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Six New Holiday Season Project-a-Plans

POPULAR MECHANICS

DEC. 1963
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FOR THE
This is Not a Price

How to Find Honest TV Service

**Garage Door
Opener for
\$35**



***Will Monorails
Ever Get Off the Ground?***

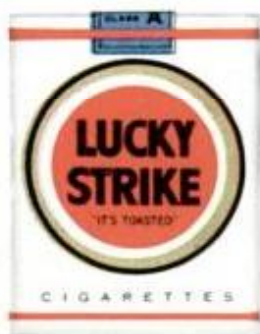
20 Tips for Snowblower Buyers



Lucky Strike separates the men from the boys...

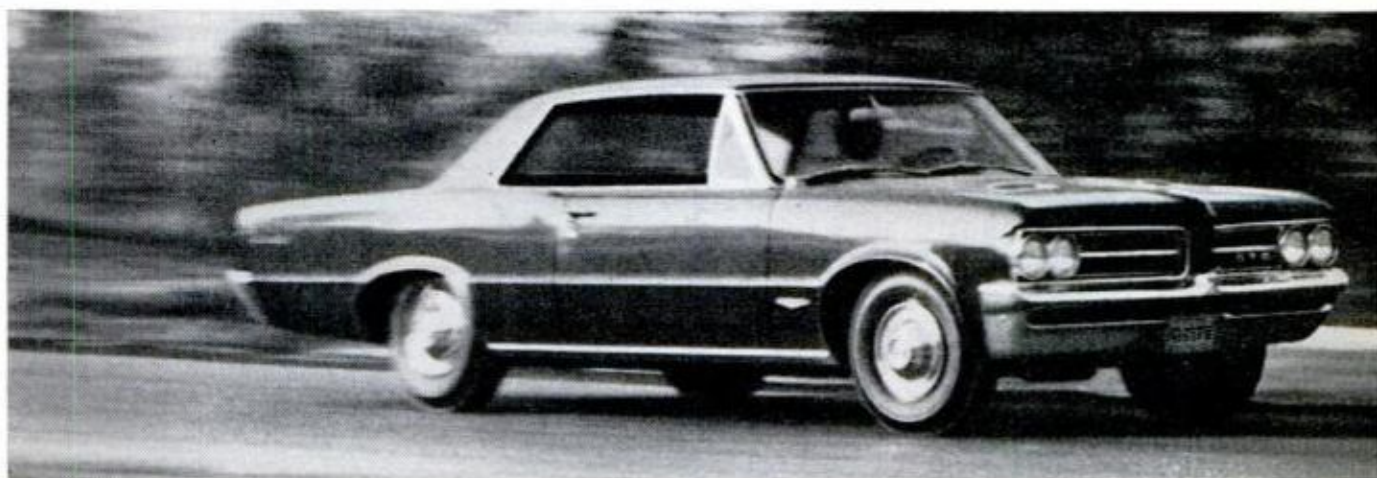
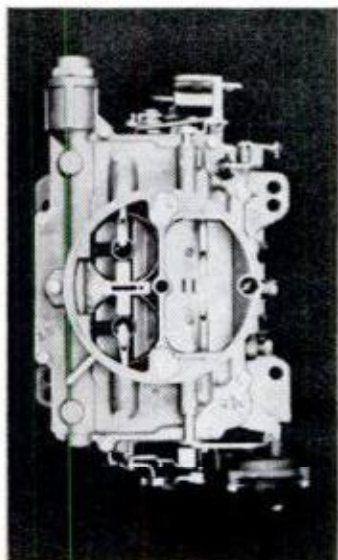
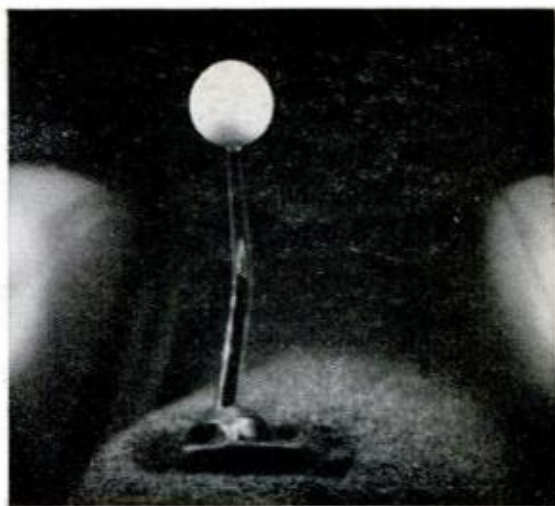


but not from the girls.



