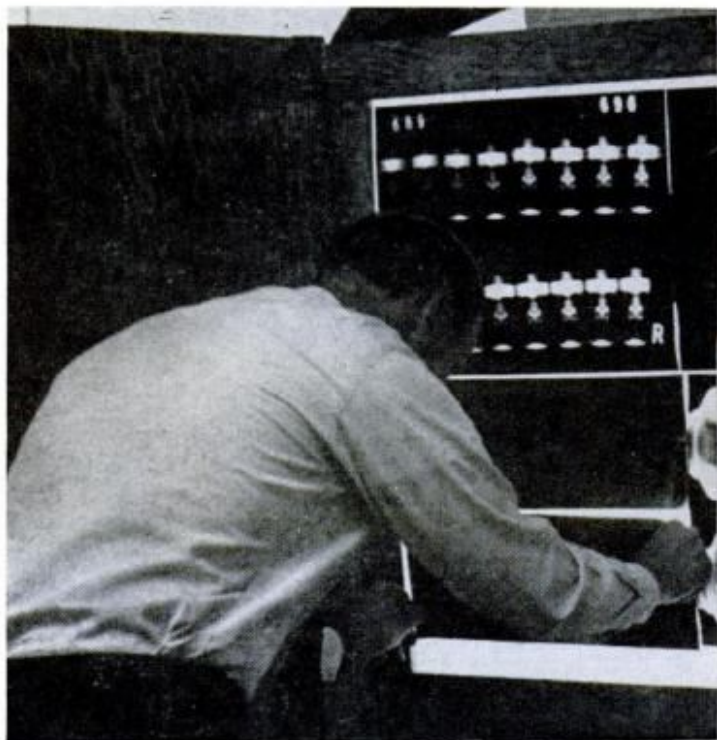
The main diagnostic tool at this center is the largest X-ray machine in the country. It can pierce the heavy metal case of the Minuteman and reveal if the solid propellant has developed a flaw such as a crack or void.

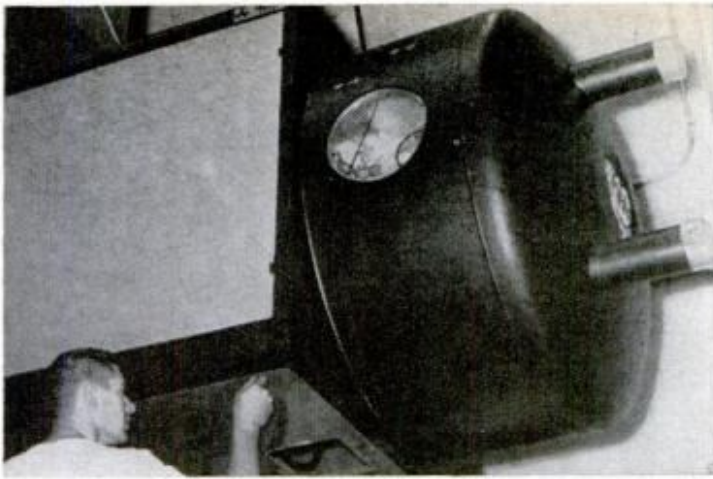
The machine can transmit 12,000 Roentgens and take pictures through eight inches of lead. (About 150 Roentgens will usually prove fatal to a human being within an hour.) To produce the tremendous energy required, a linear accelerator—Linac—is used. Electrons shot into one end are hustled along the main tube until they near the speed of light. They smash into a metal target and X rays are emitted from the force of the collision.

Exposures are governed by a radicon, a computer that determines the exact amount of radiation being received by the missile. Though over 500 pictures are required to inspect Minuteman's first stage alone, such a probe can be completed in 20 hours.



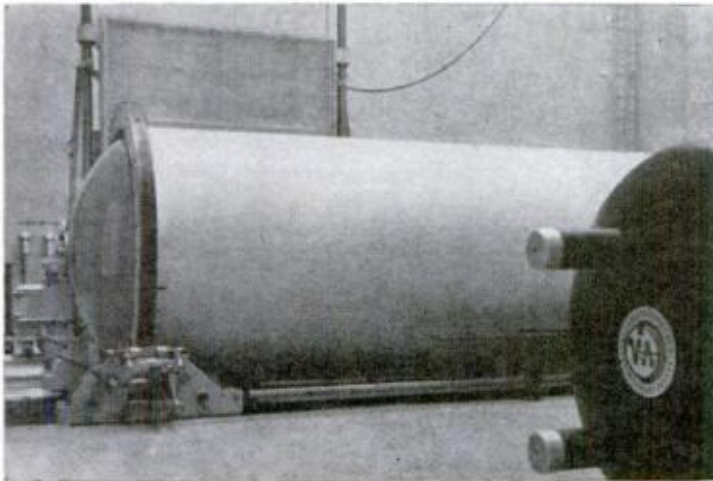
A SERIOUS FLAW, a separation in the propellant, shows up clearly on X-ray film. Such a separation could cause an explosion when the missile is fired



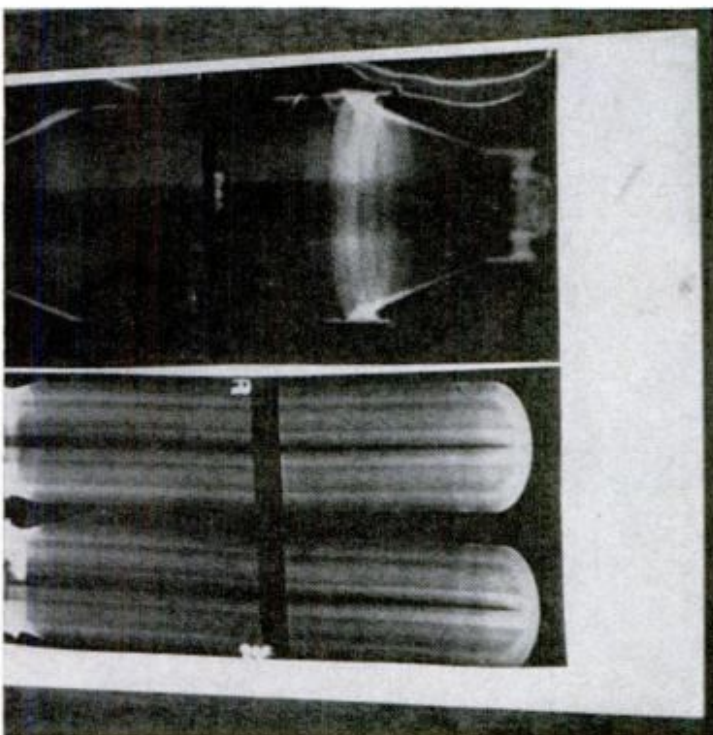


ROUND MIRROR in head of 24-million electron volt machine reflects an aiming light on target. Head can be rotated independently of accelerator tube

LOADED Minuteman first stage sits in front of big film holder. Alarm bells will warn crewmen 30 seconds before the powerful machine is turned on



SERIES of films of missile components is studied by technician (below). By comparing X rays, the expert can quickly spot deviations from norm



DECEMBER 1964

Ride a Steel Horse

Wild horseflesh isn't always available to rodeo performers. So they practice on what they succinctly call a "phony bucker."

The device consists of an empty oil drum suspended by ropes from four solidly planted poles; an ordinary western saddle is cinched to the drum. With an energetic "puller" yanking and swinging on each rope, the simple apparatus is transformed into a bucking monster.

Though they're college boys shown here taking their lumps, even veteran riders say there's nothing phony about the "phony bucker."



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...You Can

WALTER FOEGER, controversial director of the ski school at Jay Peak, Vt., has eliminated the snow plow and stem turn in his unusual teaching method

THE PROOF is in the skiing, and the student in the photo executes a parallel christie with perfect form on the seventh day of instruction at Jay Peak



Ski Parallel in 7 Days

It's tough, and critics damn it, but this system has revolutionized ski instruction

By Stuart James

PM outdoors editor

IT'S IMPOSSIBLE! I don't care what you say, it takes at least five years to ski parallel, and I think this whole system is a phony gimmick!"

I had been talking to a friend at the American Alpine Club, and the mere mention of a new method of teaching skiing was enough to send her into an angry tirade.

Last spring I received a letter from a ski instructor in Aspen, Colo., and he wrote: "Be careful what you say about the Foeger system. There is great opposition to this method all through the West."

At the center of what appears to be a storm in the small world of skiing is Walter Foeger, a stocky, bombastic Austrian skimeister, who conducts his ski school at Jay Peak, Vermont, with the zeal and fanaticism of an athletic evangelist.

The cause of the furor is simple. Recognizing that the ultimate aim of almost all skiers is to ski parallel (skiing with both skis close together at all times), Foeger devised a method to teach parallel technique from the very first time on skis, totally eliminating the snow plow, the plow turn and the stem turn, the absolute basics being taught in almost every other ski school.

"What do I care what they say about me!" Foeger exploded with indignation, when I talked with him at Jay Peak. "The snow plow is ridiculous! It is old fashioned. These people are against progress." He stormed around in the small area behind his desk, intermittently stopping to pound a fist on the desk, jab the air with his finger, scowl and shake his head. "I call my method Natur-Teknik, because it is the natural way to ski. Anyone with normal coordination can learn to ski parallel in seven days. I guarantee this, or I give the money back. You will see what I mean. You will see!"

And I did see. I spent two weeks at Jay Peak. I enrolled in a class under instructor Tom Emrich and was introduced to the Foeger system. It was an exciting experience.

The Foeger school is no place for a "snow bunny." The instructors and students take their skiing seriously—almost obsessively—and from the beginning it is hard work. Jay Peak has the atmosphere of an Olympic training camp, and the instructors work their classes with all the charm and finesse of a Marine drill sergeant. This Spartan dedication permeates everywhere, and you hear nothing but *parallel*. You practice it all day, talk about it at lunch and dinner, argue about it around the fire at Dave Allen's Jay Barn Village, and I even dreamed about it, Tom Emrich's shouts invading my sleep—*Keep them together! Bend your knees! Relax! Just relax! Keep those skis together! No, no, no.*





KICK TURN: Make secure platform with uphill ski. With poles to the rear, kick downhill ski up on tail, let it fall as shown, then bring uphill ski to bear

Oh, how can you be so clumsy? Dumkopf!"

The criticism I heard was limited to claims that the system was too physically gruelling, and a high incidence of minor injuries (sprains and pulled muscles) was blamed on the exhaustion of the students. A student who dropped out after only three days told me: "I came up here to have fun. This place is run like a concentration camp."

It is tough, but it gets results.

The instruction begins with standing and walking on skis, how to hold the poles, the step turn, how to get up after a fall, climbing a slope with the sidestep and the herringbone step. It is much the same as a conventional class, except that there is no snow plow. There is considerable stress placed on the execution of the kick turn, for the simple reason that it will speed up the classes when they get on the slopes.

Schussing (going straight downhill without checks or turns) on a gentle slope winds up the first day, and in this exercise the skier develops balance by bending down to pick up gloves on the trail, and lifting the tails of alternate skis.

Skating exercises start the second day, pushing off with one ski and then the other, improving the balance and getting the feel of using the edges. Then comes the traverse on a gentle slope. With the skies close together, the uphill ski leading slightly, the uphill shoulder well forward so that the upper half of the body is turned downhill, the skier glides across

the slope and comes to a stop. It is all very pleasant and simple—and then you head for the T-bar lift and the terror sets in.

As the beginners take their positions at the lift, take the T-bar from the attendant, and are then jerked off their feet and tumbled into the snow, you hear the first groan from the instructor. It might be comical—except that you're the one being dragged up the hill upside down.

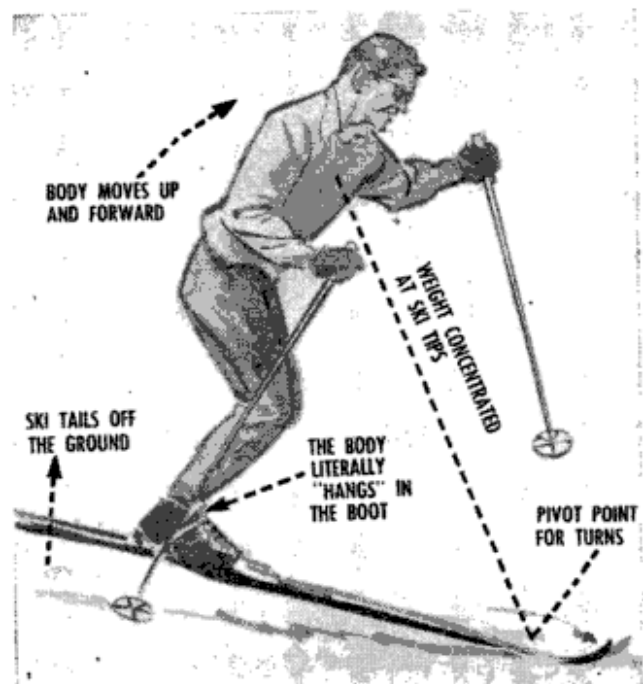
It takes time, but the class manages to get to the top of the intermediate slope. The drop-off looks awfully steep, and as you look around at the others in the class, you know they all have the same thought: *I hope he doesn't really expect me to go down there.*

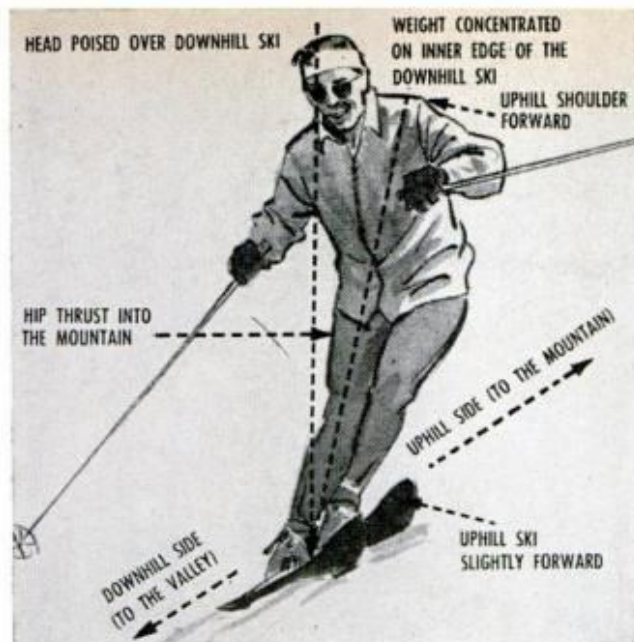
He doesn't, and there is a general sigh of relief that brings a laugh. One after another the class traverses from side to side, stopping at each side, making a kick turn, then traversing to the other side.

I have neglected mentioning the falls, but there are a lot of them. They jar the bones. Time after time you push yourself up, and by the time you reach the bottom and break for lunch, you feel as though you've been dragged down the mountain on your back.

The afternoon begins with hopping exercises. With the skis close together, you lean well forward, bend the knees, and then hop up, lifting the tails. With a ski pole stuck in the snow as a pivot point, you face it with the ski tips close to it, and

BASIC EXERCISE on flat ground. With skis together, leap up and forward to lift the tails, jumping from side to side to get natural feel of the hip action





COMA POSITION in the traverse illustrates how leaning out from the mountain places the weight on the inside edge of the downhill ski for greater control

jump around it. Next, you jump to left and right.

On a gentle traverse you practice hopping, displacing the unweighted tails downhill until the skis turn to the mountain.

Then you go to the top of the intermediate slope again, and now you traverse, using the hop technique to stop. The traverses are now longer and steeper—the falls are more frequent and harder. But you are beginning to feel confidence in your ability to control the skis on steep and difficult ground.

The third day you begin side sliding. Standing at the top of a vertical drop, you assume the traverse position. By pushing off with the poles and tilting the skis so they are flat against the snow surface, you begin to slide sideways. You are leaning out from the mountain and trying to keep the tips facing slightly downhill. In this exercise you learn that as you lean the body out and place the weight on the downhill ski, the tails of the skis tend to slide downhill.

Feels Like Skiing

Next step is the turn to the mountain, and for the first time you feel as though you are really skiing.

In the traverse position you angle down and across the slope. As you pick up speed, you go into a crouch, weighting the downhill ski to make a solid platform. You jump up and forward, unweighting the skis. Then you come down on the inner edge of of

the downhill ski, thrusting your hips into the mountain, and thrusting down and out with the heel on the downhill ski. The tails slide out and you come to a stop. When you execute this turn after a fast run directly down the fall line, it is an exhilarating feeling.

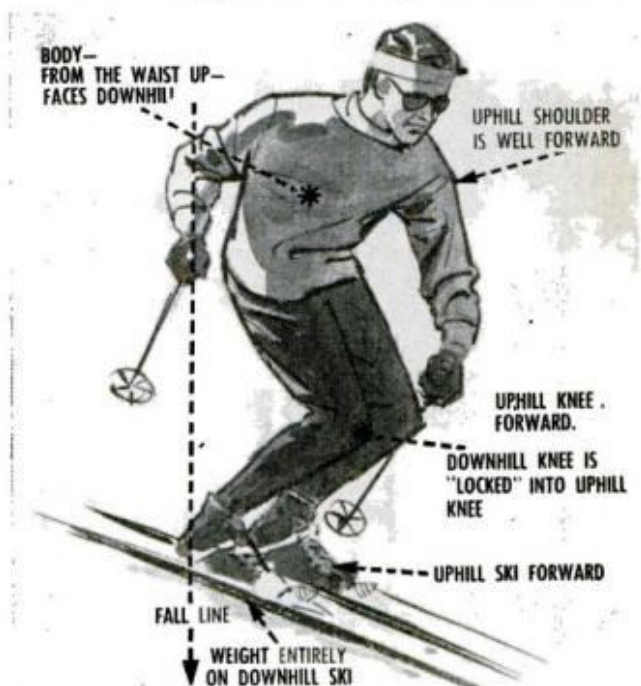
The fourth day is spent perfecting the turn to the mountain on a variety of terrain, and to stress the importance of keeping the weight on the downhill ski, you learn to execute it while wearing one ski.

Making the downhill turn is the finale. You prepare on a gentle slope using the hop technique to bring the skis into and over the fall line. Then you go on the intermediate slope.

In a relaxed position you traverse the slope. You crouch to weight the skis, then you leap up to unweight them. The weight is on the front of the skis. You thrust the heels into the mountain, moving the tails uphill. At the same time you bring the downhill shoulder forward and twist the body from the waist up. The skis slide over the fall line, still turning. You come down on the outside ski, planting the edge, and you are in the traverse for the next downhill turn.

That's it, the Foeger method. I saw, without exception, every student who went through the full seven days of instruction making linked parallel turns down an intermediate slope. The proof is in the skiing—and this system works. ★★

IN ANOTHER VIEW of the traverse, the knees point in the direction of traverse, hip is thrust to the mountain, and upper half of body faces the fall line

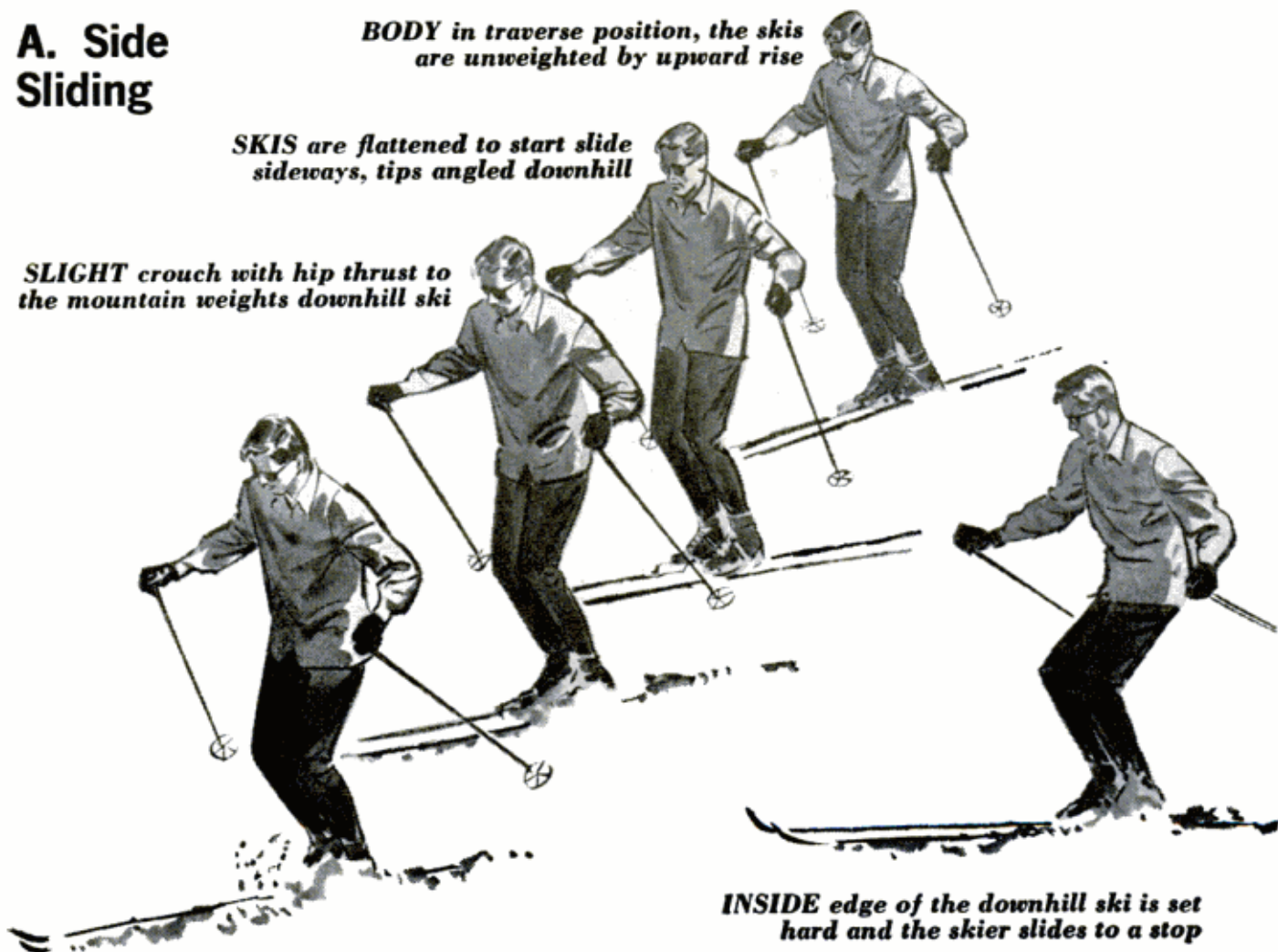


A. Side Sliding

BODY in traverse position, the skis are unweighted by upward rise

SKIS are flattened to start slide sideways, tips angled downhill

SLIGHT crouch with hip thrust to the mountain weights downhill ski



FULL weight on inside edge downhill ski stops sideslip

INSIDE edge of the downhill ski is set hard and the skier slides to a stop

A. Side Sliding

This maneuver teaches edge control and gives the beginner confidence in handling the skis. It is executed on a relatively steep slope. The skier stands with both skis across the fall line. With the uphill shoulder and the uphill ski forward, he unweights the uphill ski, and tilts the downhill ski sideways (flat against the snow surface) so that he starts to slide sideways down the hill. At the same time, the ski tips are angled slightly downhill. The beginner will find that the skis have a tendency to turn uphill in the slide, and that he can check up the slide by edging the skis (turning them so the inside edges cut into the snow). By sliding backwards, vertically and forward, the skier begins to realize that he can—after all—control the cumbersome slats on his feet, and he has experienced the practical application of edge control, one of the most important points in parallel skiing.

B. Turn to the Mountain

This maneuver incorporates the traverse, unweighting the skis, edging and side sliding. In the traverse position the skier angles across the slope. The uphill ski and the uphill shoulder are forward. The skier goes into a crouch. For just a split second the weight is transferred to the uphill ski. The skier comes out of the crouch quickly, practically leaping up and forward. The tails are unweighted and the weight is concentrated at the front of the skis. The tails start to drift downhill automatically. The skier comes down hard on the downhill ski. The body is in the extreme coma position, the hip thrust into the mountain. As he edges the downhill ski, the heel thrust slides and tails of the skis further downhill. There is a certain amount of side sliding, but the edging serves as a brake and the skier comes to a smooth stop facing uphill. With this one maneuver he can manage most trails.

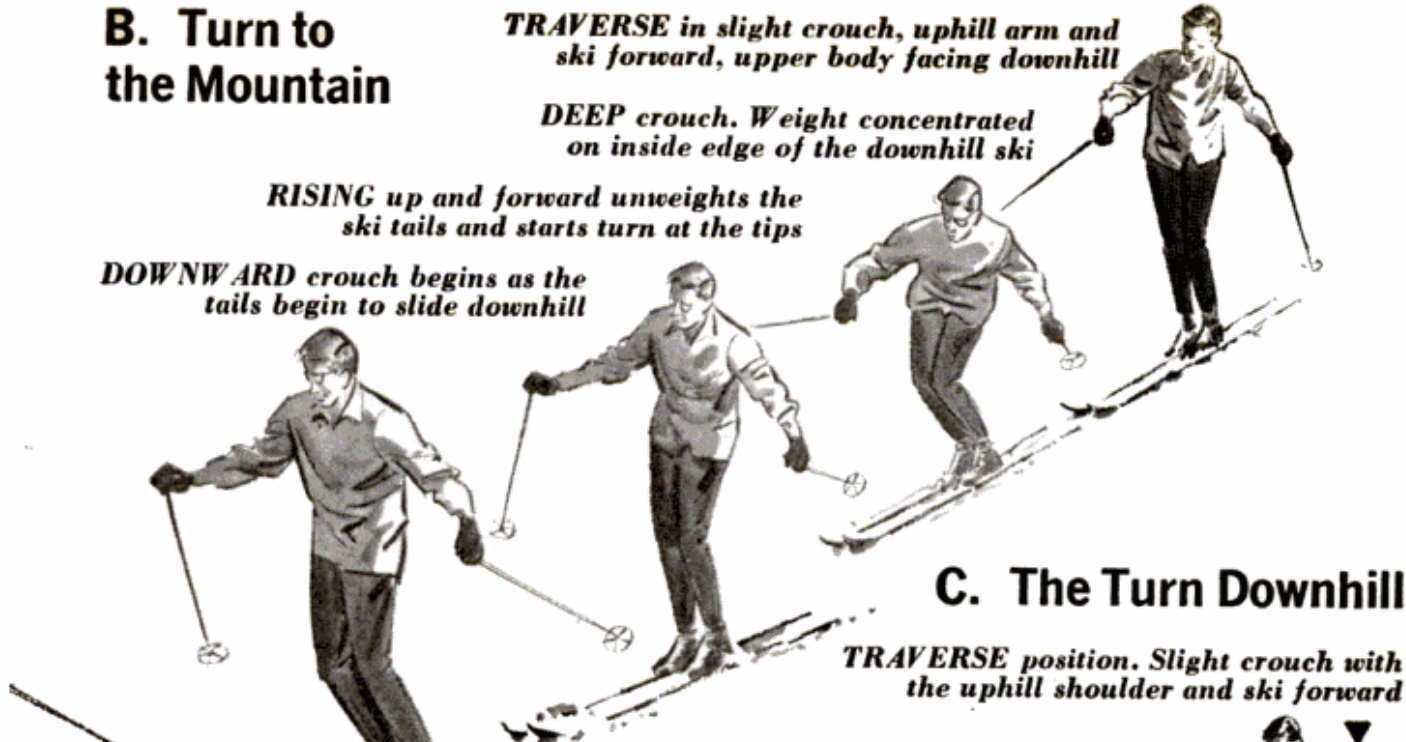
B. Turn to the Mountain

TRAVERSE in slight crouch, uphill arm and ski forward, upper body facing downhill

DEEP crouch. Weight concentrated on inside edge of the downhill ski

RISING up and forward unweights the ski tails and starts turn at the tips

DOWNWARD crouch begins as the tails begin to slide downhill



C. The Turn Downhill

TRAVERSE position. Slight crouch with the uphill shoulder and ski forward

DOWNWARD motion centers weight on inside edge of the downhill ski

RISING up and forward. Hop unweights tails, skis start into the fall line

PIVOTING on tips of skis, downhill shoulder comes forward

WEIGHT on pivot point, tails sliding over fall line, inside ski is forward

DOWNHILL ski is edged as the platform for the traverse preparatory to the subsequent downhill turn



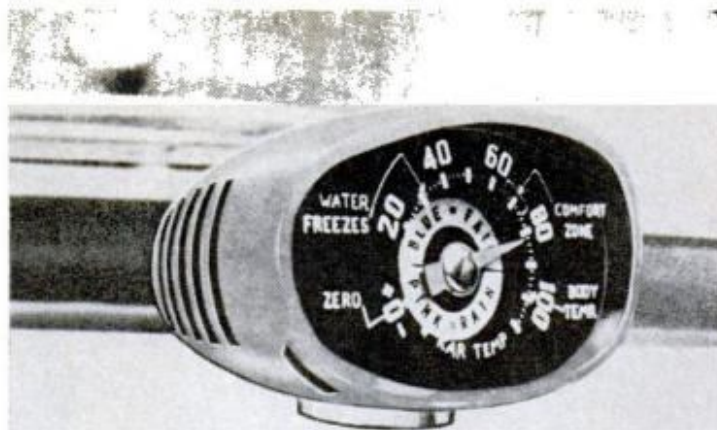
C. The Turn Downhill

This is the maneuver that will allow the beginner to make linked turns down a mountain. The skier is traversing in relaxed position. Uphill shoulder and uphill ski are leading. He goes into a crouch, weighting the skis, and in the next instant he leaps up and forward. The tails are now unweighted and the weight is concentrated at the front of the skis, creating a pivot point. As he comes down the heels are thrust uphill, turning the skis into the fall line. In this same heel-thrusting movement, the downhill shoulder is thrust forward, twisting the body from the waist up (this is also called the reverse shoulder movement), and accentuating the pivoting of the skis on the tips and the sliding out of the tails. Once over the fall line, what was previously the downhill ski is advanced slightly. The skier returns to a crouch, weighting the new downhill ski, and traverses for the next turn.



Keep Them In Their Place

This child-size safety belt is a harness so complete it's almost impossible for a youngster to wriggle out. Adults control the release. The rig comes in two sizes, one for children 1 to 4 and one for those age 3 to 5. The safety belt is sold for about \$11 by Chrysler dealers.



How Cold Is It?

For those who are curious about the weather, the Weather Guide has both a thermometer and a humidity-sensitive color disc that helps estimate what changes are coming. Dial can be inverted for under-dash mounting. Price is about \$4. By Kar Temp Co., Ruxton, Md.



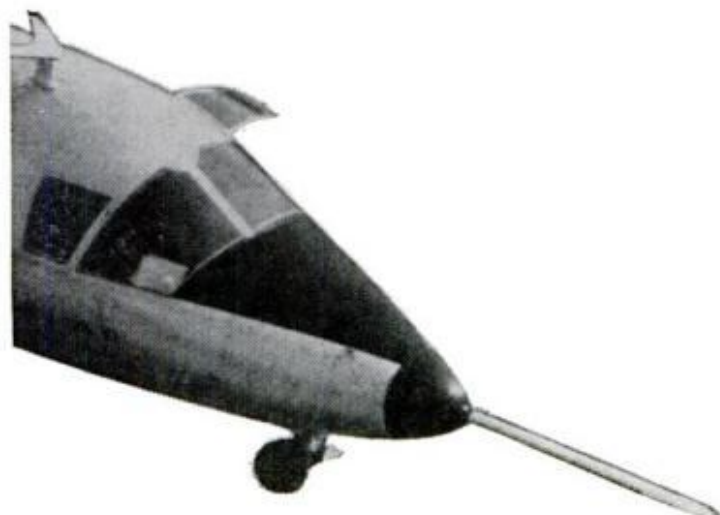
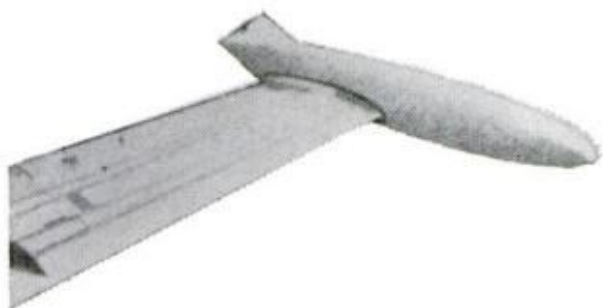
Swept-Forward Wings

Said to be the only airplane with wings swept forward, the German-made Hansa Jet will do an estimated 550 m.p.h. The forward sweep, the makers claim, will allow the jet to land in short fields, even unpaved airports with grass strips.



He Drives on Two Wheels

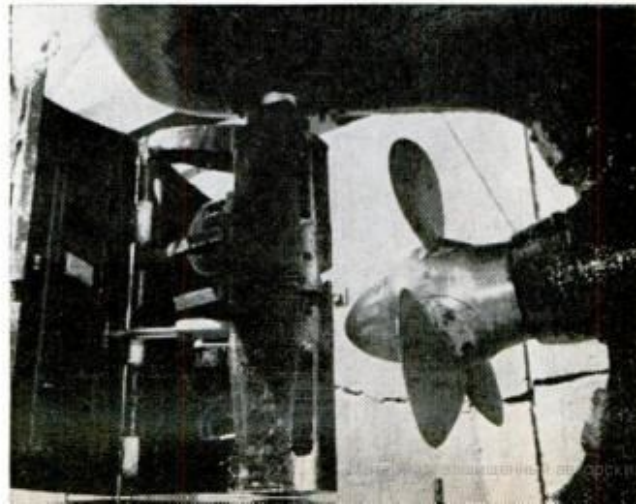
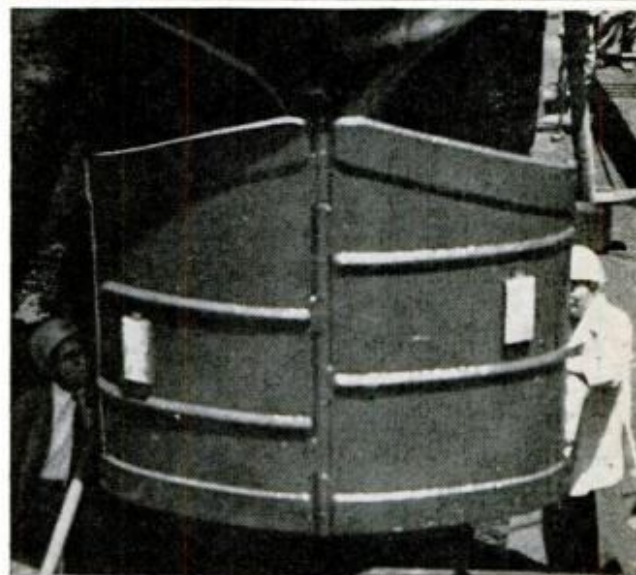
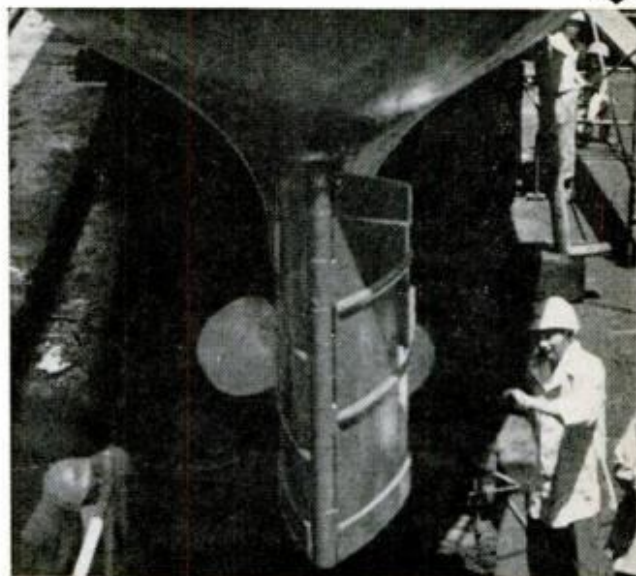
Balancing cars on two wheels is old hat to French stunt driver Jean Sunny. He's been developing the act for 12 years. His longest run was 60 miles, from Paris to Chartres. His Simca 1000 has reinforced shocks and a locked differential.



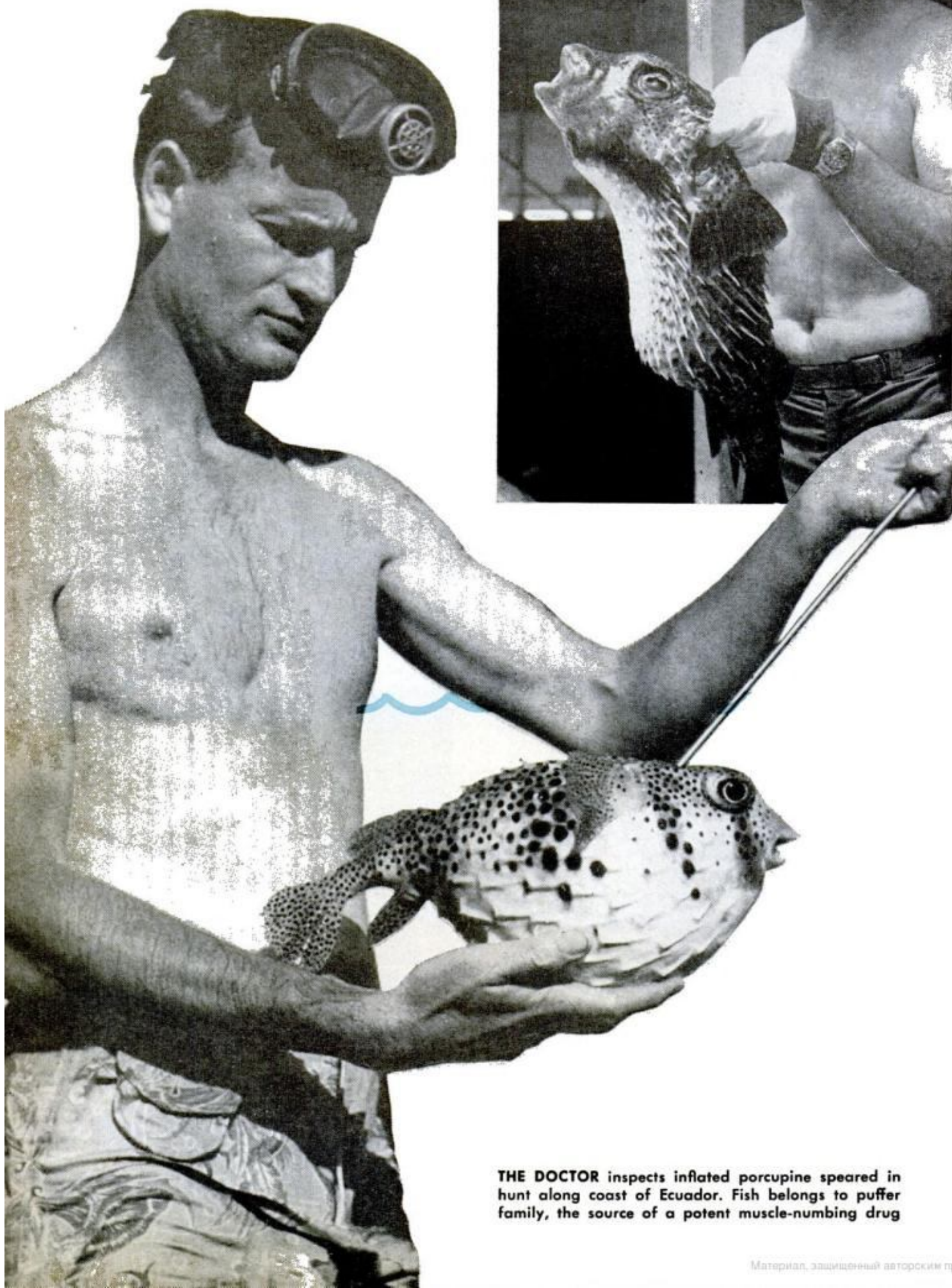
Rudder-Brake for Big Ships

Stopping distance for big ships is cut sharply with a new "water wing" rudder, according to the Japanese engineers who developed it. The rudder appears conventional (photo immediately below) until its two leaves, hinged at the rear vertical edge, swing out (other photos) to slow forward motion with parachutelike effect.

The wings normally remain folded until they are activated from the bridge. They're also said to increase maneuverability at low speeds.



BRUCE W. HALSTEAD, physician and skilled diver, hunts the seas for toxic fish such as this porcupine (right), captured in waters off Wake Island



THE DOCTOR inspects inflated porcupine speared in hunt along coast of Ecuador. Fish belongs to puffer family, the source of a potent muscle-numbing drug



EVAPORATOR is used by bacteriologist John Sieburth to extract moisture from Sargassum weed, which contains an antibiotic and is plentiful in Atlantic



IN LAGOON of Palmyra Island, 1000 miles south of Hawaii, Halstead uses steel hook to pry loose coral samples. Some corals have antibacterial property

Therapy from the Sea

Nature's medicine chest is opening to reveal potent new chemicals for fighting viruses, heart disease and a host of other ailments

By James R. Berry

MAN'S ANCESTRAL HOME—the sea—has long been a source of remedies for illnesses. Millenniums ago the Chinese prescribed seaweed preparations for dropsy, abscesses and menstrual disorders. In India, an ancient treatment for bronchitis is an algal solution called gillurka-tutta, and Polynesians have traditionally used seaweed to hasten the healing of cuts.

But despite the long history of medicinals from the sea, scientific sifting of the oceans' extraordinary pharmaceutical potential has only begun. "So far, we've studied less than one percent of all the

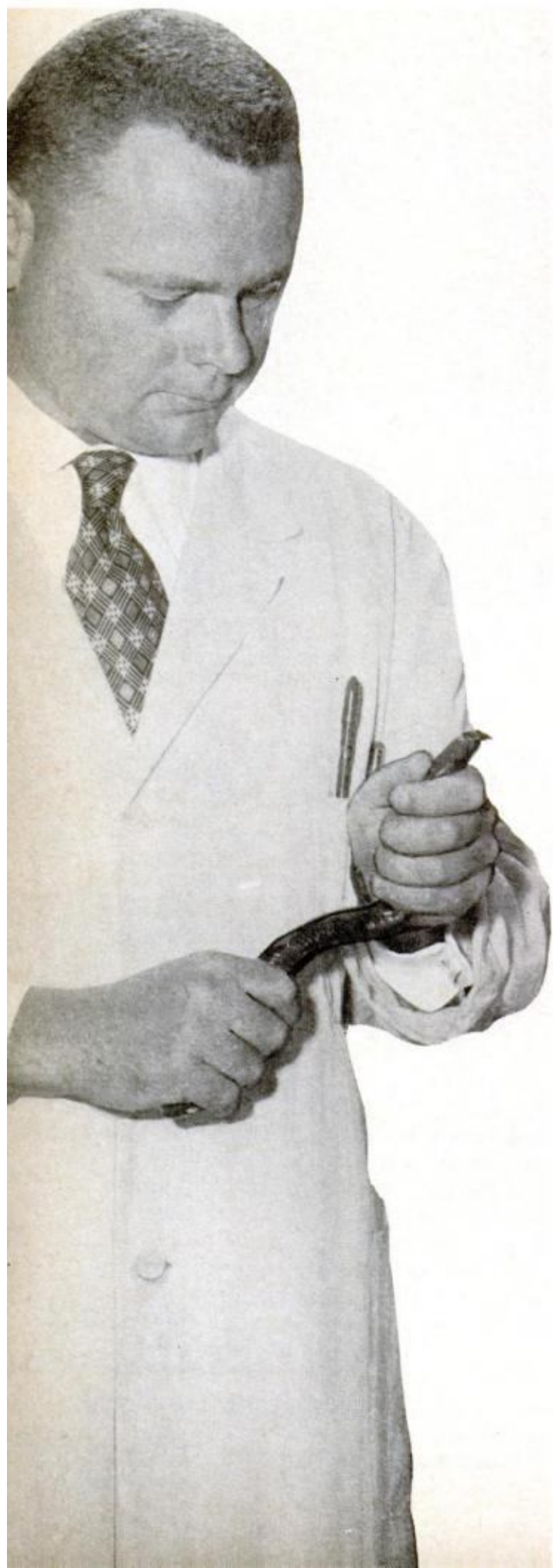
sea organisms we *know* contain biologically active materials," estimates Dr. Bruce Halstead, one of the nation's foremost biomarine investigators. But the pace is picking up; a new medical field, marine pharmacology, is fast turning the sea into nature's most promising medicine cabinet.

Here, for example are some of the discoveries that have been made:

- Dr. John Sieburth, marine bacteriologist at the University of Rhode Island, isolated a potent antibiotic from the Sargassum weed, a plant growing in the Sargasso Sea.

- Scientists at the World Life Research

PACIFIC HAGFISH (below) has three hearts and is the source for a cardiac pacemaker. The fish is examined by Dr. David Jensen, a heart researcher



HALSTEAD and colleague bring in moray eel in Red Sea. This is a pugnacious, carnivorous fish that's frequently found near reefs and coral formations

Center, a California organization studying marine life, found a compound in the poison of sea snakes that greatly reduces the coagulating time of blood.

- At Marine Colloids, a New Jersey firm making commercial products from algae, researchers extracted a drug from brown sea kelp—it's called sodium alginate—that can rid the body of strontium 90.

In another instance, research on the Pacific hagfish at Scripps Institute of Oceanography in San Diego has resulted in what may become a startling new treatment for some heart disorders. The hagfish is a 1½-foot long, eel-like animal with 12 pairs of gills and two rows of horny teeth. Dr. David Jensen, a specialist in heart research, became interested in yet a stranger characteristic of the animal—three hearts, one of which has no nerve connections to the rest of the body.

Dr. Jensen wanted to know what kept the hagfish's nerveless heart beating. Months of painstaking work gave him the answer: a powerful biochemical pacemaker he named *eptatretin*. When injected into dogs and other laboratory animals with damaged cardiac nerve centers, eptatretin jolted the heartbeat back to normal for hours at a time. According to the American Heart Association, which sponsored much of Dr. Jensen's work, eptatretin is viewed as a possible drug to regularize the heartbeat of people with faulty cardiac nerves. This drug may eventually mean that pills instead of implanted electronic pacemakers will keep hearts with damaged nerves going.



AT NEW YORK'S AQUARIUM, research associate Sophie Jakowska isolated an antibiotic from sponge. She is shown testing the drug on infected mice

Another important center for marine investigation is the Lamont Geological Observatory at Palisades, N.Y. I recently visited the observatory's marine laboratory, where I met Dr. Paul Burkholder, chairman of the biology programs and a scientist with several pharmaceutical discoveries to his credit.

In 1944, when he was at Yale University, Dr. Burkholder and his fellow researchers found a germ killer, usnic acid, in the lichen—a composite organism consisting of a fungus and an alga. (That drug is now prescribed for tuberculosis and some serious skin infections.) Later, working with a Venezuelan soil sample, he isolated a mold that produces chloromycetin, a drug that's now synthesized and used to treat typhus and typhoid fever.

Though it was years ago that Burkholder turned his attention to the sea, he still marvels at the wealth and variety of life to be found in it. Currently, he and his staff are screening some 60 potential pharmaceuticals derived from seaweeds, corals and other marine life.

One of the organisms under study at Lamont is the "red tide." During certain seasons, a one-celled plant called *Gonyaulax* blooms off Florida and other coastal areas, covering thousands of acres of sea. During the day, the organism tints the water red; at night it phosphoresces with an eerie beauty. It also secretes a poison more deadly than strychnine.

"I was studying the biology of Phosphorescent Bay in Puerto Rico and came across a bloom of red tide," Dr. Burkhol-



PUFFER FELL VICTIM to Dr. Halstead's spear on lagoon floor. Fish's poison—tetrodotoxin—is said to be the second most powerful biotoxin known

der explained. "I wondered if that species of *Gonyaulax* contained antibiotics and I looked into it out of scientific curiosity."

To collect the plant, he bought 15 large plastic garbage pails and filled them with sea water scooped up from the bloom of red tide. After several hours the water was poured off, the thin film of sludge containing the organism collected, and the pails refilled. About 3000 gallons later, Burkholder had one pound of *Gonyaulax*. When smeared onto germ colonies growing in gelatin—a favorite food of bacteria—the organism polished off many kinds of disease microbes.

At the Lamont laboratory, Burkholder separated the different organic compounds in the *Gonyaulax*, any one of which could have been the antibiotic factor, by a technique called column chromatography. He and his staff first dissolved the pound of red tide in chloroform. Then they wet the ends of slides covered with silica gel, an inert and absorbent powder, with the solution. As the liquid was gradually absorbed by the powder, several chemical compounds, their rates of molecular attraction to the silica being different, dropped out along the way to form narrow bands.

Burkholder tested each band on microbe colonies. Those bands that killed germs were put through the chromatography technique again, separating the active elements even more distinctly. After the process was repeated several times, Burkholder had as much antibiotic as can be stacked on a pinhead. "And we're still



A SCIENTIST at the National Institutes of Health in Maryland discovered that the body juices of red abalone (shown) contain a strong antiviral agent

trying to purify the drug even more with other laboratory techniques," he told me. "Gonyaulax has pigments and fatty substances that make it especially hard to separate."

He led me to a waist-high, slate-covered laboratory table. Nestled among test tubes, flasks and other glassware was a row of six-inch-long slides covered with silica gel. Burkholder pointed to one and told me to take a look.

I saw several faint, pastel-colored bands spaced along the slide's length.

"We've found three different antibiotics in this species of red tide," Burkholder told me. "We've got two of them pretty well isolated. But we haven't pinned down the third, the one that stops *Candida albicans*." He referred to a pathogenic yeast that infects about 40 percent of women in maternity wards. It affects mouth and vaginal tissues and is debilitating, which can lead to serious secondary infections.

More Sea Snooping

"Our present knowledge is like a drop in the sea compared with what remains to be discovered about the biology, chemistry and pharmacology of marine organisms," says Dr. Burkholder. "In order to provide stockpiles of miracle drugs from salt-water vegetation and fishes, we will need to generate new knowledge and perhaps develop new methods."

Laboratories in various parts of the

country have joined the hunt for marine pharmaceuticals—and have found them. At the National Institutes of Health in Bethesda, Md., for example, investigation of abalones, clams and oysters have turned up one of the most sought-after substances today—an antiviral compound. Few drugs prove effective against viruses; and those that exhibit any potency are soon nullified by fast-developing resistant strains. So, any discovery in this area is most important.

Dr. C. P. Li, specialist in viral biology, first discovered that body juices of the abalone and related shellfish contain a strong antibacterial agent, which he named paolin I. Further research revealed that the fluids of these shellfish had another factor—designated paolin II—that killed many different viruses. Now, both paolins are being exhaustively tested on laboratory animals.

Repels Cancer and Sharks

Other important finds have been made at the New York Aquarium's marine laboratory. One, a drug isolated from the toxin of sea cucumbers and called holothurin, is practically a pharmacy in itself. This chemical has kept mice infected with cancer cells alive for 18 months, about their normal life span. Control groups died of the disease within two weeks. In addition to its anticancer properties, holo-

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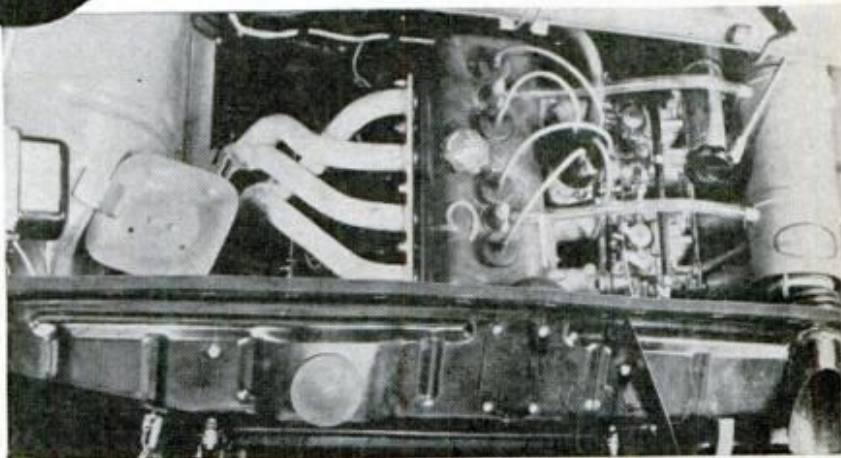
ANOTHER EEL speared for eventual testing and investigation. Catches are wrapped in paper, frozen and flown back to laboratories in the United States





Rarin' Renault

The little French lamb's turning into a lion. Economy was the strong point for Renault's Dauphine. The R-8 had more spunk. Now here's the R-8 1100 with aluminum head, hemi chambers and 10.4:1 compression. (The engine is shown at right.) Speed of 100 m.p.h. is claimed.