Smoking is a pleasure meant for adults. And Lucky Strike's fine tobaccos are blended for adult tastes. If you're an adult smoker, remember: L.S./M.F.T.—Lucky Strike means fine tobacco. Give Lucky Strike in the handsome holiday carton.

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For the man who wouldn't mind riding a tiger if someone'd only put wheels on it—Pontiac GTO

This piece of machinery is something our Engineering Department slipped a motherly big Pontiac 389-incher into and named the GTO.

It comes in hardtop, sports coupe and convertible form, based on the Le Mans—only sleekened down some and fitted with a special set of red-circle high-performance tires.

The looks you can see for yourself. The big deal is under the hood: 325 bhp at 4800 rpm and 428 lb-ft of torque at 3200 rpm. That's just the standard 4BBL engine. There's also a version with 348 bhp* at 4900 rpm and 428 lb-ft of torque

*optional at extra cost.

at 3600 rpm. This one does deep-breathing exercises through a 3-2BBL setup. Both have dual exhausts. As illustrated above, pairs of exhaust splitters that sprout just behind the rear wheels are available dealer installed*.

A 3-speed transmission is standard, stirred by a Hurst shifter on the floor. Extra-cost variations include an automatic with shift on the column . . . an all-synchro 4-speed on the floor . . . or a choice of any one of them sprouting out of a console.

Give yourself a blast of tonic. Sample one of these

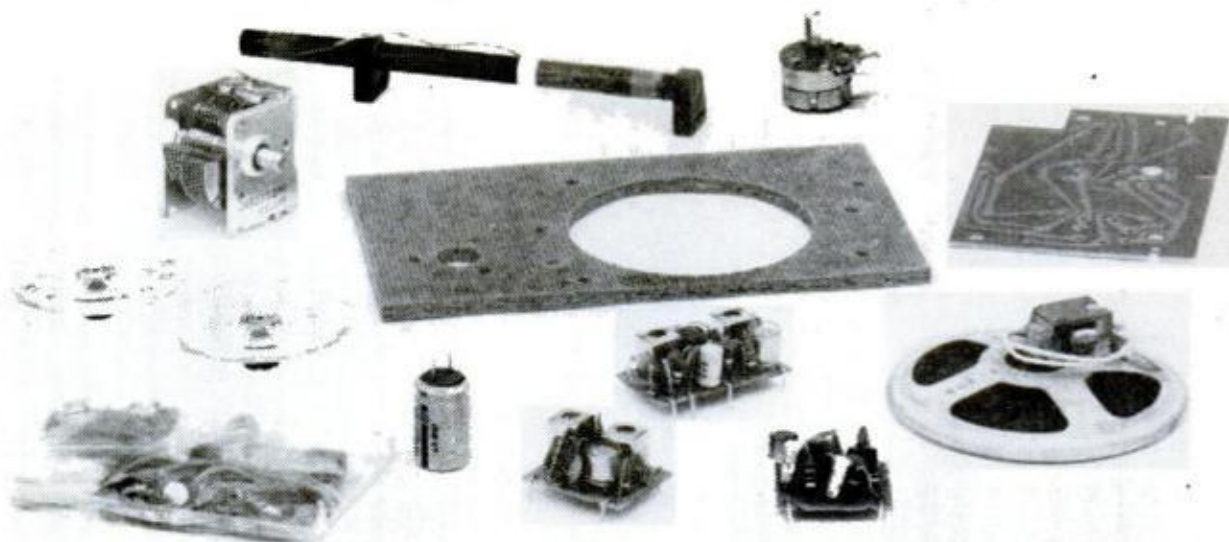
This One



P474-YLT-PK8F

110N

1



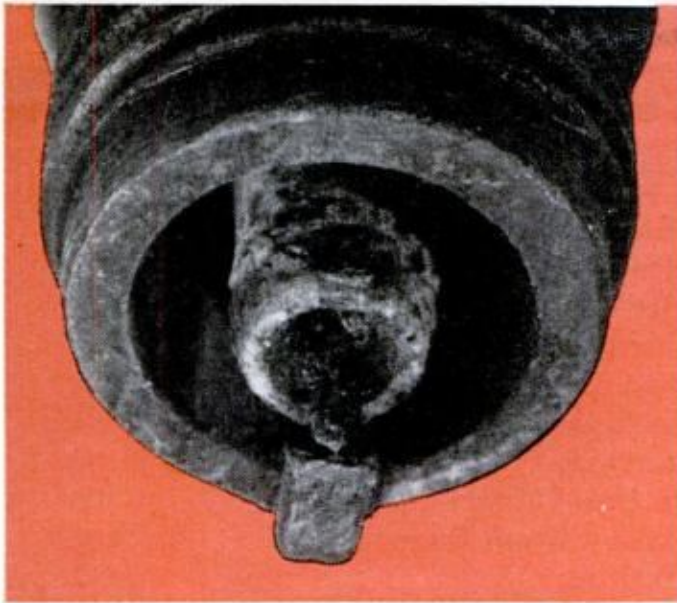
Put this 5-transistor radio together in 1 hour.