Piggy-Back Fuel Tank

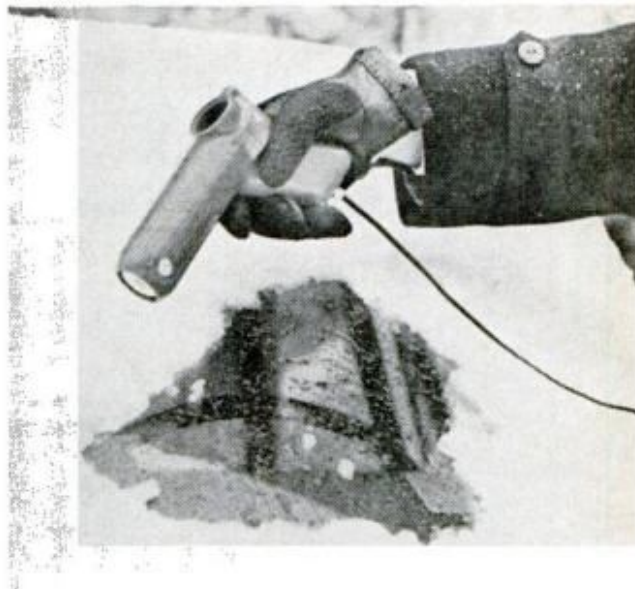
Borrowing an idea from American transport systems, the British Railways are "leap-frogging" fuel tanks carrying up to 4000 gallons.

The tank can be transferred from train to truck or ground or back again in four minutes. A sideloader does the transferring with complete precision.



Quick-Thaw Gun

Plugged into a car's cigarette lighter socket, a new defroster melts frost and ice from the windshield. Warm air, moving at 1800 feet per minute, quickly clears a windshield even in five-degree weather, according to the manufacturer. Priced at \$7.95, it's made by A. G. Busch & Co., 6138 Northwest Highway, Chicago 31.



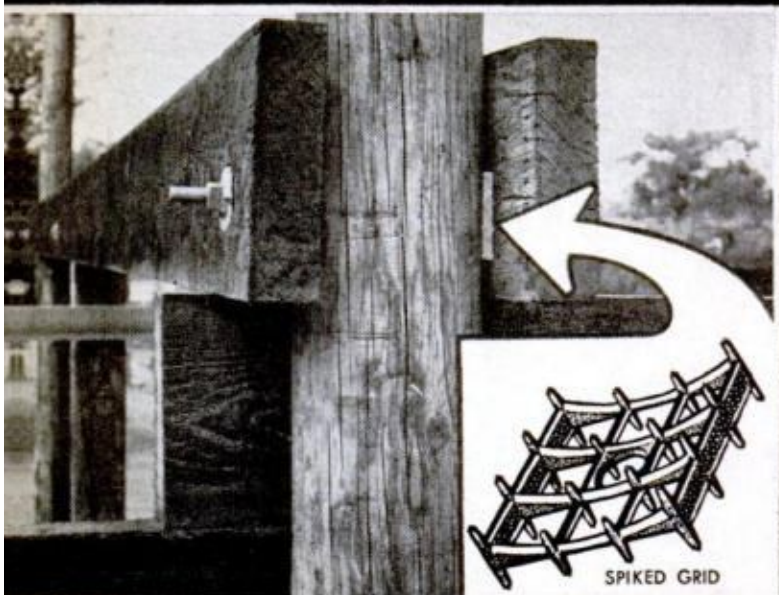
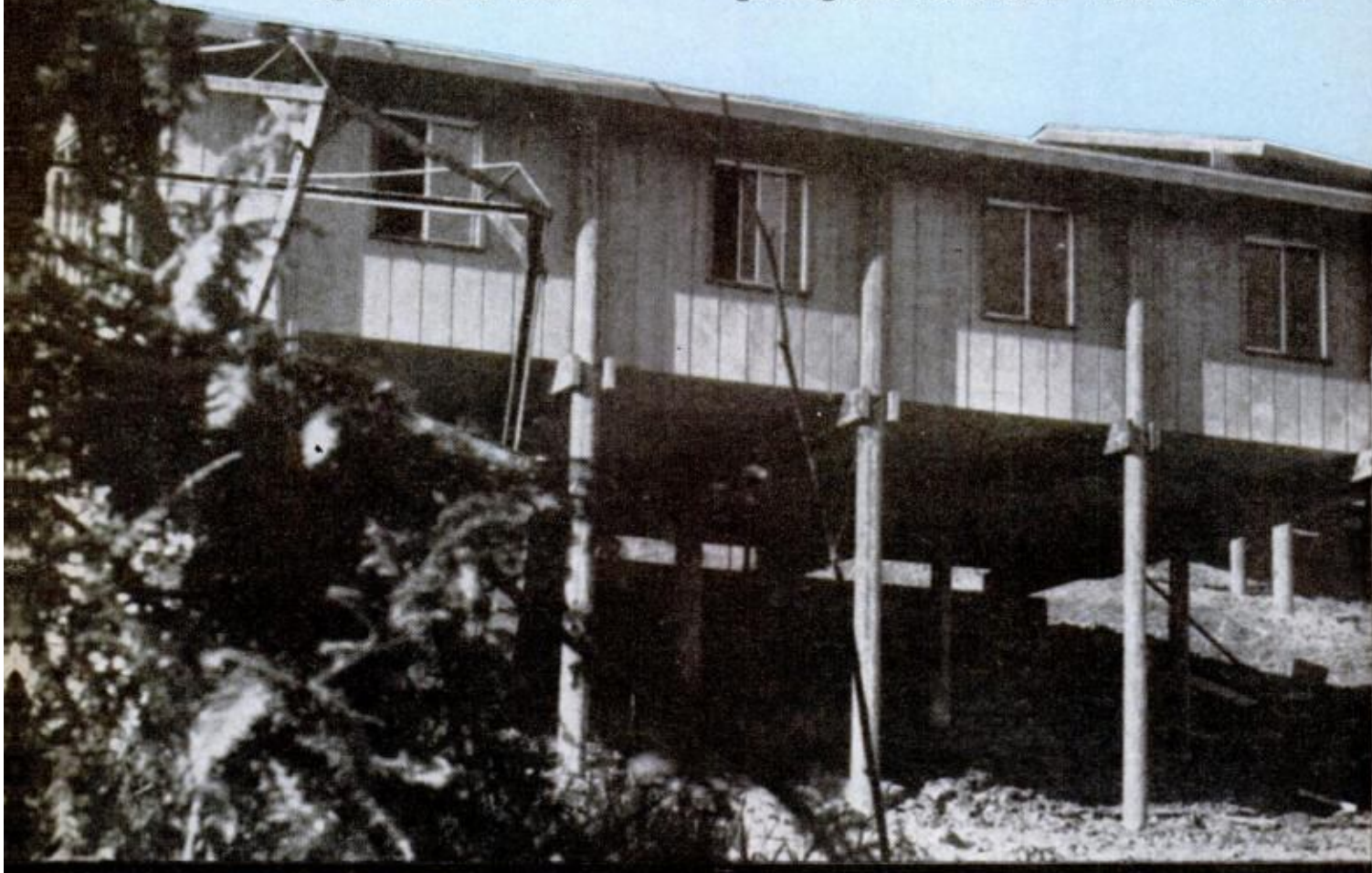
High Living On Stilts

By Merle E. Dowd

PRIMITIVE MAN once built his home on stilts to protect his family from the marauding beasts of the jungle. Today, many Americans are returning to this method of house construction, but for entirely practical Twentieth Century reasons.

Two of the main reasons are: (1) adaptability to problem building lots and; (2) savings of up to 10 percent. Often the two are combined.

Problem lots are those difficult building sites that have been bypassed because of added expense that would be required for grading and foundation work. But often



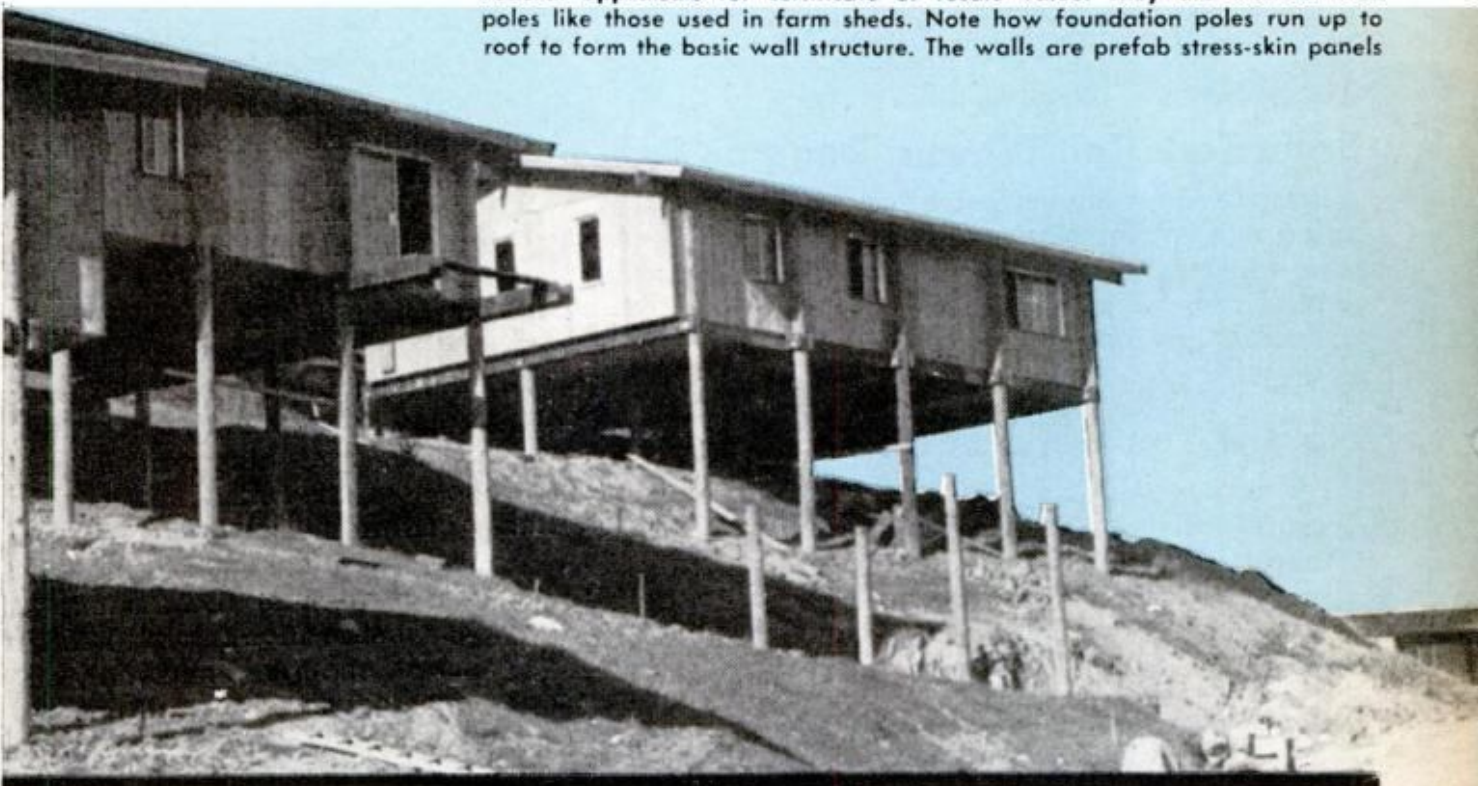
they command a sweeping view, are near a city center or are on choice waterfront land. Pole-type construction converts these lots into prime building sites.

For an idea of how this is done, look at the houses below. Building them on conventional foundations would have involved digging away part of the hill, building a retaining wall under the front of each house, or a combination of the two. With poles, all the builder had to do was sink them into the ground, and vary their lengths to conform to the slanting terrain. On swampy land, where conventional

foundations might involve pumps, underwater form-work, etc., all he'd have to do is drive the poles down to firm bearing.

But . . . how long will the poles last? Probably a hundred years or more, say the experts. Poles used for house construction, are generally "Chemonite" treated with salts of arsenic (to kill insects such as termites) and copper (to kill fungi that cause decay). These odorless salts are forced into the wood under pressure by means of an ammoniacal solution, and will not leach out. Test poles so treated in 1927 are still sound. ★ ★ ★

HILLSIDE HOMES in Marin County, Calif., sell for up to \$1500 less than their Federal appraisals for certificate of resale value. They are framed with poles like those used in farm sheds. Note how foundation poles run up to roof to form the basic wall structure. The walls are prefab stress-skin panels



FLOOR BEAMS of stilt houses are generally bolted to the foundation poles (far left), which rest on concrete pads buried 6 to 8 feet under ground. Timber connectors (inset) strengthen joints

STRIKING INTERIOR (center) is natural asset of stilt house. Roof beams, also bolted to the poles, create a dramatic cathedral ceiling. Poles themselves add pleasing accent to the walls

IN BEACH HOUSES, pole foundations raise structure above hurricane-driven floods. Space under floor is often used as a carport. Walled in, it may become a storage room or quick-change booth



Brain Tests Tell When a Dog's as Sick as a Dog

Long used on human patients to record brain activity, an electro-encephalograph is now being employed by an English vet to detect brain disorders in dogs.

Needles are inserted into the dog's skin

and wires attached (left). Impulses from the animal's brain are then recorded on a graph and read by the doctor (right). Dr. Phyllis Croft of London has spent three years developing the technique.

Now, If You Get a Battleship and Run It into the Truck . . .

It's not highway tragedy. It's a Rambler dealer's answer to crash tests staged by Connecticut police, in which big cars were driven into small ones. Supposedly, they proved small cars dangerous—but critics said they didn't take handling, braking,

and angle of impact into account. Battenfield Motors, Amarillo, Tex., ran a 10-ton truck into a Cadillac, Buick and Rambler broadside and head-on at 25 m.p.h. Their finding: All the cars sustained comparable damage.





Mover Picks Up a Tree—Roots and All

Cutting around the roots with a blade, a new machine then lifts an entire tree, all in one operation.

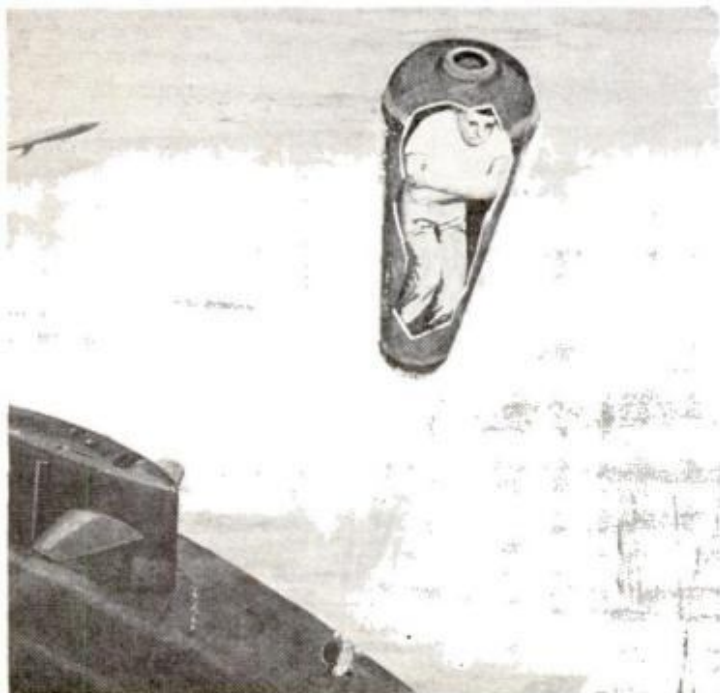
The English-made unit, a tractor shovel with the blade mounted on it, can lift up



to 17,000 pounds. It replaces the laborious method of transplanting trees by trimming and cultivating the roots up to 18 months before, then lifting and wrapping them. Cost savings are about 80 percent.

Escape Capsule

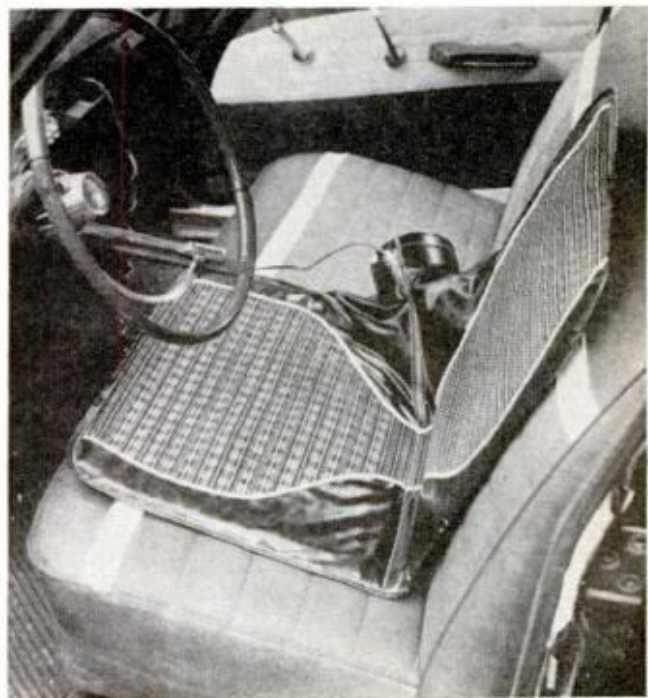
Future submariners will escape from extreme depths in one-man capsules, if current Navy experiments work out. Made of wound glass filaments, the capsules can be stored one inside the other to save space. Each will be 65½ inches long.



DECEMBER 1964

Cool Seat

Air can circulate around a driver's body when he uses a porous seat cover that's equipped with an electric fan. The fan plugs into the car's lighter socket. Priced at \$12.95, the cover is sold by Hammacher Schlemmer, 145 East 57th, New York.



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ADVERTISERS have been known to create pandemonium in parcel post when they mail transistor radios tuned to the station carrying their sales message

MaDHOUSE Behind the Mailbox

Thieving crows, ice cream mailed parcel post, oddball collectors—they're just routine for a postman

By Robert A. Kelly

FOR THE U.S. POST OFFICE and its long-suffering letter carriers, it's a mad, mad, mad, mad, mad world down in stampville.

Normally, of course, things run pretty smoothly in Postmaster General John A. Gronouski's Post Office Department, and efficiency is the byword, despite that automated post office in Providence, R.I., which (until frantic adjustments were made) happily accepted Christmas Seals as proper postage!

Along with the daily avalanche of mail, Uncle Sam has to contend with zany (and often impossible) requests, freakish mechanical breakdowns and a host of fractured postal regulations.

Much of the madness is touched by a

SAVING STEPS, a postal employee made chutes of fruit juice cans to send sorted mail to a lower floor



kind of mechanical genius. Like maybe the musical packages which crop up from time to time. Certain advertisers—always looking for a new way to get their message across to prospective buyers—hit upon the idea of actually mailing small, transistor radios to themselves! Not only were the radios turned on, they were tuned to the particular radio station carrying the advertiser's message. In this way, hundreds and maybe thousands of people (especially the "captive" postal employee) had to listen. The packages were kept in circulation by their owners as long as possible by mailing them again and again. The advertisers were warned to cease and desist or face penalties.

Another clever craftsman realized that a little scissors work on the new John F. Kennedy Commemorative five-cent stamp could well produce two halves *each* looking very much like a regular-size five-cent stamp. Some actually got through before the alarm was sounded by the department.

On the other hand, people are occasionally *too* anxious to obey postal regulations. A rural carrier in Huckabay, Tex., found that a post supporting the boxes of three different families was violating regulations by being nine inches too tall. This made it awkward for him to place mail in

the boxes without leaving his automobile. So he left a form in each box requesting that the post be lowered the appropriate nine inches. Next time around, he found that all three had complied—the post had been lowered 27 inches

Even postal employees themselves occasionally surprise the department. Take Chicago postal worker John Sestak who, applying some mechanical ingenuity, created a Rube Goldbergian device which increased mail sorting efficiency by a full 30 per cent.

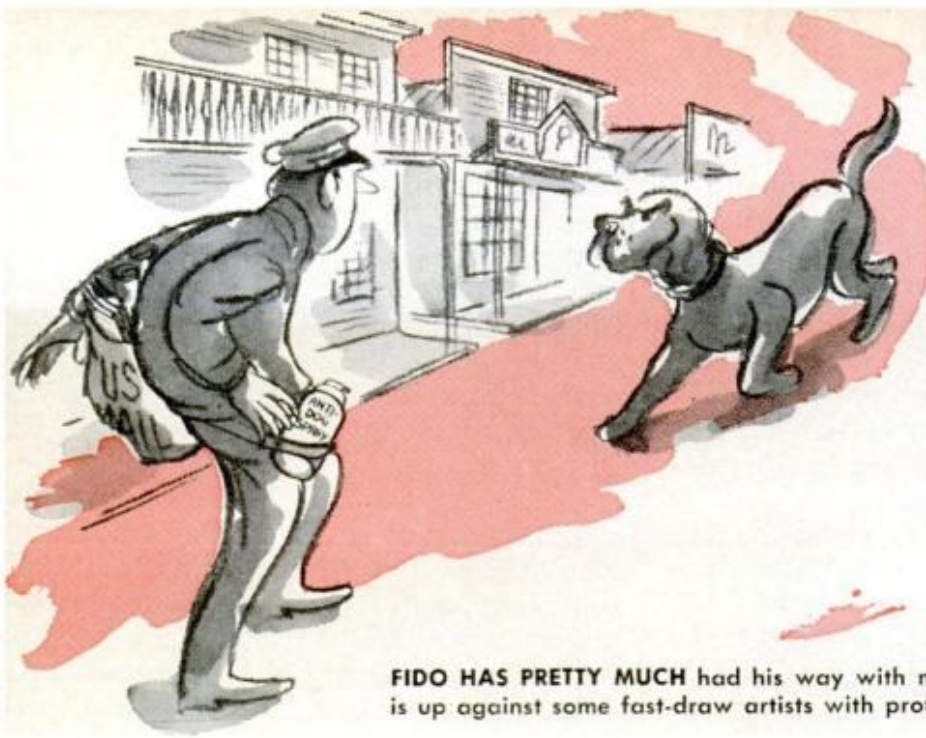
Clerks sort mail by placing it in "cases," a sort of pigeon hole rig. Before Sestak's idea, clerks lost 12 minutes each hour removing mail from the fully packed pigeon holes. Sestak simply knocked out the back of the holes and connected individual chutes made of one-gallon fruit cans from the nearby cafeteria. Mail then tumbled down the chutes to a lower floor, into a bin already separated by destination. A crazy idea, but one with a happy ending for the Post Office.

A couple of Brooklyn pot lids gave the Post Office a new safety gimmick aimed at saving children's lives. Due to the shape of postal trucks, there are "blind spots" into which the driver cannot see. Unfortunately, children often are attracted to the mail trucks and occasionally play in these

AIR MAIL ran amok when a shipment of ladybugs got loose in an airliner and swarmed over passengers

SLEET OR RAIN won't stay a courier of the mail, but one was delayed when a crow stole a letter from a box





FIDO HAS PRETTY MUCH had his way with mailmen in the past, but now he is up against some fast-draw artists with protective pepper-filled aerosol cans

blind areas—right against the front bumper or fender, for example.

While drying dishes one night, a postal employee noticed the excellent, reflective qualities of a pot lid and suggested to his superiors that similar metallic discs could be attached to the front and rear of the trucks in such a manner that all blind spots could be made visible to the driver. The idea appealed and a Brooklyn manufacturer won the order for 20,000 stainless steel discs and brackets. From pot lids to life savers, and all from one way-out idea.

One day not too long ago, a postal worker was casually instructed to take a batch of mail from one location in Washington, D.C.'s General Post Office over to that section handling New York City mail—his instructions were simply “take this load over to New York.” Imagine his supervisor's surprise, some hours later, upon receiving a long-distance telephone call from New York City's Postmaster inquiring “why in the world such a small packet of routine mail had been especially trucked all the way to New York City?”

To the dismay of the USPO, Americans apparently will ship anything through the mails . . . prickly bushes, live alligators, ashes of the deceased, stove grates and ice cream included. Recently, a New York City post office was disconcerted when a crated beehive split open on a loading platform. After everyone found cover, the Humane Society was called to put down the invaders.

However unwarranted, politics do enter postal life in one way or another. An obvious partisan wrote the department suggesting that all postage stamps in all denominations carry portraits of Democratic presidents. Postage *due* stamps, he added, should carry the portraits of Republican presidents!

Not everyone is as politically motivated, but many people are extremely observant and this often serves to keep the Post Office Department on its toes. Complained one man, “The signature of George Washington in the American Credo Series is not exactly true!” A check revealed that he was correct. A stamp designer had attempted to make George's signature a little more legible.

Unfortunately for some of us, postal regulations prohibit the return of stamps once they've been purchased. This upset a woman who bought 200 Whooping Crane Commemorative stamps with which to mail her daughter's wedding invitations. After buying them, she realized that the crane belongs to the stork family. The implication of a shotgun wedding was more than she could take.

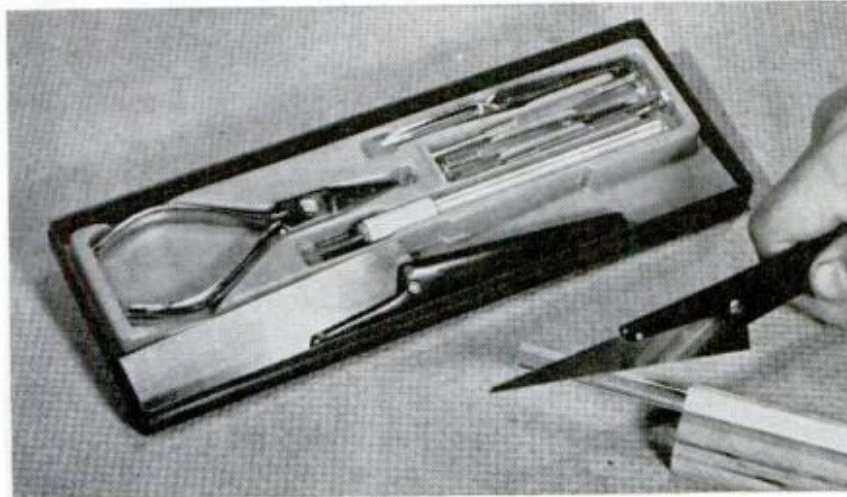
Recently, George Washington was assigned to a place of honor on the basic five-cent stamp replacing James Monroe. Reaction, at least from one furious citizen, was rapid. Said the correspondent, doing away with the Monroe stamp could mean only one thing—scuttling of the Monroe

[\(Please turn to page 186\)](#)



Poor Man's Rolls

A touch of luxury for the average motorist is the Rolls Royce aluminum Six now available in the English-made Vanden Plas Princess R. It develops 175 horsepower from 238.5 cubic inches for 112-m.p.h. top. U.S. price: about \$5600.



Precision Tool Kit

A new hobbyist's kit contains tools designed for precision work. It includes self-gripping crisscross tweezers, three swivel-head screwdrivers, two miniature saws, needle-nosed pliers and an interchangeable-blade knife. No. 7300 kit sells for \$4.95. It's made by Strombecker Corp., 600 N. Pulaski Rd., Chicago, Ill.

Filing by Television

When magnetic video tape is used to replace file folders, a secretary can almost enjoy filing. Ampex's Videofile system does just this and will soon be used by NASA.

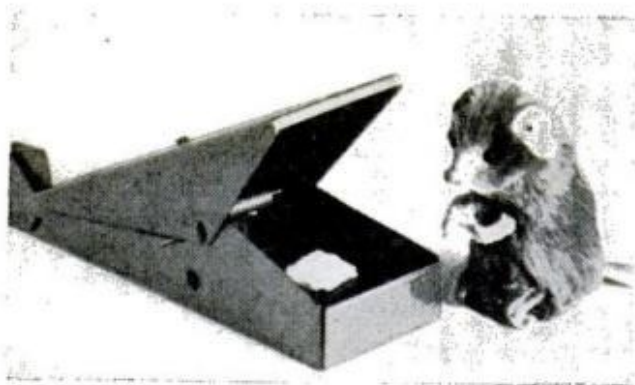
Each page of a document is televised and recorded on video tape. At the same time an identification code is added to the tape on an auxiliary track. When the file is needed, the identification code is fed into the device. It then automatically finds the proper section of tape, plays it back and prints it out on an electronic printer.



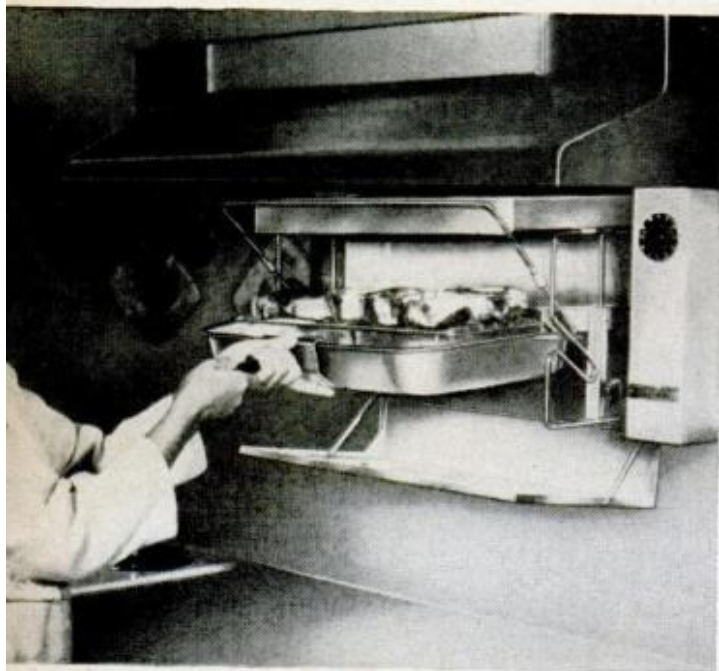
New for Your Home

RUG SHAMPOOER won't soak carpeting. Shampoo is released by handle trigger onto rollers which dry foam above rug. Nylon brushes work foam into rug as third roller keeps machine level, \$14.95. By Bissell, Grand Rapids, Mich.

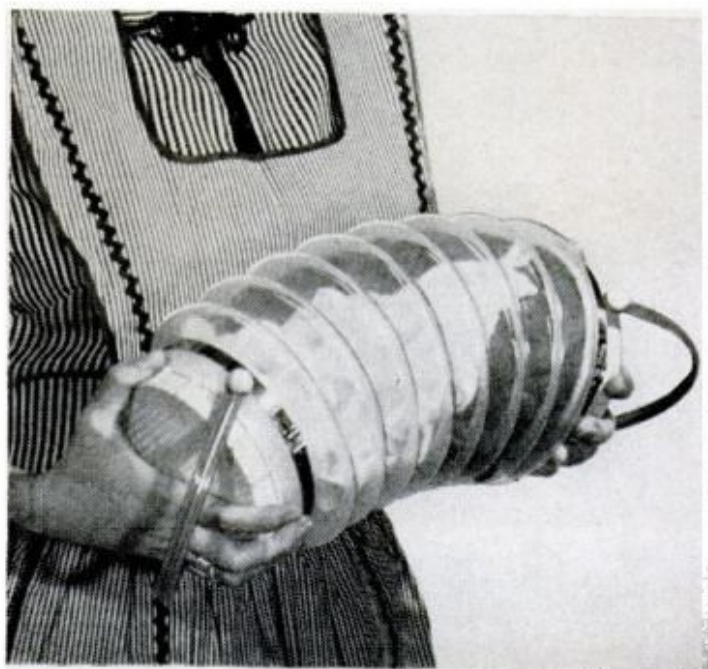
MOUSE TRAP sets and empties so that you never touch a varmint. Mouse steps on platform, triggers trap and you press tail-end to eject him. Of finished steel, two traps are \$1.25 from Ewing Co., 1621 E. 17th St., Santa Ana, Calif.

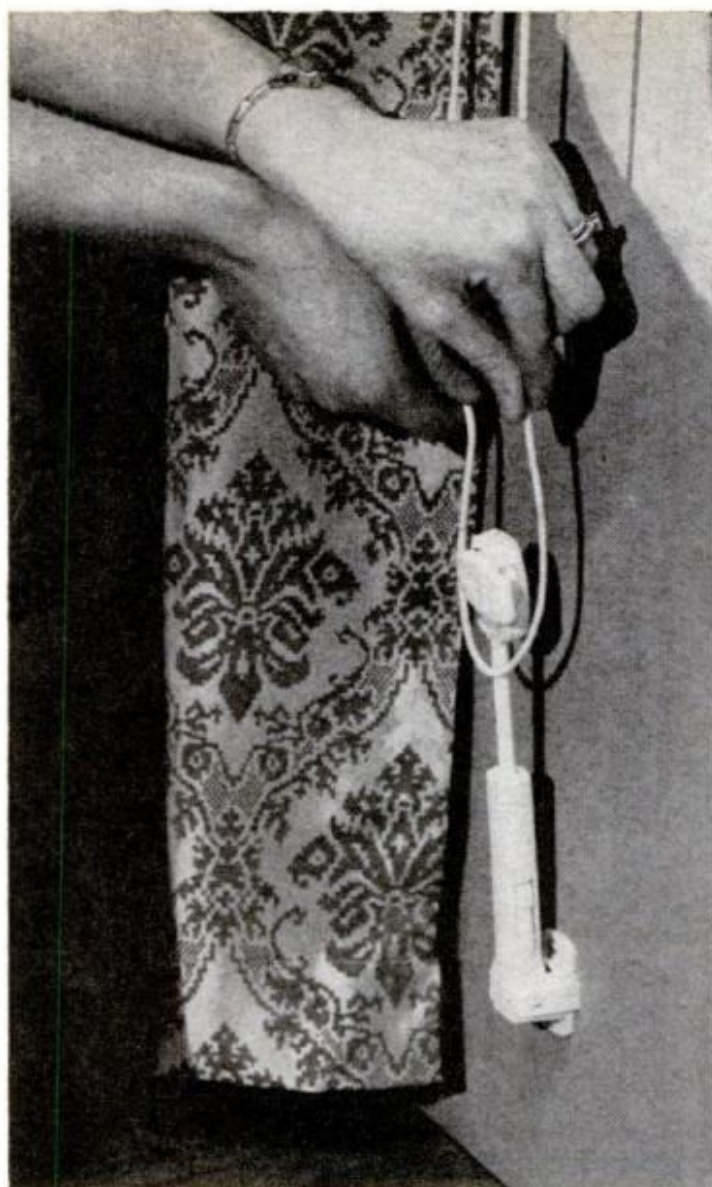


INDOOR BARBECUE cooks electrically using quartz, a permanent element, not charcoal. Spit and char-bar unit attaches to 15 by 26-inch wall space, plugs into 115-volt outlet. Prices start at \$170. Purcarb Inc., 137 W. 25th St., N.Y., N.Y.



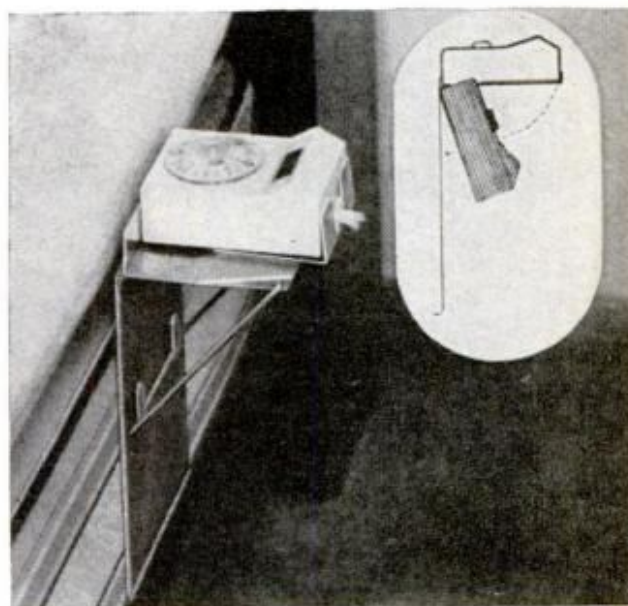
WASHER works like concertina; squeeze for woolens, swing to and fro for lingerie. Polyethylene 6 by 12-inch unit is convenient for camping or travel. Available for \$4.98 from Beh Housewares, 1150 Broadway, New York, N.Y.





DRAPERY PULLEY keeps traverse cords taut. Tension lock holds pulley head upright, fully extended, while cords are slipped into place. White plastic item installs on wall or floorboard, costs about 60 cents. The Graber Co., Middleton, Wis.

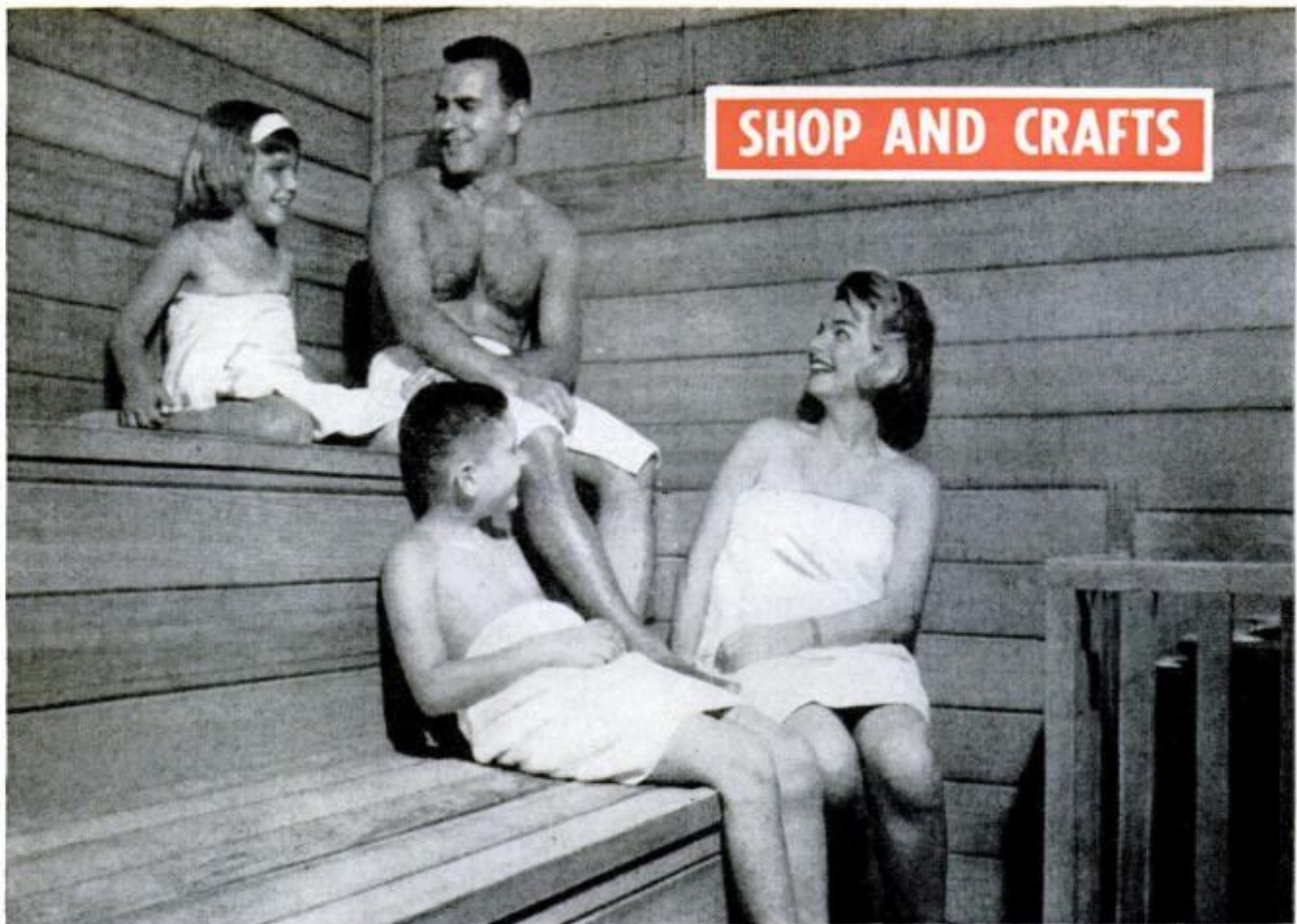
CONTROL BOX HOLDER for electric blankets, sheets or pads adapts to any style bed. Platform brings dial within easy reach and lowers for neat bed make-up. Price of aluminum holder: \$2.95. By Sinton's, P.O. Box 847, Sonoma, Calif.



CLOCK TABLE reminds guests when it's time to leave. Mechanism under 18-inch-high walnut table runs on year-long batteries, needs no winding. Drinks sit on clock face (15-inches across). \$75 from Hammacher Schlemmer, N.Y., N.Y.

FIREPLACE prefabricated from hearth to chimney top installs anywhere. All-metal, 46 inches wide, unit needs no mortar, masonry or footings. Front opening model costs \$300-350 installed. By Majestic Co., Erie St., Huntington, Ind.





Viking Sauna Corp. photo

BUILD A FAMILY SAUNA

Once you've tried this modern version of the ancient Finnish dry bath, you'll know why the sauna is sweeping America. It's not an out-of-reach luxury if you build your own

THE SWIMMING POOL has lost out as the big status symbol for American home owners. To be a master of on-upmanship today, you've got to show off a sauna. Never seen one? Well it's a specially-heated, redwood-lined room that you sit in to sweat.

"Oh, no!" you might protest. "I've tried steam baths. It's no treat to squat in a blinding cloud of hot vapor, with the air so thick you can hardly drag it into your lungs! That's for people who have to lose fat fast, and will put up with the discomfort."

Ah, but there's a world of difference between a Finnish bath and a Turkish one! There's no steam in a sauna (pronounced sow-nuh)—in fact, you deliberately keep humidity to an absolute minimum (5-10 per cent) to encourage perspiration. With the air so dry, you can up the heat to 175° and more without that sweltering sensation, and still breathe free and easy. And,

though the heavy sweating certainly melts off excess fat (some people shed three pounds per session), the sauna isn't mainly a reducing device. It's a relaxer . . . a toner . . . a cleanser.

The Scandinavians have known the secret for years—though they've always made a bigger production out of it than most Americans are likely to. They whip their bodies with leafy birch twigs and sometimes toss in a bone-jolting massage. And the classic topper for a Scandinavian sauna session is to jump naked into the nearest ice-pool or snow bank. Perhaps such "torture" elements explain why the rest of the world has been slow to share this Nordic enthusiasm. But Finnish athletes have kept insisting upon sauna facilities in their Olympic Games quarters, and competing sportsmen have given it a try and carried the message home. As a consequence, there's a sauna boom, today. Dry heat rooms are being installed in

resorts, health clubs, beauty parlors, military bases and private homes.

Once you try it, you'll see why. The profuse sweating clears the pores far more deeply than the most vigorous soap-and-water scrubbing, bringing a healthy glow to your skin. The greatly-increased body temperature burns out germs (much as a high fever does, but without the danger or discomfort), melts away tension, and increases blood circulation (as with heavy exercise, but without the exhaustion). The result: your body is simultaneously invigorated and wrapped snugly in a deep sense of well-being. After your first sauna bath, you'll swear that you've never been more profoundly relaxed, even with a potent tranquilizer!

Perhaps the strangest sensation of all is the way the stored body heat *insulates* you from cold. That's why the Scandinavians can tumble in that snow bank. If you're the type who inches into ocean surf or a cold lake, you'll be amazed how little a cool post-sauna shower or swim will shock your body.

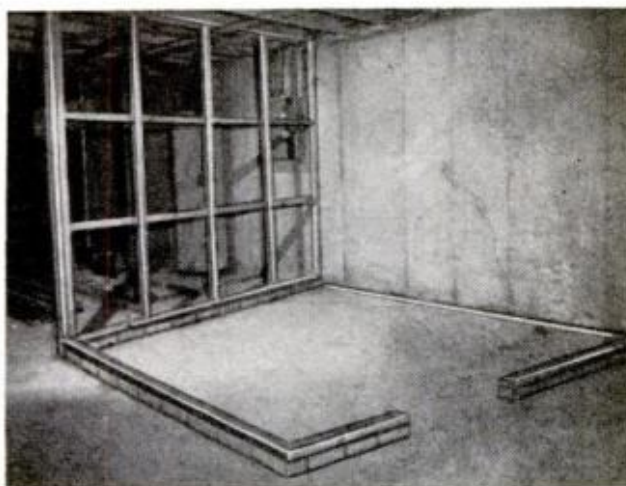
Sauna baths are equally beneficial when taken first thing in the morning to prepare you for the day, at the end of the day's work, or just before bed. And because the heat inspires complete relaxation, the sauna room's an ideal family-conference spot—and a great place to chat with friends, once you shed your initial inhibitions about shedding your clothes. No tight clothing (such as bathing suits) should be worn in a sauna; where modesty dictates, a towel tucked loosely around the body is the accepted costume.

The special boon for the home owner who's handy with tools is that a sauna is an ideal do-it-yourself project. Few people would want to risk introducing the

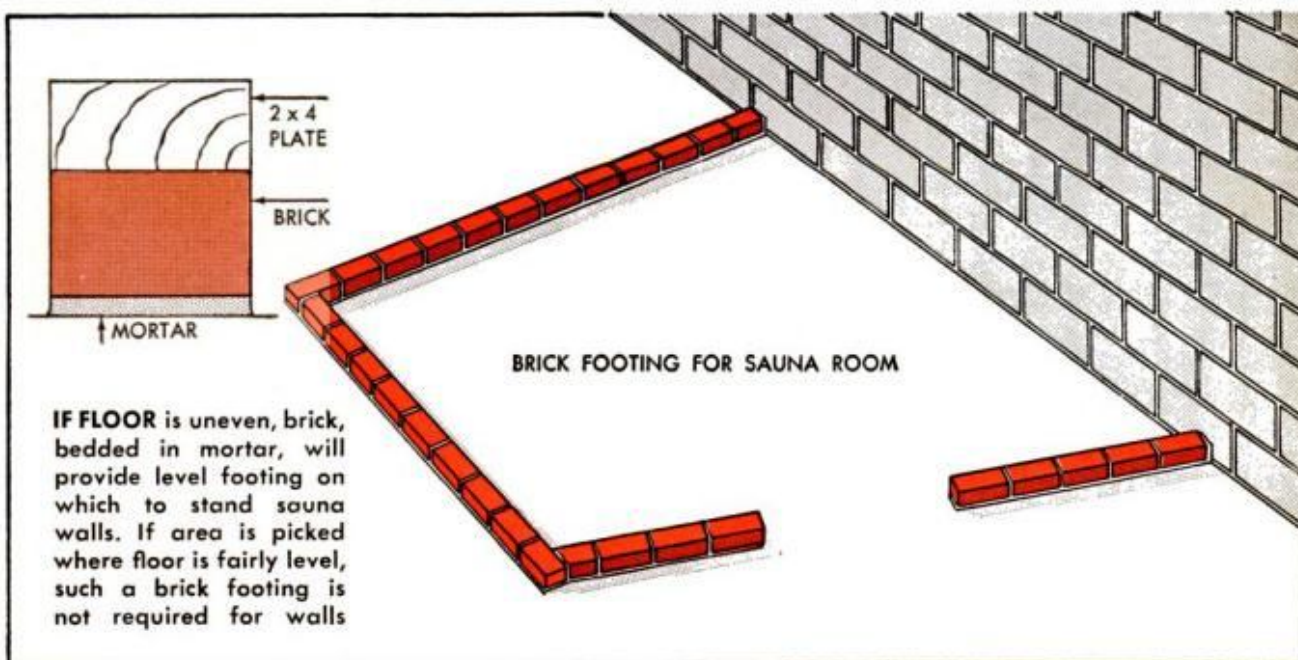


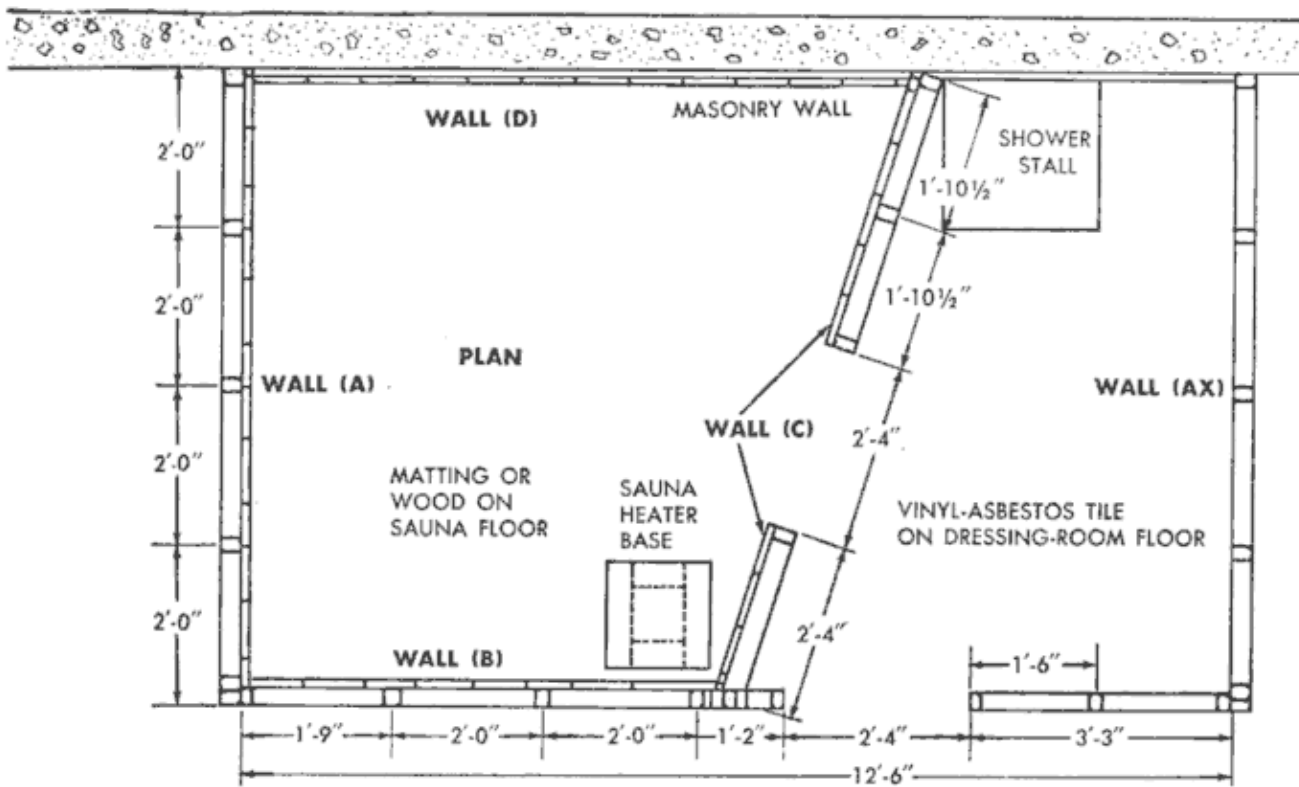
Simpson Timber Co. photo

A SAUNA doesn't have to be in the basement. If your home is without a basement, you can still enjoy the relaxation of a sauna by converting a spare closet



IF BUILDING AREA includes a window, it can be used to ventilate the sauna after using. Hinged cover backed with insulation of redwood should cover it





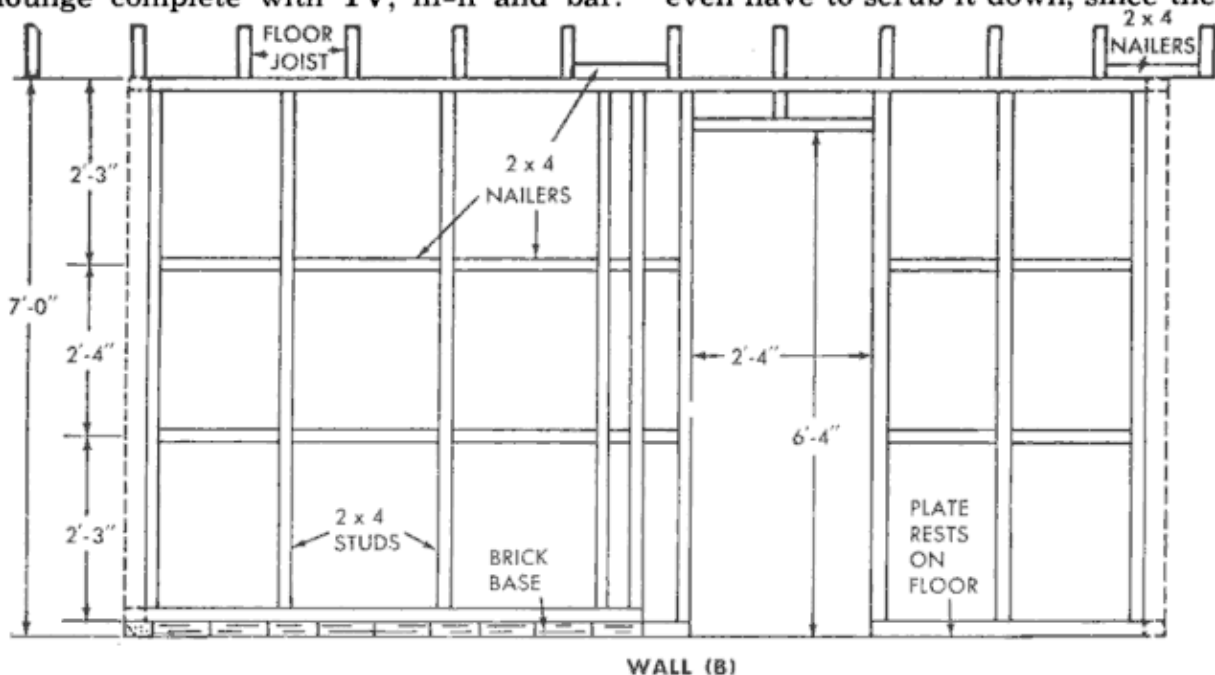
sodden air of a steam room into their homes, and installation costs would be sky-high. With an electrically-heated sauna, however, no flues or plumbing are involved. You can install one anywhere you can hook into 220-volt current. (And there's a gas heater on the market for homes that are strictly 110.)

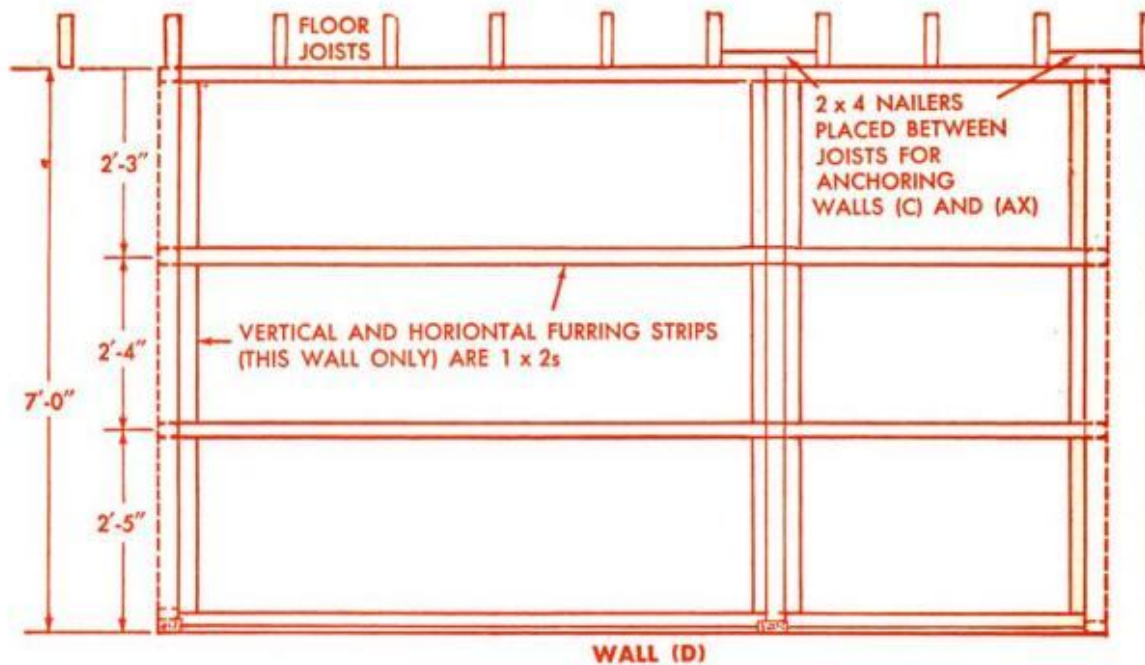
Your sauna room can be tucked into an unused basement corner, or built as a separate structure in the back yard (a cabana, if you have a pool). The basementless "House of Good Taste" on display at New York's Worlds Fair has a sauna built into the garage. The room can be a simple box as small as 4x6 ft., or an elaborate suite including the heat room, a full bath and a lounge complete with TV, hi-fi and bar.

If you're in a hurry for that first bath, there's even a ready-made plug-in "solitaire" model that looks like a phone booth.

The room is faced with redwood or red cedar since they're poor heat-conductors; they keep walls and benches cool enough for comfort and their insulating qualities contribute to the economy of sauna operation. Blind nailing is recommended for assembling the benches—sitting on hot nail heads isn't fun. Use aluminum, stainless steel or hot-dipped galvanized nails throughout to avoid stains.

You don't apply any finish. Redwoods are far more durable than anything you can coat them with. Thus your sauna room is virtually maintenance free; you don't even have to scrub it down, since the heat

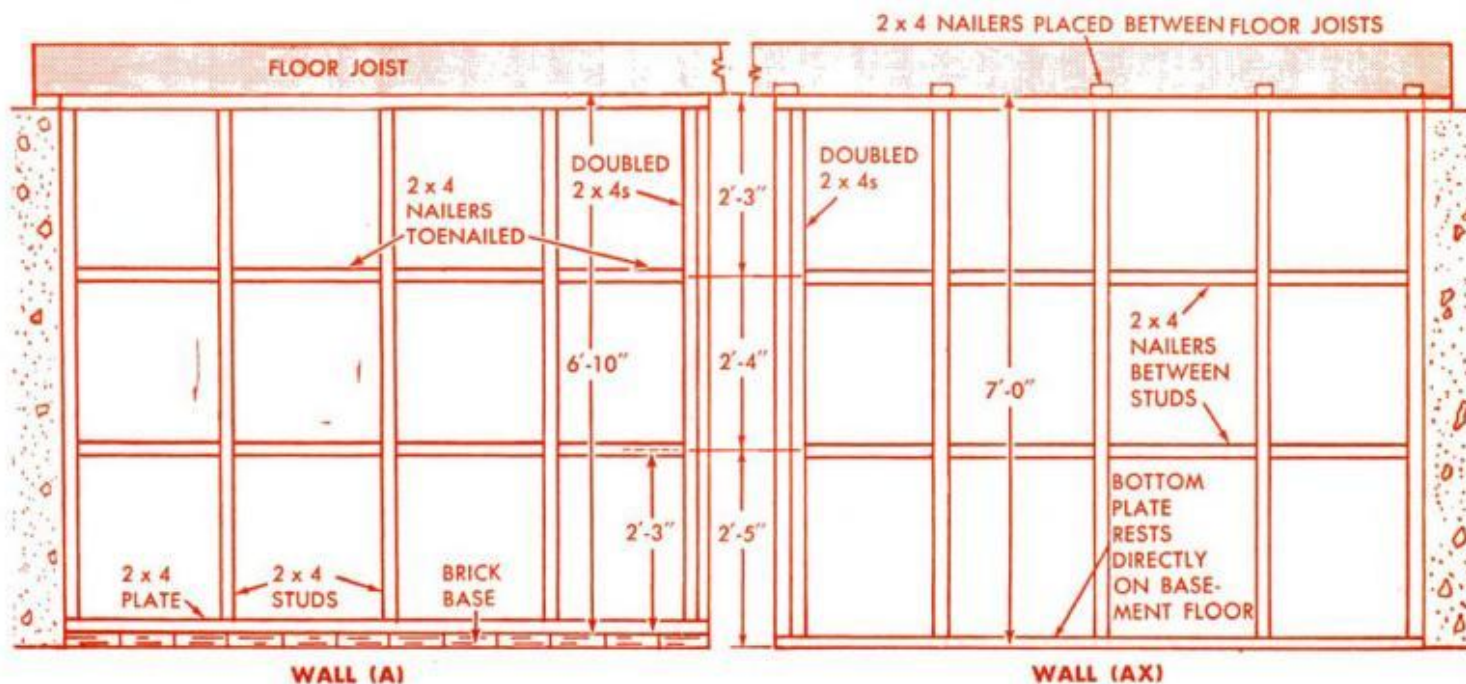
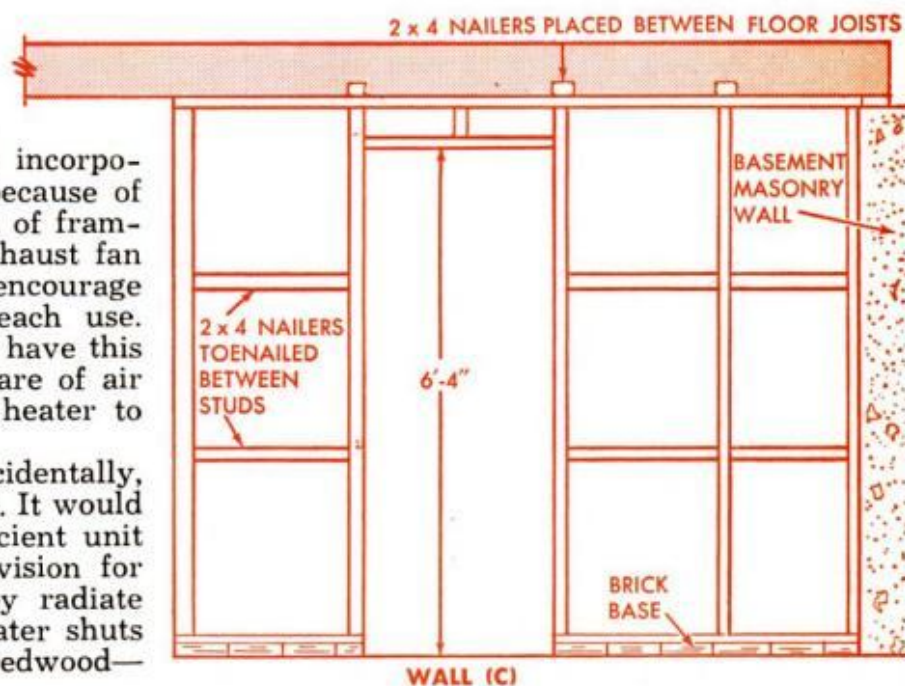


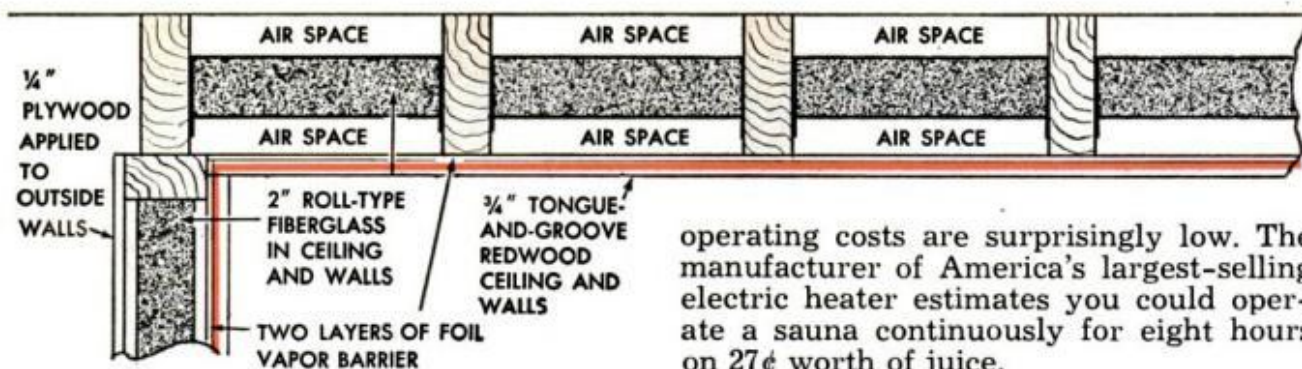


makes the sauna self-sterilizing.

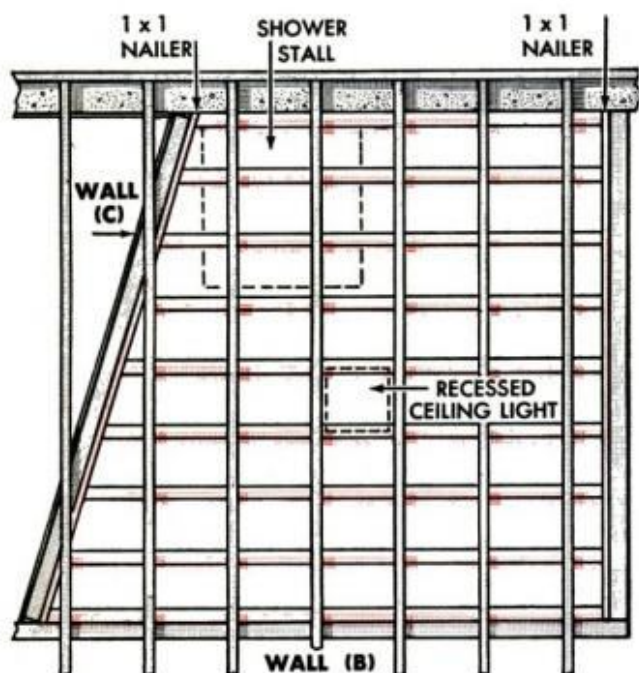
Exterior windows are rarely incorporated into sauna construction, because of loss of privacy and complication of framing. So you'll need a vented exhaust fan to suck out the hot air and to encourage circulation of fresh air after each use. Some of the commercial heaters have this feature built in; you've taken care of air circulation when you vent the heater to the outside.

Your biggest investment, incidentally, will be the sauna heater or stove. It would be impractical to design an efficient unit yourself. Most stoves have provision for holding a batch of stones; they radiate heat, and retain it after the heater shuts off. Because of this—and the redwood—

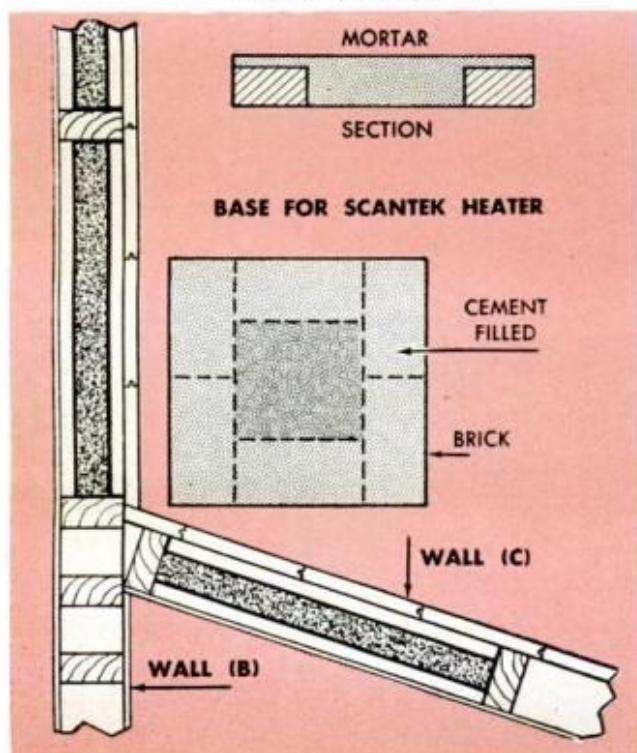




SECTIONAL VIEW through walls and ceiling show how spaces between joists and studs are filled with insulation and covered with foil vapor barrier before applying tongue-and-groove cedar or redwood lining



1 x 3 FURRING STRIPS NAILED TO UNDERSIDE OF FLOOR JOISTS FOR INSTALLING TILE



operating costs are surprisingly low. The manufacturer of America's largest-selling electric heater estimates you could operate a sauna continuously for eight hours on 27¢ worth of juice.

The bath itself can be as simple as a 15-minute stint in the heat room, followed by a shower. But for full benefits—both physically and emotionally—follow the procedure recommended on page 129. Don't take a sauna bath after exhausting physical exertion, or heavy eating or drinking. Rest first in such cases. Remember: the body works hard in a sauna and shouldn't be asked to tackle additional jobs—such as digestion—simultaneously.

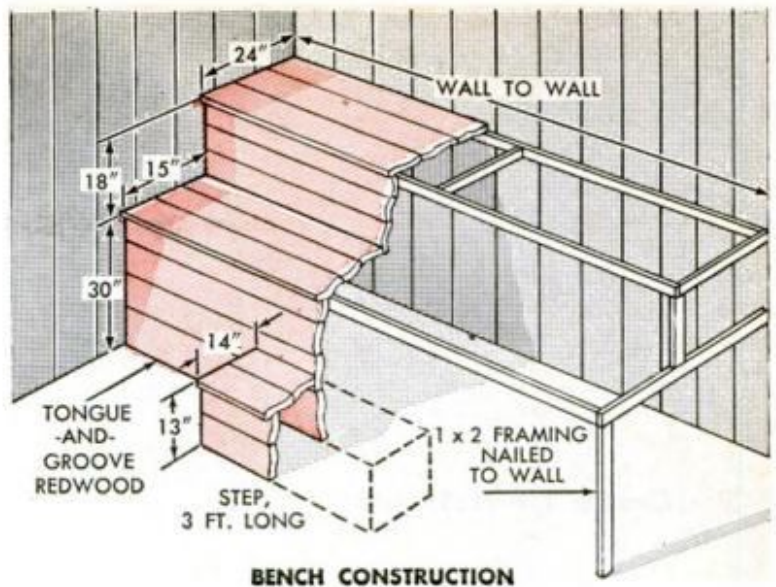
While a sauna room need not be any specific size, a 6 x 8 ft. one will accommodate a family of four nicely and heat easily. In the case of a basement sauna, overall size is determined somewhat by the overhead floor joists since it simplifies construction if the walls are aligned to bear on the joists. The sauna plans presented here include an adjoining shower and dressing room. While this adds to the convenience of the sauna, it's optional of course, since the shower in an upstairs bath can take over. Whether you build this sauna or one of your own design, you frame

VIKING SAUNA HEATER—a Swedish import—heats room to 200° in 15 minutes, shuts off until needed to maintain temperature. It includes a dehumidifier



the walls like any wall in your house, using 2 x 4 studs and plates. By using the foundation wall for one wall (or two walls when you pick a corner) you'll cut your framing costs and construction work. If the floor is pretty uneven, a footing of bricks, bedded in mortar, will start you off with a level surface on which to stand the walls. On the other hand, if the spot you've picked is fairly level, you can forget the brick footing and rest the walls directly on the floor. A plumb bob, dropped from the floor joists, will locate the walls so they'll be directly below. You can't raise the walls as separate preassembled units since you wouldn't be able to wedge them in place. So with the bottom plate resting on the floor, or the brick footing, as the case may be, only the upper plate can be spiked to the ends of the studs beforehand. The lower ends of the studs have to be toenailed to the bottom plate after the wall is up. Where the basement wall is a part of the sauna, horizontal and vertical furring strips must be attached to it so you'll have something to nail to when applying a foil vapor barrier and the kiln-dried cedar or redwood lining. Special masonry nails designed to be cemented to

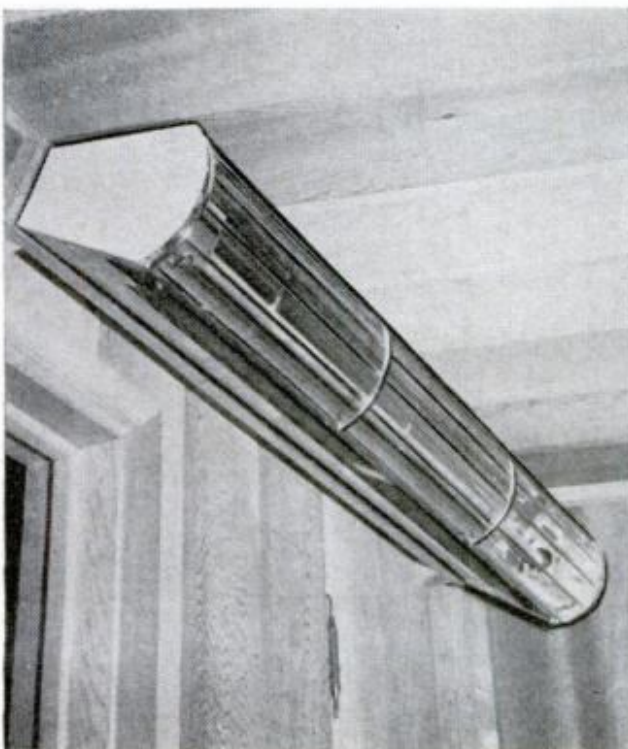
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HOW TO SAUNA-BATHE

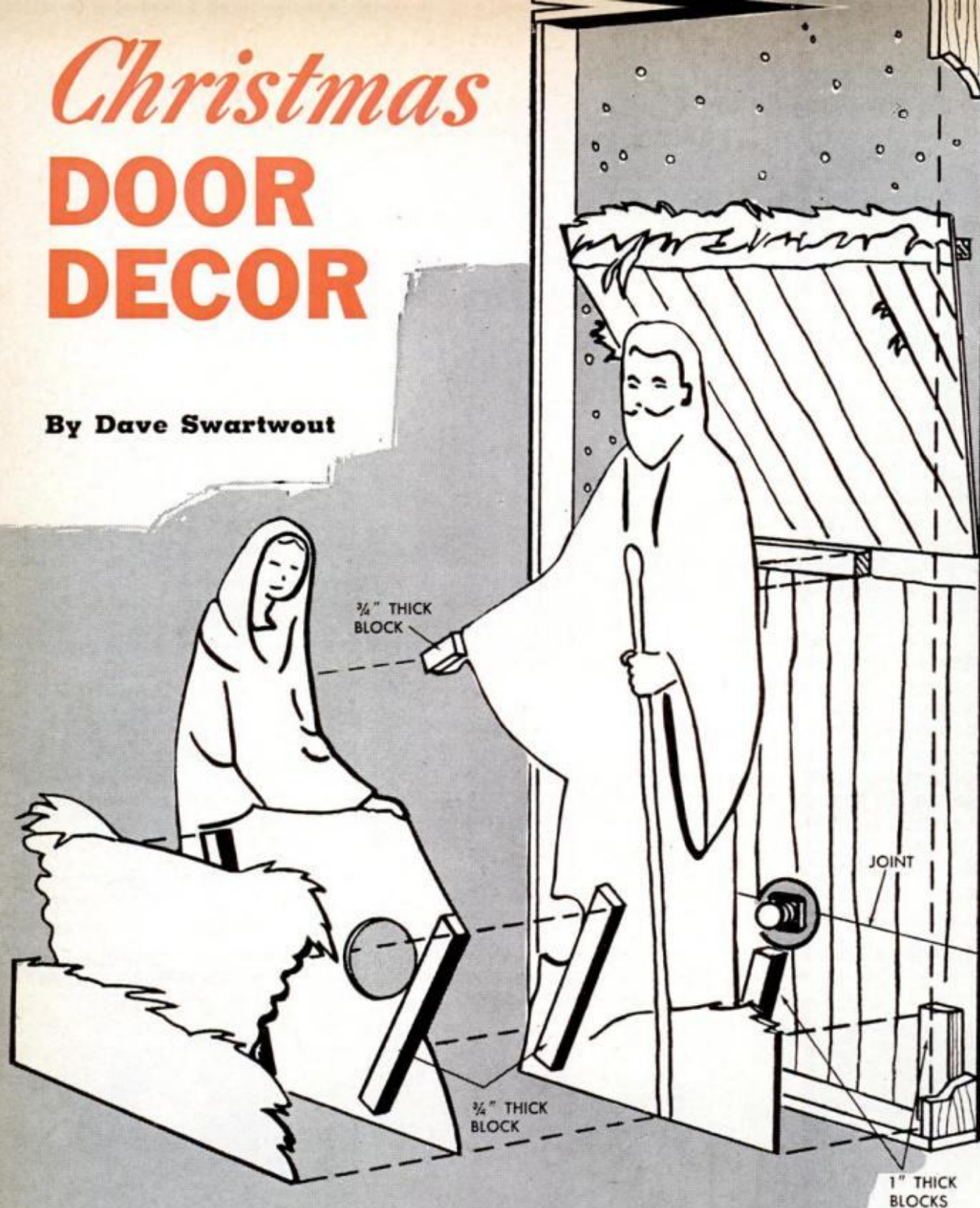
1. **SWITCH ON HEATER**, let sauna heat to 175° or more, then disrobe and enter. Sit or recline on one of the benches. If your sauna has two, start out on lower one, move up after few moments for increase in temperature. Do not exercise or smoke. First bath should last 8-10 minutes. (With experience you'll probably extend this)
2. **TAKE A SHOWER**—cold, if the idea doesn't make you flinch, or as cool as is comfortable. (A dip in a pool is the ideal alternate). Relax for 10-20 minutes
3. **STEP BACK** into heated sauna and relax completely. Since you'll start perspiring at once, you need stay only 5-10 minutes for maximum benefits
4. **TAKE LONG, COOL SHOWER** to bring down body temperature, then settle back for at least 20 minutes of peace

SCANTEK SYSTEM employs two units to heat room in one-half to one hour. Infra-red heater, left, supplies radiant heat. Electric stove, right, has inner and outer steel skin with heating elements between and stones in center. Lid is raised for rapid heat gain, closed to store heat and reduce electrical consumption

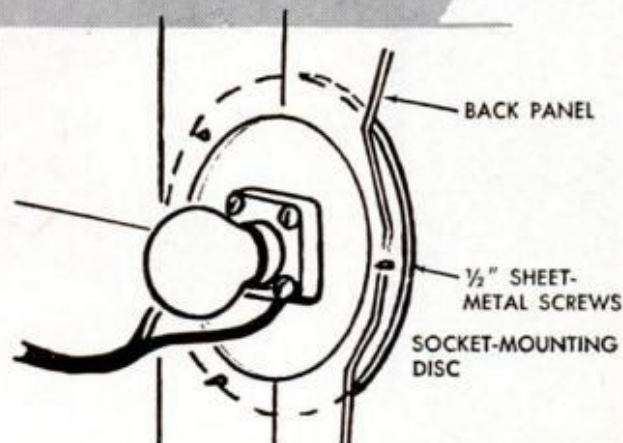


Christmas DOOR DECOR

By Dave Swartwout

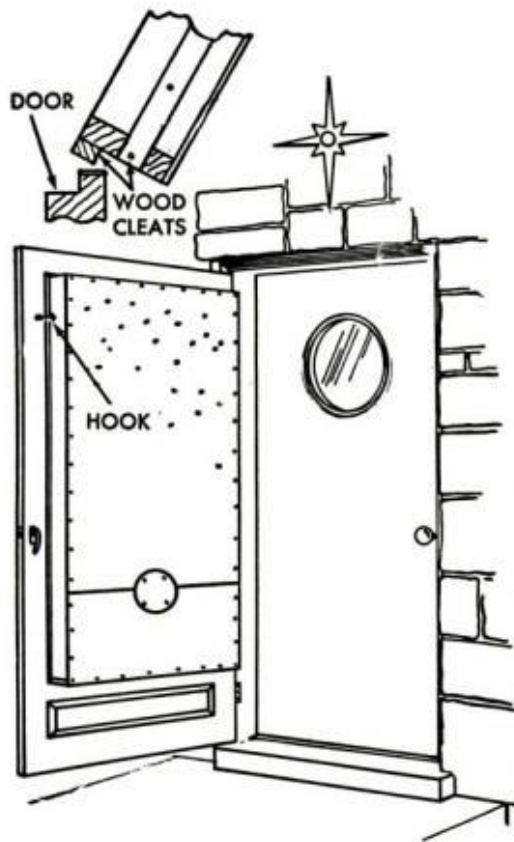


LIGHTING YOUR DISPLAY is the last step in construction. Just attach a small socket to a round hard-board plate that can be fastened to the back of the box with screws. Run the cord up the inside of the box and out to a porch outlet, tying it to the hinge pin to hold it in place when the door is open or closed

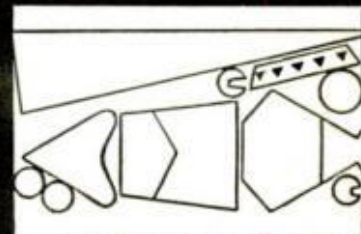
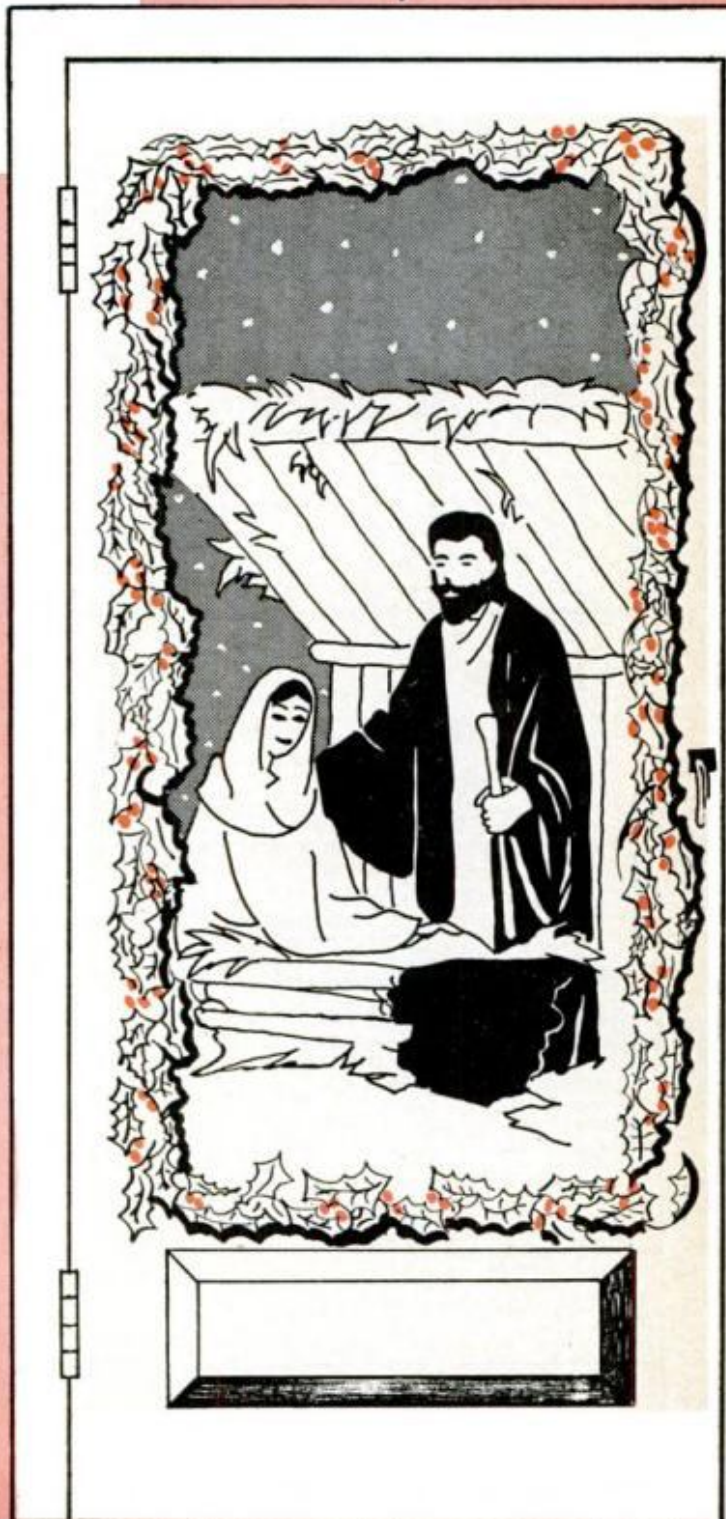


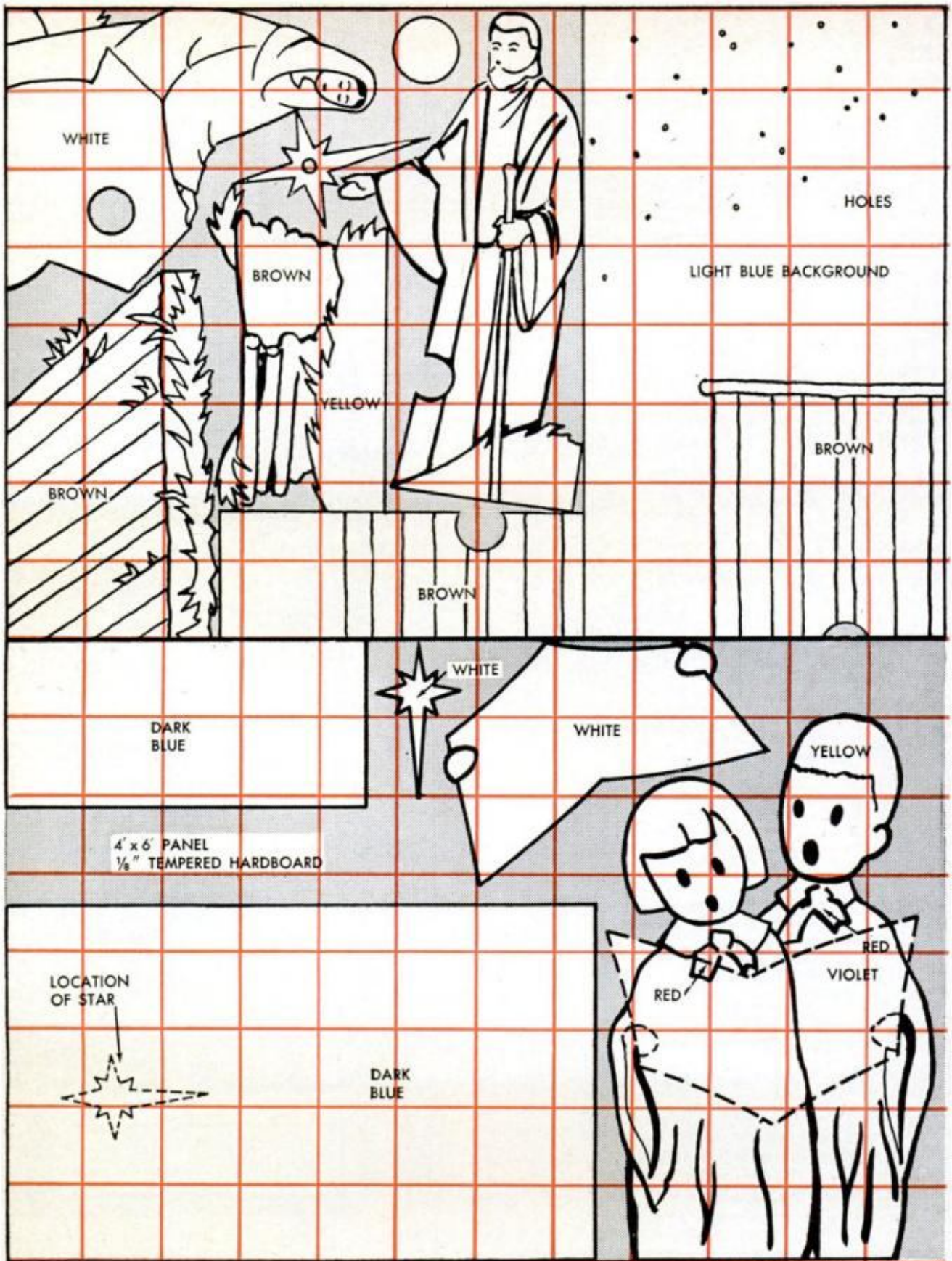
HERE'S something different in Christmas cutouts for adding the holiday spirit to your home. Two are holly-framed shadow boxes made to fit your storm door in place of the glass insert. A third, a high-hatted Santa with a blinking red nose, attaches to the outside of the door. Project-a-Plans—an exclusive PM method of enlarging patterns—make it easy to “blow up” the figures of all three displays to fit your particular door. (For those who don't own a slide projector, we've duplicated each pattern on graph squares.)

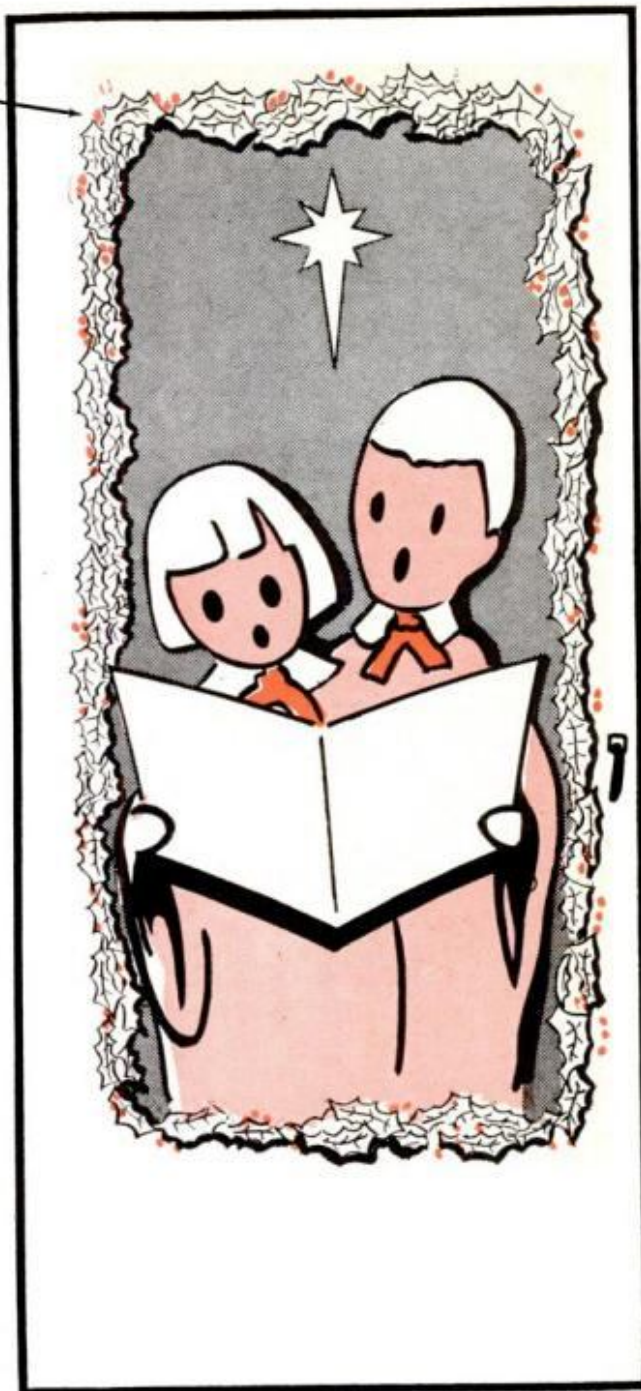
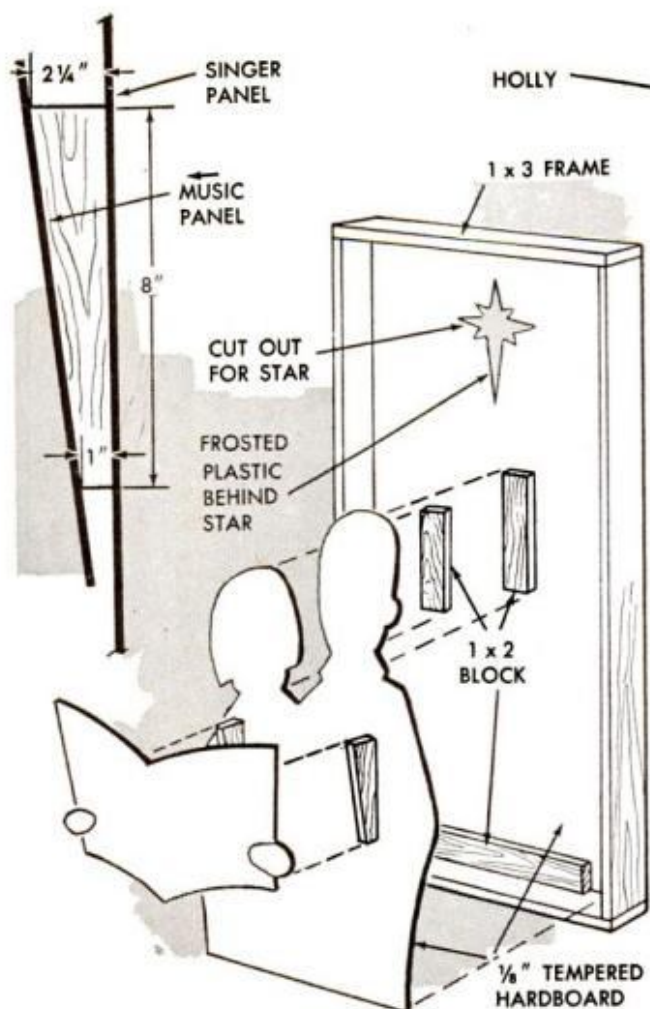
First, measure your screen door to determine the size to



PROJECT-A-PLANS, below, are paper transparencies designed to fit standard 35-mm slide mounts. Before inserting in mount, coat both sides with vegetable oil to make the paper more transparent for a sharper image of patterns







make your display, and build the background box, using $\frac{1}{8}$ -in. tempered hardboard framed with either $\frac{1}{2}$ -in. plywood or 1 x 4 stock. Next, cut cleats to fit the rabbets of the opening in the door and mount these along the edges of the box with glue and nails. The regular catches which hold the screen or stormwindow in place are strong enough to secure the display to the door, but it's a good idea to

PROJECT-A-PLANS IN COLOR

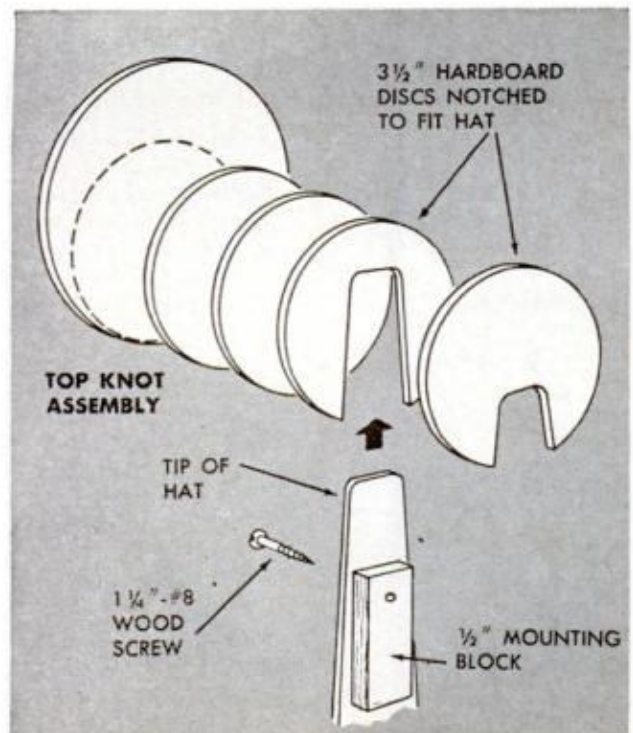
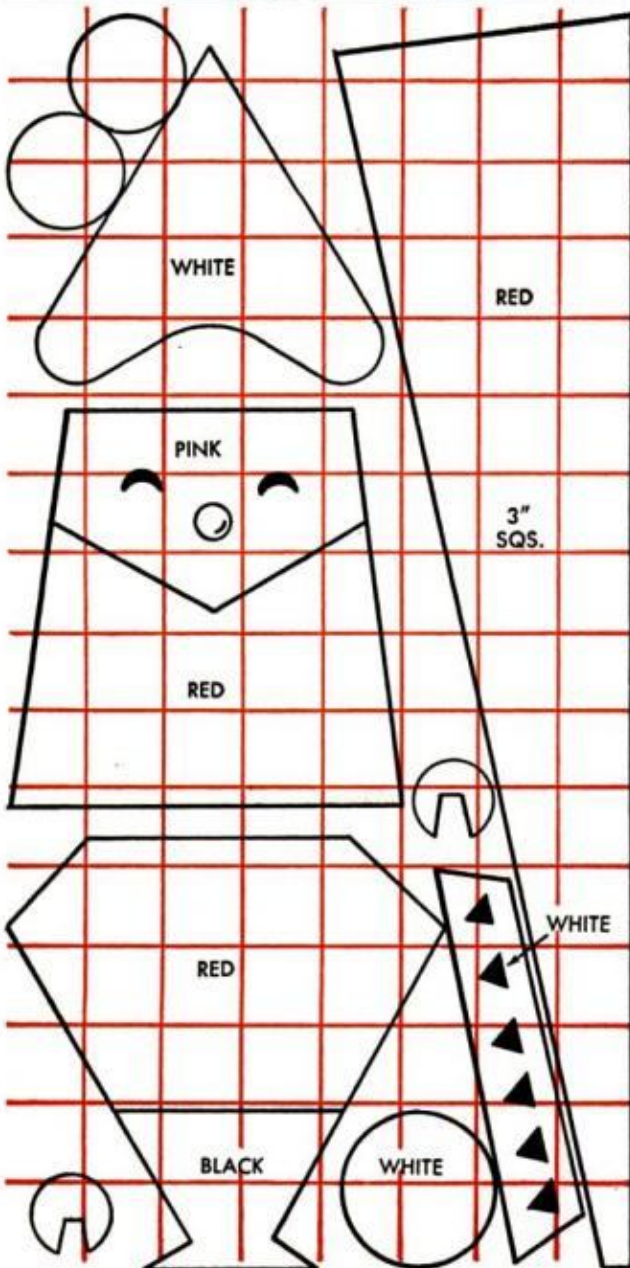
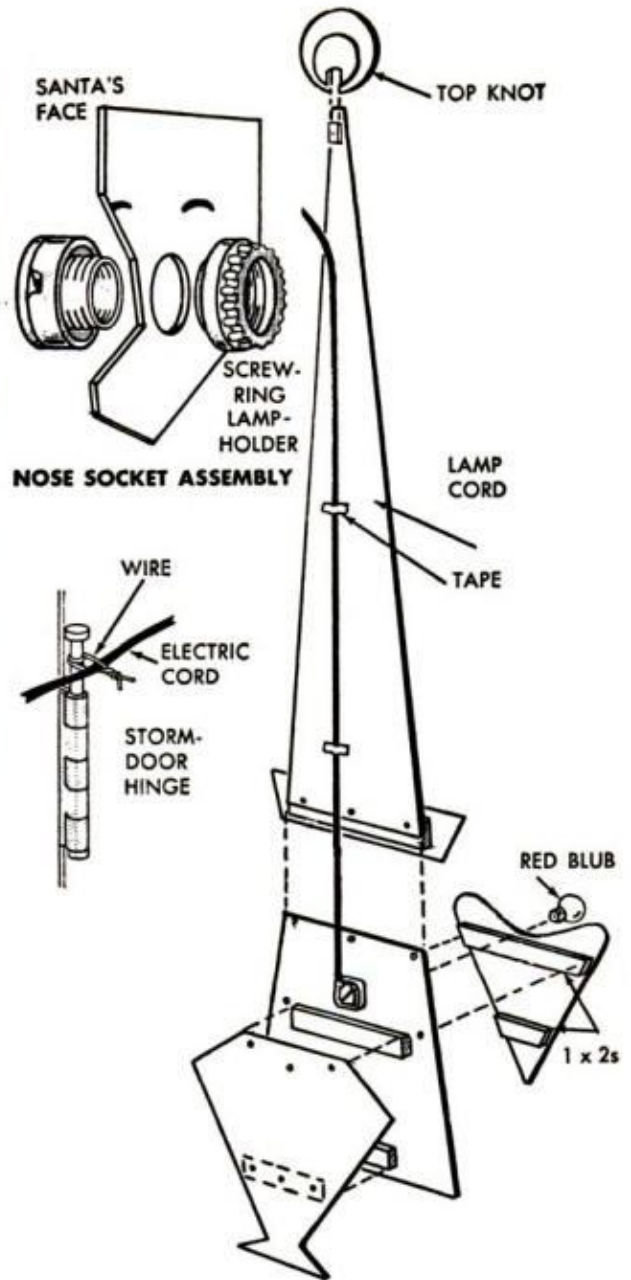
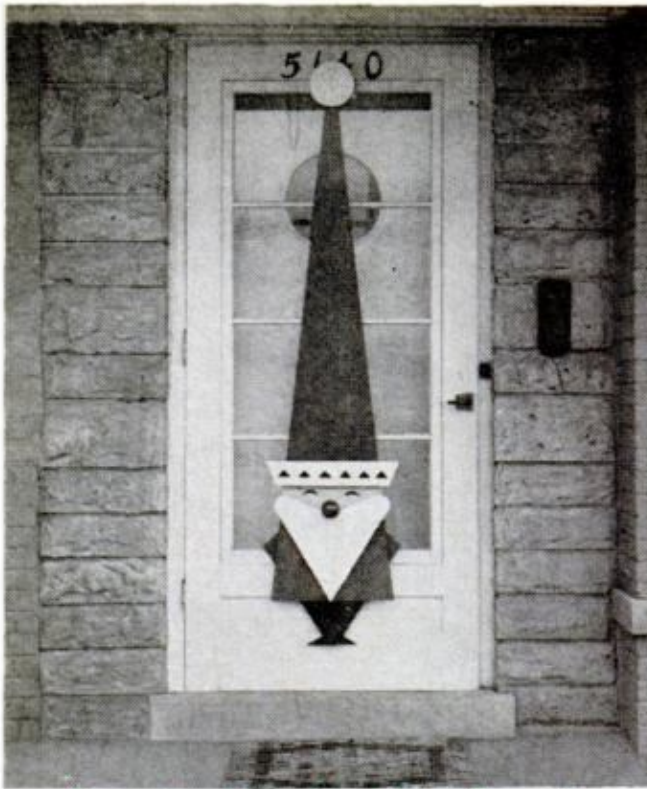
FULL-COLOR PROJECT-A-PLAN transparencies, already mounted for use in any 35mm projector, can be ordered now for prompt delivery. These slides save you the trouble of preparing your own, and give a sharper image in easy-to-copy colors. Order by number: Santa #101, Carolers #102, Nativity #103, enclosing \$1.00 for each or \$2.50 for all three. Other Project-A-Plans of our 1962 and 1963 Christmas cutouts (samples below) are also available. Address Project-A-Plan, Popular Mechanics, 575 Lexington Ave., New York, N.Y. 10022

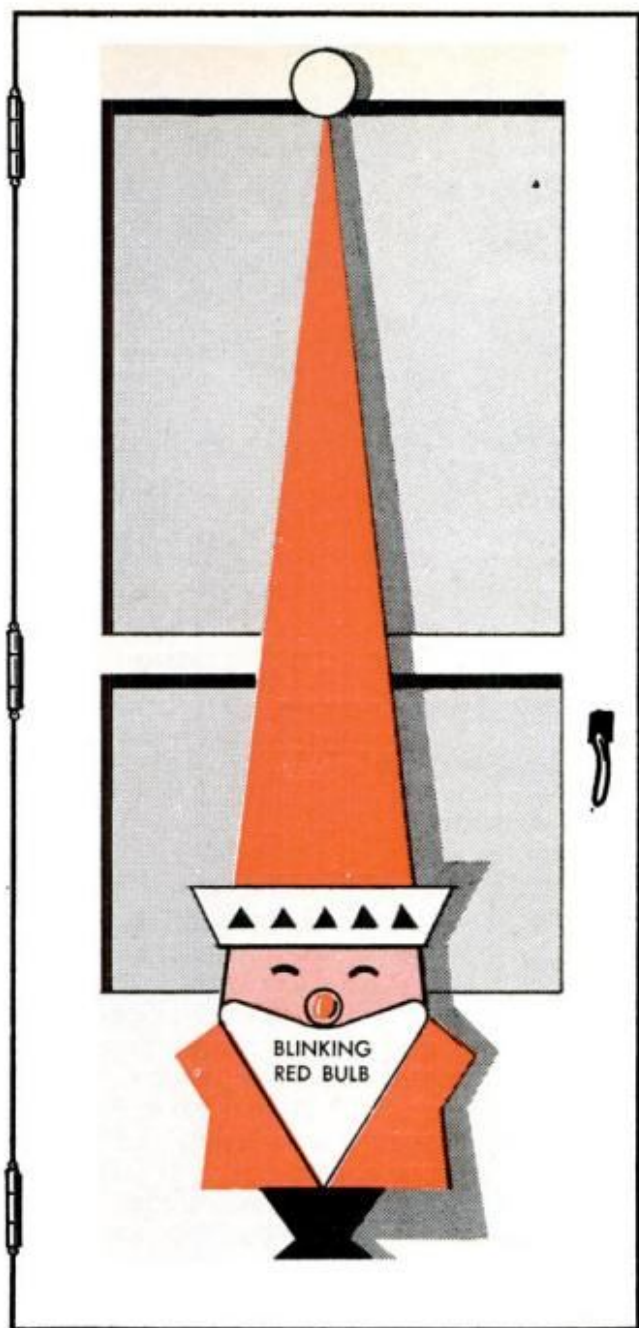
MECHANICS



5 Christmas Costumes
For Your Home with New
Project-a-Plans for Easy Enlarging





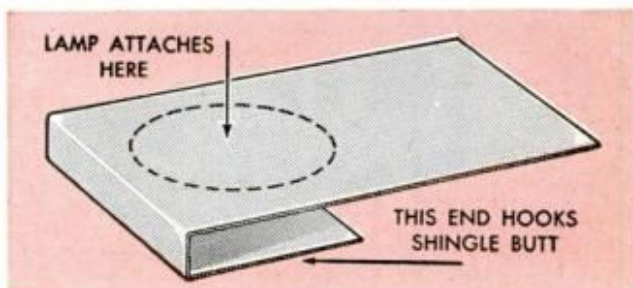
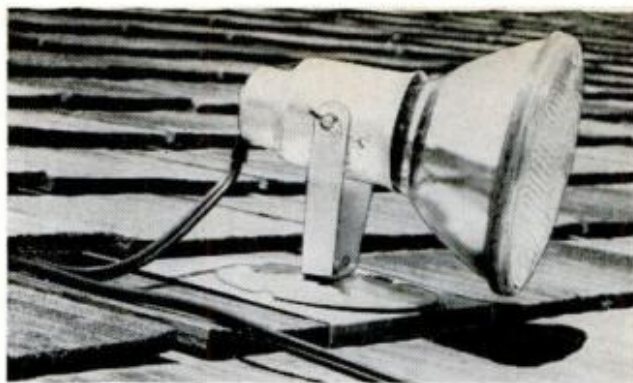


add screen hooks near the top.

Before cutting the figures, mark out an area the size of the box on the panel to be cut, then set up the projector so that the back-panel image fits this area and trace the pattern for the back. You can usually trace the other figures without moving the projector.