This is no toy! Get a General Electric Ready Set and your end product is this powerful, 5-transistor portable. G.E. does the *hard* work for you by pre-assembling the three modular sub-units that contain the electronic circuitry. You do the rest. A bit of snipping, soldering, gluing and tightening. In about an hour, you'll be ready to add the battery. Turn it on. Big, clear sound! Build the radio you can brag about, a regular G-E portable radio. Get a G-E Ready Set at your electronics parts store.

Radio Receiver Department, Utica, New York

GENERAL  ELECTRIC

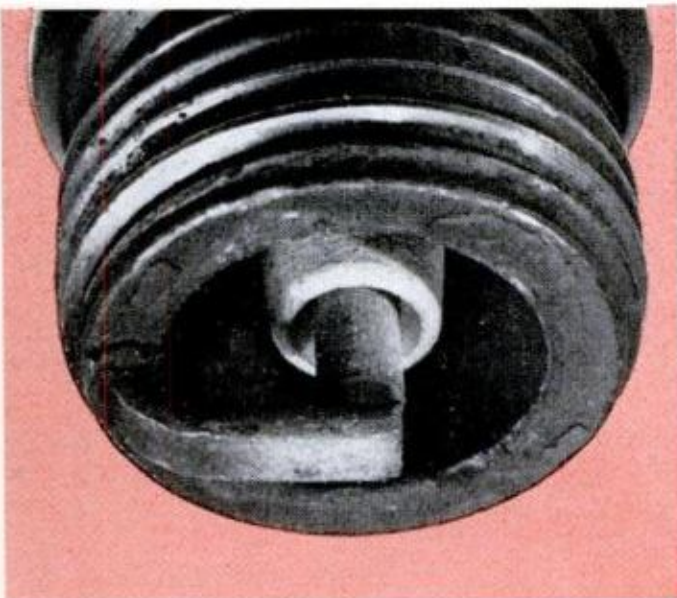
Correct "Hot and Cold" conditions with AC Spark Plugs in the right heat range



TOO HOT—Prolonged fast driving or heavy load service with spark plugs in too high a heat range are frequent causes of overheating and pre-ignition. This condition shows up in burned or blistered insulator tips and badly eroded electrodes. If this happens, switch to ACs in the next *lower* heat range.



TOO COLD—Low-speed, stop-and-go driving and prolonged idling with spark plugs in too low a heat range frequently lead to deposit fouling. This condition is indicated by red, brown, yellow and white deposits on the electrodes and insulator tips. To correct this, use ACs in the next *higher* heat range.



JUST RIGHT—Properly installed AC Fire-Ring Spark Plugs in the right heat range will eventually show brown to grayish-tan deposits on the insulator tips and slight electrode wear, indicating mixed periods of high- and low-speed driving. This means that the engine is in good working order and the spark plugs are operating at the most efficient temperatures.

The heat range of your spark plugs (temperatures at which they operate) has an important bearing on your car's performance. While other factors sometimes cause the fouling conditions shown here, the use of spark plugs that run too hot or too cold can also result in these conditions. But AC Fire-Ring Spark Plugs in the right heat range will help give you peak power and performance. To be sure you have ACs that match your kind of driving, check your spark plugs today. Then ask for AC Fire-Ring Spark Plugs in the recommended heat range.