Cut the various shapes out with a sabre-saw or jig saw and give them an undercoat of outdoor enamel. When dry, you can paint the separate areas with quick-drying enamels. Finally, assemble the inserts with glue and brads. Put cut-outs or holes in the back panel only if your main door has a glass insert.

If your storm door is metal, you'll have to make the box a bit shallower and bolt it to the face of the door. Use 1/8-in. aluminum bolts with aluminum washers, two each at the top and bottom. After Christmas, just tighten the bolts in place.

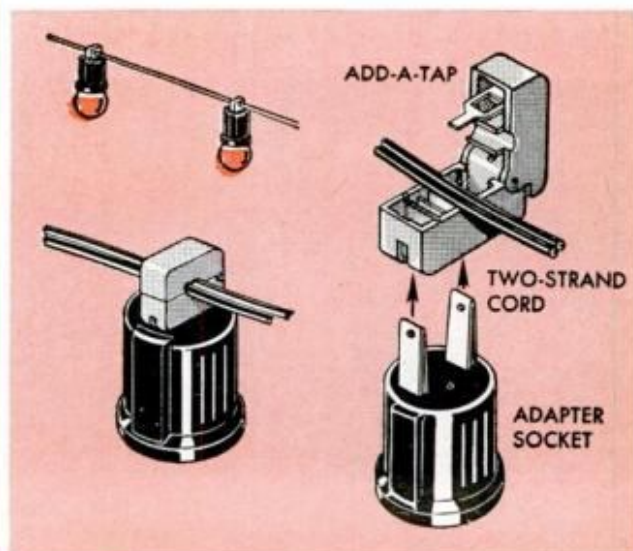


Roof Mounted Floodlight

Light up an outdoor Christmas display this season or brighten up your lawn parties next summer. This floodlight can be moved anywhere on your roof in minutes, since it clips to the shingles. It's just an ordinary outdoor swivel fixture on a standard box-mounting plate soldered to a clip made by folding a strip of galvanized sheet metal. For asphalt shingles, make clip thinner.—*Bob Gilmore*

Make Your Own Yule Lights

With clip-on adapters called "Add-a-Tap," you can turn any standard two-strand extension cord into a string of Christmas lights. Simply clip the taps to the cord, plug in adapter sockets and add colored bulbs. Such homemade lights are ideal for decorating outdoor Christmas trees, and by fitting them with Japanese lanterns you can use them for summer patio parties.—*Joseph Braunstein*



DON'T PULL IT UP— RETILE OVER THE OLD

Leaving the old tile right where it is and covering it with a special underlayment, saves work and actually gives a better base for your new floor

By Steven J. Howard

WHEN REPLACING a worn-out tile floor, it makes sense to lay the new tile over the old. You'll save the time-consuming chore of pulling up the old tile, and the new floor will be every bit as good as if you'd stripped the floor right down to the wood or concrete.

The trick in laying tile over tile is *not* the actual installation, which anybody with a little practice can do. It's in the proper preparation of the old surface and, most important, in knowing what materials to use.

Taking things logically, you could divide the job into four steps: (1) selecting the tile, (2) preparing the surface, (3) marking off the floor, and (4) laying the new tile.

TO PREPARE SURFACE, fill all cracks, gouges and dents with a compound called "floor patch and crack filler." Flatten bumps in old tile by nailing them down

Selecting the Tile. The most popular types of floor tile on the market today are asphalt, vinyl asbestos and vinyl.

Asphalt tile is the least expensive, but it offers a somewhat limited selection as far as color and patterns are concerned. It's not resistant to grease, so it's not the best choice for the kitchen floor.

This tile is used primarily in direct contact with concrete, such as in a basement recreation room, since the asphalt, asbestos and plastic filler in the tile resist the natural moisture which permeates concrete. (But no tile, including asphalt, will stay on a concrete floor that has water actually pushing up through it.)

Asphalt tile comes only in $\frac{1}{8}$ -in. thickness and 9 x 9-in. squares. It sells gener-

FILE ALL EDGES of the underlayment on top and bottom. This will remove all burrs, which could show through your new floor as unsightly bumps and ridges



ally for 5¢ to 10¢ a tile in carton lots.

Vinyl-asbestos tile, which is grease resistant, is perhaps the most popular of all since it comes in a variety of patterns and colors, and is reasonably priced. It is also easy to lay because some of its adhesives do not have to be troweled on, but can be brushed and even rolled. These adhesives, by the way, dry clear so that any excess which might seep up between the cracks doesn't mar the appearance of the floor.

Vinyl-asbestos tile is available in $\frac{1}{16}$, $\frac{3}{32}$ and $\frac{1}{8}$ -in. thicknesses, and in 9 x 9 and 12 x 12 in. squares. Prices run from about 12¢ per tile to 19¢.

Vinyl tile is the most expensive of all, running from 18¢ a tile to about \$3. It offers the widest range of patterns and colors, and also of sizes. Popular thicknesses run $\frac{1}{16}$ in., .080 gauge and $\frac{1}{8}$ in. You can get vinyl tile in practically any size up to 16 x 36 in., although the more popular sizes for home use are 9 x 9, 12 x 12, and 9 x 18 in.

In laying vinyl tile, which is grease resistant, you must use a waterproof vinyl-tile adhesive, which has to be troweled on.

A word about *cork tile*, which, although losing favor, is still fairly popular. It should only be used in light traffic areas, where it will be subjected to little wear, since it's hard to maintain. It sells for about 35¢ to 38¢ a tile.

Preparing the Surface. Before doing anything, fill up all gouge marks and large cracks with a spackling compound made for this job called floor patch and crack filler (photo, opposite page). This material strengthens the area and will prevent a spike heel or furniture leg from popping into it again.

There's a minor difference of opinion

FOR A SMOOTH FLOOR, allow $\frac{1}{64}$ in. for expansion between sheets of underlayment. Also, stagger the seams to avoid having four edges meet in one spot



DECEMBER 1964

TILE ESTIMATING			
Square Feet	Number of Tile Needed		
	9" x 9"	12" x 12"	9" x 18"
1	2	1	1
2	4	2	2
3	6	3	3
4	8	4	4
5	9	5	5
6	11	6	6
7	13	7	7
8	15	8	8
9	16	9	8
10	18	10	9
20	36	20	18
30	54	30	27
40	72	40	36
50	89	50	45
60	107	60	54
70	125	70	63
80	143	80	72
90	160	90	80
100	178	100	90
200	356	200	178
300	534	300	267
400	712	400	356
500	890	500	445
600	1068	600	534
700	1246	700	623
800	1424	800	712
900	1602	900	801
1000	1780	1000	890

Tile Waste Allowance	1 to 50 sq. ft. 14%	
	50 to 100 sq. ft. 10%	100 to 200 sq. ft. 8%
	200 to 300 sq. ft. 7%	300 to 1000 sq. ft. 5%
	Over 1000 sq. ft. 3%	

SECURE UNDERLAYMENT with 4d cement coated, annular ring or similar nails, spaced on 4-in. centers. Some underlayments come with spacing printed on





UNDERLAYMENT GRADE HARDBOARD cuts readily with standard power and hand saws. As shown above, a sabre or scroll saw is ideal for cutting the material to fit columns, corners, casings, and the like

among flooring experts concerning what type of underlayment to use—plywood, ordinary hardwood or a not-too-widely publicized product called underlayment grade hardboard. After listening to all arguments and working with one type of material, I have to agree with Harry Whitt, co-owner of Whitt Brothers Flooring in Middlesex, N. J.: "I don't advise the use of ordinary hardboard—the type you buy in a lumber yard. Tempered hardboard is too hard, and it's difficult to drive a nail so its head is flush with the

board. Naturally, any nailheads sticking up will show as bumps through the tile. On the other hand, untempered hardboard is too soft and could 'give' under a spike heel too readily."

"As for choosing between underlayment grade hardboard and plywood, it's pretty much of a toss-up, although the underlayment grade does come in 3 x 4 and 4 x 4-ft. sizes, which are easy to handle. Also, underlayment hardboard is usually marked off so you know where each nail should go. Cost of the two materials is about the same."

Underlayment grade hardboard might not be available in your lumber yard. However, most floor tile establishments stock it.

Why use underlayment at all? Tile "gives" in relation to the material beneath, which expands and contracts with changes in temperature and humidity. This offers the possibility of wide cracks opening between the tiles. Furthermore, according to Whitt, there is yet to be developed a floor adhesive which permits two tile materials of the same or different composition to adhere properly to one another.

If you've ever tried to remove floor tile, you'd know why this is not recommended. Removing floor tile that's been in place for several years is rough and takes time—too much time.

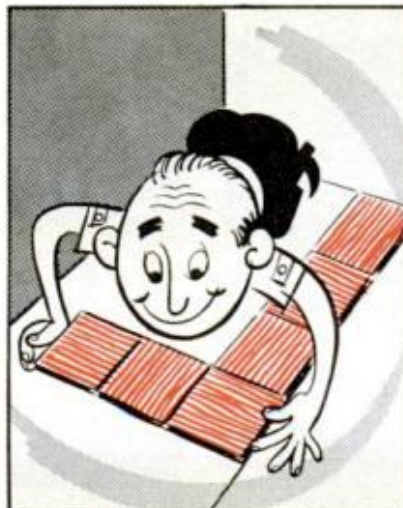
"A tiled area of 100 square feet," Whitt told us, "would take the average homeowner two days to clear—and that's not including the time it would take him to prepare the subfloor and lay the new tile. The old tile has to be heated and then scraped, and there's danger that you could damage the subfloor."

THE BEST WAY TO FIND WHERE TO START

STEP 1: Find the center of both end walls and mark floor mid-point by snapping chalk line between marks

STEP 2: Before spreading adhesive, lay two perpendicular rows of tile to determine how they will fit

STEP 3: Measure distance from last tile to wall. Space must be no less than 2 in., no more than 8 in.



"By using the underlayment method, though, a man can completely retiling the floor in from 6 to 8 hours—and it's a whale of a lot easier."

Marking Off the Floor. First, estimate how much tile you'll need. To make things easier, measure the square footage of the room. Then consult the chart on page 137.

Here's an example of how to use the chart. Suppose your room size is 253 square feet and you plan to use 9 x 9-in. tile. First find the number of tiles needed for 200 square feet (356 tile); then the number needed for 50 square feet (89 tile); then the number needed for 3 square feet (6 tile). The total is 451 tile.

But you must allow for waste—in this case, 7 percent. Thus, 7 percent of 451 is 32 extra tile. In other words, you need a total of 483 tile to do the room.

Tile is generally boxed 80 to a carton. Most floor tile dealers will split a carton for you, but buy a few extra anyway in case you have to replace a tile or two in the future.

To mark the floor, measure off the center point of the room's opposing end walls.

Hammer in a tack at the center point at one end of the room and tie a string to it that's been rubbed in chalk. Line the string up with the other center mark and snap a chalk line between marks (step 1, page 138). This is the line on which the initial row of tile will be laid. After the chalk line is made, remove the string and pull out the nail.

Lay down two test rows of tile perpendicular to each other starting from the center of the room, using the chalk line as a guide (step 2). Measure the distance between the wall and the last tile to it (step 3). This distance should not be less than 2 in. or more than 8 in. If it is either, readjust the center line parallel to the wall so the last tile is about 4½ in. from the wall. The idea is to avoid having a strip of tile less than 2 in. wide along the walls at either side.

Laying the Tile. Pick up the test tile and pour some adhesive on the floor—enough to spread over half the room.

I recommend using the clear adhesive where possible since you can see the center line through it when it has set enough to lay the tile. Whichever adhesive you use, however, note on the label whether it is combustible or not, and take the necessary precautions dictated by common sense—putting out pilot lights, not smoking while you work, etc.

It matters little whether you trowel, brush or roll the adhesive on. The key word is **THIN**. Use the adhesive sparingly to avoid excess from coming up through

(Please turn to page 196)



A. APPLY MASTIC over about half the floor. Be careful to spread it as thinly as possible, to minimize the possibility of adhesive coming up between the tile

B. WORK FROM CENTER of room laying first row of tile along the center line, which remains visible through clear adhesive. Pyramid tile for even seams



C. MARK BORDER TILE for cutting by laying a tile on last full row. Lay a second tile over it, butted against wall; mark first tile using second as straight edge





PIGGY BANK

SQUEALS ON THIEF

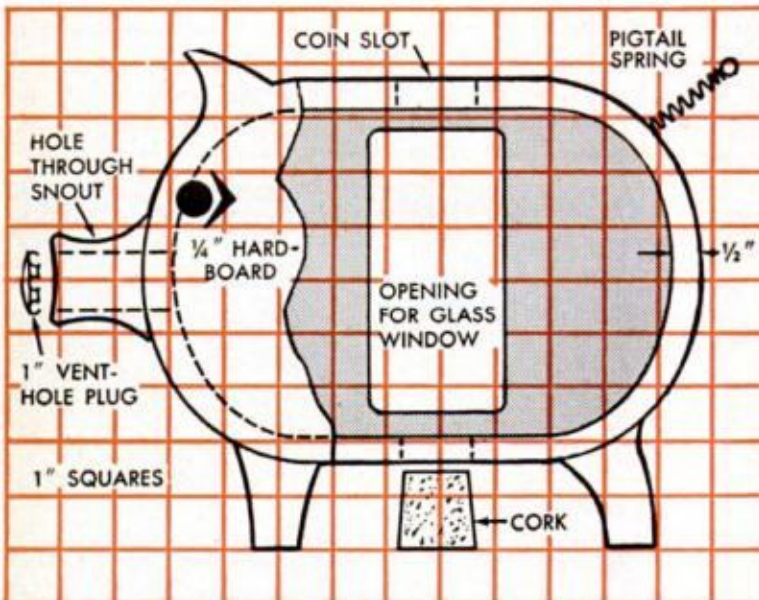
TRY to filch a coin or bill from Mrs. Tattletale and you'll be greeted with a loud squeal of protest. Her guarding voice is a buzzer which sounds off when tiny mercury switches, tucked inside her body, are tilted the least bit. Even picking her up will scare off would-be "borrowers" which will lessen the temptation to dip into a vacation kitty.

The buzzer, which should be 1½-volt, and no more than 2 in. in diameter, was taken from a bicycle horn. Power is from two 1½-volt penlight dry cells. Note that the dry cells are connected in series, and that the bottom one stands in a hole in the cork, which also plugs the bank's access hole. A 1-in. pipe clamp under the coin slot protects the batteries from being damaged by falling quarters and half-dollars.

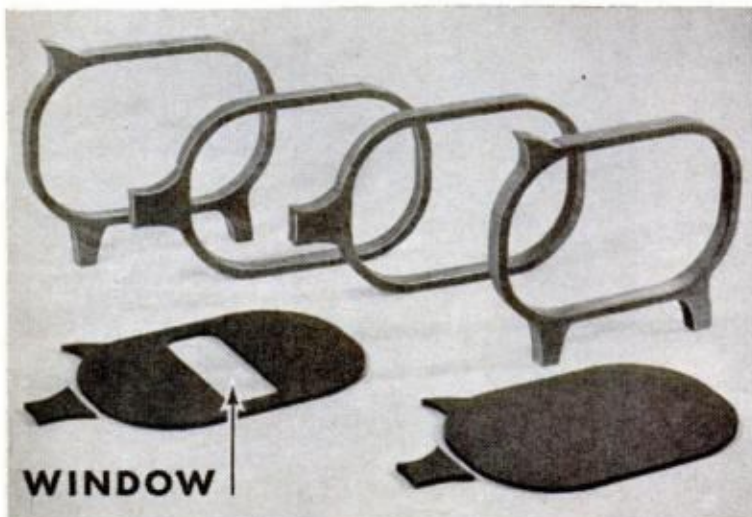
The three mercury switches are glued in "down-hill" grooves filed in the sides of a ¾-in. thick triangular wood block, 1½-in. long. To make the switches as sensitive as possible, find out by trial-and-error how close to horizontal the switches can be installed without activating the buzzer. The more gradual the incline of the switches, the more quickly they'll respond to movement. The switch block, and the buzzer, are cemented in place with epoxy.

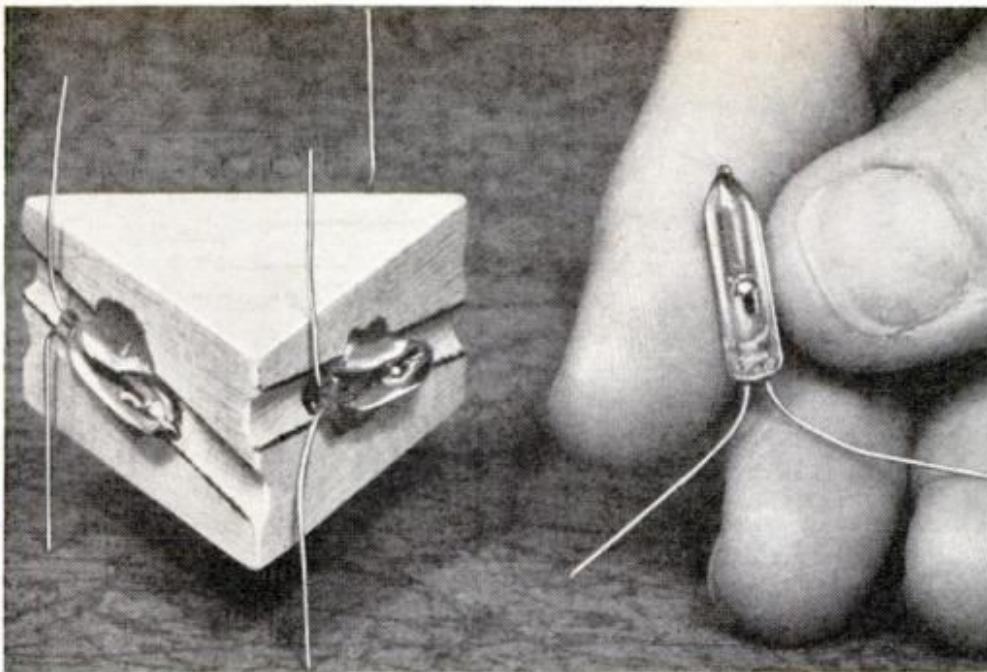
Wire the circuit according to the diagram on the opposite page. After testing, cover the buzzer and switches with heavy mastic to prevent the coins from shorting the circuit. Make sure the mastic is the type that dries; some kinds remain tacky. The cork holding the dry cells is cemented in place last, after final sanding and painting. To empty the bank (months later), just break out the cork. You can replace it with a new one when you start the next fund.

—Tommy Thomas



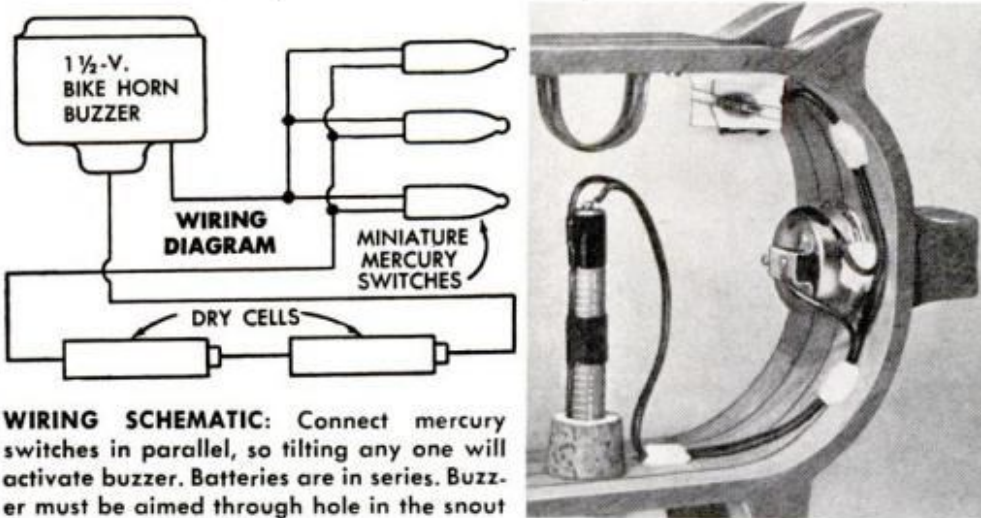
THE PIG consists of four rings cut from ¼-in. wood and glued together like a sandwich. Note that the two outer rings are provided with feet. Sides of the body are cut from ¼-in. hardboard or plywood, the snout being cut separately. The optional window is held in place with contact cement. Drill the hole for the cork and the one through the snout after the rings are glued together. A vent-hole plug is inserted in the snout





SEE REVERSE

MOUNT MERCURY SWITCHES with epoxy, making sure the longer of the wires inside each switch is on top. Cement block inside body with one of the switches forward

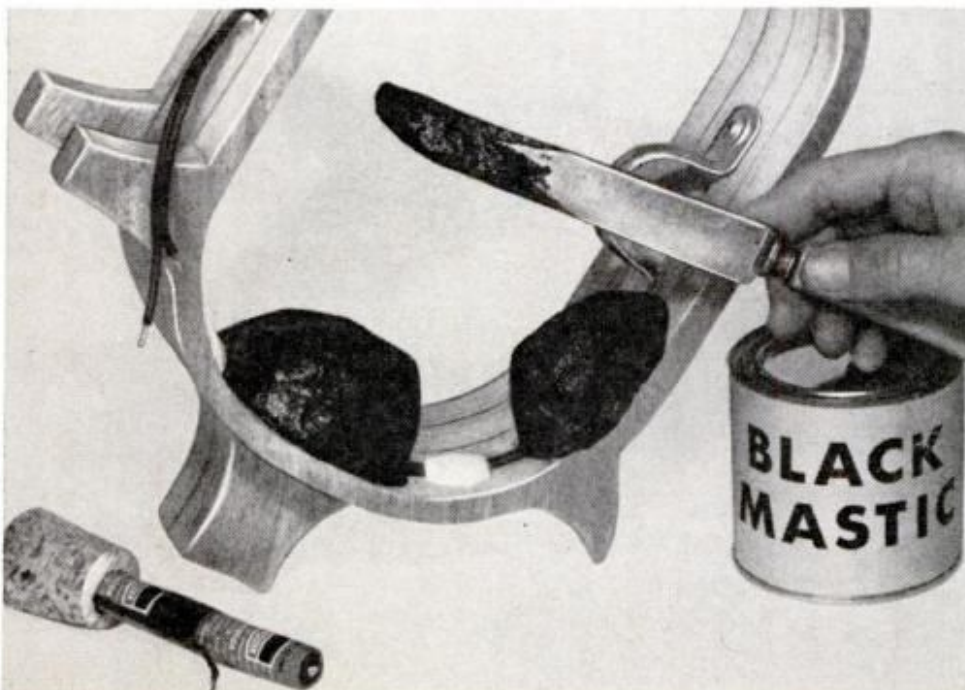


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WIRING SCHEMATIC: Connect mercury switches in parallel, so tilting any one will activate buzzer. Batteries are in series. Buzzer must be aimed through hole in the snout

HEAVY BLACK MASTIC or roofing cement prevents coins from shorting circuit or damaging the buzzer and switches. Connecting wires are tacked to body with epoxy

FOR CLIP-OUT



PROJECT-A-PLANS

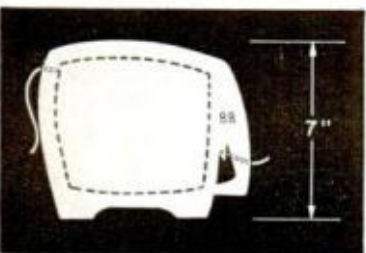
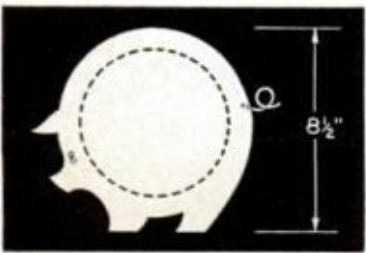
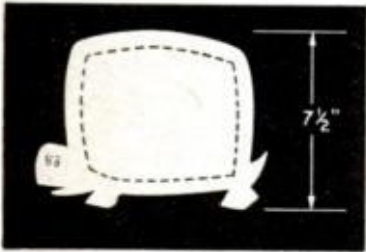
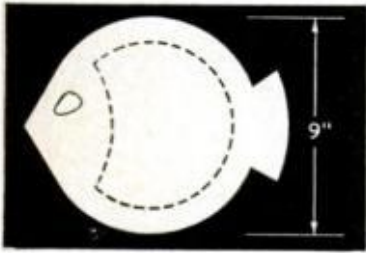
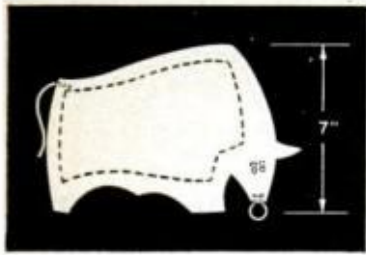
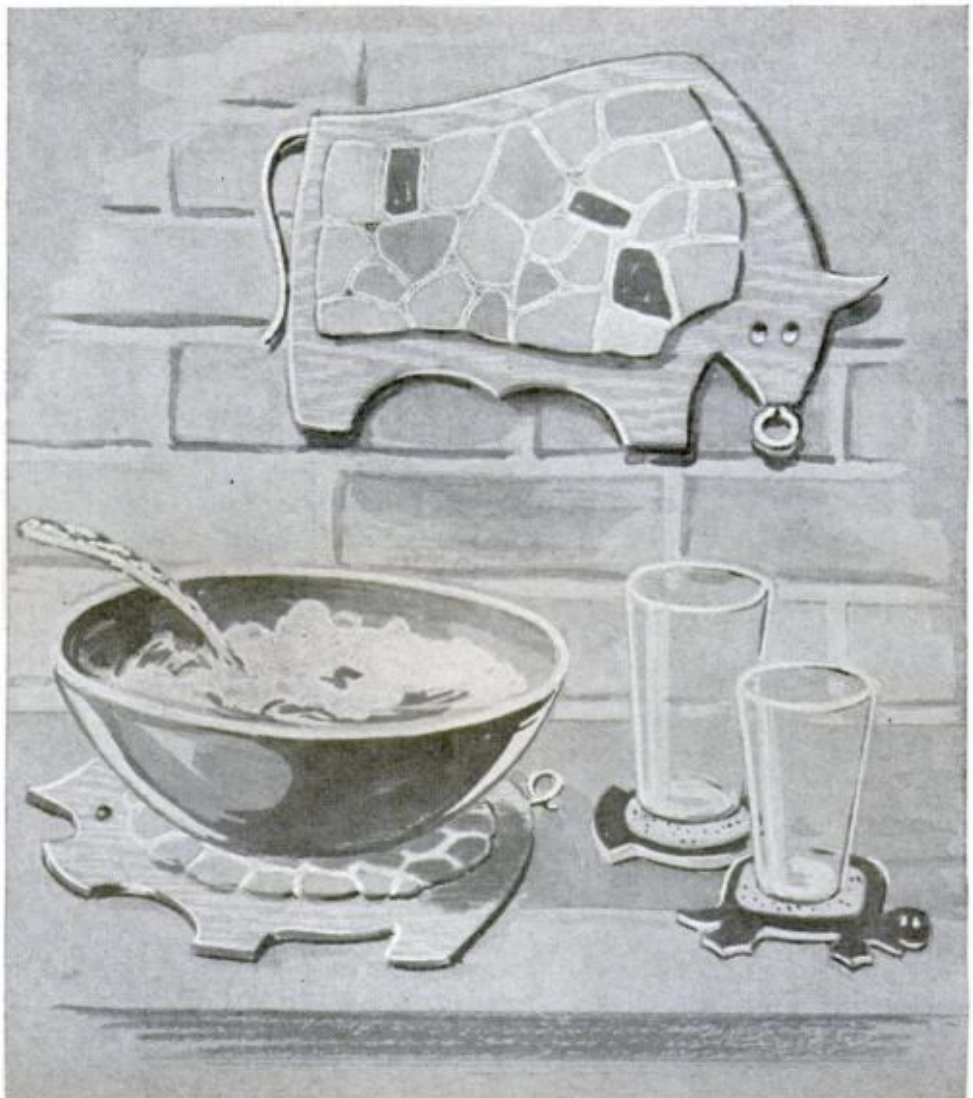
Gifts You Can

By David M. Swartwout

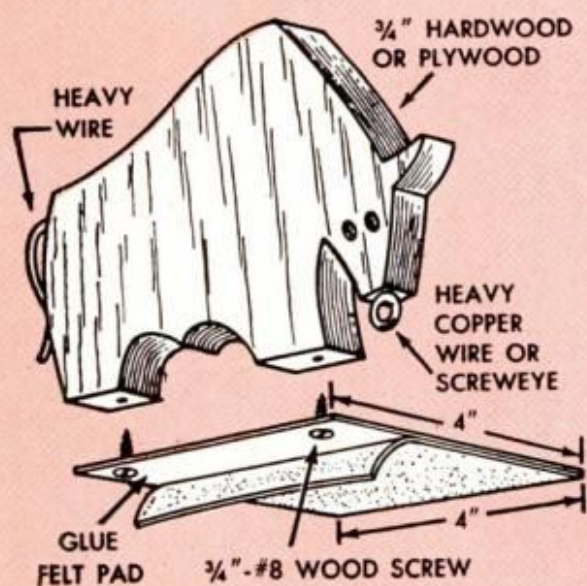
BELIEVE IT OR NOT, from the five Project-a-Plan patterns shown at the left, you can come up with at least 30 different gift ideas, including coasters, trivets, wall plaques, cutting boards, books ends and pin-up boards. Actually, from these five basic designs, project possibilities are endless and you'll find many other places where these clever patterns can be used for decoration and useful novelties.

The Project-a-Plan system makes pattern enlarging easy. Just tape a sheet of paper to the wall, then set up the projector a short distance away and focus it on the paper. Measure the projected image to make sure that it's the size you want for the project of your choice. If not, move the projector to change the image size. The pattern may then be outlined on paper and transferred to the wood with carbon paper. The chart on page 144 gives suggested sizes, though you may prefer to vary them.

THE CLIP-OUT Project-a-Plan transparencies at the left make it a snap to enlarge the patterns to the size you want. They're designed to slip in a standard slide mount for projecting full size with any 35mm slide projector. Coating the paper with vegetable oil will make it more transparent, for a brighter projected image. The height dimensions shown apply only for use as trivets

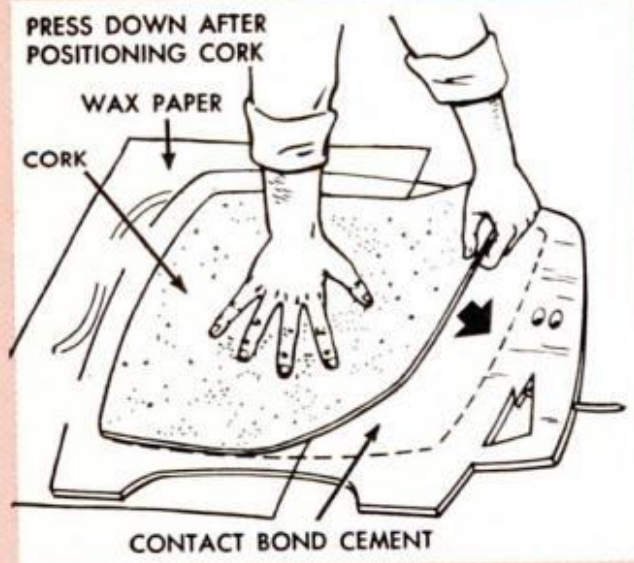


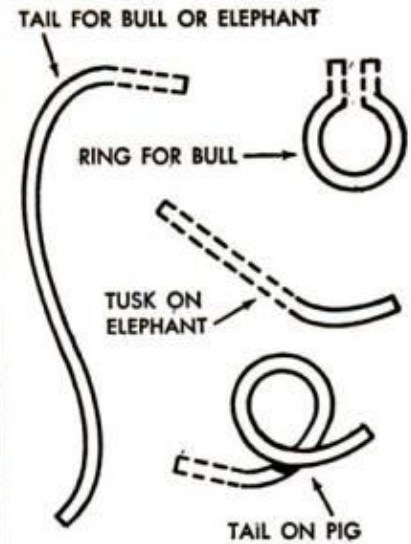
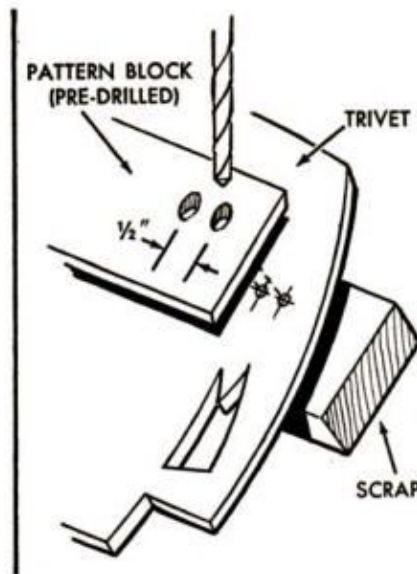
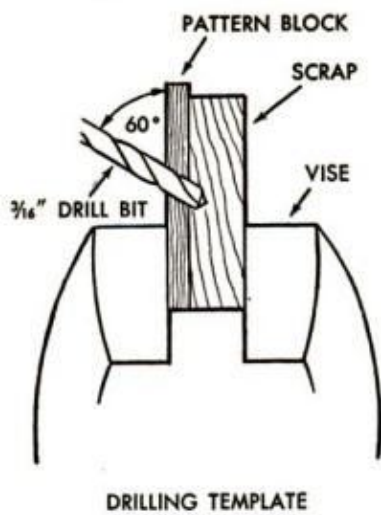
Make for Christmas



BULL BOOK END is a handsome addition to a boy's room. Or make a set to match whatever design you pick for the bulletin board. The square sheet-metal base should be felt padded to prevent marring furniture

CONTACT CEMENTING the bulletin-board cork calls for a special technique. First, coat both surfaces with cement and allow them to dry. Then lay a sheet of wax paper over most of the bonding surface. Position the cork, press down as you withdraw paper





For trivets, coasters and wall plaques $\frac{1}{4}$ -in. hardwood plywood is best. The pin-up boards require $\frac{3}{8}$ -in. plywood and the cutting boards should be made from 1-in. solid stock, preferably maple or other hardwood. The thinner stock can be cut to shape with a jigsaw or even a coping saw; the heavier material used for the cutting board and book ends can be handled best on a bandsaw. After cutting, the edges should be sanded and the top surface outlined for the placement of tile, cork or linoleum.

Copper wire is used for the trimmings, such as the bull's tail and the elephant's tusks. An extra inch should be allowed so that the wire can be firmly inserted in a hole drilled in the edge of the cutout. The drawings at the top of the page will guide you in bending the wire and drilling the

holes for the eyes, which have an especially realistic appearance when angledrilled with the pattern block.

Tile, base glue and grout are standard items at most hobby shops. Sheet cork may be obtained at many auto supply and department stores. Very small tile should be used for the coasters, or if you prefer, a disc of $\frac{1}{16}$ -in. cork may be used instead. Center panels for the pin-up boards can be made from insulating cork or linoleum.

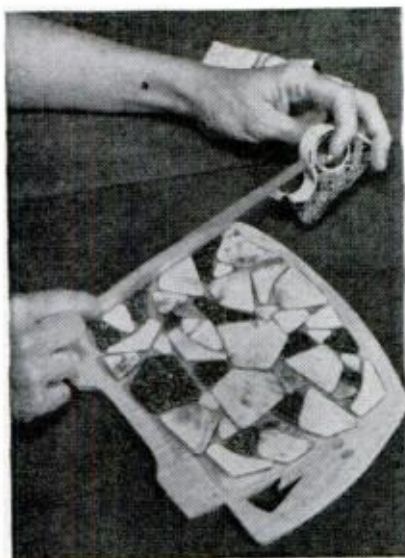
A natural finish with either varnish or shellac is attractive, or the wood may be stained and when dry, rubbed with paste wax. To avoid possible contamination of food, the cutting board should not be finished with any sort of paint or stain. If a finish is wanted, rub the smooth-sanded face with vegetable oil, and clean after each use with a damp cloth. ★ ★ ★

SUGGESTED SIZES FOR VARIOUS USES

	Fish	Bull	Turtle	Elephant	Pig
Coaster	3"	3½"	3½"	3"	3"
Trivet	9"	7"	7½"	7"	8½"
Wall Plaque	9"-12"	9"-14"	9"-14"	9"-14"	12"
Cutting Board	10"	10"	10"	10"	10"
Pin Up Board	18"	16"	18"	18"	18"
Book Ends	5"	5"	5"	5"	5"



FIRST STEP when working with mosaic tile is to find the most pleasing arrangement of pattern and color. Special attention should be given to each border tile to make certain that it fits neatly inside the lightly penciled dotted line



CELLULOSE TAPE or masking tape applied in a criss-cross pattern will keep tiles from shifting while glue is applied to the back. Leave the tape in place for at least 24 hours to give base glue plenty of time to dry thoroughly

AFTER TAPING tiles together invert the assembly and apply a quick-setting base glue to the underside. Then lift the board and press it down onto the glued tile. Flip unit face up between palms



DECEMBER 1964



ANY OF THE FIVE animal cutouts lend themselves to novel tile-covered trivets, the turtle being particularly appropriate. The five simple steps for applying the mosaic tile to the plywood cutout within a border outline are shown at left and below

WHEN GLUE has dried, remove tape and apply liberal coat of grout. The mixture should be about as thick as toothpaste. Work the grout into all cracks, then squeegee excess off surface of tile

LET GROUT SET about 30 minutes then wipe the surface with a damp rag to remove any bits of grout that may remain on the tile. When the grout is completely dry, polish carefully with a clean, soft cloth



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HI-LO TABLE



By Steve Ellingson



**Faced with a space problem?
Here's a table that plays two
roles to relieve a crowded room**

THE APARTMENT DWELLER or small home owner can't stretch his under-sized rooms. But he can make the most of his available space by choosing dual-purpose furniture such as this combination dining and cocktail table. The secret behind its double life is a unique leg design that permits instant adjustment of height.

Building the table isn't difficult, but if your toolkit is limited or if you have no convenient place to work, you may find it best to lay out the work on a sheet of hardwood veneer plywood and have the lumber yard or a cabinet shop do the cutting for you. In most cases only a nominal charge will be made for such work.

For strength, all joints are glued and nailed. Care in setting the nailheads and in filling holes with a matching wood putty will pay dividends when the table

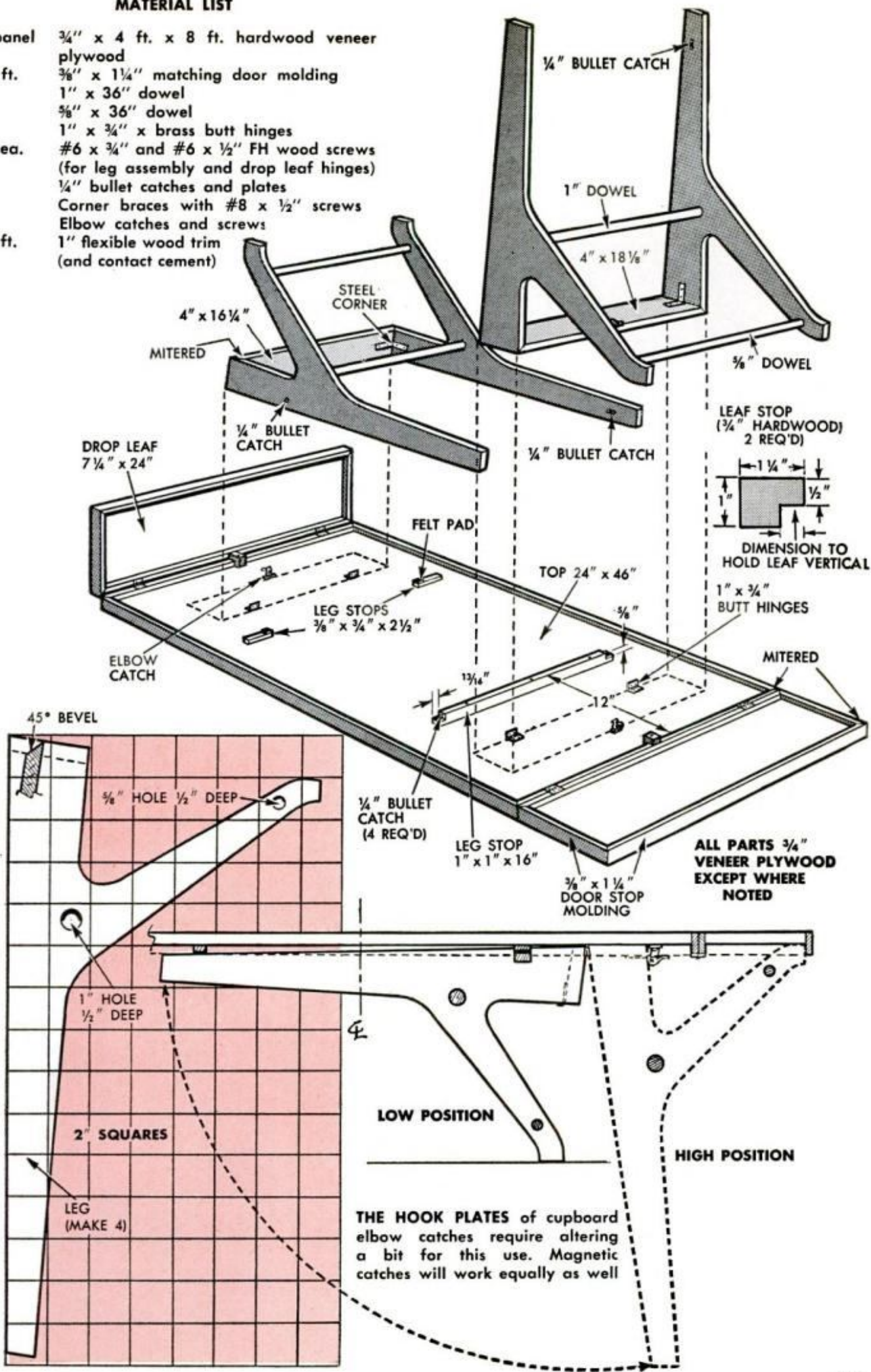
is completed. A roll of matching wood tape conceals the exposed plywood edges.

To correctly locate the first set of bullet catches in the 16-in. leg stop and in the narrow (16 $\frac{1}{4}$ -in.) leg assembly, start by placing the bullet part of the catches in the ends of the 16-in. stop. Next, fasten the strike plates to the inside of the legs to engage the bullets. The bullets of the second set are positioned on the outside of the narrow leg assembly directly above the 2 $\frac{1}{2}$ -in. leg stops. The strike plates are placed on the inside of the wide (18 $\frac{1}{8}$ -in.) leg assembly.

If you prefer to work from a large plan which includes an actual size leg pattern ready for tracing, send \$1.00 to Steve Ellingson, Popular Mechanics Pattern Dept., Box 2383 Van Nuys, Calif. and ask for plan #314.

MATERIAL LIST

- 1 panel $\frac{3}{4}$ " x 4 ft. x 8 ft. hardwood veneer plywood
- 24 ft. $\frac{3}{8}$ " x $1\frac{1}{4}$ " matching door molding
- 1 1" x 36" dowel
- 1 $\frac{5}{8}$ " x 36" dowel
- 8 1" x $\frac{3}{4}$ " x brass butt hinges
- 16 ea. #6 x $\frac{3}{4}$ " and #6 x $\frac{1}{2}$ " FH wood screws (for leg assembly and drop leaf hinges)
- 4 $\frac{1}{4}$ " bullet catches and plates
- 4 Corner braces with #8 x $\frac{1}{2}$ " screws
- 2 Elbow catches and screws
- 40 ft. 1" flexible wood trim (and contact cement)



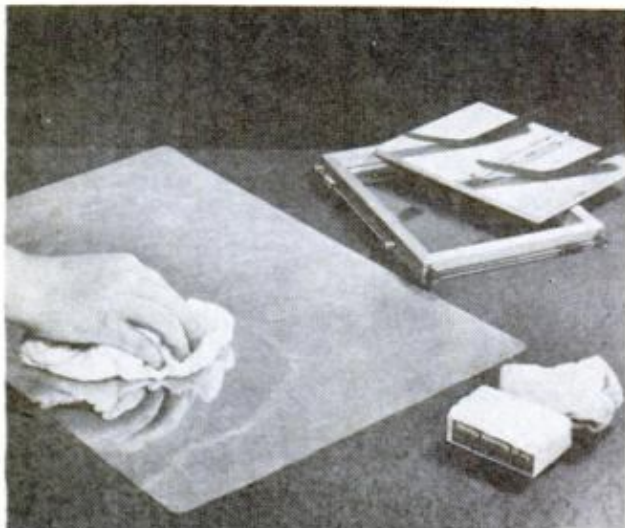
New for Camera Buffs



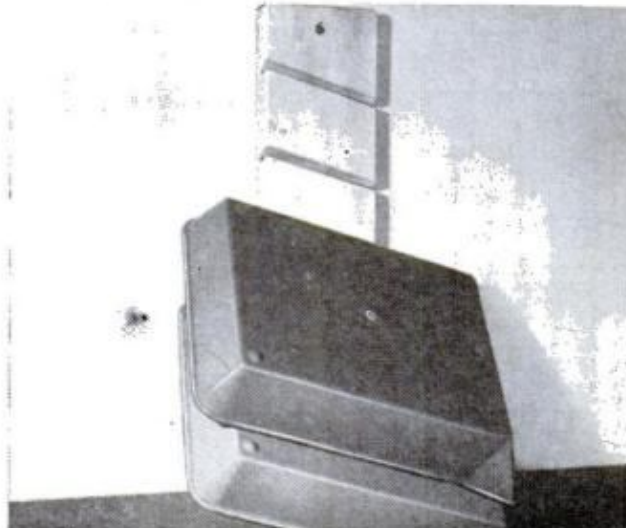
600-MM F:8 TELEPHOTO LENS sells for only \$129.85. Focuses from 33 ft. to infinity, and is said to have a resolving power of 200 lines per millimeter. For 35-mm single-lens reflexes. Equipped with a tripod socket at its center of gravity. Considering the low price, we were very impressed with the sharpness of black-and-white shots made with this lens. Sterling-Howard, Box 236 South Sta., Yonkers, N.Y.

DARKROOM HINTS

CLEAN YOUR FERROTYPE TINS with non-scratching cake-type kitchen cleanser. Apply the cleanser gently with a damp cloth, then buff with a clean, dry cloth. Finally, rinse the tins thoroughly with hot water and stand them on edge to dry. This method is also effective on the glass from contact printing frames



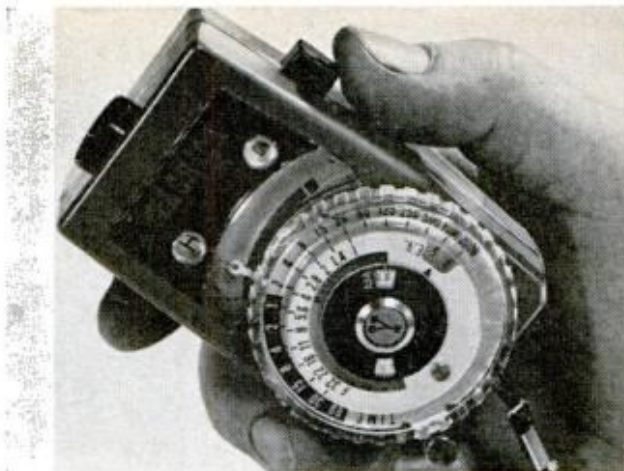
SPACE-SAVING TRAY RACK: Conventional racks for drying darkroom trays are effective, but take up a lot of room under your table. If your darkroom is a bit cramped, make a tray rack by cutting grooves at a compound angle into a block of wood measuring $1\frac{1}{2} \times 4 \times 18$ in. The dimensions and spacing of the grooves will depend on the size of your trays. To use, mount the block over your sink and hang the trays by hooking one edge of each tray into a groove



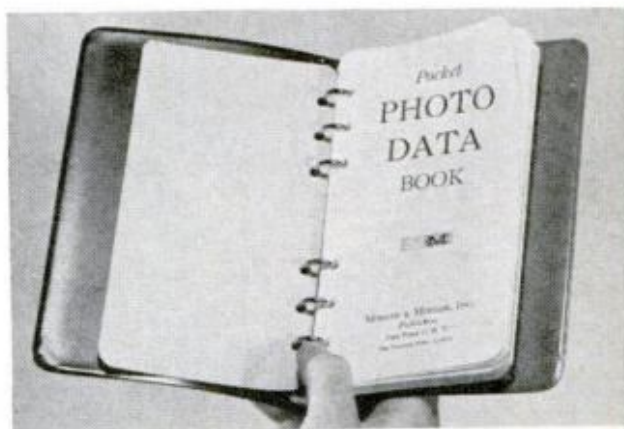
YEM-55 EXPOSURE METER uses a highly sensitive CdS cell. Clearly printed scales read from ASA 3 to 12,000 at exposures of 60 sec. to 1/2000, and apertures of F:1 to F:32. On-off switch minimizes battery drain. We tried this meter and found it rivals others costing almost twice as much. Retail for under \$25, with mercury battery, cord and leather case. Yashica, 50-17 Queens Blvd., Woodside 77, N.Y.



LATEST EDITION of "Pocket Photo Data Book" contains 160 pages of valuable information, such as exposure indexes for current foreign and domestic films, flash and flood guide numbers and depth-of-field scales. Also gives formulas and instructions for 25 negative developers, 29 paper developers, 10 fixing baths, 9 replenishers, 6 stop baths, 27 paper toners. The loose-leaf volume sells for \$3.95. From Morgan & Morgan, Inc. 101 Park Ave., New York 17, N.Y.

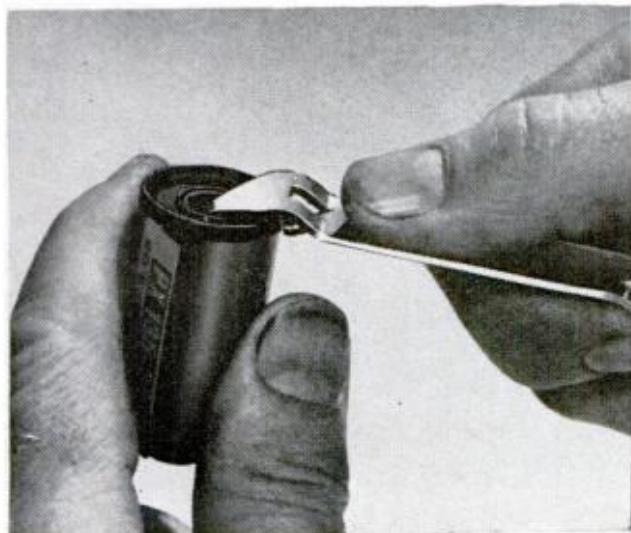


TAKE A PICTURE A SECOND with the Instamatic 150, motorized camera that employs the drop-in, cartridge system of loading. After loading the camera, you wind the spring-drive motor. As you take each shot, the motor advances the film, then winds off film after the last shot. About \$29.95, including film, flash bulbs, batteries and compact carrying case. Eastman Kodak, 343 State Street, Rochester 4, N.Y.



FAST, EASY CARTRIDGE OPENER: When opening a 35-mm cartridge, pry off one flange with a can opener. With the non-reloadable cartridges now used for many films, this method is much more effective than the usual technique of rapping one end of the cartridge on a table. With reloadable cartridges, you have to be careful not to bend the flange. But you'll find the opener prevents the flange from popping off onto the floor, to be lost or stepped on and ruined

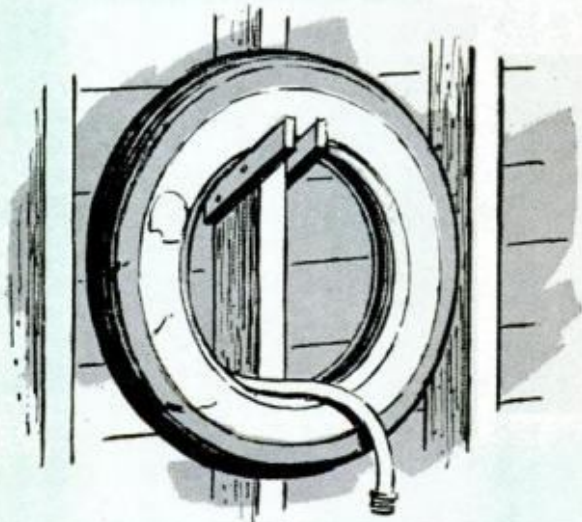
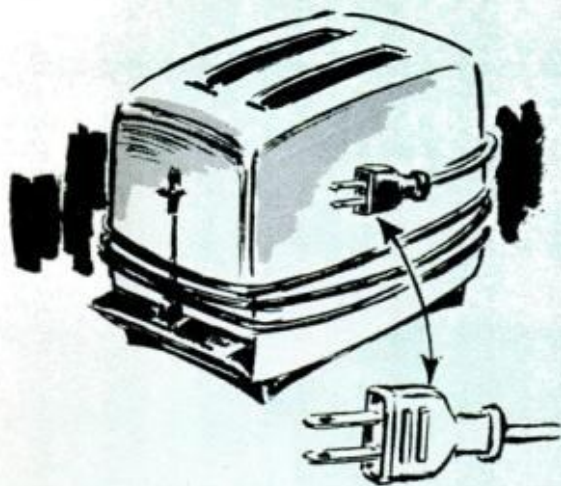
DUSTPROOF SQUEEGEE HOLDER: Even a squeegee that looks clean can harbor dust that will scratch your negatives severely. To avoid this, mount a jar upside-down on your darkroom wall. The spring action of the squeegee will hold it in the jar, keeping it safe from stray dust. On most walls, a good way to mount the jar would be with two loops of wire secured to the wall by drywall anchors or toggle bolts. Brick or block walls require masonry anchors





HOME PROBLEMS

APPLIANCE CORD is usually stored by coiling it around the appliance and twisting the plug under the last coil to hold it tight. An easier way is to cement a pair of magnets from a magnetic catch to the plug. These will hold it flat against metal



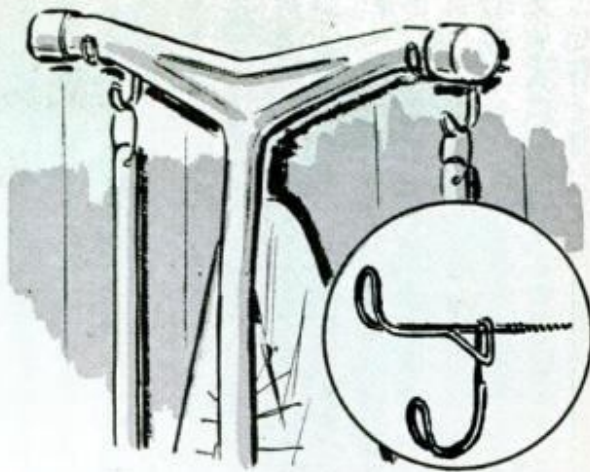
HOSE HOLDER that can be rolled easily from place to place is just an old tire casing. It's a real space-saver for off-season storage, since an 8:00 x 14 tire will hold as much as 75 ft. of hose. If you're cramped for storage space, give this idea a try

IF YOU BEND the handle of a medicine spoon so that it sits level, you'll be able to put the spoon down while you replace the stopper in the bottle or pick up the baby to give him his medicine. Keep this no-spill spoon in the medicine chest



SCRATCHING WALL for your cat will save the drapes and furniture. Just mount a piece of carpeting on the end of a kitchen counter and train the cat to restrict his scratching to that spot. Most cats will prefer this wall to a commercial scratching post

SIMPLEST METHOD of storing an ironing board is to hang it by the legs from a pair of wire coat hooks. Bend the upper part of each hook to prevent the board from slipping off. The two lower hooks come in handy for hanging brooms, mops, dust pans, etc.

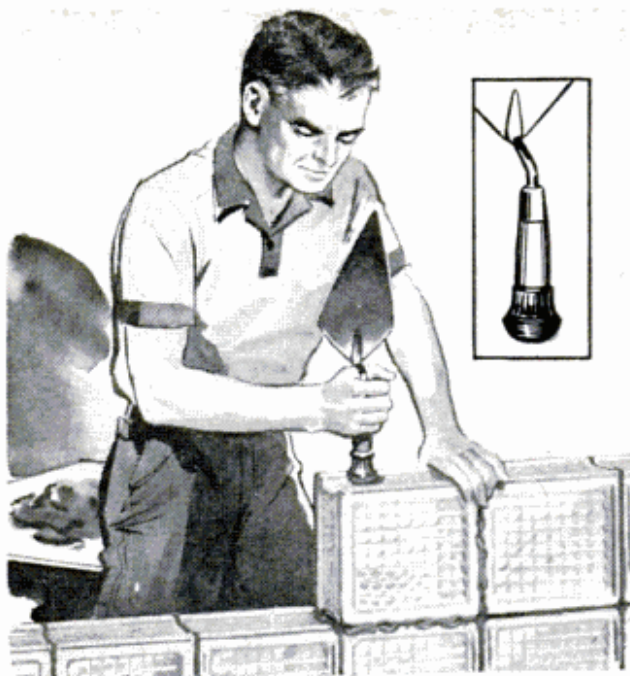


PREVENT PIRACY around your feeding station by hanging bells over the tray, as shown at left. Small birds will slip between the bells and feed undisturbed, but squirrels or large birds will hit the bells and be frightened off by the noise

WHEN YOU RUN OUT of vases for large flowers, you can make extra ones in a hurry by washing the labels off fruit juice cans and perforating the tops with a beer-can opener. To doll them up, give them a coat of quick-drying enamel or cover with wallpaper



SHAPING SHEATH for old brushes holds the bristles together and prevents them from splaying outward after cleaning. Make it by folding a sheet of stiff plastic to fit the brush and stapling side. place it on brush by slipping it down the handle



Crutch Tip Cushions Handle

When laying structural glass blocks, one mason found that with a rubber crutch tip on the end of his trowel handle he didn't have to be so careful in tamping the blocks in the mortar bed. Cushioned by the rubber tip, there no longer was the chance of chipping the glass as there was with the plain hardwood handle. In some cases, it may be necessary to trim down the end of the handle a bit so the crutch tip can be forced tightly over the end.

—Victor Lamoy

It's difficult to do a thorough cleaning job in most kitchens because the appliances are so close to one another that there's not enough room to reach between with a mop or vacuum cleaner. You'll find cleaning easier if you use a long handled auto windshield snow brush.

The paper-like bark of a dead birch tree is a perfect kindling for starting a campfire. It burns even when damp, making it possible to build a fire under adverse conditions. Bark should never be stripped from living trees.

After applying varnish remover and giving it time to work into the finish, sprinkle the surface with some fine sawdust. This will absorb the thick, gummy residue and greatly facilitate removal of the finish with a scraper or brush.

Safeguarding Your Home Against Moisture Damage

Much has been said and written about the moisture problem in homes of modern construction and of the damage it does during the colder months. But where does this moisture come from?

According to the Paint, Varnish and Lacquer Mfgs. Asso. each member of the family contributes about 2 oz. of water vapor per hour to the moisture in your home merely by perspiring and breathing normally. When you shower-bathe in water warmed to average shower temperature you add nearly a half pound of vapor. The average tub bath contributes somewhat less. Washing the tableware and utensils used in preparing and serving three average meals can raise the vapor content of the air by as much as a half pound. Cooking the three meals can add as much as five pounds when gas is used as fuel. Laundering for a family of four or five can add another five pounds or so, much, much more if you dry the laundry with an unvented automatic dryer. There are, of course, other sources, such as the moisture from a damp unvented crawl space and unvented heaters that burn concentrated fuels. But it is those sources enumerated that usually produce the greatest concentrations of water vapor in homes tightly constructed and insulated without proper moisture barriers. Of course, much of the moisture produced

dissipates slowly by various escape routes to the drier air outside without appreciably damaging the structure. But the vapor can penetrate most common building materials and wherever and whenever it becomes entrapped in walls and ceilings, when cooled to the dew (condensation) point it can cause quite rapid deterioration of building materials and blistering and peeling of protective paint applied to wood siding.

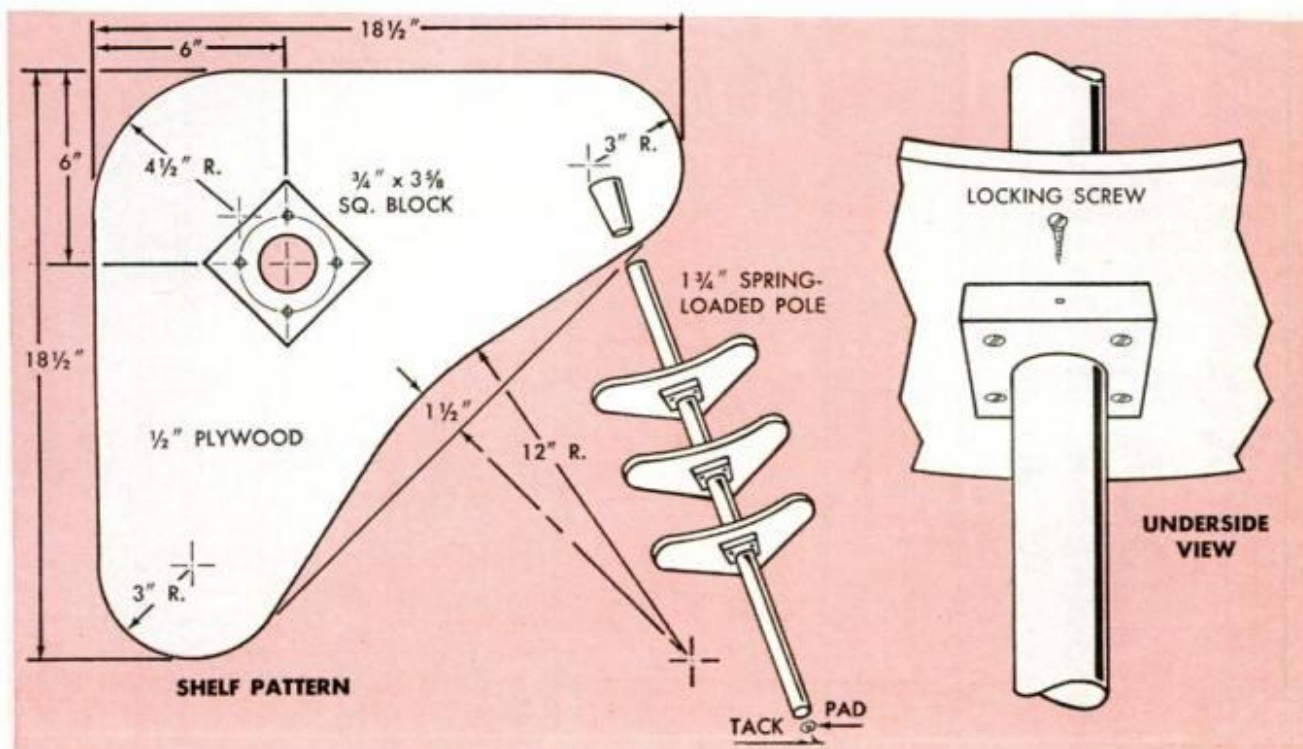
Yet even in homes that are constructed without the usual safeguards against moisture damage, there are several simple steps that can be taken to prevent, or at least minimize, the possibility of damage. Merely closing the bathroom door and opening a window will dissipate excess water vapor resulting from tub bathing or showering. You can do the same in a kitchen or you can install a ventilating fan and operate it during or after the preparation of meals. Opening a window in the laundry room will lower the vapor content of the air resulting from laundering. Painting the room side of all outside walls with two coats of an oil-base enamel will serve as a fairly effective vapor barrier. You can, of course, paint or apply wallpaper over the enamel. You can reduce the output of your furnace humidifier or shut it off for certain periods. Any unvented gas or oil heater should be properly vented to the outside.

PLANT TIER

BRIGHTEN a corner where you are with a pole tier of colorful plants. By supporting the shelves on a single free-standing pole wedged between floor and ceiling, you can place plants in a sunny corner of a porch or a bare corner of living room.

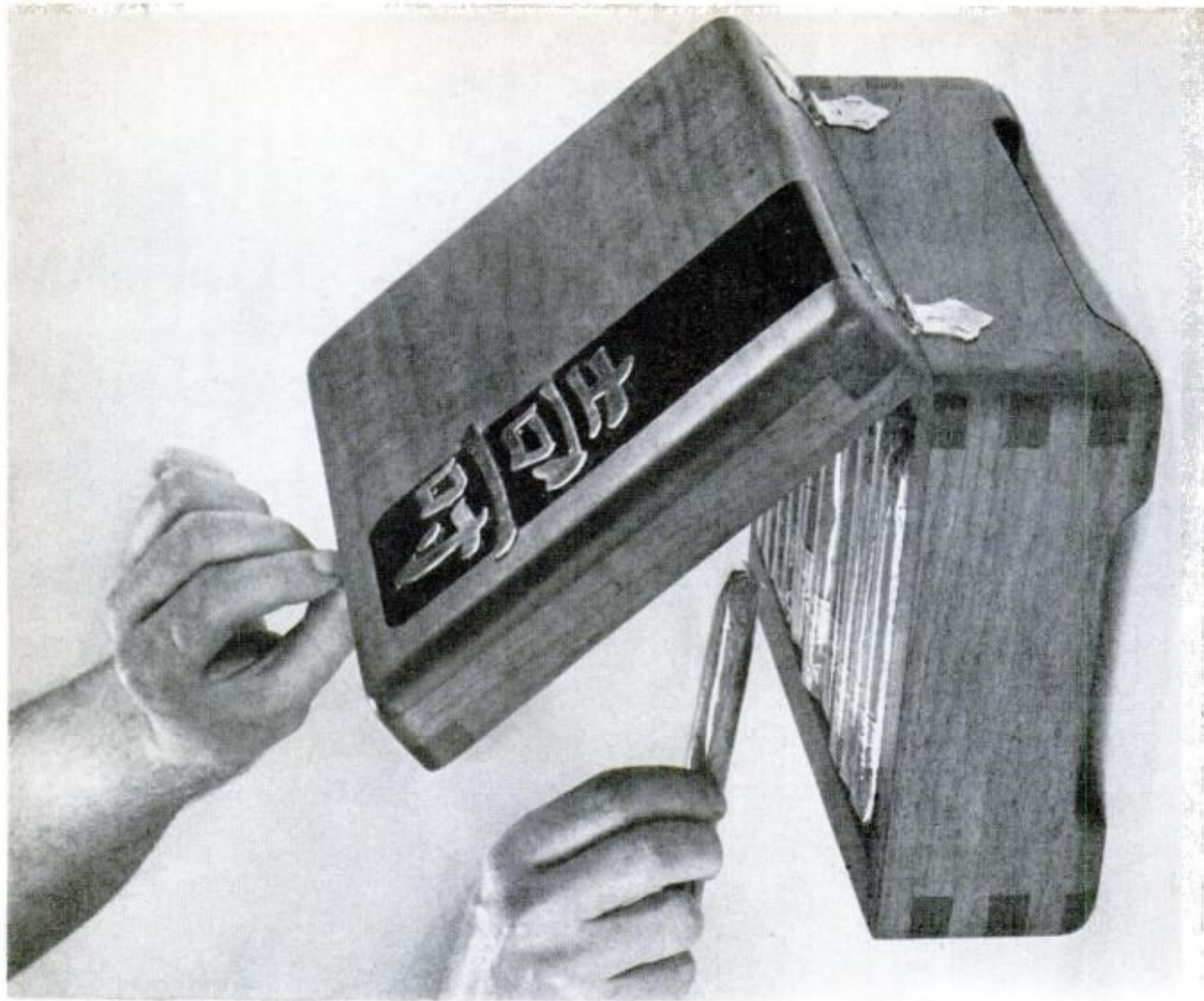
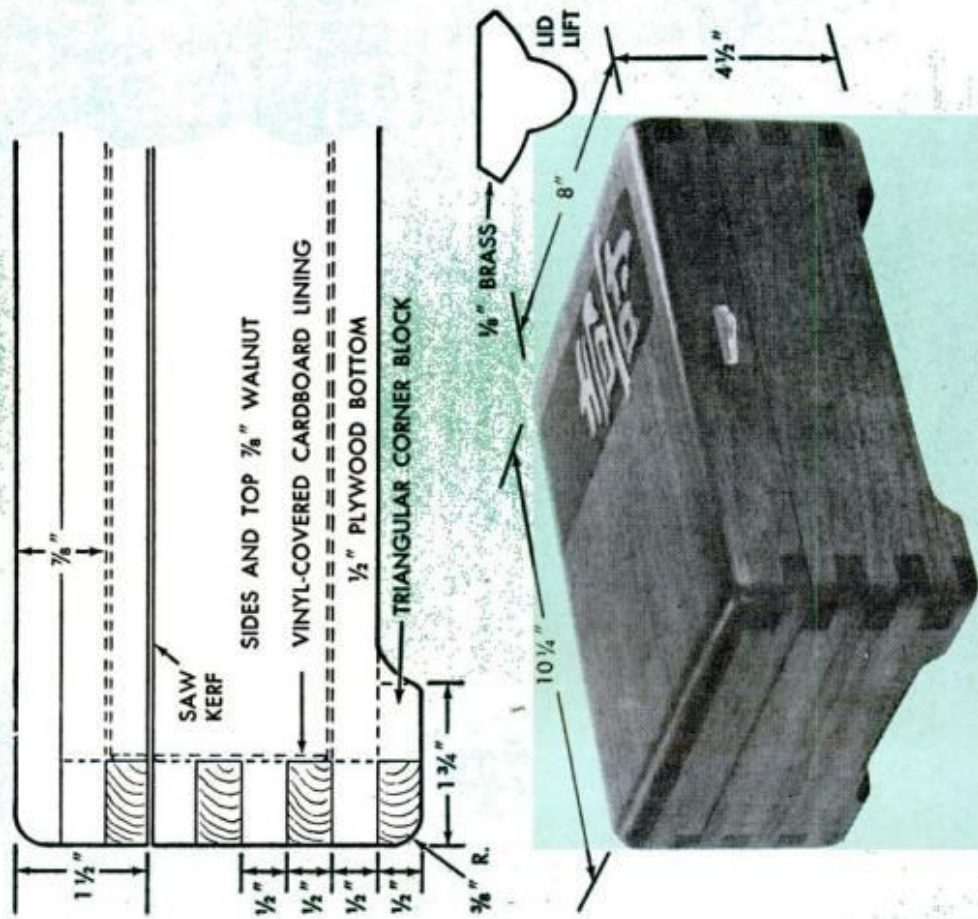
For my pole I used a unit called Timber Topper. This is a 1 $\frac{5}{8}$ -in. wooden pole which has a spring-loaded top to bear against the ceiling. You'll need to cut off the pole itself 3 in. short of your floor-to-ceiling height. I fitted the pole with three shelves, but more can be added.

If you nest the shelf patterns, three can be cut from a 2 x 4-ft. sheet of plywood with a minimum of waste. Each shelf is attached to the pole by a 2 $\frac{1}{4}$ -in. locking screw which is driven through the edge of a square block fastened to the underside of the shelf. To bore the large hole through both shelf and block you'll need a hole saw or a fly cutter. Both of these tools work best in a drill press—particularly the fly cutter—but you can use a hole saw in a portable electric drill. Note that the hole should be made slightly larger (1 $\frac{3}{4}$ -in.) than the diameter of the pole so the shelves will slide in place freely. To wedge the pole against the ceiling, first tack the soft pad that comes with it to the bottom, slip the spring-loaded top onto the pole, and push it in place so it's straight up and down. If your hardware or lumber dealer don't stock spring loaded poles, you can order one from the Brewster Corp., Old Lyme, Conn. for \$2.28.—*L. D. LaBarge*



HAVE A CIGAR FROM THIS HUMIDOR BEAUTY

By John Burroughs



YOUR SMOKING PLEASURE takes on an extra puff of elegance when you reach for your favorite cigar from this humidor beauty. Made of rich walnut or mahogany, hand-rubbed to a fine finish, and topped off with a polished brass ideograph, it's stunning enough to grace the finest coffee table and please the most discriminating smoker. As a gift it's doubly appropriate, since the oriental character on the lid wishes the recipient "long life."

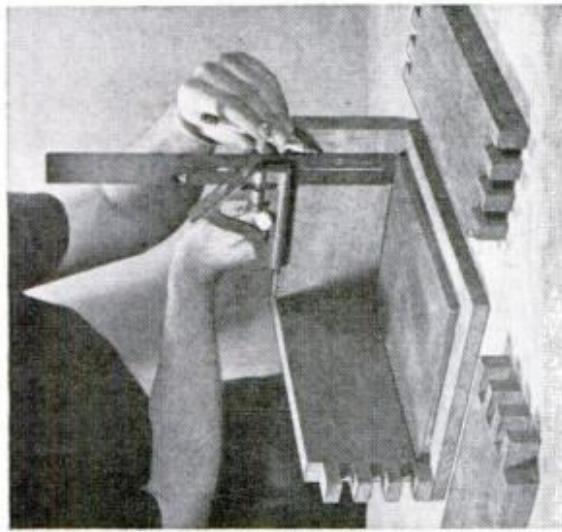
Cut the top and sides of the humidor from thoroughly seasoned $\frac{7}{8}$ -in. stock. The dimensions shown are for 6-in. cigars. For longer or shorter smokes, vary the front-to-back dimension.

To make sure the lid fits neatly and accurately, assemble the humidor as a bottomless box and saw the lid free with a table saw. Start by rabbeting all four edges of the top piece to take the side members. Then cut the corner finger joints with a backsaw or fine-toothed blade on a table saw. To assure accuracy, lay out the fingers with a steel rule and scribe the lines with a sharp penknife.

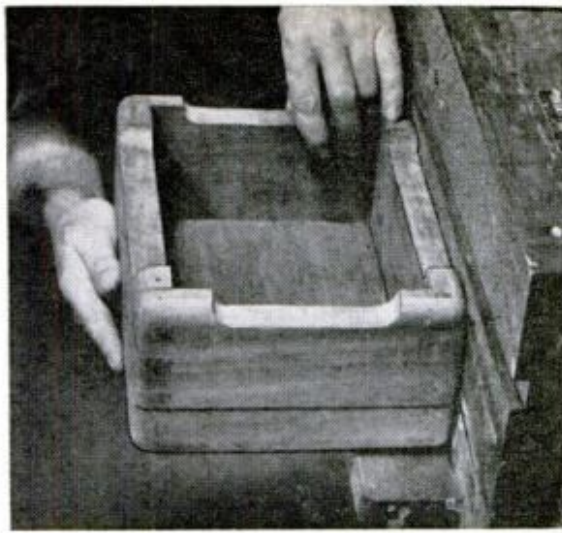
Assemble the top and sides with white glue. After the glue dries, round the corners and top edges to a $\frac{3}{8}$ -in. radius, sand the entire box smooth, then cut the lid off. Next, sand the lid and box glass-smooth with progressively finer grades of garnet paper and finish with spar varnish or a low-luster urethane.

Now attach the lid by means of solid brass hinges, and inset the $\frac{1}{2}$ -in. plywood bottom, which is supported by small triangular corner blocks of walnut glued inside the legs. Jigsaw the ideograph for the lid from heavy sheet brass, using the character printed in color as a full-scale pattern. File the lid handle from $\frac{1}{8}$ -in. brass. After polishing, coat both brass pieces with clear lacquer and epoxy in place.

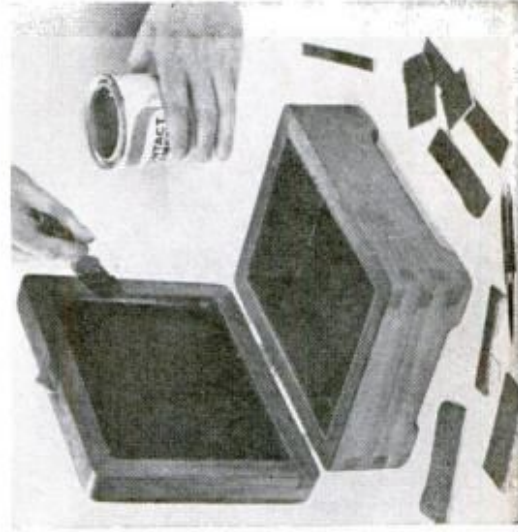
Finally, line the box with black leather-grained vinyl upholstery fabric cemented to light cardboard, and give the hardwood several coats of paste wax.



FOR PERFECT JOINT at last corner, match depth of handcut notches to rabbet on lid



TO CUT LID from the assembled humidor, use a fine-toothed blade and feed slowly



BLACK VINYL lining, put in with contact cement, helps prolong freshness of the cigars



BLACK BACKGROUND of high-gloss enamel accents decorative oriental character on lid

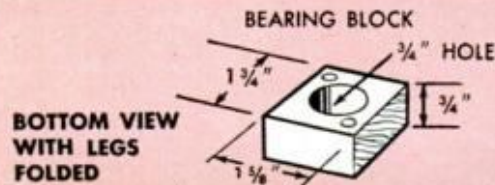
FOLDING LECTERN

IT NEVER SEEMED TO FAIL. Every time a club asked me to give a talk, the meeting was held in a restaurant or hall that had no lectern. This can be disconcerting to anyone with a written speech, since it means either juggling a handful of pages or hunching over a low table to search for one's place. Now I take my own lectern along. It's as easy to carry as a briefcase, and can be set up in seconds on any table or desk.

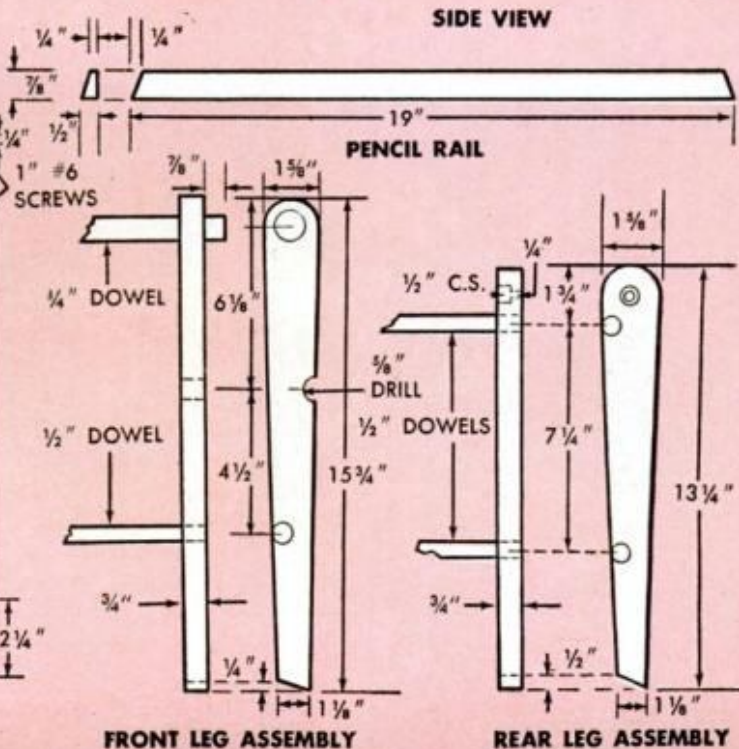
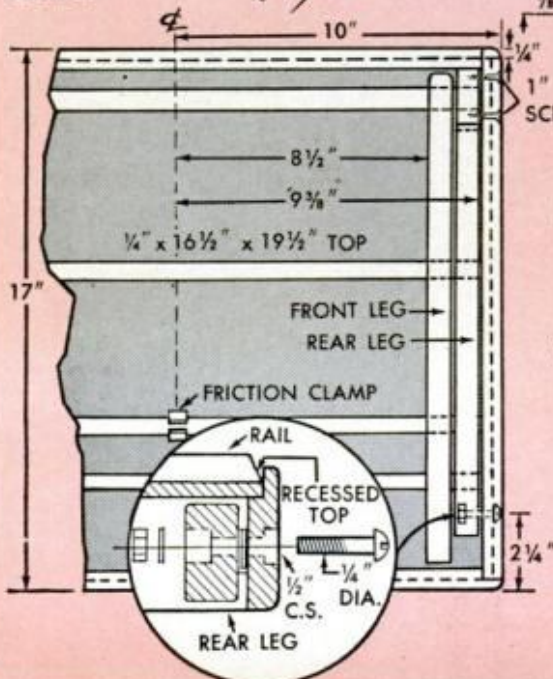
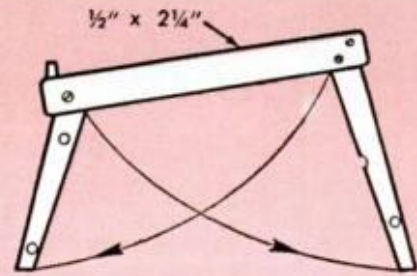
The drawings below show how to cut and assemble the parts. The sides are 1/2-in., the legs 3/4-in. pine; the bearing blocks are 3/4-in. maple. The top panel, which sets in 1/2-in. rabbets, is a 16 1/2 x 19 1/2 piece of 1/4-in. hardboard. The front leg unit folds over the rear one, and one friction clamp holds both in place.

Due to the spread position of the legs, my lectern has withstood the heavy thumping of some pretty heavy handed speakers, despite its light weight. And the slight incline of the top has proved excellent in that it permits me to glance repeatedly at my notes without losing eye contact with my audiences.

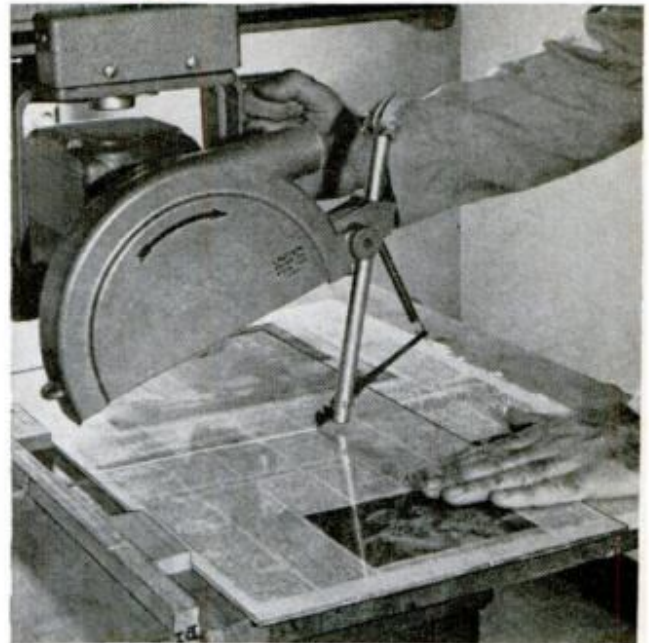
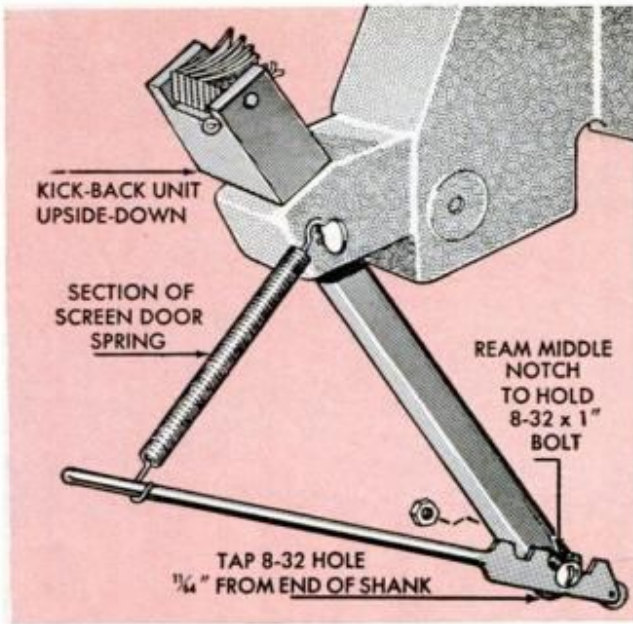
—P. L. Stotler



BOTTOM VIEW WITH LEGS FOLDED



Scoring Glass with Radial-Arm Precision



With the blade removed from your radial-arm saw and a glass cutter attached to the inverted kickback rod, you can score glass as neatly and squarely as you'd saw a board. And where an angle cut is required, the machine's settings save fussing with protractors and straight edges. In fact, you can cut glass scraps into tiny geometrical shapes that would be next to impossible by hand.

To attach the cutter, simply drill and tap a hole at the end of the kickback rod

for a bolt to fit a notch in the cutter, and add a section of screen-door spring to make the cutter bear on the glass.

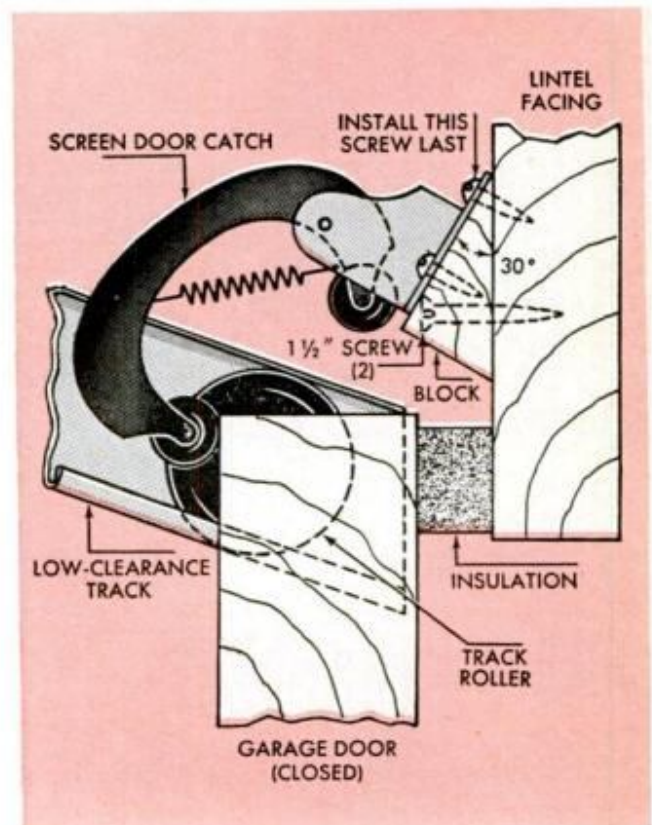
Lower the saw arm so there's just enough tension on the spring to score the glass, then press down on the back of the cutter and slide the glass under it. The newspaper cushioning shown in the photo is optional, but you'll probably need the spacer blocks against the fence to bring the cutting wheel to the edge of the glass. Simply pull the motor for an even score.

Screen Door Catches Make Your Garage Door Weathertight

Upward-acting garage doors that are equipped with low-headroom tracks often give a poor weather seal at the top where the edge of the door fits loosely in the tracks. I found that roller-action screen door catches mounted across the door opening—one for every four or five feet of span—made the door fit snugly when closed. As shown in the detail, the catches are mounted on wood blocks screwed to the lintel so the base of each catch is inclined about 30 deg. from vertical. The upper roller of each catch is tripped by the top edge of the door when the door is lowered, which simultaneously snaps the bottom roller against the inner face of the door to hold it snugly against weatherstripping applied across the top.

—Thomas H. May

When polishing your car with paste wax or cleaner, a fast way to bring up a high gloss is to buff with a strip of felt cut from an old hat. Place the felt in a soft-faced sanding block, or wrap it around a kid's blackboard eraser. Works on both enamel and chrome.



PART 1

CONTROLLING YOUR CAR'S CONTROL CENTER

By Morton J. Schultz

That octopus under your hood is well-named: the distributor is the nerve-center of your car, distributing precisely-timed sparks to each cylinder in turn

WHAT'S THE CAR OWNER on the facing page got in mind as he hunches over that fountain of cables in his stalled car? It depends on how well he knows his distributor. If he regards it as a troublesome stranger, his impulse may be to strangle it. Or maybe he's just awed by its mysterious power and is trying to "read" it, like a crystal ball. But let's hope that gesture of his expresses confidence that his skilled hands can control this vital unit—once he learns what it does, and how. This article, and one to follow next month, will supply that information.

Without doubt, the distributor in your car has more to say about the operation of the engine than any other unit in the automotive power train.

It's the car's nerve center. Not only does it help produce the hot sparks needed to ignite the fuel mixture, but it also has full control over delivery of those sparks. If you doubt its importance, just scan this list of troubles it will cause if permitted to malfunction—

- It can prevent the engine from starting or make it hard to start.
- It can cause the engine to misfire at any speed, or to stall.
- It can prevent the engine from put-

ting forth its maximum power at any speed, or make it idle rough.

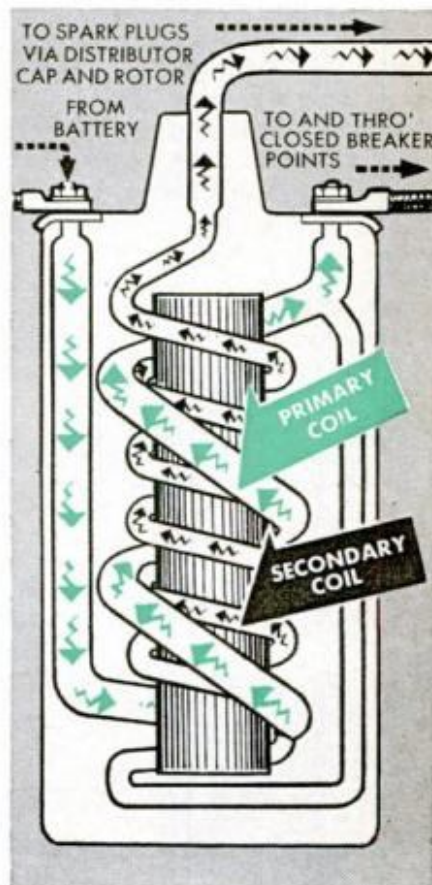
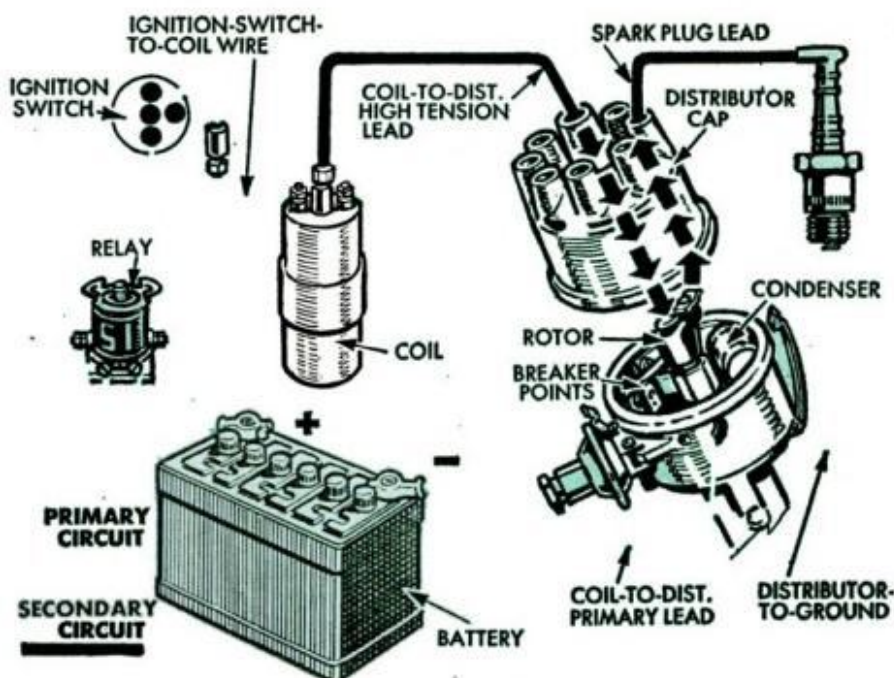
● It can cause internal engine damage by producing knocks or pings, or by inducing backfire.

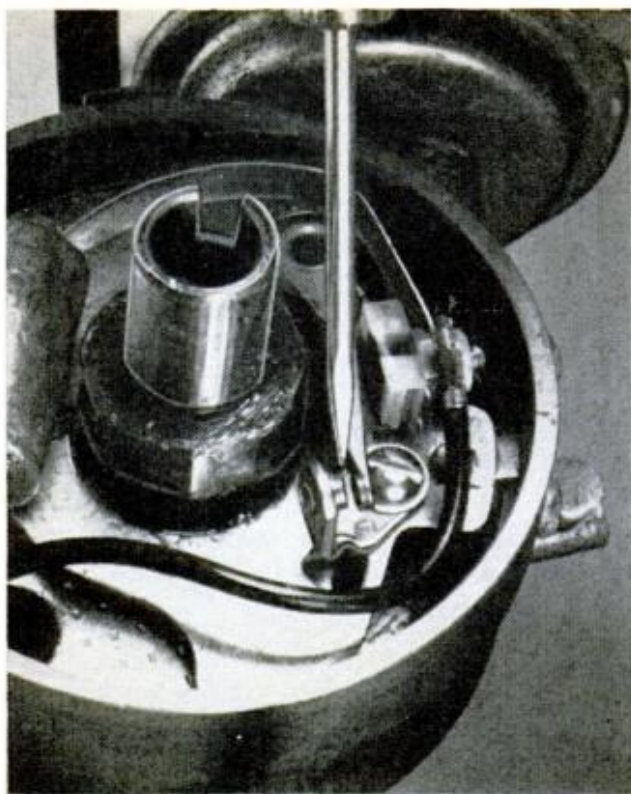
But the biggest "problem" of all posed by a distributor is the fear it inspires in the hearts of many ardent and capable do-it-yourself auto mechanics. They look upon this black object as a Pandora's box full of mystery and misery for those who dare to open it. And strange-sounding words like vacuum advance, centrifugal advance, dwell, cam angle, capacitance, induction, primary and secondary—all of which surround the distributor like pawns protecting the sanctity of the king—don't help matters.

I'm not exaggerating. I've had capable amateurs tell me either "I'm a do-it-yourself mechanic up to—but never including—the distributor" or "I'll tackle it, with misgivings, but I don't understand the first thing about it."

Yet, they admit—and rightly so—that you can't mention the word *tuneup* without including the word *distributor* in the same breath. It's like saying Gilbert without Sullivan. So, obviously, an educational campaign is overdue, where distributors

THAT FAT SPARK each cylinder needs is produced by the chain of components shown in simplified wiring diagram below and stylized "close-up" of the coil at right. The primary (low-voltage) circuit—colored cables, below—includes battery, ignition primary coil, breaker points and condenser. Secondary (high voltage circuit) includes coil's core, distributor cap and rotor, and all leads from cap to spark plugs





DISTRIBUTOR POINTS determine whether low-voltage current flows smoothly through coil or is forced to jump windings. Points—forced open here—open and close as result of rotation of distributor shaft

are concerned. Knowledge helps two ways:

For those of you who do-it-yourself, distributor functioning isn't really that much of a mystery and, provided you have the correct equipment, you can and should work on it yourself.

For those of you who aren't do-it-yourselfers but are interested in keeping the buggy in top-notch running shape, knowing how the distributor operates and what can happen to it will (1) enable you to know when the distributor is probably at the root of a problem; and (2) permit you to describe and pinpoint the trouble area for your mechanic.

CAP AND ROTOR are two secondary-circuit parts of distributor. Rotor is two-pronged affair. Center part picks current off as it enters cap from coil; rotating end clip passes current to each plug in turn



In the first article, we'll deal with the functioning of an ignition system, focusing on the distributor as its most important part. If we seem to devote too much space to what-it-does, remember that if there's one part of a car you *can't* work on without first understanding its function, that part is the distributor. We'll get into repair and tuning next month.

The basic makeup of distributors and, for that matter, of ignition systems, hasn't changed much in 50 years. Yes, we know all about transistorized ignition and the promise it holds for trouble-free ignition (see our *Saturday Mechanic* piece in the Sept. '63 issue). But this promise is in the future since transistorized ignition is still optional equipment on new cars, and most people aren't ready to pay good money to buy something that does a job done by something else they've already paid for. So, we doubt if one car in 5000, today, is equipped with transistorized ignition.

To study an automotive ignition system, you've got to think of it in terms of two circuits: a primary (low voltage) circuit and a secondary (high voltage) circuit. And when you consider the makeup and functioning of the distributor in relation to that ignition system, it's easier to understand and trouble-shoot if you separate its parts into these two families—that is, whether the part's associated with the primary or with the secondary circuit.

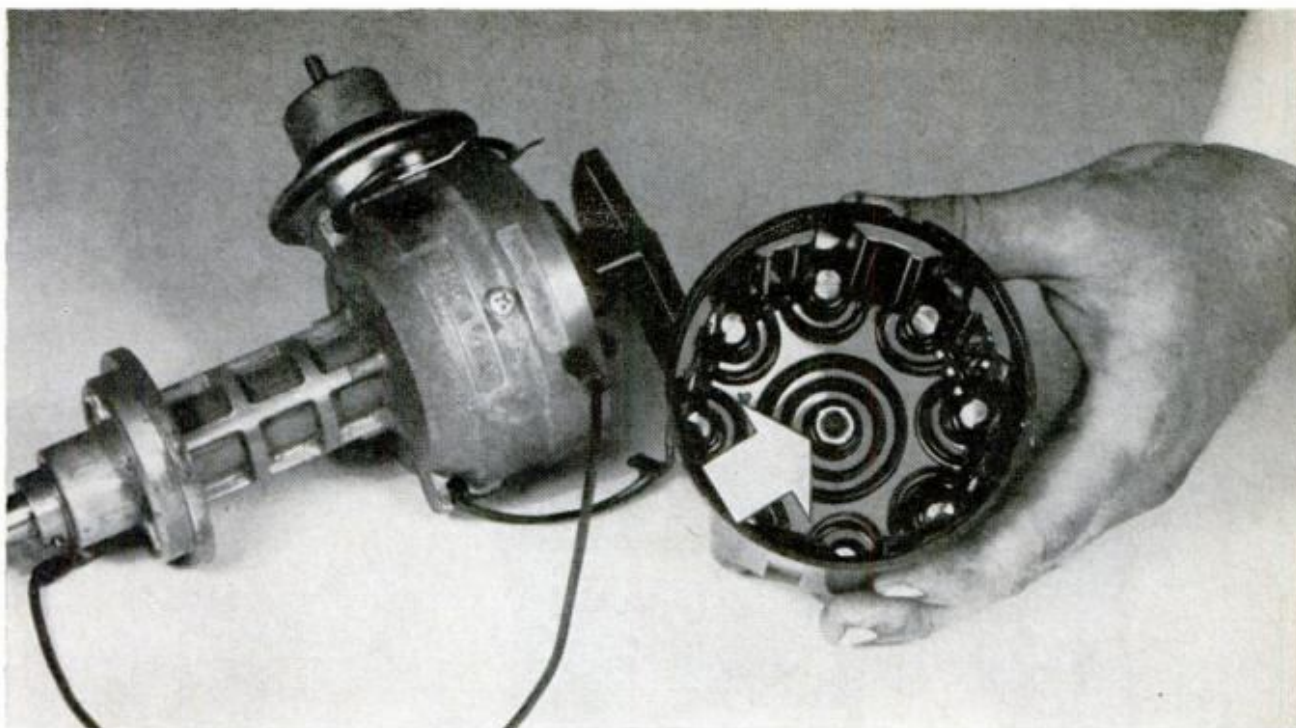
The diagram on page 159 breaks the system into its two ignition circuits. Parts are considered "primary" when they handle none of the high voltage induced in the system. Most of them do, however, have a direct hand in the production of this high voltage.

The secondary ignition circuit consists of the secondary winding in the coil, the coil-to-distributor high tension lead, the distributor rotor, the distributor cap, the high tension wires going from the distributor to the spark plugs, and the spark plugs themselves.

All these are carriers and passers of high voltage, but not one has anything to do with the actual production of that voltage.

Here's how these parts work to produce and deliver the nice fat spark you need to run the engine:

When you turn on the ignition switch, current (6 or 12 volts of it, depending on your car) goes from the battery, through the switch and into the primary winding of the coil. The coil is actually two coils in one, as shown in the stylized "x-ray" on page 159. The outer (primary) coil is composed of heavy wire (usually No. 18) that's wrapped around the inner coil a few hundred turns. The inner (secondary)



INSIDE OF CAP (right) is an in-and-out unit, like rotor (left). Current flows through center electrode (arrow), passes through rotor then back out of cap through one perimeter contact after another as rotor spins

coil is composed of fine wire (usually No. 38) that's wrapped around a core of soft iron many thousands of turns.

As low-voltage current comes from the battery into the primary winding of the coil, it continues to flow through the coil via this winding, into the distributor by means of the coil-to-distributor primary lead, through the breaker points, to ground, and then back to the battery.

Nice, orderly march, isn't it? But it depends on one important condition—the *distributor points must be closed*.

Once these points open, breaking the circuit, the magnetic field that's built up in the coil, as electrons march through, rapidly collapses.

The once relatively small voltage (6 or 12 volts) suddenly finds itself stepped up to a higher voltage, *induced* to jump from the primary into the secondary winding of the coil, and then *transformed* into still higher voltage.

Those words *induced* and *transformed* are significant. The coil, in reality, is a transformer that steps up low voltage into high voltage by self-induction—in other words, by pulling low voltage electrons from the heavy primary wire into the fine secondary wire. This induction results when the magnetic field collapses, which occurs when the circuit is broken. The field collapses *inward* toward the soft iron core of the coil, spring-boarding electrons from one wiring circuit to the one below it.

According to electrical theory, when a counter-voltage is induced from one winding to another, the collapsing magnetic field across the windings is about the same

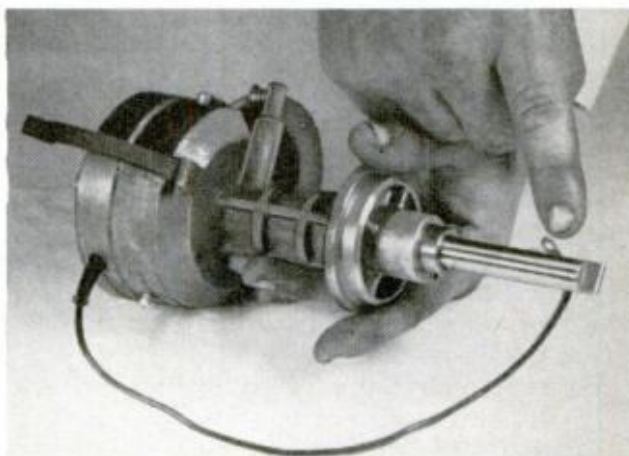
value for each turn. Thus, since the secondary coil has many more turns than the primary, the voltage in the secondary will assume a proportionate increase.

Assuming a turn ratio of 100:1, the secondary voltage will go at least 100 times higher than the primary voltage.

When the breaker points open, causing the field to collapse across the primary, this action creates an immediate step-up in voltage in the primary of some 200 volts. As this still relatively small voltage is induced into the secondary, it increases in value 100 times. Thus, the voltage that begins to flow through the secondary wiring is in the neighborhood of 20,000—and that's hot enough to jump the gap of a spark plug and fire a fuel mixture.

The high voltage pours out of the coil

DISTRIBUTOR SHAFT on some models has tang at end, like this one, that fits into slot in camshaft. Other types have gear. Either way, shaft rotates to open and close breaker points and to spin the rotor





CONDENSER SNUGGLES against rotor shaft. It's a decoy for left-over current when breaker points snap open, prevents arcing which could burn up points

and to the center tower of the distributor cap through a high tension lead. Here, the spinning rotor picks it off and carries it to each distributor tower, in turn, where a metal contact again picks it off and shoves it through a high tension wire to a spark plug.

When the points open, the voltage built up in the primary before it collapses across the secondary can jump the relatively slight gap between the points. If this arcing, as it's called, were allowed to happen, the points would soon become ruined because of the searing heat.

So, a condenser (merely an insulator) is added and connected across the points. To the electrons, it looks like a detour to the point gap; but it turns out to be a one-way street, and the electrons pour into it before they can get to the point gap. By the time the waylaid electrons find out they've been duped and reverse themselves, the plug has fired, the contact points are closed and the electrons are again marching in orderly fashion to ground.

When you consider how fast and how frequently all this happens, you begin to wonder why distributors don't fail more often. For example, if it has taken you 10 minutes to read to this point, and you'd been traveling in a car that was going 60 miles an hour, the breaker points in the distributor would have opened and closed 100,000 times and the rotor would have handled a cumulative voltage equivalent to one trillion volts!

So that's how the system *should* work. Now let's consider what can be done if it *doesn't*. Whatever you've read else-

where, you can't properly repair and tuneup an automotive ignition system without certain basic pieces of test equipment.

This is no place for a "Kentucky windage" approach. Ignition has to be smack on the beam for the following reasons:

- Only by correct ignition tuneup can you get maximum power output from your car.

- Only by correct ignition tuneup can you expect to run your car in the most economical fashion—and this includes getting full wear from parts such as plugs and breaker points—plus every possible mile from a gallon of gas.

- Only by correct ignition tuneup can you extend the life expectancy of your car. The internal operation of that engine depends as much on ignition as on anything else, and serious damage can be done to pistons, valves, and associated parts if ignition tuning is botched.

By proper repair and tuneup, I don't refer to emergency repair. In an emergency, of course, your only interest is to get started and rolling, and any gimmick that enables you to do this is OK. You'll find a run-down on emergency ignition repair in the August 1964 issue of *PM*, page 146.

Now, what constitutes a correct repair and tuneup ignition procedure? First, the time element is an important factor.

You should check and test, and replace *known* malfunctioning parts at least *every 10,000 miles*. Note that I said "known" malfunctioning parts. The only parts, in the entire system which definitely need replacing every 10,000 miles are the distributor breaker points. But simply replacing them and setting them with a feeler gage is not enough. There's a lot more to doing this job right, as we'll see next month.

As to what test equipment you need for tuneup and repair, logic and discretion must be used or you can find yourself in a financial nightmare. In some cases, you're better off simply replacing a part rather than buying a piece of test equipment to test it. For example, replacing a condenser every 10,000 miles, which costs about 85¢, is a lot wiser than buying a condenser tester for maybe \$20 or \$30.

However, there are several pieces of equipment you can't do without. These are—

- A dwell/tach meter. This is a dual-purpose device. If you now own a separate tachometer, you can buy the dwell meter itself, or vice versa. The dwell portion has just one purpose—to indicate the number of degrees of rotation through which the distributor cam moves to open and close the points. The tachometer portion of the

tester is used to indicate engine speed while performing your tests, and permits you to adjust that speed for performing the test according to specification.

A good dwell/tach meter can be bought for about \$50. A separate dwell meter sells for about \$25 to \$35, and a separate tach goes for about \$35 to \$40.