AC SPARK PLUG  THE ELECTRONICS DIVISION OF GENERAL MOTORS



FIRE-RING SPARK PLUGS

POPULAR MECHANICS®

DECEMBER 1963
VOL. 120 NO. 6

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

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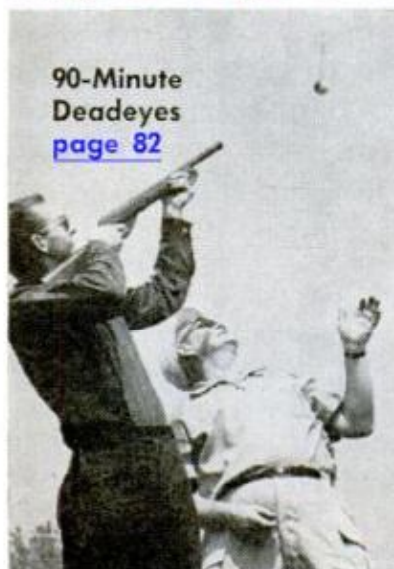
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NEXT MONTH—*Racing champ* Sam Hanks track-tests Detroit's new 400-horsepower models out West. While *PM* wrings out the family models at Limerock; it's all part of *PM*'s January Auto issue. You'll also find how to arc weld at home in six hours, how to build four stowaway workshops and how to beat the problem of cold weather starting.

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ADDRESS COMMUNICATIONS TO: 575 Lexington Ave., New York 22, N.Y. For additional sources of information on the articles in this issue, or the name and address of the manufacturer of a particular product, write to Bureau of Information, Popular Mechanics for free "Where-to-Find-It-List."

SUBSCRIPTION SERVICE: Mail all subscription orders, changes of address, correspondence concerning subscriptions, and Postmaster notices of undelivered copies to Popular Mechanics, 250 West 55th St., New York 19, N.Y.

ADVERTISING OFFICES: New York: 575 Lexington Ave., Murray Hill 8-8500; Chicago: 740 N. Rush St., Whitehall 4-0100; Detroit: General Motors Bldg., TRinity 5-8711; Cleveland: Hanna Bldg., 1422 Euclid Ave., PRospect 1-0456; Los Angeles: 3460 Wilshire Blvd., DUmkirk 2-8458; San Francisco: 111 Sutter St., YUkon 2-0823.

Published monthly by Popular Mechanics Company, 575 Lexington Ave., New York 22, N. Y. Richard E. Berlin, President; Richard E. Deems, Vice President; Fred Lewis, Vice President; John R. Miller, Vice President; Joseph F. Kern, Vice President; Frank Massi, Treasurer; R. F. McCauley, Secretary. Single copy in the United States and Canada, 35 cents. Subscription prices: United States and Canada, 35 cents. Subscription prices: United States and Possessions, \$4.00 for one year; \$7.00 for two years; \$10.00 for three years. Canada, add \$0.50 for each year. Pan-American Postal Union countries, add \$1.00 for each year. All other countries, add \$2.00 for each year. When changing address, give old address as well as the new, with postal-zone number, if any, and allow six weeks for change to become effective. Second-class postage paid at New York, N.Y., and at additional mailing offices. Authorized as second class mail by the Post Office Department, Ottawa, and for payment of postage in cash. Registered as Second Class matter at the Post Office at Mexico, D.F., Mexico, June 20, 1950. ©1953 by Popular Mechanics Company. All rights reserved. Printed in the United States of America.

BACKSTAGE

at PM

We visited one recent evening with a successful inventor.

We term him "successful" because he numbers among his past creations such well-known appliances as the Waring blender, steam iron and hair drier.

He arrived slightly late for our appointment, explaining that his first day of rehearsal (by the way, he's also a musician) had been a long one, and his orchestra and chorus—known as Fred Waring and His Pennsylvanians—was busily preparing for a 100-city tour through the fall and winter.

They will feature some unusual instruments that former banjo player Waring helped to design. You might call it the inventive mind—set to music this time.

We had arranged to meet the versatile Mr. Waring when we found we'd be near the Shawnee Inn (another of his varied enterprises) during a trip to the Pocono Mountains of Pennsylvania.

Looking much fresher than anyone has a right to look after working hard until 10 o'clock in the evening, Mr. Waring stole the beat on us and started the questions.