● A timing light that permits you to set ignition timing and determine the number of degrees advance of the distributor. Try to tune up a car without one. A good timing light will cost in the neighborhood of \$12 to \$15.

● A voltmeter to detect resistance by measuring voltage drop between any two points in the ignition circuit, and to measure available voltage at any point in the circuit, is nice to have, but not absolutely necessary. As you'll see in next month's article, you can judge the availability of voltage without a voltmeter by observing the condition of a spark or by use of a troublelight. However, a voltmeter will give an accurate reading—the other two won't. A good voltmeter will cost about \$15 to \$25 (volt-ammeter combinations like the one at right run \$35 to \$45).

In next month's article, we'll go right through ignition repair and tuneup from beginning to end, showing you how to handle this equipment, and other procedures, such as replacing points.

Modern distributor design makes that job less tricky than it used to be. You no longer have to worry about the spring tension, for example. And, if you wish, you can probably get by without setting the gap of new breaker points.

Today's points are one-piece sets that are machine-calibrated at the factory. Although it's a good idea to check gap as a precaution, all you have to do to replace points is remove the old ones and drop a new set in.

But, as with anything automotive, easy or hard, you can't do much unless you know procedure and, especially, what pitfalls to watch out for. True, it's simple, but only one mistake can make an otherwise fine tuneup job go sour within the first hundred miles of travel.

Furthermore, it never hurts to know the tricks of the trade that permit you to test and tune without need for professional equipment. Several of the tricks we'll demonstrate next month have never before been publicized—and the garage men who let us in on their professional secrets are now smoking good cigars.

Whether you actually try these yourself, or pass the tips along to your mechanic, you'll find the information will take still more of the mystery out of that octopus beneath your hood. ★★★

TESTING'S A CINCH WITH THIS EQUIPMENT



VOLTMETER (OPTIONAL)

Материал, защищенный авторскими правами

AUTO CLINIC

Q My 1961 Rambler with aluminum block engine has had its spark plugs and ignition wires replaced twice in a few thousand miles because the car bucks badly in low speeds, especially under a pull and on a rainy day. It runs well in high speeds and pleasant weather. My dealer is stymied—suggests I try you.—J.S.B., N. J.

A There's a couple of things to look into. First, you say the ignition wires have been replaced, but I'm wondering if they were replaced with the regular resistor-type which the car used as original equipment or with a copper type. There have been numerous reports of resistor-type wiring breaking down when there's moisture in the air, causing the problem you describe.

If the wire angle doesn't prove out, I'd look for a sticky valve condition. One of those valves might be hanging up in wet weather. As a matter of fact, Rambler has issued a heavier valve spring for aluminum blocks to alleviate the problem.

Q I always set my own timing and want to check something out with you regarding my 1962 Valiant with 225 CID engine. The shop manual says to set timing at $2\frac{1}{2}^\circ$ BTDC. The timing plate, though, has four lines on it. The bottom one's marked "0" and the third line is marked "10." The others aren't numbered, but I assume they'd represent 5° and 15° . Would $2\frac{1}{2}^\circ$ BTDC be between the "0" line and the one I assume to be the 5° line?—G.O.W., Ind.

A Right you are. Why another little line wasn't included and marked $2\frac{1}{2}^\circ$, so people wouldn't have to guess at the specified timing is a \$64 question.

Q Volkswagen mechanics seem adverse to giving information. Can you tell me if an interested owner, such as myself, can consult any manual that gives particulars about the VW engine and other areas?—D.P., Fla.

A You're in luck. Volkswagen only recently came out with a brand new publication that's being sold at VW dealers throughout the nation. It

gives complete details concerning the entire car. It's called "Owner's Service Manual, VW 1200." The publication deals only with the sedan from 1961 through 1964. Charge for the book depends on who's selling it. We got prices ranging from \$3 to \$5 a copy.

Q I have a terrific growl, noticeable particularly at low speeds, but also at other times, coming from the front of my 1959 Chrysler New Yorker. Mechanics have replaced the idler puller bearing, the bearing in the air conditioner compressor, and two bearings in the generator. Still, the growl continues. I'd be grateful for any hint as to where the trouble lies.—J.H., Texas

A With a growl like this, one of the first things to check is the water pump. Just take the fan belt off the pump and run the car for a few seconds without it. If the growl is coming from the water pump, there will be no noise.

Monthly Service Tips

★ Chevy Corvette convertible owners (1963 and 1964) who desire to have the softtop replaced with a hardtop can have their wish by installing roof panel assembly 3838439. The assembly comes unpainted, so it can be sprayed to match the color of the car. For installation instructions, see Chevrolet Service News No. 5 (May 1964).

★ If you've been having trouble with your 1963 or 1964 Studebaker stalling during warm up and hard starting at temperatures of from 50° to 70° , you'll be glad to hear that a new automatic choke thermostatic coil and cover assembly, cover gasket, and choke piston lever are available to eliminate the problem. Part number for the coil and cover assembly is 1563427; for the new gasket, 1563428; for the lever, 1563445.

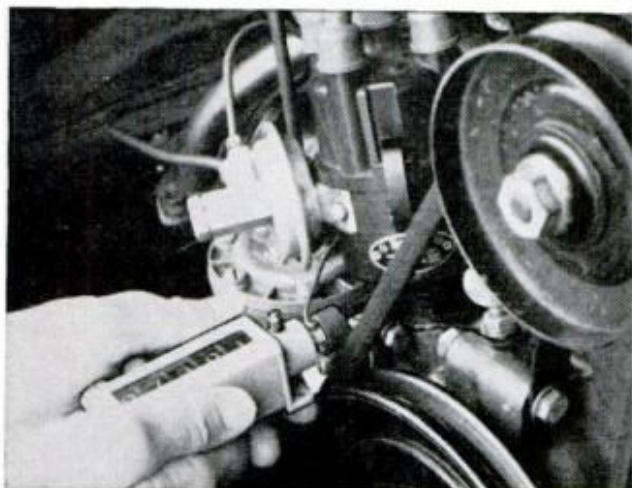
As a service to Popular Mechanics readers with problems relating to their cars or to driving in general, we invite you to submit your questions for answering through this column or by mail. Address Auto Clinic, Popular Mechanics Magazine, 575 Lexington Avenue, New York, N. Y. 10022, enclosing a stamped, self-addressed envelope.



FOR THE MOTORIST

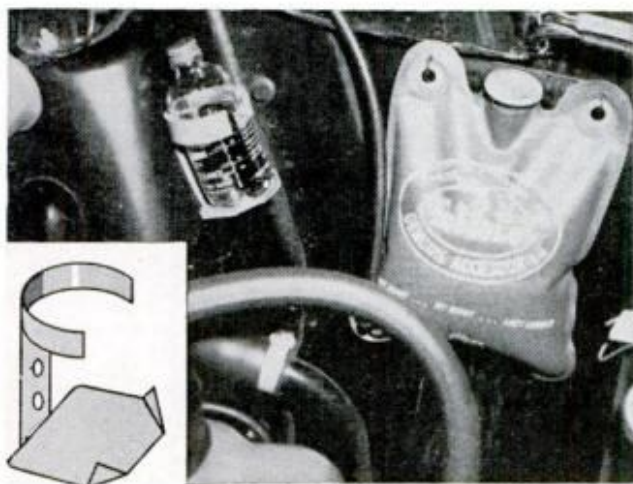
Flashing Masks Tire

When repainting car wheels, you can protect the tires from overspray by using metal flashing as a shield. A strip 4-in. wide and about 5-ft. long is adequate. The flashing, obtainable at lumber yards, is bent into a circle of the same diameter as the wheel. The ends of the strip may be clamped with a locking plier wrench, which also serves as a handle to hold the shield in place with one hand.—*L. Campbell*



Count Those Revs

Car owners who do their own tune-up work often need a tachometer. This may be improvised with a four- or five-digit rotary counter fitted with a rubber wheel. Hold the wheel against the generator belt; then turn the belt one revolution and note the number on the counter dial. Start the engine and allow it to reach normal temperature, then zero the counter and hold the wheel against the belt for one minute. To determine r.p.m. divide the number shown after one revolution into the number indicated by the counter after one minute of running time.—*R. Micals*



No More Freeze-Ups

An under-the-hood bracket that holds a bottle of anti-freeze fluid for the windshield washer is a handy accessory. The bottle is not likely to break, as it might if kept in the trunk or glove compartment—and there's less chance of forgetting to add the fluid to the washer water. After forming the bracket from sheet metal as shown in the drawing, it should be lined with felt to prevent rattling. The bracket is fastened with self-tapping screws to a convenient spot on the firewall, preferably near the reservoir.—*W. Rudolph*

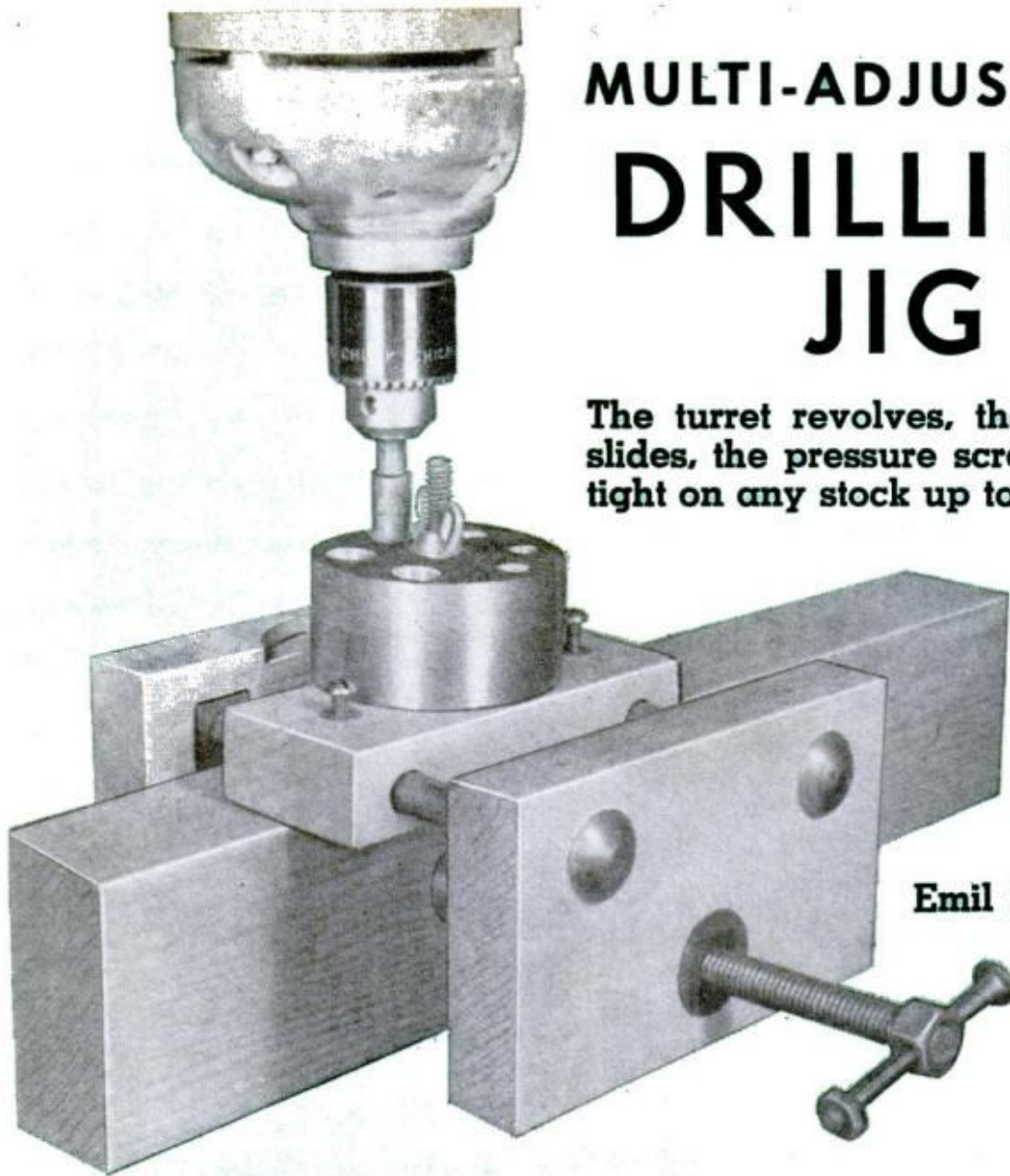


Lost Cap Comes Back

Hub caps on most late model cars are expensive. I know—I had to replace one that I lost on a recent vacation trip. After that, I decided that if I ever lost another cap, a simple precaution would make it possible for the finder to return it. On the inside of each hub cap I printed the words; "Finder please notify," followed by my name, address and telephone number. As an inducement, I indicated that a reward would be paid. A felt tipped marking pen, or a china marking crayon makes it easy to do a neat lettering job.—*Andrew Vena*

MULTI-ADJUSTABLE DRILLING JIG

The turret revolves, the platform slides, the pressure screw clamps tight on any stock up to 4 in. thick



By

Emil P. Kushner

ASSEMBLE THREE hardwood blocks and a steel cylinder with a few bolts, and you've ended the grief of trying to drill true holes at precise locations. Two of the blocks position the jig on the work with a vise-jaw action. The third serves as a sliding platform for further adjustment of the rotating cylinder, which is pre-drilled to present a choice of guide holes for bits of six different diameters.

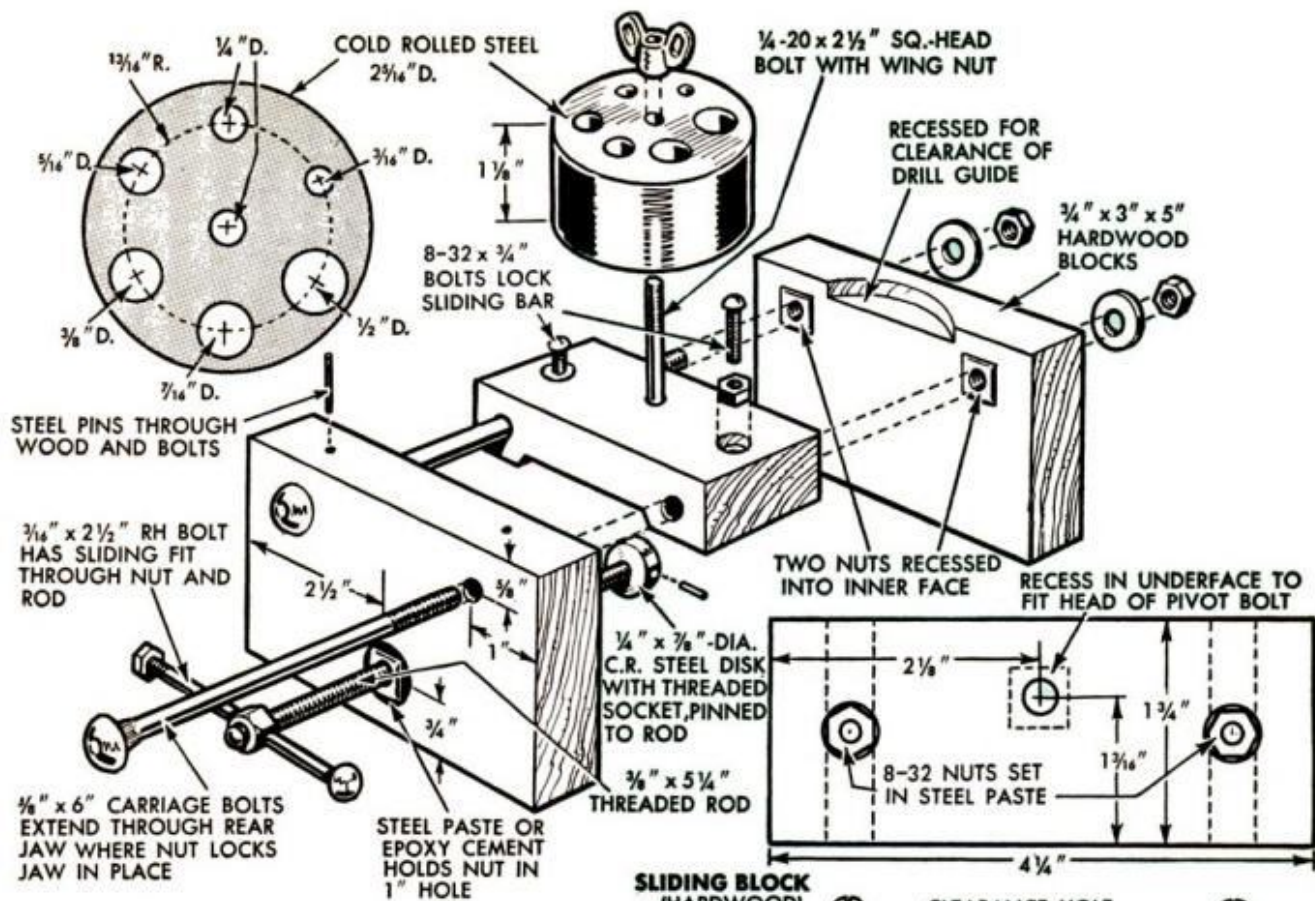
The jig is especially handy when drilling holes for dowel joints with a hand brace or portable electric drill. Such holes must be in perfect alignment and at exact right angles to the edges joined. The same goes for bolt holes in critical assemblies. This versatile jig ends the guesswork.

Cut the vise-jaw blocks and brad them face-to-face temporarily, in order to drill $\frac{3}{8}$ -in. holes for the carriage bolts through both at once. Separate the blocks, drill the 1-in. hole to recess the nut, then, using the same center, drill a $\frac{3}{8}$ -in. hole

on through the block to pass the tightening screw. Place the nut in the recess and pack steel paste or epoxy around it to fill the hole flush. Before this sets, thread the rod into the nut and through the block, to assure alignment.

In the corresponding face of the second block, chisel two square recesses around the holes, deep enough to seat the nuts you'll use on the carriage bolts. These are held in place by press-fit.

Now, using either jaw block as a template, drill the carriage-bolt holes through the edges of the sliding hardwood block. Wrap sandpaper around a $\frac{1}{4}$ -in. dowel and relieve these holes enough to provide a sliding fit on the bolts. Cut the chip recess in the undersurface, then drill the $\frac{1}{4}$ -in. hole for the square-head bolt, and chisel a square recess for its head. Drill the holes for the locking bolts and counterbore to recess their nuts, which, like the rod's nut, are anchored in steel paste or epoxy.



FOR PRECISION WORK, all hardwood blocks must be squared and bolt holes carefully aligned; holes in steel cylinder must be square with bottom face. Since nuts would have to be pried out of rear block to permit adjustment of space between jaws, pressure-plate screw is used

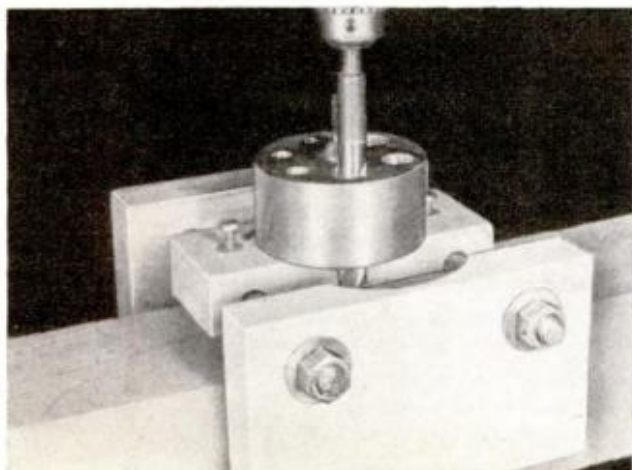
Drive the carriage bolts through the front jaw-block, ending with a sharp blow to sink the square shoulder into the wood. Drill holes down through the bolts from the top edge, to take steel pins. Slide the platform block onto these bolts, then turn on two square nuts before sliding on the rear jaw. Adjust the nuts until the two

DRILL BIT is inserted in hole of matching diameter, which has been positioned so bit will clear edge of sliding bar and center over layout mark on work

jaws are parallel when the nuts are snug in their recesses.

After bolting the steel guide to the sliding block, you can mark the upper edge of the rear block for cutting the circular gain. This allows the cylinder to lap the jaw when you're drilling small holes on narrow stock, with the jig compressed. ★ ★

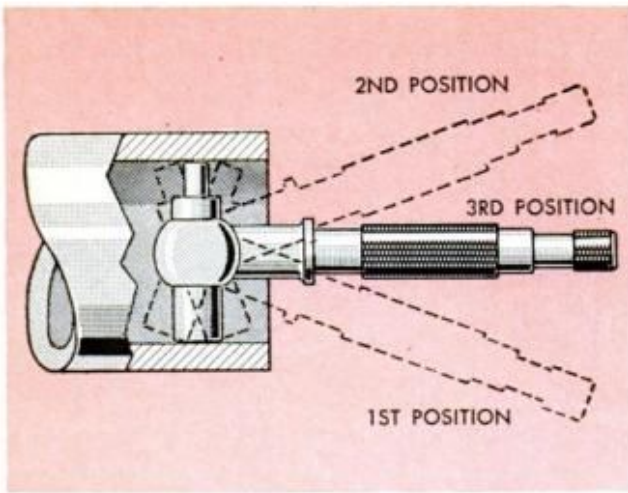
ANGLE DRILLING is done by tilting jig until jaw ends align with sliding T-bevel set for desired angle. Clamp jig tight, hold steady while drilling



SHOP SHORT CUTS

Rock It for Accuracy

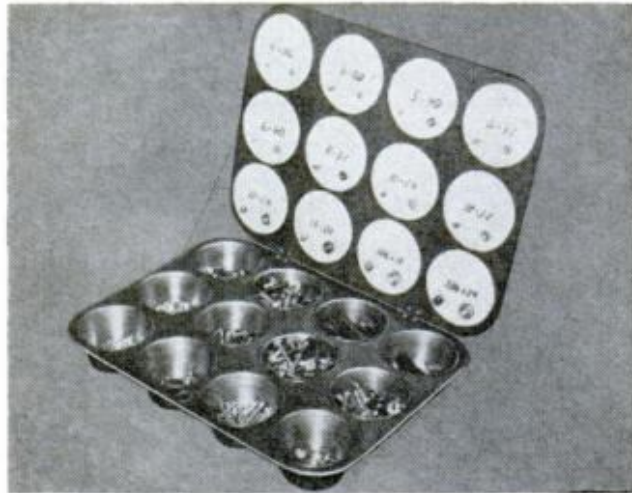
Measuring inside diameters to thousandths of an inch can be tricky with a telescoping gauge—especially if the compression spring is weakened with long use. For greater precision, place the gauge in the tube or hole with its handle at an angle to the axis (1st Position, left). After the gauge expands, snug the knurled ring, rock the handle upward past the axis and back down.—*H. J. Gerber*



For Nuts and Bolts

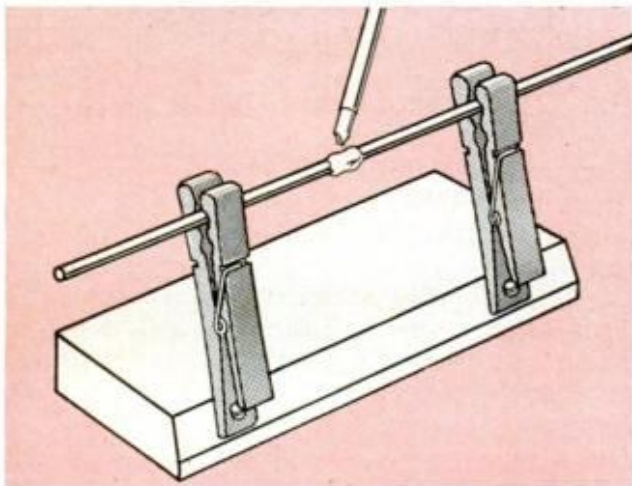
A 12-compartment muffin tin serves as both a sorting and storage tray for nuts, bolts and small parts. A lid of 1/8-in. hardboard is hinged to one long edge; light chain holds it upright. For quicker selection or sorting, a sample from each corresponding bin can be glued to a label stuck to the underside. Or, if it's a bolt, turn it through to protrude slightly and trim flush on top. To attach the hinges to the hardboard cover and to the muffin pan, use short aluminum rivets.

—*W. G. Waggoner*



Jig Lends A Hand

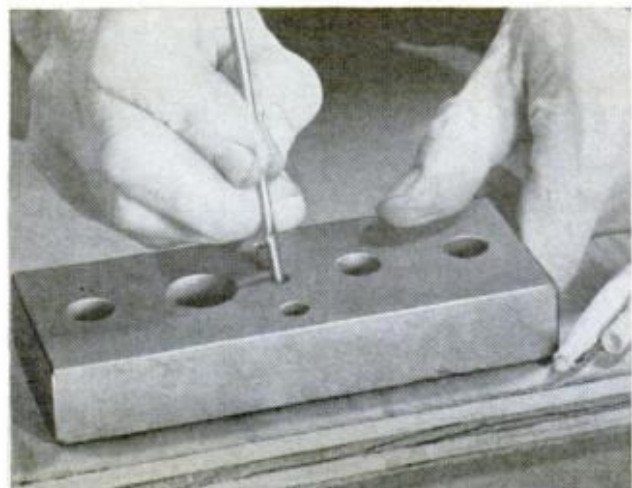
Trying to keep two pieces of wire or light rod in perfect alignment while manipulating solder and soldering iron can be pretty frustrating. Fortunately, there's an easy way to handle this tricky job. A simple jig can be made by screwing two spring-type clothespins to the beveled edge of a block of scrap wood. The jig holds the work firmly in the desired position and lets you concentrate on applying the solder. Note that one leg of each pin must be shortened to permit attaching it with a screw.—*Daniel Bousha*



Marking In Tight Spots

A ball-point pen cartridge is handy for marking holes in situations like the one shown. The thickness of the block and the small diameter of the hole make it impossible to mark the work with a conventional pencil. The cartridge, on the other hand, is slender enough to make nearly a full-size tracing of a hole as small as 1/4-in. dia. The cartridge may be fitted with a dowel handle to make it comfortable to hold, if you have a lot of such marking to do. Hold the cartridge at a slight angle as you mark around the hole.

—*W. B. Burton*

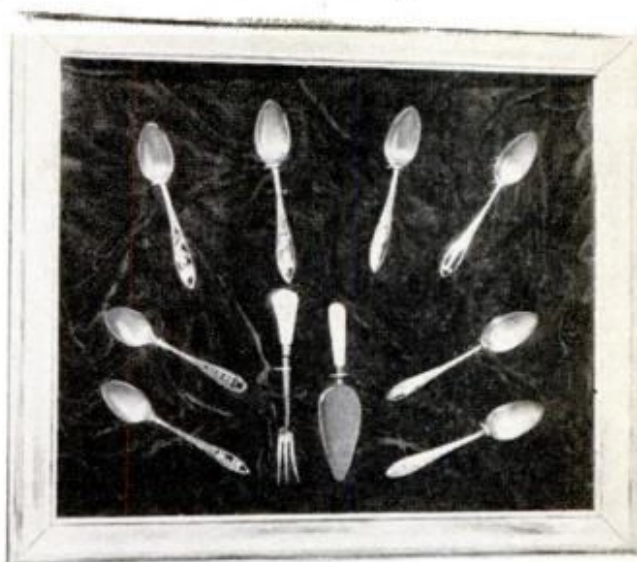


Shadow Box Displays Prized Keepsakes

BABY SPOONS and other pieces of treasured family silver become a colorful conversation piece when displayed against the red velvet that covers the back of this picture-frame shadow box. The rich red texture adds sparkling contrast to the silver to make it a handsome decoration.

The sides of the box are $\frac{1}{4}$ -in. plywood, the back is carton cardboard. While the depth and size will of course depend on the number of items to be displayed, the overall size of the box should be a bit smaller than the outside dimensions of the frame. Fasten the glass in the frame with brads and hinge the frame to the box at the top, so it can be opened. Line the inside with velvet; and attach the silver with loops of elastic cord pulled through the back.

—Gerald and Frank Callahan



YOUR FINE SILVER won't tarnish if you insert a piece or two of camphor inside lower corner of frame



CORRUGATED CARDBOARD is cut to fit the back of the box, then items to be displayed are arranged on cardboard and locations for elastic loops are marked



SPREAD GLUE generously inside box, then press velvet in place. The material should be gathered as shown rather than stretched taut. Trim off excess

NEXT MONTH IN SHOP AND CRAFTS

- ★ **REAR-PROJECTION CABINET.** It looks like a luxurious TV console with a giant 20 x 24-in. screen, yet this handsome piece of furniture is actually a rear projector screen for showing your slides. When not in use, it serves as a storage cabinet for your projector and slide magazines. You'll find detailed how-to-build-it plans in the January *PM*
- ★ **PLUG-IN POWER CONTROL.** Utilizing a new semiconductor device, this simple control unit makes it possible to dial any speed for your electric drill or sander, any heat for your soldering iron or shop heater, any light intensity for your living-room lamps or photofloods. No cumbersome in-the-wall box, just plug the compact control unit into any handy 110-v. outlet. Watch for the plans for this bargain \$12 project in next month's issue
- ★ **\$3.00 COPYING MACHINE.** How many times have you needed copies of important correspondence or legal papers? Next month, *PM* brings you plans for a low-cost machine which makes exact copies of any 8½ x 11-in. document for less than one cent each. It's a simple project that will probably pay for itself during the first year of use. Watch for it in January
- ★ **GRINDING YOUR OWN GEMSTONES.** Beginners in the fascinating hobby of making gemstones should make a special note to get the January *PM*. It contains an easy-to-understand article describing the construction of a basic grinder-polisher which can handle all the common grinding, sanding and polishing operations. All you need is \$11 and a $\frac{1}{4}$ -hp. motor

HEAT TREATING IN THE HOME SHOP

By Manly Banister



What's the difference between hardening and tempering? What's the best temperature for these jobs—and for forging? Can you "read" a heat rainbow? Not sure of the answers? Then read on

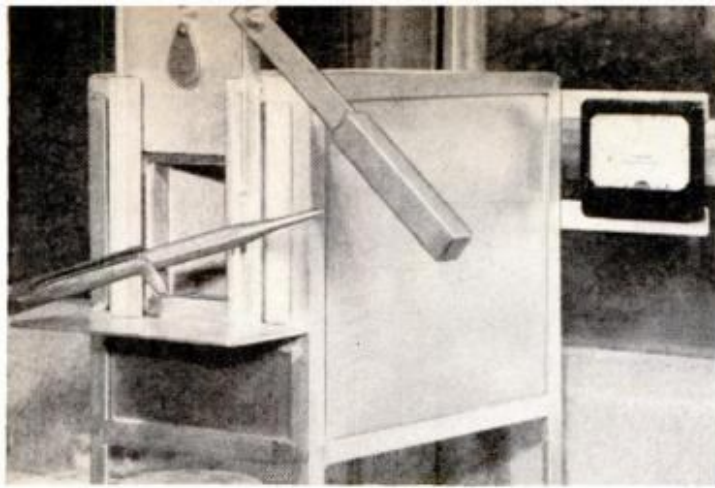
SNAP! goes your favorite chisel or screwdriver or wrench. It needn't mean a sad waste of fine steel. If you've got a corner of your shop set up for heat treating, like the outfit shown above, that broken metal will be a challenge. Soften it by annealing; forge it into a new tool, then bring back its toughness by re-hardening and tempering.

And that's only a start. You can buy your own drill rod or tool steel and create new tools, tailor-made for a job at hand.

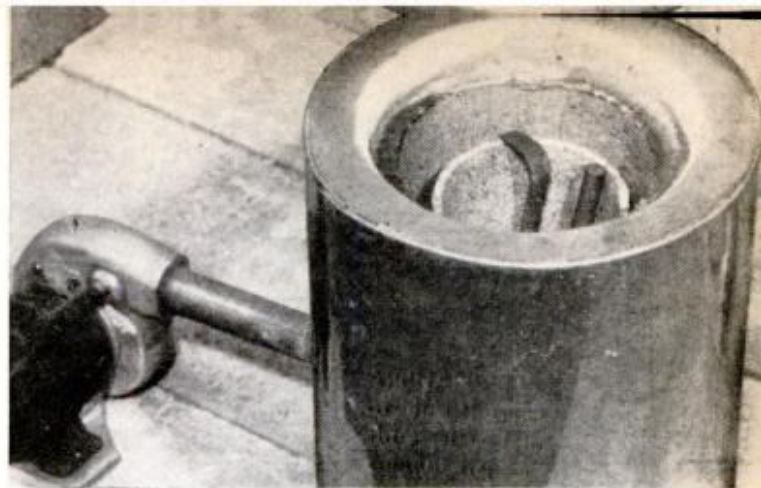
Heat treatment of alloy and high carbon steels needn't be a chore fraught with bewildering technicalities. Strip away the complex graphs and the metallurgist's fancy jargon and you'll find that the basics of heat treating are easy to master. And you won't have to make a big investment in equipment. The largest item in that line-up above is a homemade oven!

As for safety, only common-sense precautions are necessary. Concrete patio blocks under and behind the oven and blast furnace serve as fire protection. And since the gas flames will burn the oxygen out of the air of a closed room, you'll want a window or two you can open.

The steels listed in the chart at right should cover any job you're likely to tackle. We've selected them, from the many varieties of steel available, as being most useful to the home craftsman or job shop operator. An alloy steel results when one or more *additional* metals are included in the melt. Carbon is not properly an alloying material, but when added to the melt in varying amounts from 0.10% (1010 steel) to 1.5% (High Carbon) it increases the hardness proportionately. These steels are designated as Low Carbon (hot- or cold-rolled steel) and High Carbon (tool



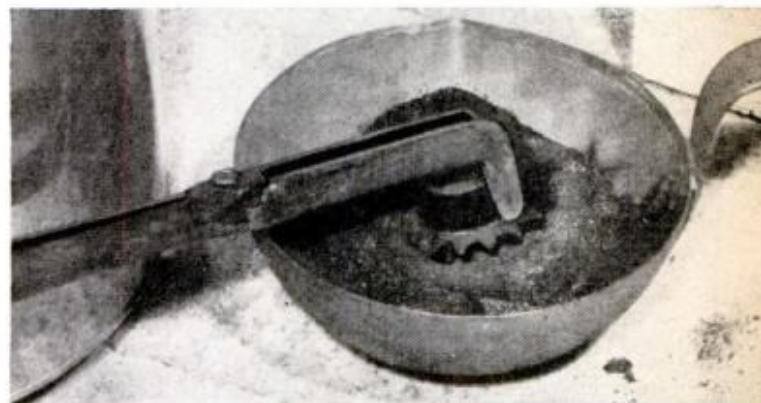
OCTAGON BAR of high-carbon tool steel is withdrawn from preheating oven when pyrometer indicates temperature of 1200° F. Gradual preheating avoids thermal shock from too-rapid heating in blast furnace



PREHEATED STEEL has just been transferred to blast furnace. Crucible keeps direct flame from metal, preventing burning and decarburization. Glowing steel looks black because of superheated furnace

steel, drill rod). Only High Carbon steels can be hardened by heat treating. When the Low Carbons need toughening up, you accomplish it through "case hardening," as shown at right.

In the alloys, manganese is added to make steel easier to forge, to increase the strength and depth of hardness, and to reduce the distortional effect of quenching. Molybdenum increases strength and hardness, too—as well as reducing temper brittleness—but it also raises the temperature required for forging. Chromium in steel is a third way to increase strength and hardness; it provides a hardening effect



RED-HOT SPROCKET is dipped in carburizing (case-hardening) compound, which sticks to it as sprocket is returned to furnace. After compound melts over surface, procedure is repeated before quenching

THESE STEELS ARE BEST FOR HOME WORKSHOP USE

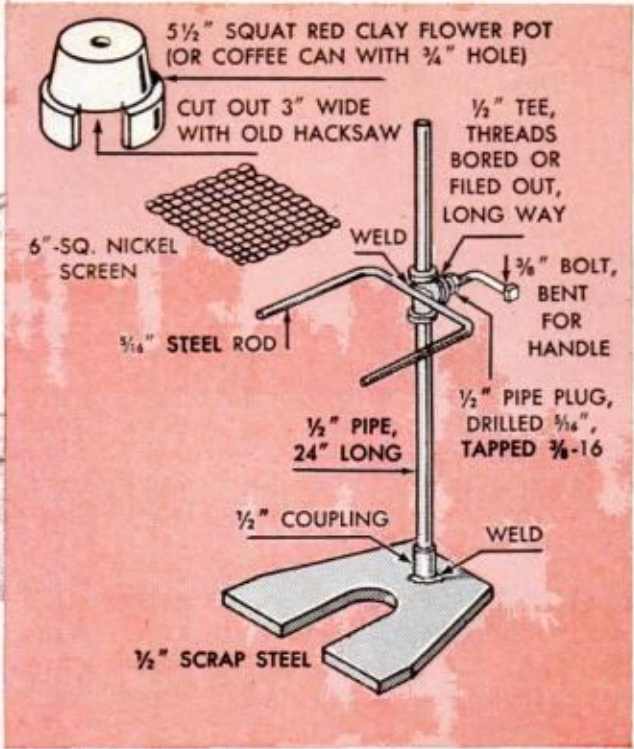
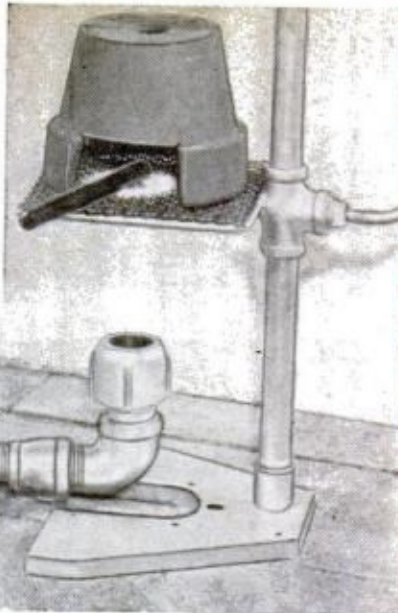
Temperatures for:

Type of Steel	Characteristics	Forging	Normalizing	Annealing	Quenching	Drawing	Sample Uses
AISI* C-1040 SAE** 1040	An open hearth, medium carbon (0.30-0.50%) fine-grained, manganese alloy steel. Good machining and forging qualities	2250°- 1900° F.	1650°- 1750° F.	1500° F.	1550° F. Oil or water	400°- 1200° F.	Shafts, pins, bolts, bushings, machine parts, rollers, etc.
AISI A-4142 SAE 4140 Annealed	A chromium-molybdenum-manganese alloy, 0.40-0.45% carbon. Easily fabricated, forged, machined, welded and heat treated. Resists fatigue, abrasion and impact	2200°- 1900° F.	1600°- 1650° F.	1500° F.	1550° F. Oil	400°- 1200° F.	Boring bars, wrenches, small tools, shafts, axles, cams, bolts, connecting rods, pins, hammers, mandrels, ratchets, rollers, gun barrels, etc.
AISI C-1075/ 1090 High Carbon	A general utility steel where toughness plus hardness is required	1900°- 1600° F.	1600° F.	1450° F.	1450°- 1500° F. 10% Brine or water	300°- 550° F.	Forged tools, blacksmiths' tools, cold chisels, pinch bars, crow bars, cold cutters, hardies, swages, anvils, etc.
AISI C-1095 SAE 1095 Drill Rod	0.90-1.05% carbon, possessing good stiffness and toughness as supplied — without heat treating. Highly finished surface, no decarburization. Heat treats very hard	---	1650° F.	1450° F.	1475° F. Oil 1450° F. Water or 10% brine	300°- 550° F.	Small shafts, dowel pins, scribes, small machine parts, punches, rollers, arbors, lead screws, etc.
S-5 Tool Steel ASM Classification I11C (Omega Tool)	Hardness with great ductility for shock resisting parts. Subject to decarburization if held too long at forging temp.	1900°- 1650° F. Cool slowly	1500°- 1600° F. After forging cool in ashes	1450° Cool slowly to 800° for best machining	1625°-50° Oil (pref.) 1550°- 1600° F. Water	400°- 650° F.	Chipping chisels, rivet sets, punches and other tools subject to heavy impact
AISI W-1 Tool Steel ASM Classification IA	A carbon tool steel for high wear resistance, cold cutting qualities, and high impact resist.	2000°- 1500° F.	---	1450° F. Cool in dry ashes or in furnace	1450° F. Water or brine (1 lb.) salt gal.	300°- 550° F.	Punches, rivet sets, cold forming tools, shop hand tools, arbors, forming tools, carbon steel lathe centers

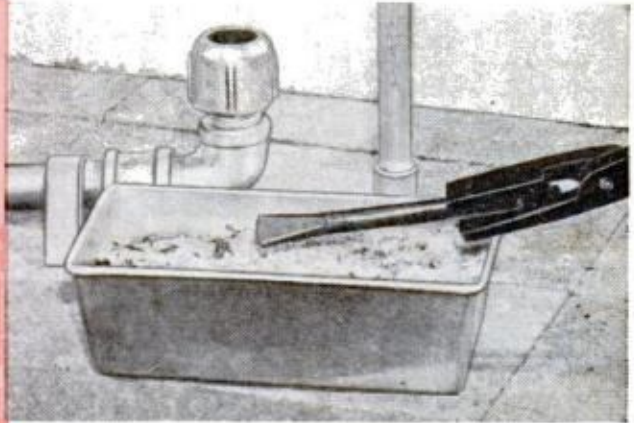
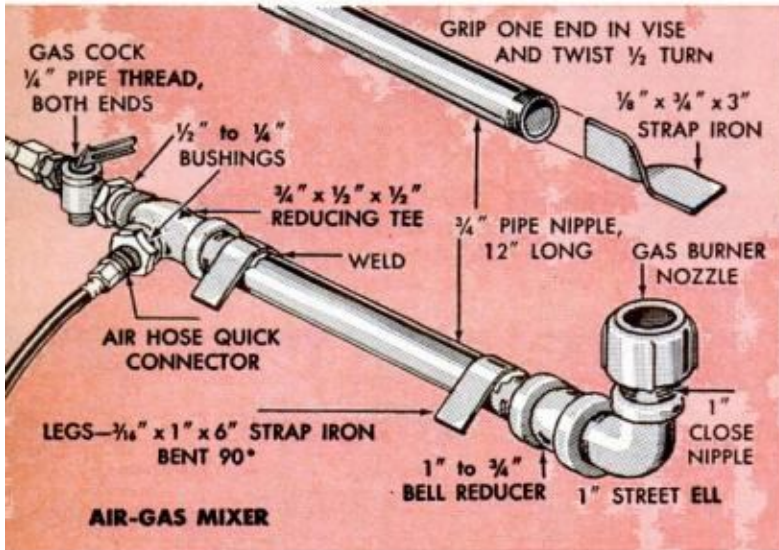
*AISI: American Iron and Steel Institute

**SAE: Society of American Engineers

MAKING A CHISEL WITH A HOMEMADE BURNER



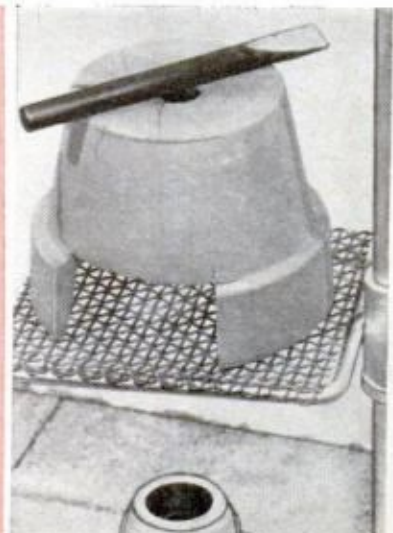
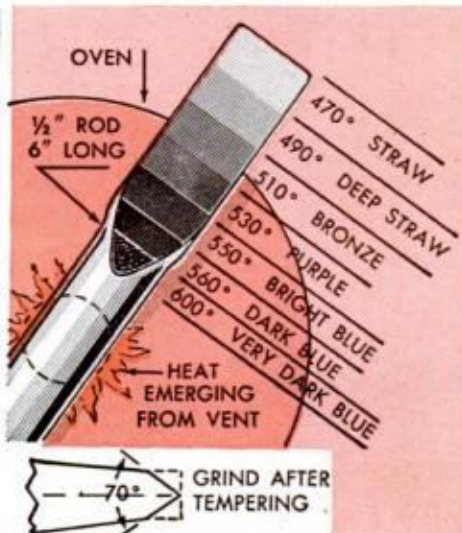
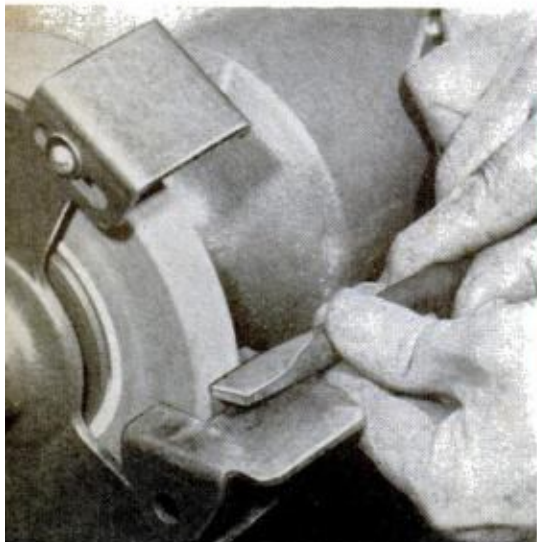
1. Burner is made of standard pipe fittings, plus Eclipse nozzle. 1-in. size gives good blast of heat at 15 lbs. air pressure, works well at 3 to 5 lbs. Photo shows tool steel being heated for forging



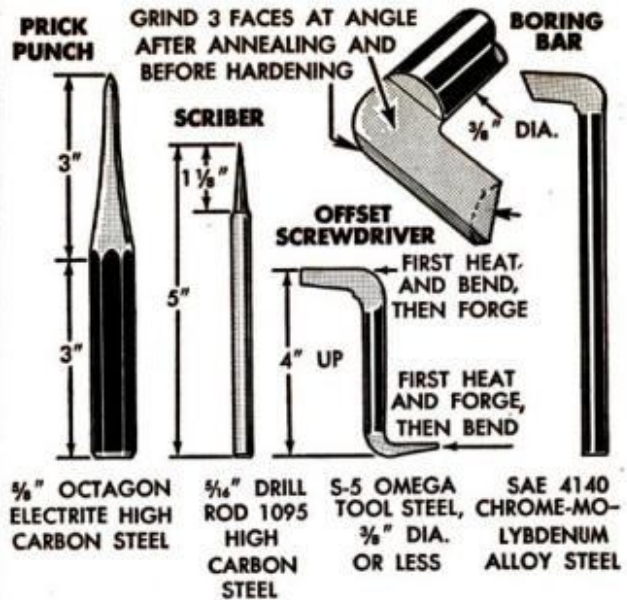
2. After forging on anvil, chisel blank (1/2-in. rod W-1 tool steel) is reheated to annealing temperature and buried in dry ashes for slow cooling. Blacksmith's tongs let you handle hot steel

3. When cooled to room temperature, flat is ground to shape, but end is left square-blunt through hardening and tempering, as steel is now too soft to hold edge. Final grinding is detailed in inset below

4. Tempering is done on top the oven where you can watch colors run down polished blade toward blunt tip. Each color appears at base of flat; when ranged as in sketch, quench and grind



OTHER ITEMS YOU CAN MAKE



similar to High Carbon steel.

Blacksmith-type heat treating requires the least amount of equipment—a small forge, or an oxy-acetylene, acetylene or LP torch. But you'll find a homemade gas burner of the type detailed on the facing page comes in handy. You can make it yourself, using a commercial 1 or 1 1/4-in. nozzle (see product list, page 175). When ordering, specify whether you want it for manufactured, natural or LP gas. Air is supplied by a compressor at 3-5 lbs. pressure (or up to 15, for a really hot flame). Don't have one? Then hook the burner up to a small blower or even to the exhaust of a vacuum cleaner. (You'll probably need an air cock to regulate the flow.) The air-gas mixer is nothing more than a foot-long pipe with a twist of strap iron driven into each end. Twist the two pieces in opposite directions, then hammer their ends broad enough for a drive fit.

The flower-pot oven helps retain the heat when you're heating work in it, for forging; and the pot's hole "focuses" the heat when you're tempering work on top the oven. Don't worry if the pot develops a crack; this won't affect its efficiency.