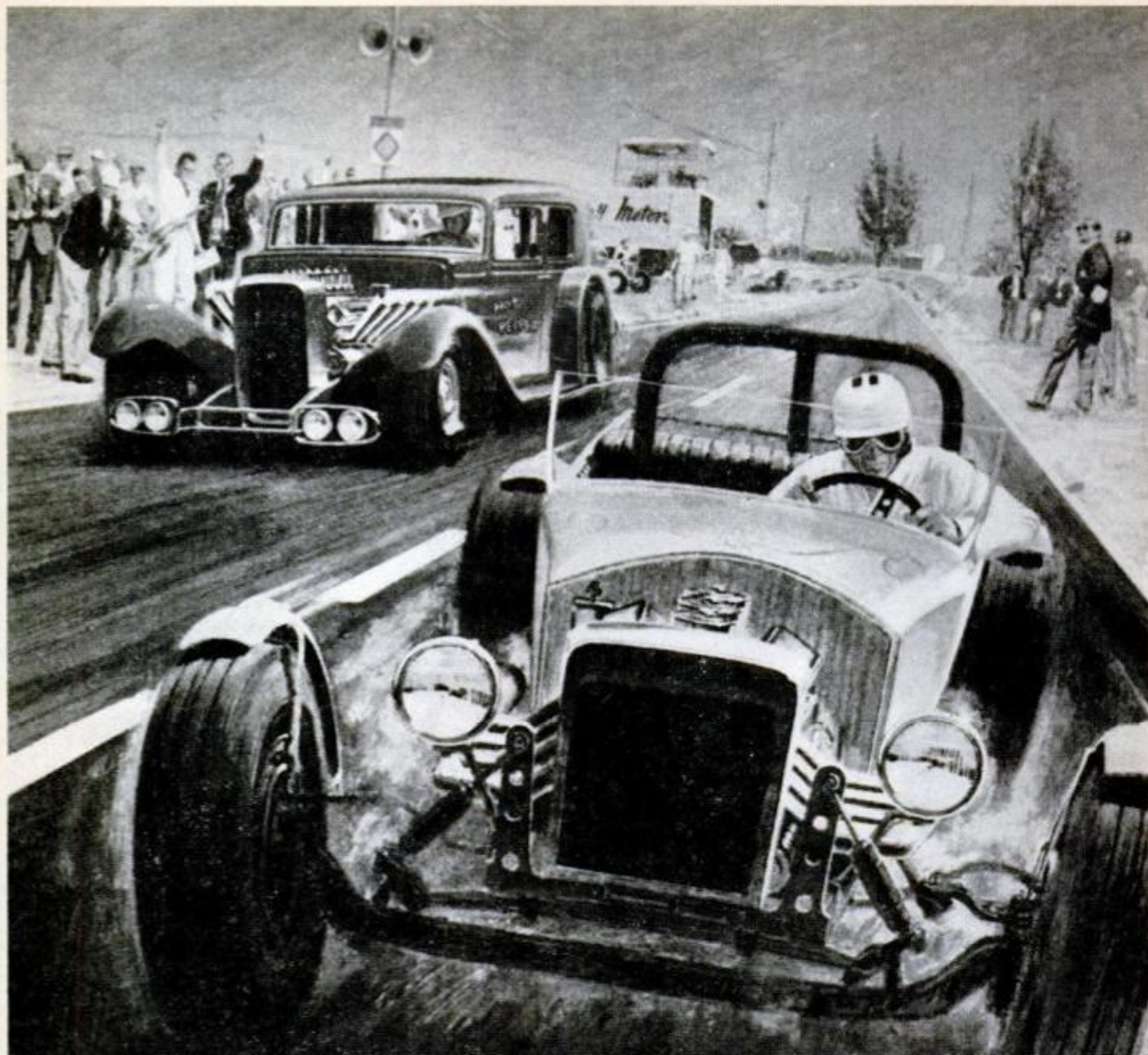
"What about those monorails? Why are they coming along so slowly?"

We assured him that we had a writer asking the same thing. (Look on page 69, Mr. Waring, to see what he learned.)

A short while later, a chance mention of plastics set us off on a tour to the Cartoon Room of the Inn. Here we saw large drawings by top cartoonists—all friends of Mr. Waring—laminated under plastic to make the tops of the room's tables.

All the while, we were learning about his newly invented drapery rods, which are designed to telescope as the drapes are opened and remain hidden behind the fabric.

It seemed that we had scarcely begun to explore his interests—he mentioned at least a half dozen more—when Mr. Waring departed for the next event on his schedule: A one-man thinking and planning session. That, we'd guess, is a good part of the secret of his great creativity.



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WOW! Wait'll you dig Aurora's new SUPER MODEL MOTORING with 'way-out cars! At last — real customized slot cars! Even the size is new — 1/4-INCH SCALE! Bigger than HO but smaller than the 1/32 jobs, SUPER MODEL MOTORING is scaled right in between! Under the hood of these wild 'n woolly whiz bangs is a souped-up version of Aurora's lightning-fast, ultra-dependable THUNDERJET 500 MOTOR, the mighty mill that never knows when to quit! Aurora's combing the sticks for zany zoomers so there'll be a whole raft of 'em coming along. Hey, what a great idea for Christmas! Go, man, go — to your neighborhood hobby shop for SUPER MODEL MOTORING. SUPER MODEL MOTORING WITH 1/4-INCH SCALE CARS IS SOLD IN HOBBY SHOPS ONLY.