The chisel being made in the steps at left is shown above with other finished homemade tools. The bushing is 1040 machinery steel, quenched in oil and drawn at 400° in a kitchen oven. The sprocket was case-hardened at 1650° and quenched in brine (no tempering required). The prick punch and scribe were machined on a lathe, then finished to a high polish with a file and emery before being heated to hardening temperature, quenched in brine, and drawn at 300°. The offset driver was forged, annealed, and rough-ground to shape (note that the sequence differs for opposite ends). The boring bar was heated and bent, annealed, ground to

HEAT COLORS OF GLOWING STEEL

Color	Temp. °F.	Notes
Dark Red	1100°-1300°	
Cherry Red	1350°-1450°	Carbon steel is hardened at temperatures from 1350°-1550°
Bright Cherry Red	1500°-1650°	
Orange Red	1700°-1850°	
Salmon Red	1900°	Alloy steel is hardened at temperatures from 1450°-1950° F.
Yellow	2000°-2250°	
Yellow White	2300°-2450°	High speed steels are hardened at temperatures from 2250°-2400° F.
White	2500° up	

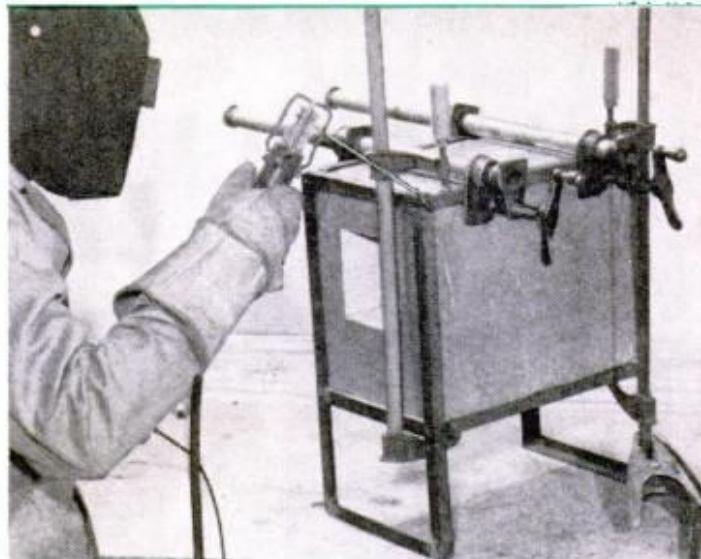
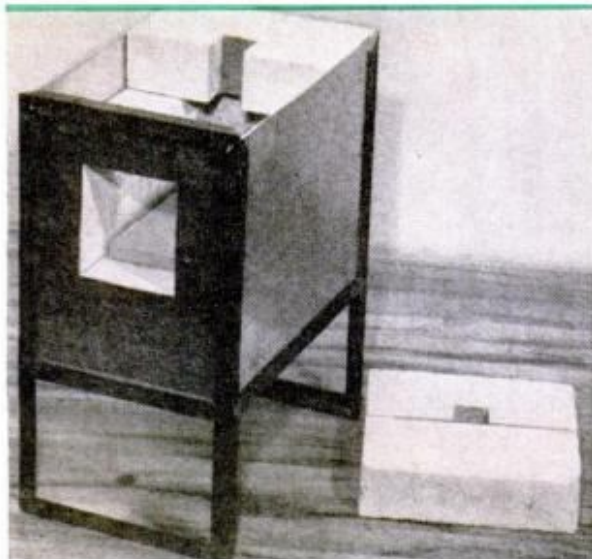
TEMPERING COLORS OF STEEL

Color	Drawing Temp. °F.*	Suggestions for Use:**
Faint Yellow	300°	Scribers, cutting tools, cams, rollers, bushings, etc.
Light Straw	400°	
Light Straw	425°	
Straw (Yellow)	470°	Razor steel, cold chisels, screwdrivers, punches and dies, boring bars, mandrels, shafts, axles, arbors, etc.
Deep Straw (Yellowish Brown)	490°	
Bronze (Purple Brown)		
Bronze (Purple Brown)	510°	
Purple	530°	Woodworking tools
Bright Blue	550°	Lead screws, nuts, bolts, hammers, wrenches, etc.
Dark Blue	560°	Knives and springs
Very Dark Blue	600°	Saw steel, hack saw blades, etc.
Glow black-ish red in dull light	700°-850°	Tool steel spring temper (700°-800° F.)
Glow very dark red	900°-1000°	

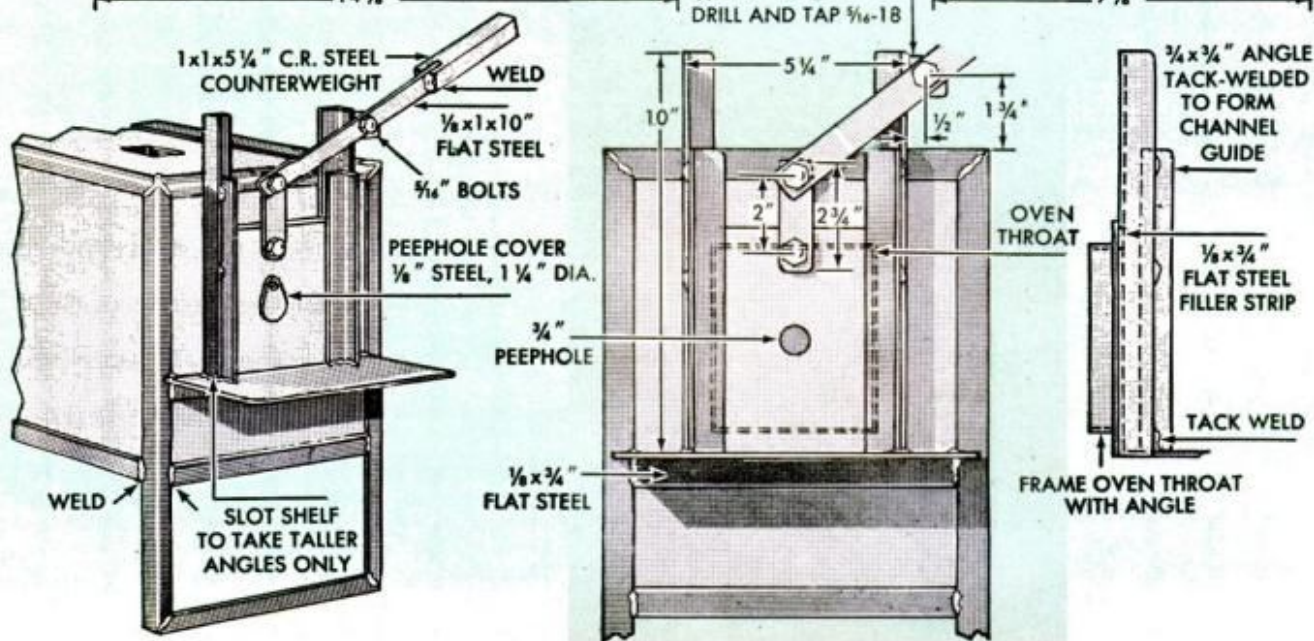
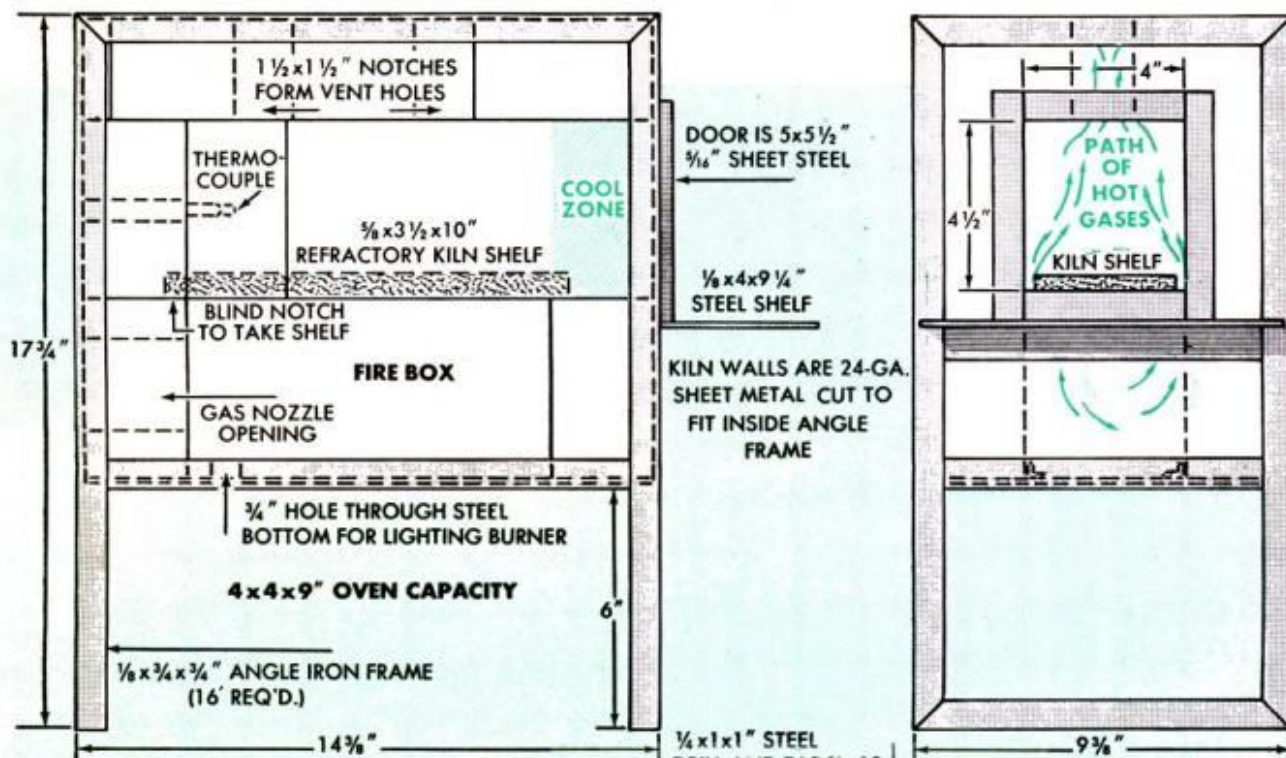
* Draw (temper) 1 hour per inch of thickness (or fraction) at indicated temperature.
** Use this column as a guide only. Let experience determine whether a higher or lower drawing temperature is to be preferred for the particular application.

Carbon steel tempering range: 300°-1050° F.
High speed steel tempering range: 350°-1100° F.

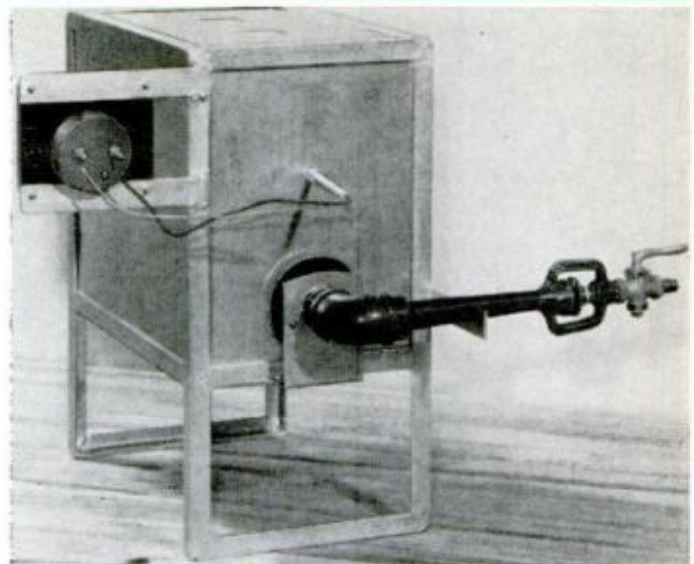
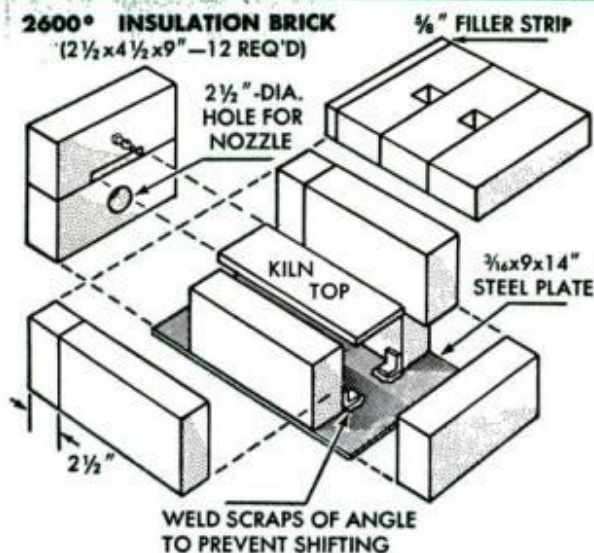
MAKING A PREHEATING/TEMPERING OVEN



ASSEMBLY STARTS with angle-iron frame, then sheet steel bottom and sheet metal sides are set in. Fire bricks are stacked inside to form lining (left) with two of top bricks notched to create vent holes. Matching holes are cut in sheet metal top before it is laid over bricks and top rails are clamped in place for welding (right)



WITH A VENTURI NOZZLE GAS BURNER



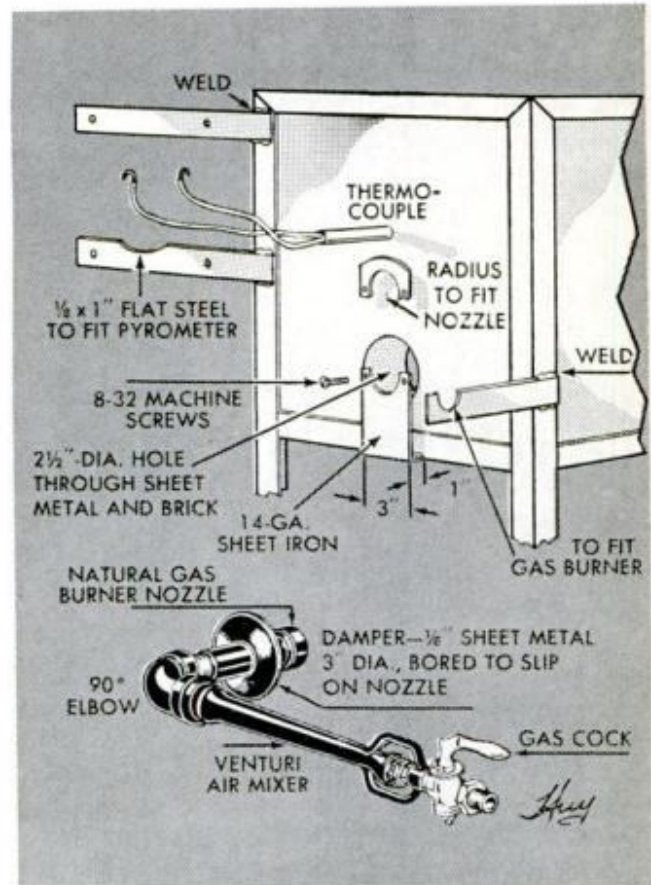
KILN SHELF "floats" within brick lining. There must be a gap of at least $\frac{1}{4}$ in. along each side for adequate draw. Thermocouple brick is notched to fit over shelf. Rear view, right, shows plus and minus thermocouple leads attached to matching terminals of pyrometer—also how Venturi burner nests in two brackets for easy removal

shape (any angle that provides cutting clearance is okay for the three flat faces). Then both these tools were hardened, quenched in oil, and drawn at 400° . After final quenching, those tools that required a sharp edge were finish-ground and polished with emery cloth.

But how about that big homemade oven? Its construction is detailed on these pages. You'll find it very effective for preheating work to the required 1200° F. before placing it in the blast furnace. The Venturi burner uses gas at atmospheric pressure, so needs no blower. The nozzle shown has a 90° angle burner, and a capacity of 25,000 BTU per hour. It lets you regulate and hold temperatures by throttling the gas supply. You can also control heat by moving the sheet-metal damper disc toward or away from the oven's back wall (the bracket provides an inch of space for this), or by partially covering the flues.

There's no trick to welding up the angle-iron-and-sheet-metal oven with its brick lining, as shown in the two top photos, facing page. But the angle-iron throat frame should be welded *in place* for a good

(Please turn to page 192)



WHERE TO BUY THE PRODUCTS MENTIONED

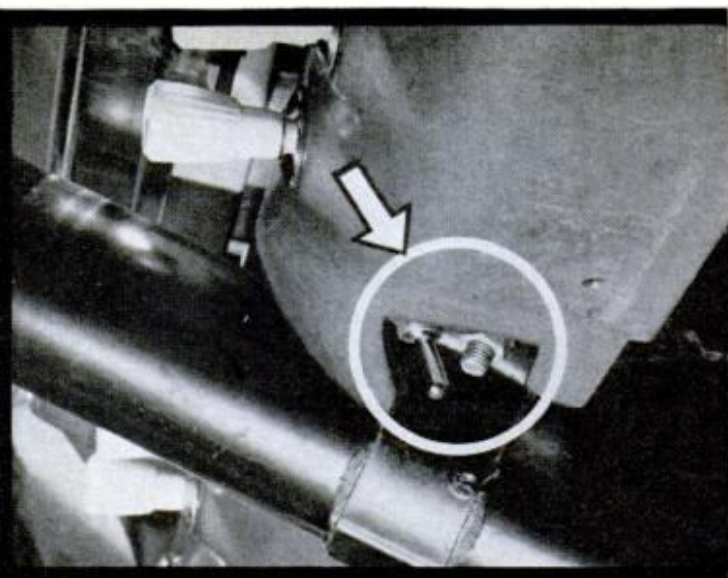
ITEM	SAMPLE SOURCE	STOCK NO.	PRICE
1" or 1 1/4" Eclipse Stick-Tite Nozzle	Industrial gas burner dealer; check GAS BURNERS in yellow pages	Approx. \$2.00
1" "Buzzer" Venturi Nozzle	Charles A. Hones, Inc., 2473 So. Grand Ave., Baldwin, L.I., N.Y.	VNB100	18.50
Blast furnace	Kansas City Specialties Co., Marysville, Kans.	Complete range of sizes	
Pyrometer	Edmund Scientific Co., Barrington, N. J.	70,408	26.00
Thermocouple		40,478	3.75
Case hardening compound	Kasenit Co., Mahwah, N. J.	1-lb. can	

Foil the Car Thief

By Warren Roy

Add a toggle switch to the ignition system wiring and make your car too much trouble to take

THIS YEAR some 400,000 cars will have been stolen in the United States. And if you aren't careful, one of them may be yours. About 30 percent of all stolen cars



ONE PLACE to hide the toggle switch after you have it wired in series with the ignition switch is under dash. Recess it enough to make it hard to see

are never seen again, and while you may be insured, the inconvenience can be a real headache.

The two most common car theft methods entail the thief's getting into your car and under the dash. Many times getting into the car means only opening the door. You'd be surprised how many people don't

Changer for 80 Records

It works like a jukebox, plays both sides of every record, holds 40 discs in interchangeable racks

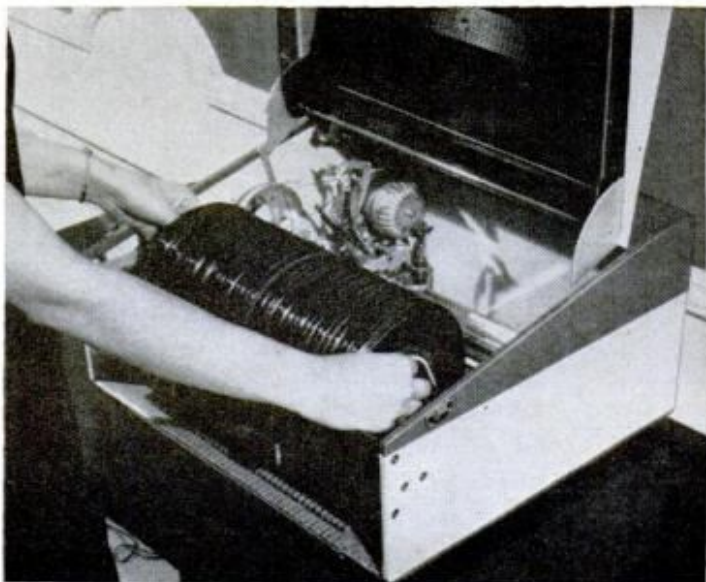
WE'VE GOT ONE COMPLAINT when it comes to long-playing records—you can't select individual pieces from individual records unless you do it manually. This defeats the purpose of that automatic record changer. The other choice is to listen to a lot of unwanted music, just so you can hear the one or two bands of music you really care for.

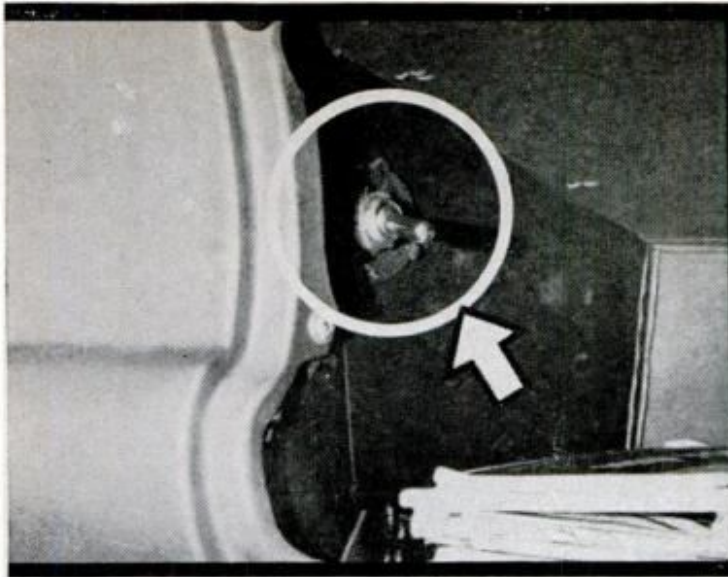
But this doesn't have to be a problem any longer. The other day we saw a new record changer that can play up to 40 seven-inch records, on both sides, auto-

matically. It's just like putting a jukebox in the home. But this one is completely portable and self contained. It even stores 40 records.

Made by Gerinvex in Switzerland, the Discomatic will play either 33 $\frac{1}{3}$ or 45-r.p.m. records. As you can see in the photos records are held vertically and played.

IF 40 RECORDS aren't enough, just lift out the rack you're finished with and slip a new one into place. You can't have too many records for this changer

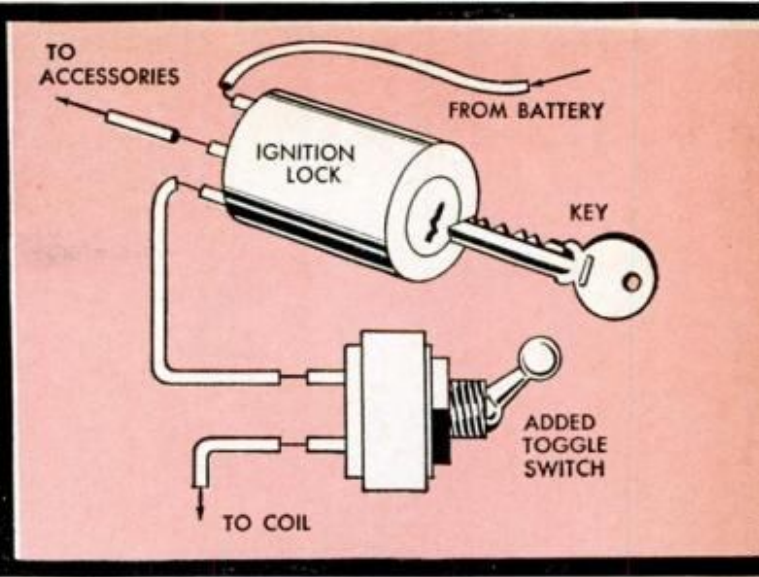




INSIDE the glove compartment is an even better hiding place. Not only does it put the switch out of sight, but the compartment can be locked

bother to lock their cars. Once in the car it's under the dash with a jumper wire to circumvent the ignition switch. The real pro goes one better. He removes the entire ignition lock cylinder and replaces it with a new one—one he has a key for.

Thefts of both these types can often be prevented by simply adding a con-



ADDING the switch is easy, but you may have to poke around until you locate the proper lead from the ignition switch. Ask your mechanic for help

cealed toggle switch in series with the ignition switch. Locate the added switch in some out-of-the-way place—in the glove compartment, under the seat, or under the dash.

When you leave the car, flip the switch and the ignition system is disengaged no matter what is done at the ignition switch.

The single pickup arm has one cartridge with two opposing diamond needles. One needle gets the left side of the disc, the other one gets the right side.

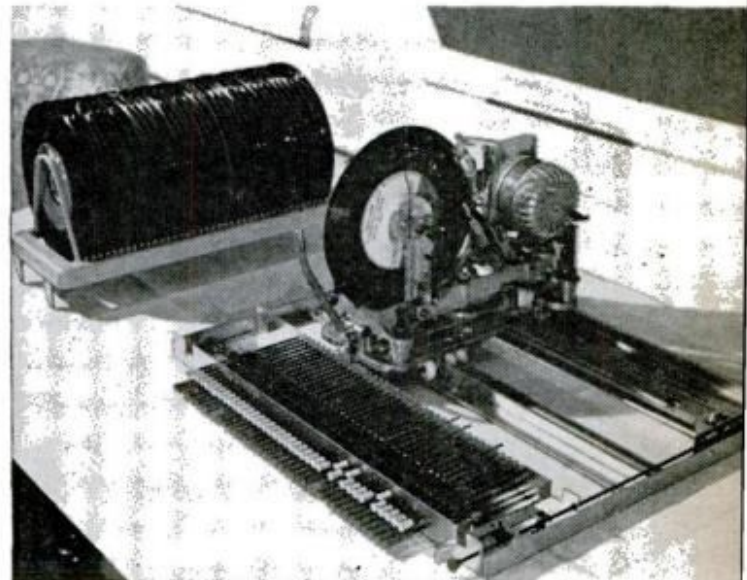
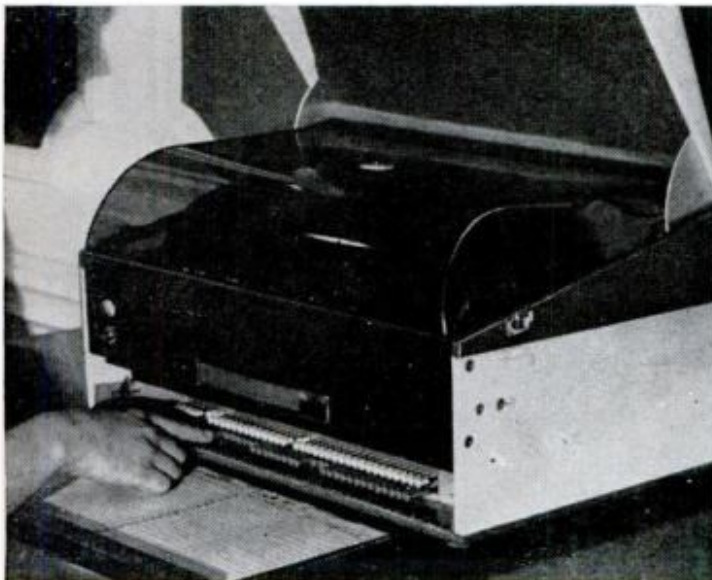
The record rack may be lifted out of the changer and another rack of 40 records put in its place. Each record slot is numbered, and title sheets are supplied for

PUSH THE BUTTONS to select the music you want to hear. Index sheets fit into sliding drawer under pushbuttons. Plastic cover protects against dust

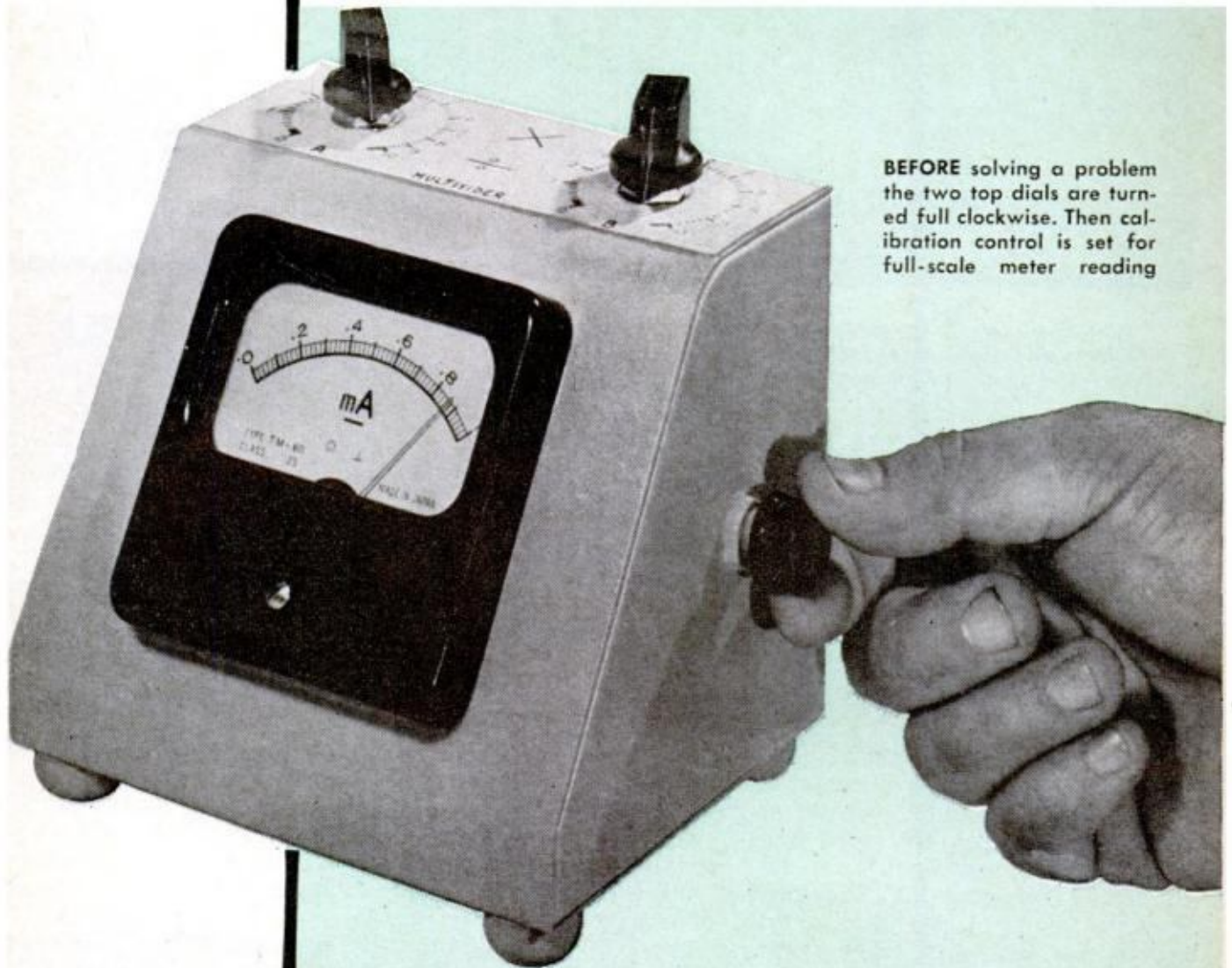
each rack. A series of 80 pushbuttons lets you pick the tunes you want to hear. A lever on the front of the unit allows for cancelling all previous selections.

Discomatic will soon be available in kit form for around \$100. It will also appear in portable phonograph versions. It is being imported by the Lehara Corporation.

HERE'S WHAT the basic mechanism looks like. We've put one record in the play position. The pushbutton selector system and automatic reset lever are in front

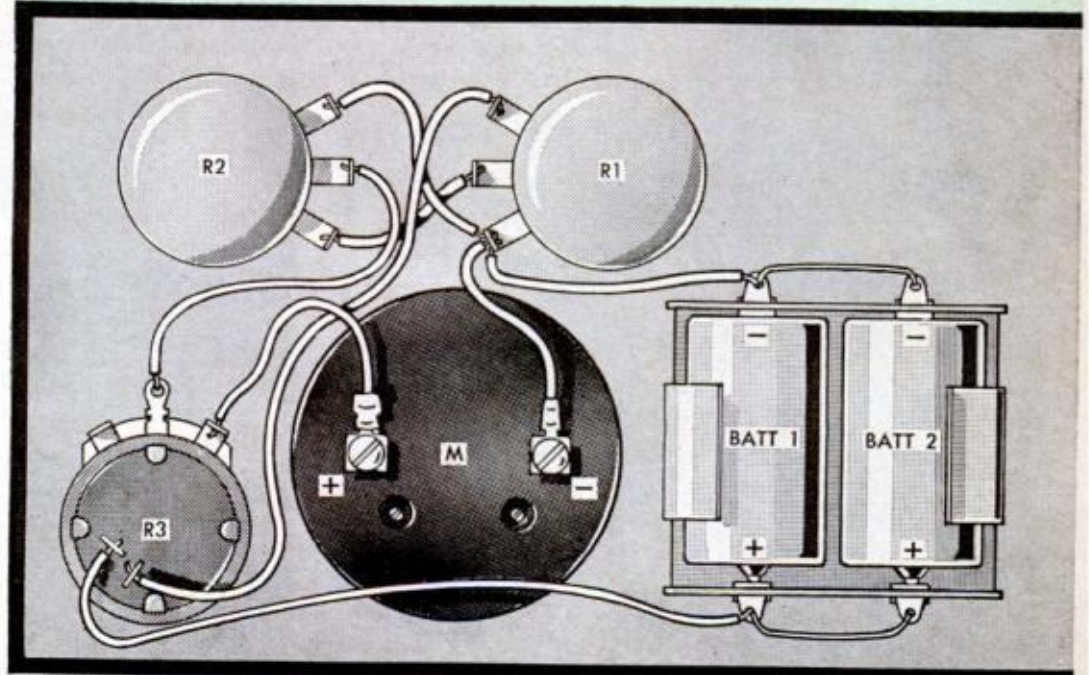


The Multivider-



BEFORE solving a problem the two top dials are turned full clockwise. Then calibration control is set for full-scale meter reading

PICTORIAL DIAGRAM shows how the six electronic components are interconnected. Wiring is simple and can be completed in a very short time. Don't rush and you'll be right the first time



Electronic Slide Rule

*\$10 analog computer multiplies and divides.
Put your own together in less than two hours*

ONE OF THE SIMPLEST of computers, the Multivider has only six parts. The settings of R1 and R2 represent the first two quantities of a problem, while the meter reading represents the third.

Construction is simple; just follow the pictorial to be sure wiring is correct. The case is already punched for the meter.

To calibrate the unit, take a piece of white paper and cut holes in it for the potentiometer shafts. Mount it atop the meter case, fastening it in place with the potentiometer mounting nuts. Now turn on the unit and set R1 and R2 fully clockwise. Then adjust R3 until the meter needle is at the high end of the scale on the 1. Then turn the left-hand control all the way to the left and the meter will read zero.

Now advance the left-hand control until the meter needle is on the first small division. Mark this point at the tip of the control knob with a short line on the paper scale. Continue this until you come to the first heavy line on the meter scale (between 0 and .2). Mark this point with a heavy long line and label it 1. Continue

marking the scale using short lines for the small divisions and long heavy lines for the numbered divisions. When you reach 10, leave the control in that position and turn the other control to zero and use the same procedure to calibrate it.

To multiply 5 times 6 set the left control to 5 and the right one to 6. Read the answer off the meter, as 30 (the meter dial will read 3, but as in using a slide rule the decimal place is known).

To divide 10 by 2 reverse the procedure. Set the left control to 2. Adjust the right control until the meter reads .1 (10, again as for a slide rule). Read the answer on the scale of the right control—5.

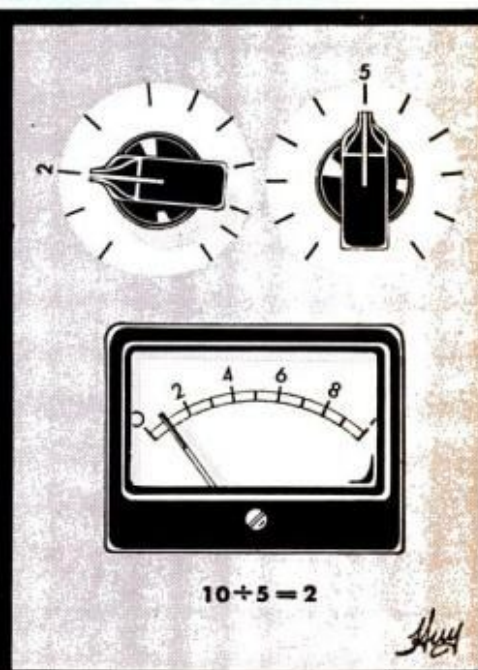
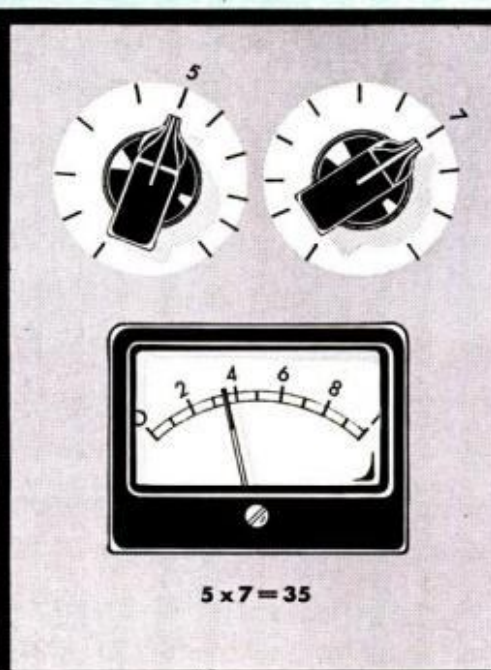
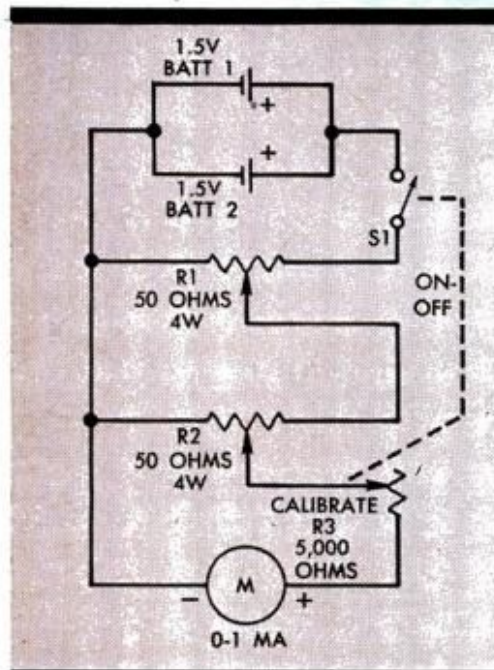
PARTS LIST

- R1, R2—50 ohms, 4 watts, wirewound, linear taper potentiometers (IRC Type WPK-50)
- R3—5000 ohms, linear taper potentiometer with slt switch (Mallory U14 with US-26 switch)
- M—0-1 ma. 3-inch meter (Lafayette TM-60)
- BATT1, BATT2—1.5 volt C cells (RCA VS-335)
- Meter Case (Premier ASPC-23)
- Battery bracket (Lafayette MS-174)
- Pointer knobs (2) Lafayette KN-42)
- Standard knob (1) Lafayette KN-39)

FOR the electronically minded try working from the schematic and double check all wiring against the pictorial diagram at the left

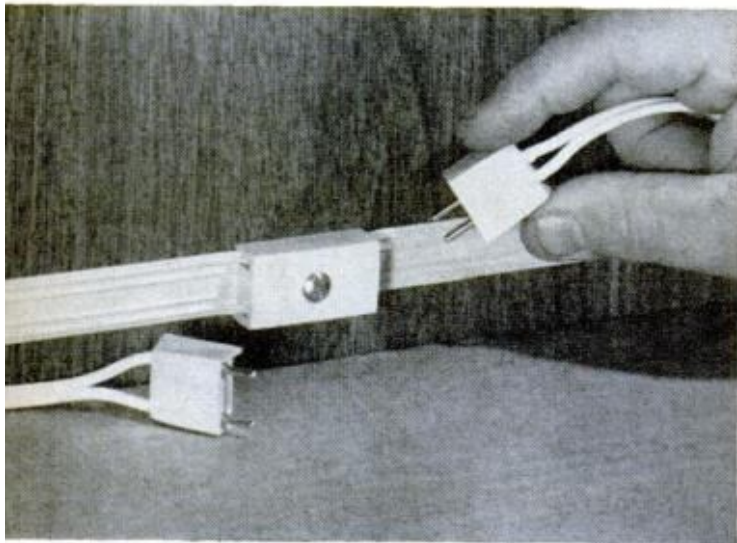
HERE'S the setup for a sample multiplication problem 5×7 . The answer as shown on the meter dial is the expected 35

THIS TIME it's division; $10 \div 2$. Set 2 on left control. Rotate right control till meter reads 10. Read answer, 5, on right

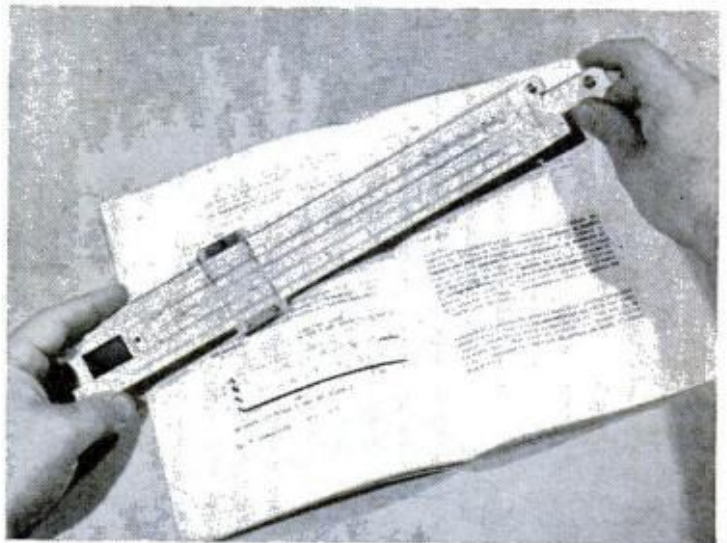


New in Electronics

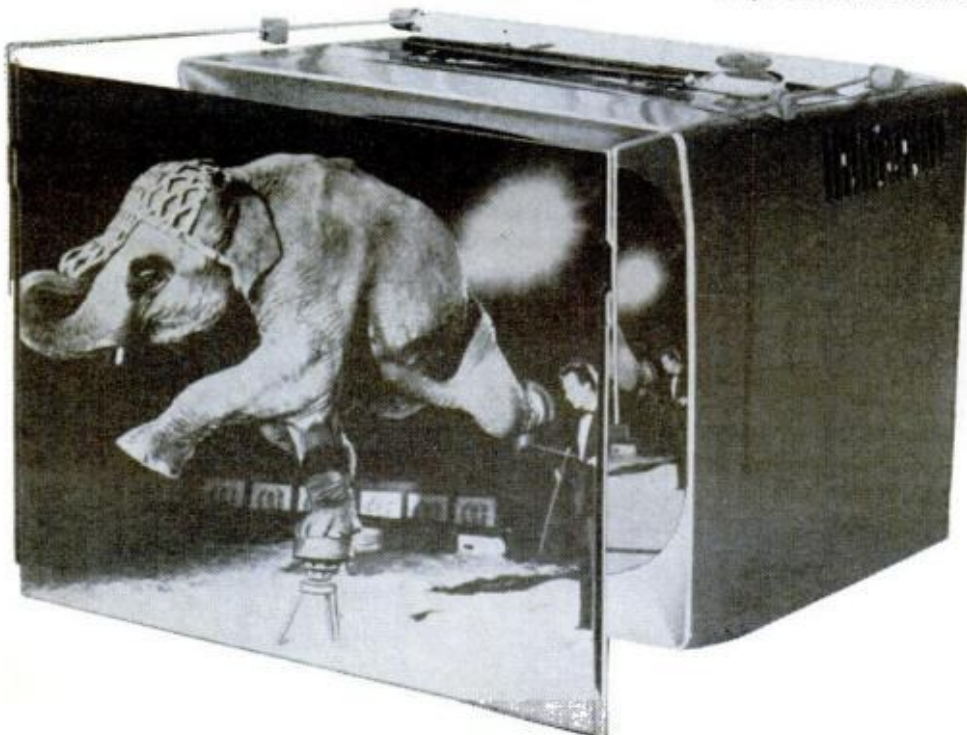
TUNE IN THE TOWER when you use this converter to turn your AM radio into an Aircraft Band Receiver. To use it, turn on both radio and converter, place the converter next to the radio and adjust tuning. It's surprising how much there is to listen to. \$14.95 from Skyway Radio Inc., New Castle, Delaware



EXTENSION STEREO SPEAKERS are easy to hook up when you use Scotchflex audio cable system 800. 4-wire flat cable sticks to most surfaces, and stereo speakers plug right into the convenient connectors. 3M Company, 2510 Hudson Rd., St. Paul, Minn.

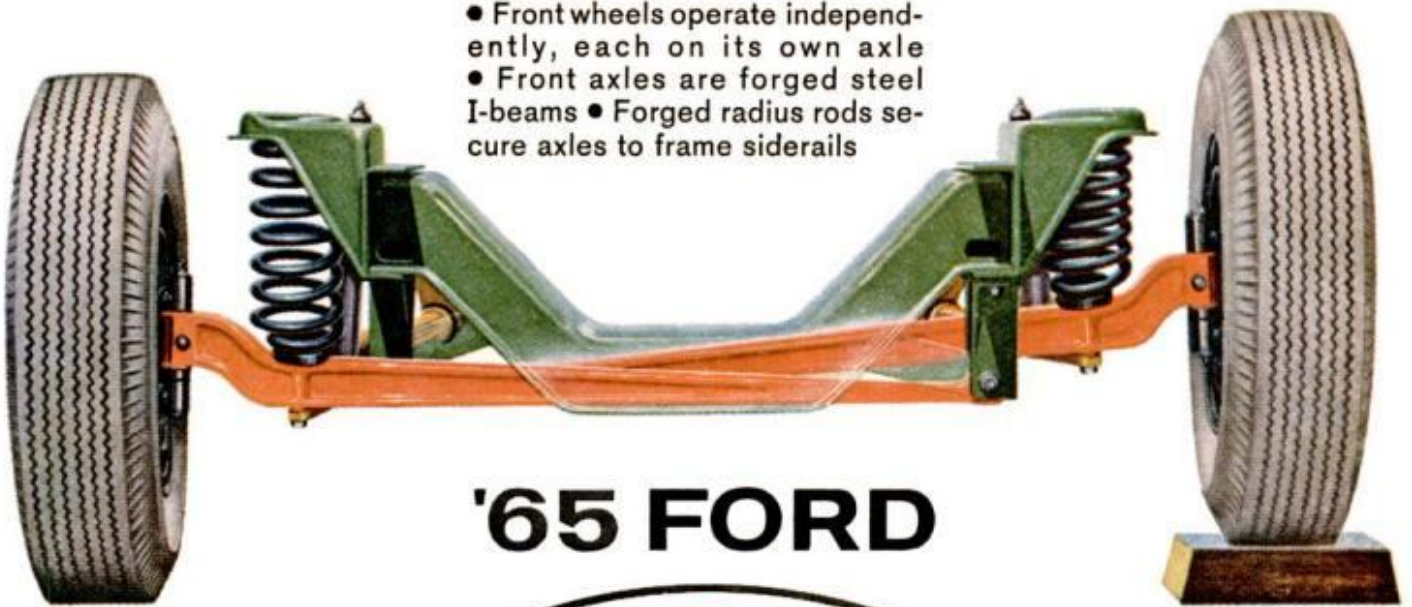


SLIDE RULE FOR ELECTRONICS makes quick work of most any electronics mathematics. Equipped with special scales not found on other rules and accompanied by a 123-page manual, it's an excellent electronics help. Cleveland Institute of Electronics, Cleveland, Ohio



TV SCREEN MAGNIFIERS are back. Eight models from an 8-inch screen unit to a giant 31-inch screen unit are available. All add about a third to the existing screen size. They're made by impressing Fresnel rings into a clear sheet of 1/4-inch plastic. Scope Giant Co., 8447 Wilshire Blvd., Beverly Hills, Calif.

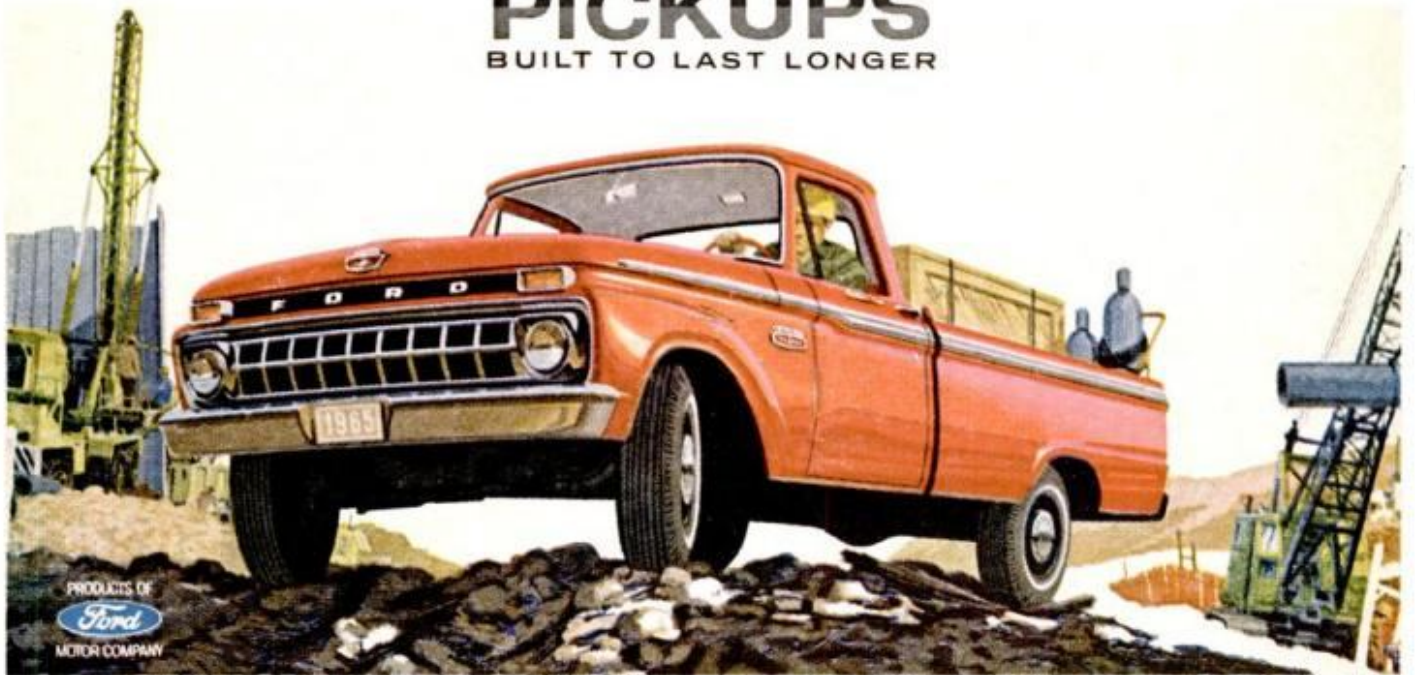
- Front wheels operate independently, each on its own axle
- Front axles are forged steel I-beams
- Forged radius rods secure axles to frame siderails



'65 FORD



PICKUPS
BUILT TO LAST LONGER



Two independent front axles share the shocks, smooth the road!

That's right, Ford's revolutionary new Twin-I-Beam suspension has two front axles to share the roughest abuse! And because of drop-forged I-beam construction—like the big trucks use—they'll really stand up! Moreover, both axles have I-beam radius

rods to hold wheel alignment, cut tire wear and reduce front-end maintenance! But you get more than toughness. Independent action smooths away road shocks . . . gives you a wonderful new feel of control. Try it soon at your Ford Dealer's!



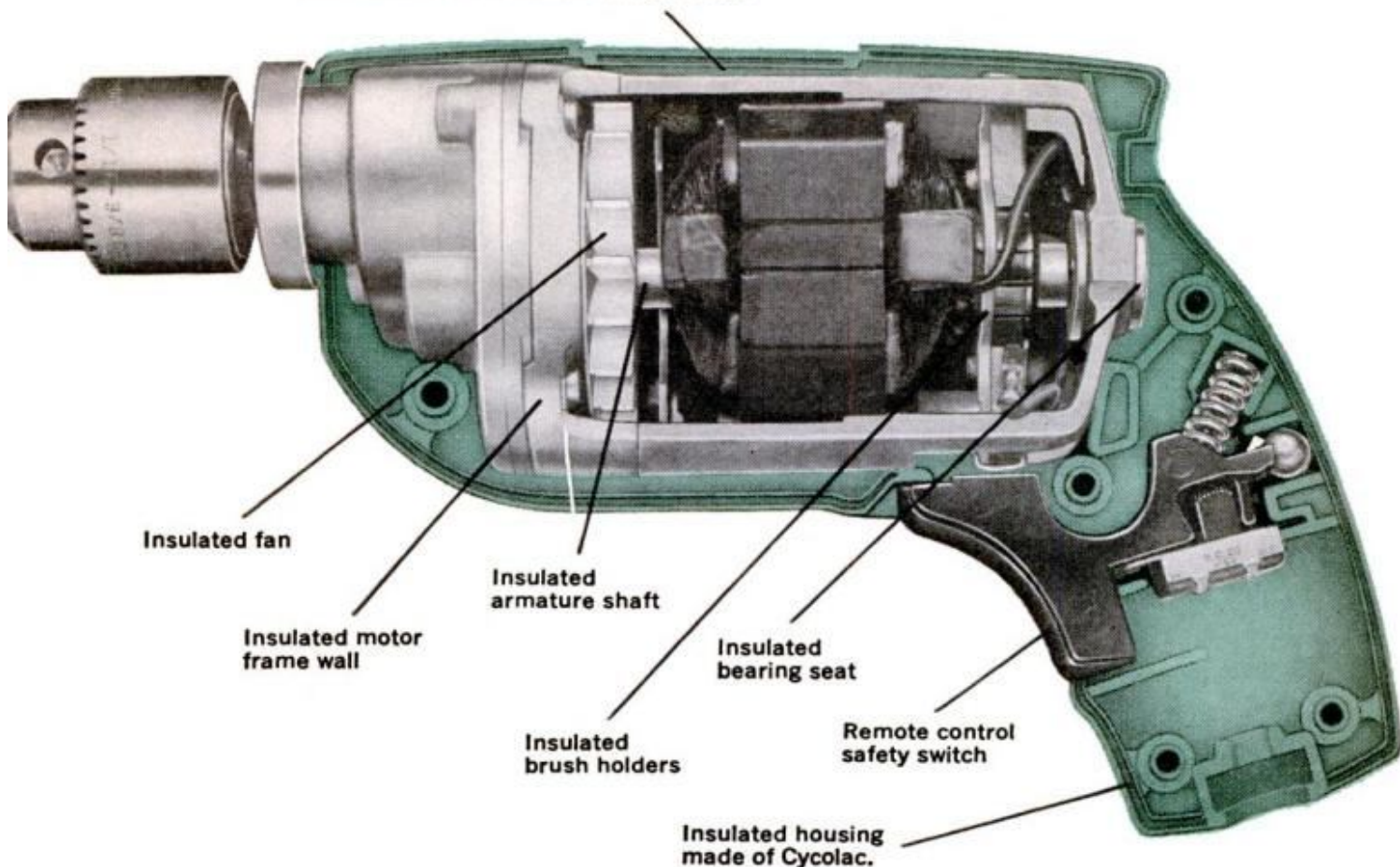
3 all-new engines! New economical 240 cu. in. Six is standard. Or take your choice of two optional engines: 300 cu. in. Big Six or 352 cu. in. V-8, most powerful engines ever offered in Ford pickup trucks!



NEW! The world's safest



***SHOCKPROOF**—Constructed of non-conductive Cyclocac. Double insulated against electrical shock to conform with all Electrical Safety Codes.



power tools by Rockwell Porter-Cable

You've never seen anything like these Porter-Cable tools! They give you qualities that, up to now, you couldn't buy in any tool at any price. These tools are:

Shockproof*—Total insulation assures complete user protection against electrical shock. No three wire plug or adapter needed. Use anywhere with confidence.

Breakproof—Housings of amazing new CYCOLAC® are so tough, they're unconditionally guaranteed against breakage—FREE replacement.

Failure Proof—All motors are protected with high temperature insulation, they last longer, won't burn out from overload.

These tools are industrially rated, have the power and convenience features of tools costing much more.

Available through December 31, 1964 at these introductory prices: 1/4" Drill—\$14.88,

Reg. T.M.—Marbon Chemical Div., Borg-Warner

3/8" Drill—\$19.88, Jig Saw—\$22.95, Finishing Sander—\$22.95. Drills and saw available in kit with accessories—about \$10 more.

Look for your Rockwell Porter-Cable dealer in the Yellow Pages or write—

POWER TOOL DIVISION
502M N. Lexington Ave.
Pittsburgh, Pa. 15208

Gentlemen:

Please send me

Complete literature

Name and address of my nearest dealer

Name _____

Address _____

City _____ State _____ Zip Code _____



Rockwell
MANUFACTURING COMPANY

Buy the Green Line for safety.



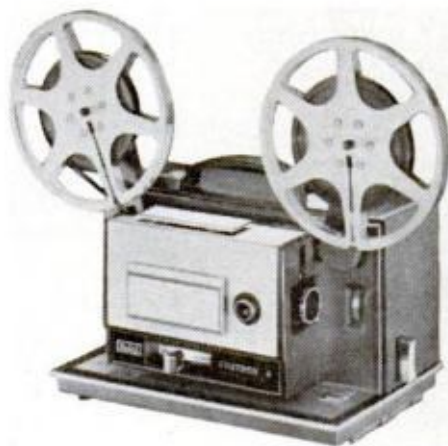
Never before has an advanced camera been so automatic. Loading, exposure settings for daylight or flash, and film advance are all auto-

matic. Built-in rangefinder. 1/250 shutter. Built-in, pop-up flash holder. **KODAK INSTAMATIC 800** Camera, with $f/2.8$ lens, less than \$130.

1964 KODAK Gift



Superb gift for family movies! Drop-in cassettes eliminate in-camera film threading, make loading easy. Battery drive winds film. Electric eye adjusts lens aperture automatically. **KODAK Electric 8 Automatic Camera**, with fast $f/1.6$ lens, less than \$80. **KODAK Electric 8 Zoom Camera**, with $f/1.6$ zoom lens, pistol grip, cassette, carry straps . . . less than \$160.



Shows movie "stills" as brilliantly as color slides. Dual air jets cool film, let you project stills brighter than ever to give you a fascinating new look at movie action. Slow motion and reverse action let you add interest, humor, pace. **KODAK CHEVRON 8 Projector, Model 10**, with $f/1.2$ lens, less than \$190. With $f/1.0$ lens or $f/1.2$ zoom lens, less than \$215.



Wonderful way to start someone out in photography. Camera loads instantly. No threading, no settings to make, no focusing needed. Has built-in, pop-up flash holder. **KODAK INSTAMATIC 100 Outfit**, with camera, film, flashbulbs, flashguard, wrist strap, and batteries, less than \$18.



Can't make a mistake. Electric eye automatically sets exposures outdoors. Dim-light signal in viewfinder warns you to switch to flash. Film advance is automatic, too. **KODAK INSTAMATIC 400 Outfit**, less than \$60. **KODAK INSTAMATIC 300 Outfit** has camera with same electric eye, manual film advance, less than \$50.



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Guide for Men



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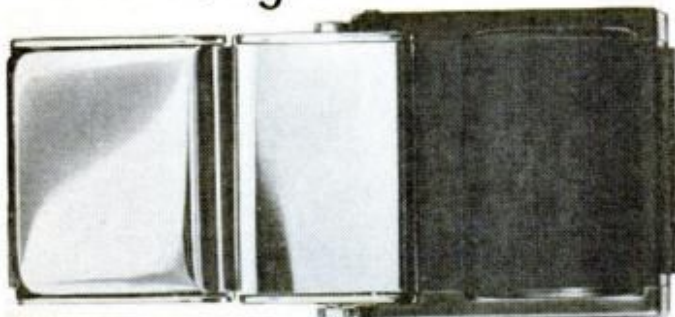
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Build a Family Sauna

(Continued from page 129)

the concrete with mastic can be used to hold the furring in place. Such nails are spaced about 2 ft. apart, in rows, and the furring is impaled on the protruding nail points by rapping the strips with a hammer and then clinching the nails.

Spaces between the 2 x 4 studs and the overhead floor joists are filled with 2-in. blanket-type fiberglass insulation which is stapled to the studs and joists in the conventional manner. After this you cover all four walls of the sauna, plus the ceiling, with two layers of aluminum foil to form a vapor barrier. Before the insulation and foil are applied, however, 2 x 4 nailers must be installed between the wall studs so you'll have something to nail the redwood or cedar boards to. If you plan to recess a light in the ceiling, which should be a weather-proof fixture, do it before you nail the redwood to the joists. After bringing in a connection for the sauna heater, you can line the walls with redwood, applying the boards vertically and nailing at the top and bottom and to the 2 x 4 nailers. Blind nailing the 6-in. tongue and groove redwood is preferred over surface nailing. Here the nails are driven at an angle through the tongue of each board (using a nailset to avoid banging up the tongue) so they are hidden by the succeeding board. The walls of the adjoining shower room can be lined with any kind of panel board, the ceiling can be furred for 12-in.-sq. tile. Outer wall covering can be the same as that used to panel the shower room. The shower stall is simply a commercial unit.

Low or High Benches

The redwood benches in the sauna can be single or double tier. In some saunas you'll find them left open underneath, but by boxing them in as shown, you can cut down on the cubic area to heat. Some saunas are fitted with wooden floors, others are covered with fiber matting. One or the other should be added to keep you from doing an Irish jig on the hot concrete. The door leading to the sauna is built up around a 2 x 4 frame, faced with redwood on the inside, filled with fiberglass insulation and covered on the outside with 1/4-in. plywood. A wooden turnbutton can be used to hold it shut; any metal lock would soon become too hot to handle.

The sauna detailed here was designed for the Scantek heating system but, of course, can be used with other heaters. Whatever heater you use, a picket guard fence should be erected around it to keep anyone from touching it. ★★★

POPULAR MECHANICS



What an experienced gift giver did with \$46 for Christmas

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HARLEY-DAVIDSON

Madhouse Behind the Mailbox

(Continued from page 120)

Doctrine as an obvious first step toward a "get soft with Cuba" policy.

Americans constantly flood the Post Office Department with requests for all kinds of commemorative stamps to be printed. Recent suggestions have included requests for new stamps to be issued in praise of such items as Elvis Presley, dinosaurs, tobacco, hamburgers, the totem pole, a champion hog caller and the completion of the 3000th swimming pool in Palm Springs, Calif.

One woman asked that a Battle of Gettysburg commemorative stamp be based on portraits of Lincoln, Grant, Lee and her grandfather, an aide to Jeb Stuart.

Addresses Like Parlor Game Clues

One of the reasons the letter carrier must know his route so well is the "unusual" addressing often found on the envelope. The Post Office (taking it calmly) delivered a letter from a Texas woman addressed, "Downtown furniture store, run by two brothers who look alike, across the street from dime store, appliance store at one end of street, dry goods store at other, Gulfport, Miss."

And on and on . . . a Des Moines, Iowa, man became very upset about stamps he had ordered for mailing church notices. He refused to accept Devil's Tower National Monument Commemoratives.

"People waste a lot of time," wrote a California man, "in arranging stamps right side up." He suggested that stamps be designed "upside down proof" so that they can be affixed at random.

Among many kinds of stamp collectors in the United States is an inner-sanctum group called the Pre-Cancel Society, one of whose aims is to be first-on-the-scene when a new stamp is issued.

Of course, when a new stamp is issued, the Post Office holds a traditional "first day ceremony" in the appropriate city. Atchison, Kansas, birthplace of Amelia Earhart, for example, was the first-day-city for a commemorative stamp honoring the famous aviatrix. On the same day, the Kansas Pre-Cancel Society—recognizing an opportunity when it saw one—held its annual meeting in Atchison.

Once aloft on a commercial airliner, one might believe that the U.S. mails are protected from the unusual. Not so! A while back, 20,000 ladybugs on their way from the West Coast to New England (where they were to attack the aphid problem) managed to break loose from their crate and concentrate on passengers instead.

The department's "front-line soldier,"

the letter carrier, is not exempt from odd-ball happenings. In Mankato, Minn., a rural carrier looked over his shoulder and saw a crow pry open a box and fly off with a letter. It was recovered.

And in San Jose, Calif., someone tried out a new idea in credit services. The carrier found a note in the mailbox ordering postage stamps and accompanied by a credit card. It didn't work.

When it comes to danger, however, the ordinary dog creates the greatest threat to the letter carrier's life and limb.

Funny, yet ironic, was the cartoon recently carried in a national magazine. It showed executives of a dog food company in conference over a new product they felt would dominate the market. It was a biscuit in the shape of a letter carrier.

The dog, as every postman knows, is *not* man's best friend. Mailmen, of course, have been attacked by everything from goats to roosters. In Philadelphia, one homeowner posted a sign reading "Bad Cat." But it's still Fido who has the reputation.

When the National Association of Letter Carriers meets in convention, casual conversation usually drifts to a familiar topic—dog bites. America's beloved dogs chew on 7000 postmen a year and cost the government about \$1,000,000.

Turnabout for a Hairless

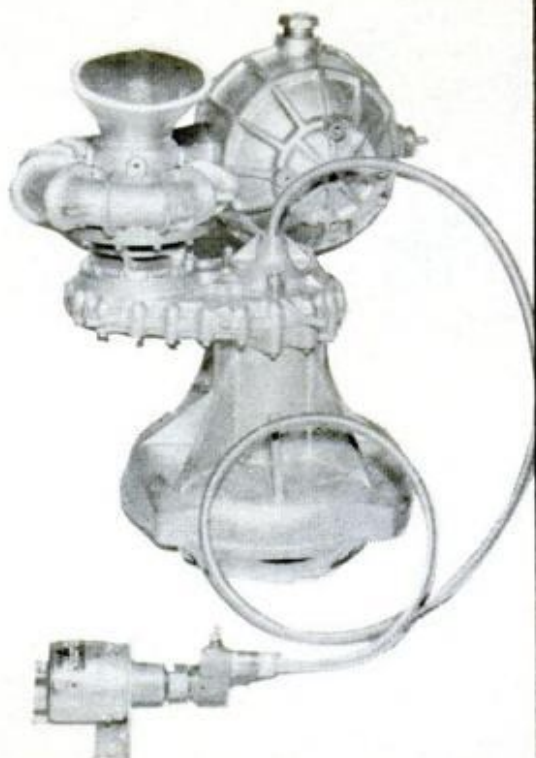
One postman, fed up with being attacked, reportedly took the classic reprisal against the breed by biting back. According to a Washington correspondent for a Newark, N.J., newspaper, letter carrier John Doherty bit a Mexican hairless in suburban Silver Spring, Md., after it had repeatedly nipped at his heels.

The Post Office Department, equally fed up with the high cost of medical and legal treatment following 7000 dog bites, is striking back with an anti-dog weapon, an aerosol bomb containing an extract of cayenne pepper which besieged letter carrier can squirt in the faces of their foes. The sprayed dog slinks away with only his ego damaged.

Then there was the man who had a stamp cancelled on his forehead. Actually, as a Pre-Cancel Society member, he had just purchased an Earhart stamp at the post office. After being told that postal regulations require that stamps be affixed before they can be cancelled, he pasted the Earhart stamp on his brow, thrust his head inside the cage and said, "Cancel!" The clerk complied with a handstamp.

Standing in line behind him, waiting to buy stamps, was a young woman. "Is this unusual?" she asked the postal worker. Told that it was, she said, "I think I'll have one too!" ★★★

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Therapy From the Sea

(Continued from page 112)

thurin is a nerve blocking agent and an anticoagulant. As a bonus, it's a possible shark repellent.

The Aquarium's laboratory was the scene of another significant discovery: ectyonin, a broad-spectrum antibiotic found in the red-beard sponge by Dr. Sophie Jakowska.

"Water around sponge beds usually stays fresh and clear even though sponges die," says Dr. Jakowska, research associate at the Aquarium. "We suspected that the sponges kept the colonies pure by secreting chemicals that prevented decay germs from growing. Such chemicals might make useful antibiotics, so we decided to investigate."

Power of the Red Beard

Dr. Jakowska tested extracts from various species of sponge on germ colonies growing in gelatin. Several sponges—the heavenly sponge, fire sponge and bleeding sponge, for example—were deadly to a few kinds of disease bacteria. But the red-beard sponge wiped out many, including those responsible for penicillin-resistant staphylococcus infections, tuberculosis, trench-mouth and some bladder disorders. The drug finally extracted from the red-beard sponge—ectyonin—is still being looked into for its action against other microbes and for possible side effects on persons using it.

Deep Secrets of Trade

How long before marine drugs reach your medicine cabinet? Only the country's pharmaceutical companies have the money and manpower to give a prospective drug the years of screening demanded by the U.S. Food and Drug Administration before tests are conducted on human beings. And these companies are as talkative as clams. In the highly competitive pharmaceutical trade, details of any progress with new drugs are guarded like a formula for turning lead to gold. There are rumors that some marine drugs are now being tested—or ready to be—in hospitals. But exactly which ones, if any, have reached the finish line isn't public information.

No one in the field doubts that when marine drugs start flowing from the oceans, a new era in therapy for human ills will begin. "The sea is a gigantic pharmacy," says one biomarine scientist. "All you have to do is go to the right shelf for treatment of a particular illness. The research going on now is showing us what shelf to go to." ★★★

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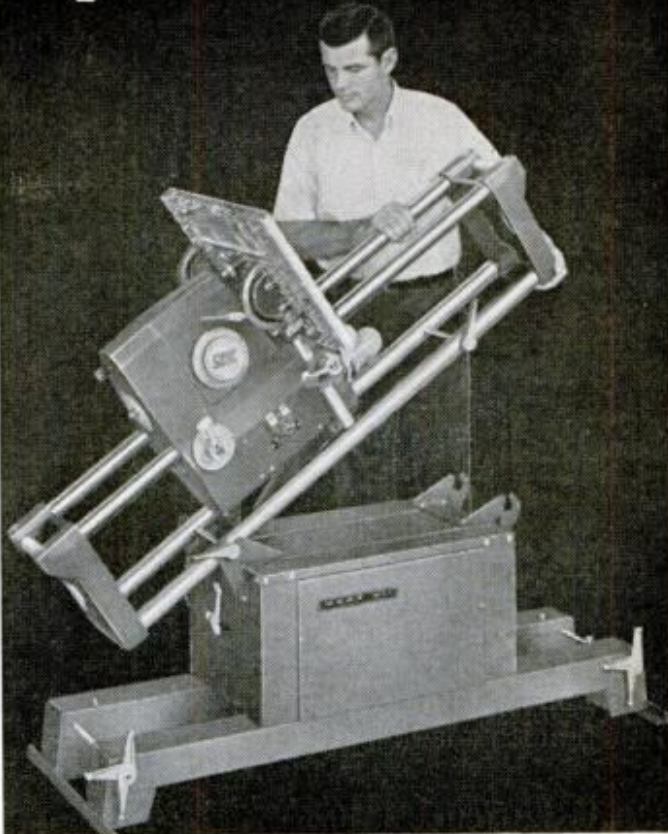
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Speed Carnival at Bonneville

(Continued from page 73)

hit the dip, the nose wheel went 68 feet through the air, but the car was still on the ground and I was really moving. Only now I was heading for the second row of telephone poles.

"I threw the fin as hard as I could to the right, and the car started veering gradually. If I had had steering, maybe I could have spun it. But maybe it was better this way. I might have flipped it instead. Then I was headed exactly for this pole. It was a dead hit—impossible to miss. I closed my eyes and stuck my head down just before I hit, waiting for that real sick feeling you get when you get swatted hard. And I heard a little thump and opened my eyes and there was no pole. I was still there and the car was still going. The left rear axle fairing had splattered the pole in a million pieces but it hardly did anything to the car. I haven't figured it out. I don't know whether God moved the pole or what happened.

"Then I hit water about four inches deep and this slowed me down a great deal. I saw the embankment coming, and I thought 'This is going to flip me for sure.' I was doing about 200 when I hit it, and the car glanced off and sailed through the air about 50 feet. When I was up in the air, I saw that I was going into the water. So I threw the canopy off while still in midair, and the car hit the deep water at about 160 m.p.h.

"When the water started pouring in, I pulled my harness and started out. But I was stuck. I finally realized my air mask was still plugged in and I ripped it from my face just as it pulled me under to eye level. I thought 'Oh my God, I got through all that and now I'm going to drown.'"

Breedlove swam ashore and waited. "When I saw them coming," he said, "I waved to show I was all right. You know, our crew of eight had donated a lot of time gratis—a bunch of guys who believed in something. We all went to school together, and the last election was the first time we'd voted. President Kennedy was kind of our hero. You know, he said, 'Ask not what your country can do for you, but what you can do for your country.' This was what we felt we could do—bring the land speed record title back to the United States. That's why we call this car we built the *Spirit of America*. It sounds corny, but that was the spirit in which we did it. And when that car went down and I turned and saw just the fin and the American flag sticking out—that was really it—beautiful. Then I had to let them know I was okay."

The cars at the Bonneville free-for-all

this year—like the drivers—were terrific performers despite their troubles. Two machines in particular—Breedlove's *Spirit* and Arfon's *Monster*—were outstanding. While both are capable of bettering 550 m.p.h., they are designed along diametrically opposed principles. *Spirit* is slim and elegant, like a jet fighter without wings. She's designed to slip through the air as smoothly as an eel through oil, and develops maximum speed for every pound of thrust. She is relatively low-powered, with a 5700-horsepower J-47 jet engine.

Monster, on the other hand, has the graceful lines of a sawed-off stove pipe and gets her speed by brute force: 17,500 jet-powered horses are harnessed under her skin. She'll win no beauty contests ("I didn't make her to look pretty," said Art) but she took off like a startled gazelle when Art stomped on the throttle.

Rumor got around this summer that Breedlove had recently upped the power of his J-47 by adding afterburner or water injection. Neither was used, although water injection was available on standby. Breedlove says the car has always had the ability to exceed 500 miles an hour. He just hasn't used it before. "This business is a little bit like Russian Roulette," he told me, "except each time you put more bullets in the gun." He didn't go faster than 407 last year "because I didn't see anybody that was going to come close to it, and it's very dangerous."

Three changes were made in Breedlove's car before this year's run. First, the steering linkage was strengthened (it still may not have been strong enough, since linkage failure probably caused the loss of steering in the last run). Second, the nose fin was made smaller. And third, streamlining of the rear axle housing fillets were improved. Breedlove also had a new engine this year, identical to the one it replaced. It had, however, been tuned to operate at high exhaust gas temperatures and r.p.m. which means it will furnish up to 500 lbs. more thrust than the static sea level rating of 5200 lbs. for the old engine.

Art Arfon's car was the most powerful racing vehicle ever built. Art managed to get a J-79 jet—the only one released by the military as surplus so far—which delivers 10,000 pounds of thrust straight, 17,500 with afterburner. "The J-79 drives an F-104 faster than 1600 miles an hour," Art told me in Akron last July. "It will push nine tons straight up and hit the speed of sound. I could put it in my bus," he said, referring to the rebuilt city bus used to haul his racing cars around, "and break the sound barrier."

But power is only one ingredient in building a race car. Control is the other.

Breedlove's car is designed like an arrow. The high tail and rear axle fairings act like feathers and hold it straight at high speeds.

Arfons, however, figured his greatest problem would be the tendency of the front end to leave the ground. His solution was a small, horizontally pivoted wing mounted over the nose (see photos). Also, for better directional control, Art linked a small rear rudder to the steering. Early trials showed that it wasn't needed, so it was disconnected and bolted in place.

After his 500-mile-an-hour blowout, I asked Art how much speed he thought was built into his car. "I believe," he said, "it would still handle at 600. If the course was smooth, I wouldn't mind trying it." His run on the 27th proved the point.

Says Breedlove of the *Spirit*: "I think we had the potential to go into the high 500s and possibly 600 miles an hour. We didn't really find out on that last run (officially clocked at 539) because I stepped down on the throttle too fast and got a compressor stall. Then I took my foot off the throttle once during the mile when the car started to drift off course." *Spirit's* top speed, unfortunately, will never be known. The car, says Craig, has had its last run. He plans to repair it and keep it for its historic value as the first car to break 400, then 500.

Mach 1 Racer

Breedlove still discusses his record run with considerable humility. I noted that he'd disappeared Wednesday night after the run, and asked where he went. "I wanted to be by myself," he said. "I drove down to Nevada and stopped and looked at the stars and things, you know. I was thinking I was the luckiest guy in the world to still be alive, and I kept trying to figure out how that pole got out of the way . . ."

Meanwhile, the *Spirit's* pilot is already planning his next racer. "We learned a lot from this one," he says, "and our next car will be practically unbeatable." How fast will that be? Breedlove, reportedly, is working on a car to break Mach 1—the speed of sound.

Art, on the other hand, says he is satisfied with *Monster*. She'll go, he says, faster than he'll ever push her. (The J-79, he says, would drive a properly designed car 1000 mph. *Monster*, however, isn't designed to break the sound barrier.) This winter, he plans to hook one of his 1700-hp Allison aircraft engines to a tire-testing machine so Firestone can build and test 700-mph tires for his next run.

Next year should be quite a season.

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Heat Treating in the Home Shop

(Continued from page 175)

fit. Then weld on the flat steel cross-brace and weld the bottom flange of the throat frame to it. Next, add the two tall door-slide angles and weld a filler strip between them, across the top flange of the throat frame. Add the steel shelf, notch-welding it to the door-slide angles, then set the shorter slide angles on top this shelf and tack-weld them to the taller angles. Before slipping the door in place, coat all oven parts with a high-heat aluminum paint.

The insulation brick can be bought from an industrial supply house (at around 50¢ per brick for the 2600° grade)—or from a fire-brick dealer. You should be able to build the oven for \$10, not counting the cost of the burner, pyrometer and thermocouple. And the burner is installed so you can remove it easily for paint burning, singeing, welding pre-heat, or other jobs.

The pyrometer is a must for exacting work, but you can get adequate results by learning to recognize the colors of heated steel. The glowing colors of "red hot" steel are given with their corresponding temperatures in the smaller chart on page 173. The tempering colors are given in the second chart; unlike the first list, these colors don't give off light, but are caused by oxides forming on the polished surface, starting with pale yellow at about 400° F. As the temperature rises, the colors change, passing through straw, bronze, purple and various shades of blue. By using these charts you can do as the blacksmith does: When the pre-hardened work turns the tempering color desired, quench it immediately.

Tempering in a Kitchen Range

Better results can be had, however, by heating the hardened steel to the tempering temperature listed in the second chart and holding it there for one hour per inch of thickness (minimum time, one hour). The kitchen range, gas or electric, is ideal for this, as it provides thermostatically-controlled temperatures up to about 600° F. Many professional job shop operators buy an electric range on the second-hand market and use it for all their tempering needs. If you do this, make sure the oven thermostat is in working order.

Before you attempt any hardening and tempering, you should know what happens to the steel during such processes. As steel is heated, a change occurs in its internal structure. At a point called "the critical temperature," the change is completed and the properties of the steel become different from what they were in the cold state. The critical temperature varies with differ-

ent compositions of steel, but it is always in the glowing state and the steel becomes soft, ductile and non-magnetic. You can tell when the critical temperature has been passed by holding a compass near the hot steel; the needle should not deflect. Quenching temperature is only slightly higher than the critical, so you can determine this with a fair degree of accuracy by touching a bar magnet briefly to the glowing steel. When it no longer sticks, the work is ready to be quenched.

In the slow cooling of steel, the carbon separates out as carbides, and the cooled product is soft and easily filed or machined. This process is called "annealing." When cooling is rapid, as in quenching, the carbon does not have time to separate and the internal structure of the steel changes into a product supersaturated with carbon. This makes the steel very hard and brittle. In the tempering process, some of the temper is drawn by re-heating the steel to a degree lower than its critical temperature, further changing the internal structure by precipitating some of the carbon in the form of carbide. Steel gains in ductility and loses hardness with increase of tempering temperature. It is necessary, therefore, to choose a tempering temperature at which hardness and ductility are balanced to best serve the purpose for which the steel is to be tempered (see third column in Tempering Colors chart).

Why Pre-Heat Steel?

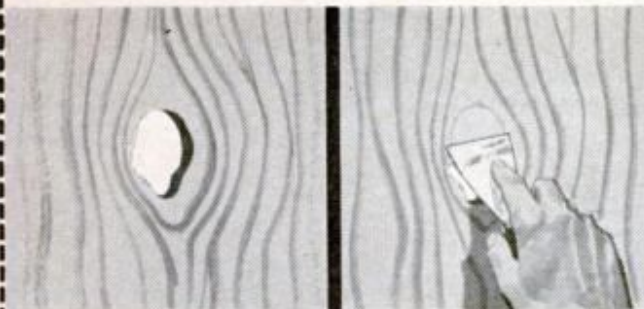
To avoid stresses and thermal shock, the work must be heated slowly and evenly. It should be put into the cold pre-heating oven and the temperature brought up to 1200° F. in not less than a half hour. In forge work, steel is pre-heated at the edge of the flame area, then moved over for final heating. If using a high temperature heat treating furnace or a blast furnace, the work is transferred when it reaches a dull red glow (1200° F.), then brought up to the final temperature for forging or hardening, which can be determined from the glowing color of the metal.

Forging is, of course, the act of hammering hot steel to shape on an anvil or block of steel. Proper hammering improves the steel by compressing its structure. The chart on page 171 indicates that alloy steels require a higher forging temperature than carbon steel. Forging temperatures are given as maximum and minimum. Forging at temperatures lower than the minimum risks cracking or damaging the internal structure of the steel.

Tool steels must be cooled slowly after forging to prevent air-hardening. Bury the work in dry ashes or mica and leave it

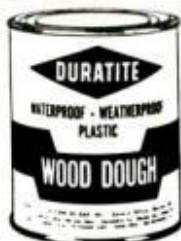
(Please turn to page 194)

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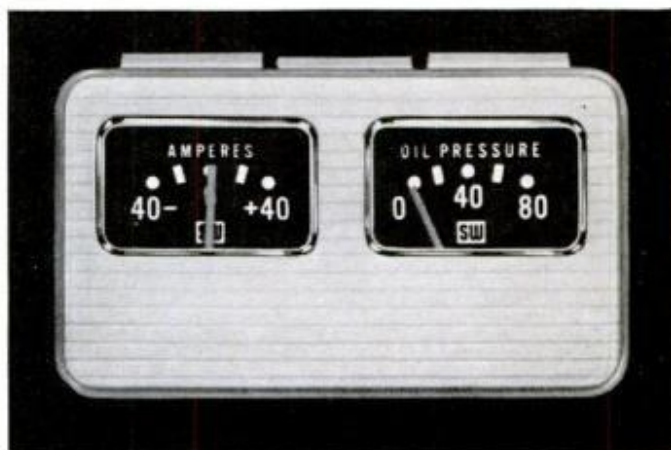
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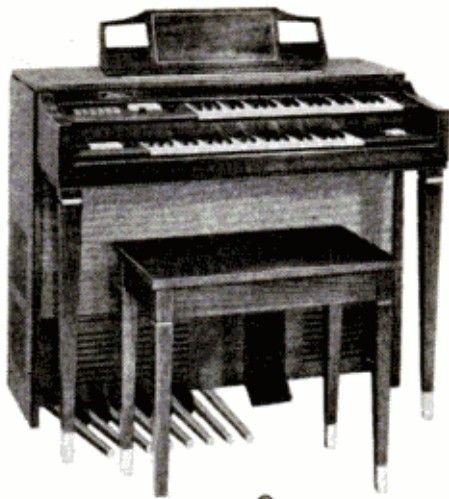
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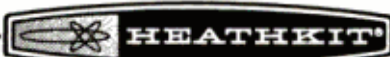
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Heat Treating in the Home Shop

(Continued from page 192)

there until it reaches room temperature. Steel is often "normalized" after forging—heated to normalizing temperature and air-cooled. It is then annealed to relieve the stresses caused by air cooling—that is, brought slowly up to annealing temperature and cooled in ashes, or in the furnace with the gas shut off and the cover on.

If the work requires grinding after forging, this is done immediately after annealing. Machining is also taken care of at this stage. Heavy machining can cause stresses that should be relieved by heating the work slowly in a tempering oven set at 900–1100°; then turn off the gas, shut the damper, plug the flues and let oven and work cool slowly together.

Hardening vs. Tempering

The work is now ready for hardening and tempering, the history of which goes back to ancient times when the process was known only to a chosen few and performed virtually as a magic rite. Today, the biggest mystery to most of us is: Exactly what is the *difference* between hardening and tempering?

Steel is first hardened by heating it to the proper temperature (as listed on page 171, then rapidly cooled by plunging it into a bath of oil, water or brine maintained at a temperature between 60° and 100° F. This makes the steel hard and brittle—full of "temper" which must be "drawn" to make the steel less hard, but tougher. This is done by re-heating the work to another specified temperature and holding it there for at least an hour, then quenching it again.

The process of heating the steel for hardening is the same as already detailed for forging, except that the quenching temperature is considerably lower. The quenching medium may be water, brine, or oil (cottonseed oil, SAE 20 motor oil, or one of the high-flashpoint oils manufactured particularly for quenching). If a given steel can be quenched in either oil or water, oil is preferred as it is less drastic in action, minimizing the risk of cracking the work through too-rapid cooling. For somewhat the same reason, a 10 per cent brine solution is preferred to water. The dissolved salt (12 oz. to 1 lb. and promotes more rapid cooling for a harder case on the quenched steel. Stir the quenching medium vigorously before plunging in the hot metal, and keep it agitated while the work is immersed.

Remove the work immediately from the quenching medium—before it has cooled

to room temperature, which means as soon as it stops quivering (about 200° F.). Place it at once in the tempering oven (kitchen range) which has been preheated to the proper tempering temperature. (Second chart, page 173.) Quenched steel allowed to reach room temperature may crack.

The hardening-tempering procedure can be summarized as follows: Heat the work slowly and evenly in an oven to 1200° F., then transfer to the hardening fire; quench, then transfer the work to the tempering oven immediately and let it soak for a minimum of 1 hour at the proper drawing temperature; quench again, in the same medium used for hardening.

Hardening Low Carbon Steel

As stated earlier, low carbon steels must be put through a process of "case hardening" in which carbon is introduced into the skin of the metal through a carburizing process. This gives the steel a hard, abrasion-resistant case with a tough, ductile core. A case hardening compound (such as Kasenit) can be sprinkled on steel brought to a temperature of 1650° F., or the hot steel can be dipped or rolled in the stuff. Either way, the work is then returned to the furnace for several minutes to give the compound a chance to penetrate. A deeper case can be had by dipping the work a second time while still hot and returning it to the furnace for several minutes. It is then quenched in water. No further treatment of low carbon steel is required.

Cast or tool steel can also be case hardened to bring out its limit of hardness and to prevent cracking. Heat the work to a light yellow (about 2000° F.) and dip in the compound. Leave it there until it cools to the correct quenching temperature, then plunge into cold water. Follow by tempering at the correct heat for the job the piece must do, as listed in the chart. ★★

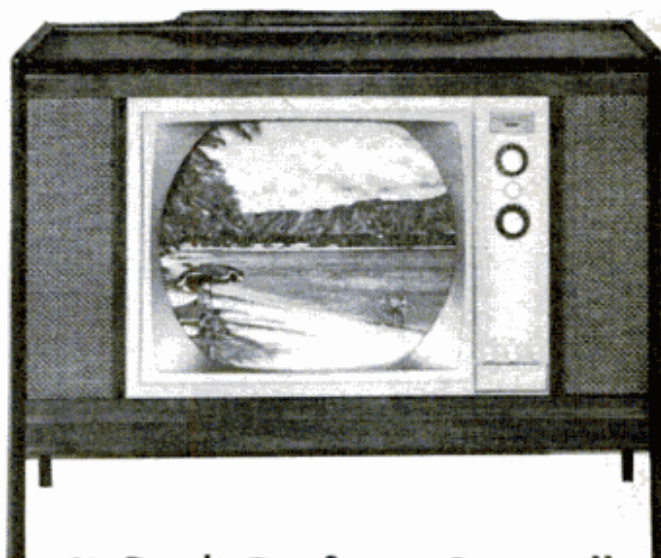
Fish Eyes for Research

Deep-sea fishermen are helping medical science in research on the human eye by preserving the eyes of fish they catch and sending them to the Retina Foundation in Boston. Scientists there hope to discover, among other things, why the cornea of a shark's eye shows little or no swelling following injury.

While they prefer the eyes of the shark, other fish orbs are valuable, too. These include tuna, swordfish, marlin, the larger cod and some striped bass. The eyes must be at least an inch in diameter. Tuna eyes, incidentally, are larger than whale eyes.

The foundation has available leak-proof cardboard containers, with special instructions for packing and handling.

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Retile Over Old Floors

(Continued from page 139)

the joints once the tile is laid. If you use a trowel (photo A, page 139), make sure you get the notch size recommended on the can of adhesive for your size tile.

When the adhesive dries, you can begin laying the tile, starting on the chalk line (photo B). Do not step on the adhesive, even when it is dry. By the way, you'll know the clear adhesive is dry when it loses its color. Black adhesive won't stick to your fingers when it's ready to take the tile. If any adhesive comes up between the tile, remove it while still fresh with fine steel wool.

Here's an easy way to fit border tile (photo C). Put a loose tile over a tile in the installed row. Take another loose tile and lay it on the first loose tile, butting it against the wall. Use its outer edge as a guide to mark the first loose tile, then, cut along the mark.

Vinyl asbestos tile can be cut straight across by scoring with a plasterboard knife and snapping it, or by heating it over the stove and cutting with a scissor. If you have to make irregular cuts, the tile is heated and cut with scissors. On warm days, however, the heating opera-

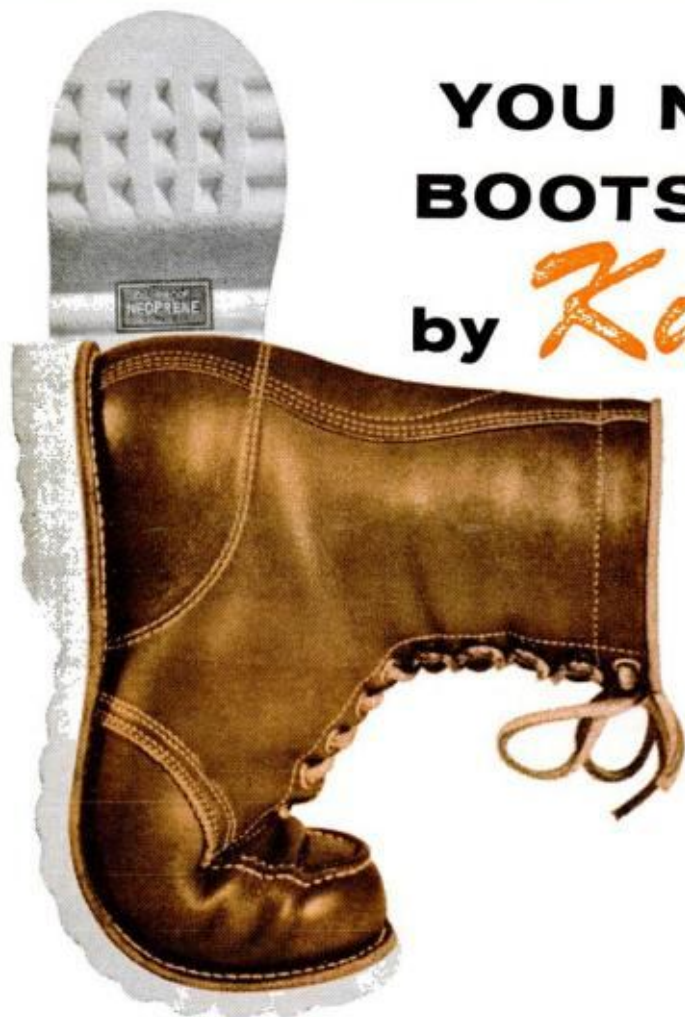
tion might not be necessary since the tile could be soft enough for cutting.

Vinyl tile doesn't have to be heated. Just cut it with scissors.

There's one other hint that might come in handy. It concerns the movement of heavy appliances, such as refrigerators. If you put a square of carpeting, nap down, beneath each corner of the appliance, you can slide it easily in any direction, even over the edge of newly laid tile.

Now, in years to come, suppose a gouge or two appears in one of the tile and you want to replace it with a spare you kept on hand. Just take a propane torch and heat the tile which, at the same time, loosens up the adhesive beneath. Be careful not to harm the tile around it, though. Remove the damaged tile and lay the new tile into the softened adhesive. ★★★

Sticky-fingered doughnut eaters may become a thing of the past, thanks to a Marine inventor. Maj. Albert L. Protz has perfected a doughnut on a stick and has patented the idea. It's been tried before, he says, but no one has ever found a way to make the doughnut cling to the stick without falling apart. A special deep-frying machine he perfected does it.



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Better Things for Better Living . . . through Chemistry

Ford's Turnpike Truck

(Continued from page 89)

idle. We talked without raising our voices. "In my truck I only have 220 horses under me and it's much louder," Kirby said. "But this steering wheel bothers me." It was a small, passenger-car type, mounted nearer to vertical than is usual in a truck. "The steering feels too sensitive. Maybe if the wheel was bigger. . . ."

We were at the end of the straightaway and into the banked curve. Kirby steered part way up the bank. The cab springs kept us practically upright. The Fruehauf trailers behind us also hardly leaned, thanks to air suspension. The ride got choppy in the corner because of changes in steering geometry, then smoothed out in the straight. "Hardly any bouncing," Kirby said. "Much better than my truck."

He paused. "You know, I think I might even get used to that steering wheel."

After a few more laps around the track, Kirby stepped on the retarder pedal; this fills the transmission torque converter with fluid for braking. Then he pushed the brake pedal and we stopped.

He stood up in the cab. "There's plenty of room to walk around in here," he said. "Nice flat floor. In our trucks there's always a hump or a bulge here and there."

He looked at the back wall of the cab, at the oven and refrigerator. "It's a driver's dream. Even a kitchen in here."

"Mind if I try driving her?" I asked.

With damp fingers I twisted the shift control. As I stepped on the gas, the turbine wheels revved up. "Time lag on take-off isn't important in a truck like this," the Ford engineer said. "The kind of use it's designed for, it'd probably never see a red light." And then we were off.

I was very much aware of the width of the truck. I preferred not even to think of the length. But visibility was superb. Steering didn't take any more muscle than a big, manual-steering passenger car.

Kirby, meanwhile, was checking out the TV set, the kitchen and toilet facilities and the reading lights. "There's only one thing I don't like," he told the engineer. "This reclining seat for the co-driver feels fine, but the sunlight will come in through the windshield and keep him awake. In our trucks the bunk is behind the driver, and there's a curtain to keep out the light."

This was the only criticism I heard Kirby make—and stick to.

I stopped and pulled a switch in the cab, and once again the door swung open and the ladder slid down. We climbed out and walked back toward the car. Kirby kept looking back at the truck. "I hate to walk away from it," he said. ★ ★ ★

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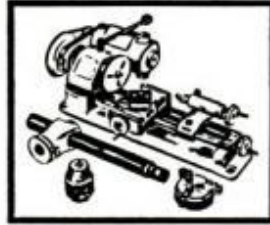
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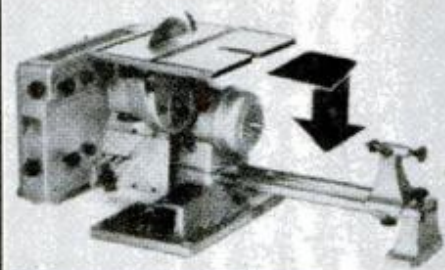


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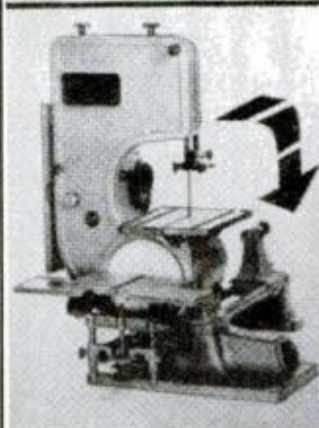
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All Metal Plane You Can Build

(Continued from page 84)

riveting becomes a one-man job. Standard aircraft riveting requires two men, plus an expensive compression gun, and you must countersink the frame and dimple the skin metal. "Pop" rivets can be installed by one man with one hand.

There are no compound curves on the T-18, only simple bends. On the wing panels, for instance, the skin is wrapped around from the trailing edge, over the leading edge and back to the trailing edge. The fuselage is almost hexagonal in cross-section, and its skin sections are bent slightly from the cockpit area down toward the tail. And so it goes.

The raw materials, with some exceptions, are easily available. The plane is mostly aluminum—sheet for the skin, frame and ribs, and plate for the fittings.

Other specialized parts, if the builder doesn't have the skill or equipment for making them, can be purchased. Aluminum extrusions are used for the main wing beam and fuselage longeron, and steel tubing for the A-frame landing gear and cockpit roll bar. Either glass-fiber or metal can be used for the cowling, fuel tank, and tips of the wings and tail assembly. Except for the A-frame, the only other welding necessary is at the base of the control stick and rudder pedals or, if metal, the fuel tank.

Thorp insists that a really skilled amateur could build the entire T-18 himself, purchasing only the raw materials and the extrusions, plus the usual items bought over the counter by all homebuilders—engine, wheels, brakes, instruments and radio equipment.

As for shop tools, Thorp suggests a band saw and a drill press, plus these hand-held tools: an electric drill with bits and disc sander, a tin snips, Whitney punch, Cleco pliers and fasteners, and "pop" riveter. Optional equipment includes a set of files for smoothing cut or drilled edges, and a brake for making sharp bends. Welding, as noted, can be sent out. So can the small amount of milling necessary. And that's it.

The T-18's basic design is built around a 130-hp. Lycoming engine with a "dirty" configuration—cowling that exposes the cylinders, exposed rivets and an open cockpit. Some of the refinements that would clean it up, adding an average of 5 m.p.h. each to the speed with the same power, include a sliding canopy, a pressure cowling to cover the engine, flush rivets, wheel pants and gear fairing. The canopy seems mandatory. Thorp flew in the first T-18 during its early test flights and reported, "It was going so fast, it

nearly sucked us out of the cockpit." He's working on a design now.

Also, larger engines will boost speed according to horsepower. As a rule of thumb, the T-18 will give about a mile-per-hour in speed for each horsepower, slightly more with smaller engines and slightly less (because of the extra weight) with larger engines. For instance, the recommended 130-hp. engine will give, in the "cleaned up" configuration, 150 m.p.h. cruising. The one completed T-18 has a 180-hp. engine and is averaging 170 m.p.h. at 75-percent power. The T-18 design, incidentally, is built around Lycoming engines; the mounts would have to be changed for other makes.

First T-18 Built

The completed T-18, which we flew, is the work of Bill Warwick of Torrance, Calif. He lives near Thorp and finished it, without complete plans, by verbal advice from the designer. In addition to the large engine, Warwick has a heavy controllable-pitch propeller on it, plus a large battery starter and radio equipment which runs his empty weight above 900 lbs.—about 200 lbs. more than the specs on the "basic" plane with the small engine. However, the extra horses plus a canopy pressure cowl, flush rivets and wheel pants made up most of the loss in speed.

Warwick had built two wood-and-fabric planes before the T-18, but had never handled metal and admits to "throwing away a few parts" before getting them made right. He says, with a lot of scrounging, it cost him only \$2000. After he finally completed it last summer, and it was inspected and approved by the Federal Aviation Agency, he flew it to the annual get-together of the Experimental Aircraft Association at Rockford, Ill. That's where we caught up with him, and it was appropriate enough because Paul Poberezny, EAA president, first told us about the T-18. We've been chasing it ever since.

Rockford was beautiful, the day we flew with Warwick—hot and muggy, but beautiful. So it was a relief to get in the air. We started down the 4400-ft. paved runway smoothly, accelerating steadily, and the T-18's tail came up almost immediately. About a third of the way down, indicating 100-m.p.h., the T-18 lifted off.

We carried 27 inches of manifold pressure at 2700 revolutions per minute on takeoff but, climbing out, we cut back slightly. Warwick had only 70 hours on the plane and hesitated to use full throttle too long. Even so, we continued climbing at 1500 feet per minute, indicating 110 m.p.h. Warwick says he has had it up to

(Please turn to page 200)

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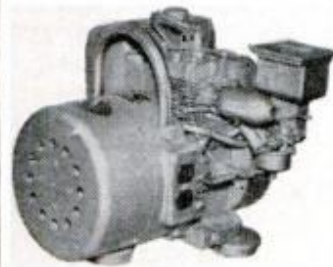
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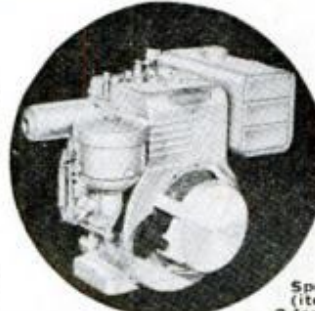
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All Metal Plane You Can Build

(Continued from page 198)

2100 f.p.m. and held it steady. Like, wow!

We leveled off at 3000 feet altitude, cutting back to 23 inches at 2400 r.p.m. The first thing you notice straight and level is the stubby wing—not so much the gulled-up outer sections, but the stubbiness of the wing itself. It spans 20 feet, and knock off three feet for the cockpit, that leaves about eight feet on each side. Hardly enough for a grown man to lie down on.

The cockpit incidentally, is small but not uncomfortable. It might become so on long flights, however. The stick control comes up between the knees, and on sharp turns you have to move the knees.

Our speed built steadily until it came to rest just above 170 m.p.h. We kept it there a few minutes while Warwick "trimmed" it up. The T-18, as an "irreducibly simple" airplane, has no built-in trim control. With Warwick's big engine, it needs back pressure for takeoff and climb and forward pressure for cruise. He has rigged a Rube Goldberg spring, attached to the floor board, which he slides up the stick for nose-down trim and down for nose-up. Without it, he could get arm-weary. Some kind of internal trim is also on Thorp's agenda.

Warwick's T-18 stalls at about 68 m.p.h., and very sharply. There's no warning. Just vroom! The nose drops, and in Warwick's plane to the left. He says one of his wings is twisted slightly, accounting for the "lefty" quirk. Thorp, however, says that the sharp stall will probably be characteristic of all T-18s unless he designs a warning "shudder" into it.

Its hotness shows up best in maneuvers. It is extremely responsive on the controls, especially the ailerons—probably those gull outer sections. The T-18 rolls—like "right now"—and the elevator (or "flying tail") control is good. Climbing turns, and rolling into flat tight turns, are a real joy.

Warwick, understandably, had never really opened up on his T-18 with so few hours on it, so it had never been put through its aerobatic paces. But the feel is there. It wants to move.

Straight and level, there won't be too many amateur-built planes that will keep up with the T-18, power for power. One indication is that when we went up to shoot aerial pictures of Warwick's plane, the only two-place chase plane we could find that could stay in front of it was a Steve Wittman *Tailwind*, long the amateur's standard for speed.

We never went above 4000 feet at Rockford, but Warwick says he has had his T-18 up to 11,000 feet without laboring it.

Coming back to the airport, the T-18's hotness again was evident. We entered the pattern at 130 m.p.h. indicated, turned onto the final approach at 120 m.p.h. and touched down at 90. That's pretty warm for a small airplane. Warwick claims that his air-speed indicator reads "high" at low speeds and guesstimated that we were closer to 75 m.p.h. That's still warm. However, Warwick has no flaps. There are none called for in the basic design.

Otherwise, the landing—again, in about a third of the runway—was rough, but not uncomfortable. The A-frame gives a little, but doesn't bounce the plane.

Hot Little Plane

In sum, we found nothing radically wrong with the T-18 on our test flight, and much to recommend it. The canopy is a necessity, and we'd strongly advise elevator trim and flaps. The sudden stalls may bother some, but there's nothing about them—nor any of the other T-18's hot characteristics—that an intelligent pilot can't handle. In fact, we know some intelligent pilots who would be tickled to death to have a plane as hot as the T-18.

Whatever problems it has seem to be on the ground. We talked with Warwick and some of the other T-18 builders (there were about 50 of them at Rockford, and most of them went up with Warwick).

Warwick, for one, is quite happy. He likes the T-18's distinctive looks, that "leaning forward" configuration and gull wings, and he is very high on its maneuverability and speed. He mentioned specifically its great aileron control, good pitch control and absence of torque or yaw. In fact, he claims he can make turns with his feet off the rudder pedals. The landings, he said, are consistently solid, neither too mushy nor too hard. But he flies from paved airports regularly, and said sod fields may give "stiff" touchdowns. Considering the short takeoff and landing roll at Rockford (less than 1500 feet on a paved runway), the T-18 seems suitable for small fields, especially with flaps.

Some of the other T-18 builders, naturally, had more to say about its construction problems, especially the beginning builders. Metal was the big nemesis. They were surprised, and a little discouraged, to find how easily it would warp, "run" and rip on them, and they wish now that they had taken a basic course in metalworking before starting.

Thorp's answer is that each piece made in the workshop should be considered expendable—if at first you don't succeed, throw it away and try it again.

Also, the beginners recommend a basic

(Please turn to page 202)

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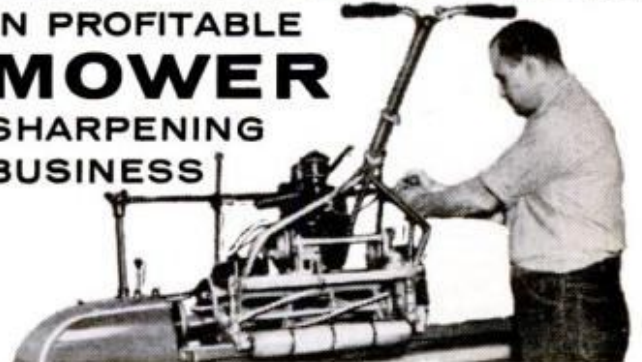
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All Metal Plane You Can Build

(Continued from page 200)

course in reading blueprints. Thorp's drawings, they say, are excellent but a bit much for a novice.

The extrusions caused the most confusion. They are not stock items, and no metal manufacturer will make up special dies to form them without a minimum order of about 300 lbs. of extrusions—enough for twenty T-18s.

Thorp's solution is that twenty T-18 builders should band together and order the extrusions en masse. One T-18 man, in fact, ordered the dies on his own and sold the extra extrusions to other T-18 men to get his money back.

Texas T-18 Club

There were some complaints about the tools necessary, but Thorp sees nothing exotic about them and feels they can easily be absorbed in the estimated cost of \$3000.

One group in Texas has solved some of their problems by forming a T-18 club and dividing the work. One man makes all the skins, another man the fittings, another man the formed parts, and so sharing their individual skills.

Ironically, some of the complaints were about what wasn't on this "irreducibly simple" airplane. As the Detroit auto manufacturers learned when they built compacts, customers responded with: "Yes, but we want *luxury* compacts."

The most common luxury asked for at Rockford was a retractable landing gear. For this, Thorp said, the wing would have to be redesigned. It's a tail-wheel plane now because the A-frame main gear is forward of the wing (so the wing can be removed) and forward of the center of gravity. To make either a tricycle gear or retractable gear would cause changes.

All in all, none of the problems in building the T-18 seem insurmountable, and it all hinges on Thorp's definition of "irreducibly simple." He insists that if it were made any simpler it would be unsafe to fly.

It's *Popular Mechanic's* considered opinion that the T-18 is probably the easiest-to-build all-metal plane ever designed. It could be recommended even if its performance were ordinary. And it's not. Once built, the T-18 will take off into a class of its own, because it will out-fly almost any amateur-built plane in the air today. And, with proper construction and care, it should last a lifetime.

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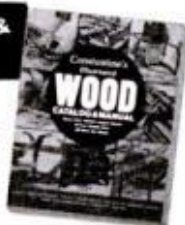
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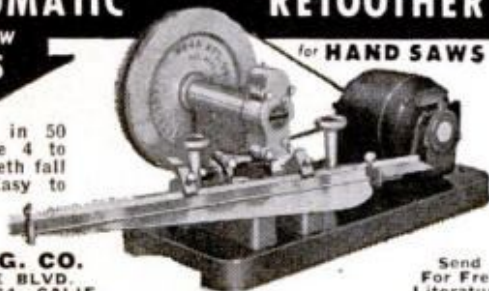
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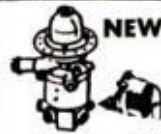
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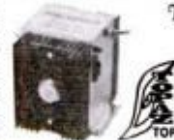
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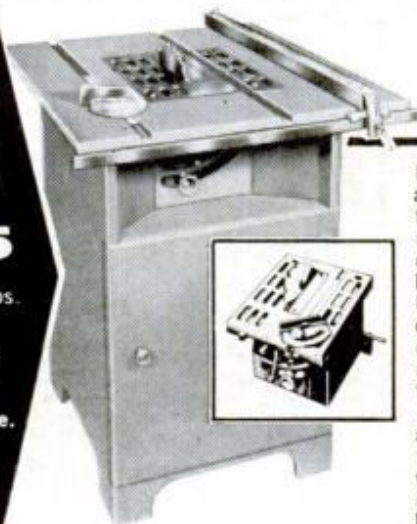
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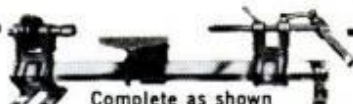
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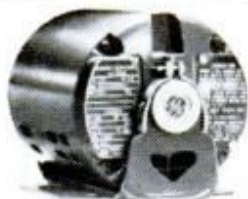
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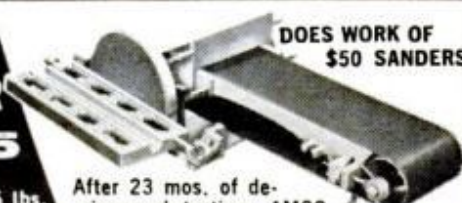
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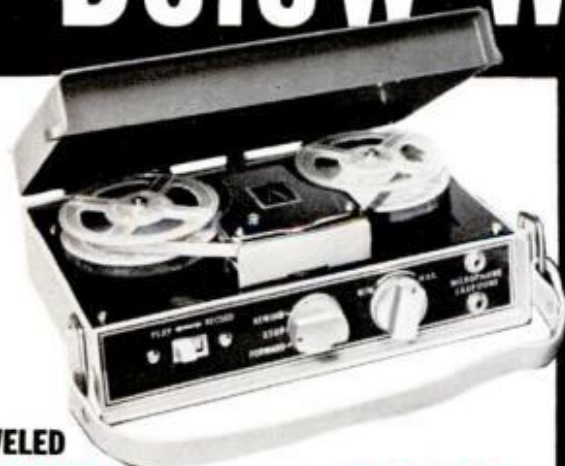
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