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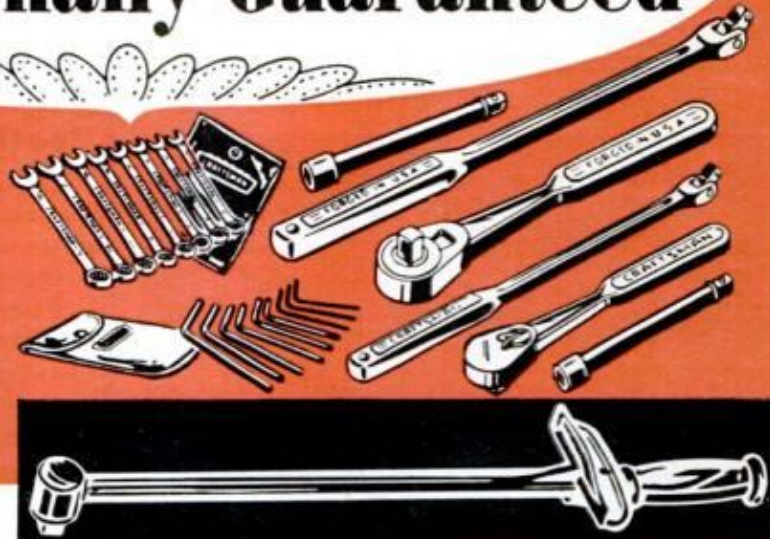
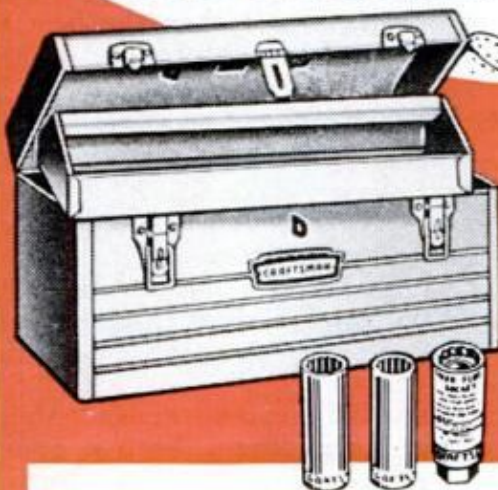
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Regular separate prices total \$44.26! For auto, shop, farm and home repairs.

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Regular separate prices total \$82.89! Can handle a variety of maintenance jobs.

49⁹⁹

See These Sets at Your Nearest Sears Retail Store

Over the Editor's Desk

Kayak Stretchers

We extended the over-all dimensions of the *Folding Kayak* (page 152, June *PM*) by two feet to make it a 12-foot craft with a two-man capacity.

This addition was well worth the in-



creased cost. We and our friends (and even their fathers) have had plenty of enjoyment from our craft. The labor and cost (\$10 more than the \$15 you estimated for a 10-foot kayak) have been repaid many times over in enjoyment.

Yonkers, N.Y. STEVE and JOE SENESI

Is Glass Really Better?

Your experiment with the fiberglass vaulting pole (*The 16 Extra Inches in Fiberglass*, page 114, Sept. *PM*) was interesting yet incomplete. You fail to recognize the human factor involved.

If the fiberglass pole was tested first, the vaulter was more tired when he tested the metal pole. You did not state which pole the vaulter was accustomed to using; if it was fiberglass, he could not use the metal one nearly as well. And a split-second error in timing could have ruined an otherwise perfect vault with the metal pole.

The glass pole would never have been accepted by the governing bodies of track if there was not conclusive proof that there is no unfair advantage with the pole. Springdale, Conn. DONALD BOWLBY

"Unfair" or not, there is a height advantage in the fiberglass pole. As Outdoor Editor Stuart James pointed out in the story, many vaulters say that there's such a difference between vaulting with glass and

with steel poles that they should actually be separate events.

Chuck Barr, who participated in the four-hour test for *PM*, was a New York City high school vaulting champion—using a steel pole. He has been vaulting with a fiberglass pole during his three years at St. John's University, so he knows how to use both types. He alternated types of poles during our tests, so tiredness and a split-second error in a single jump couldn't affect the results. And he did go 16 inches higher on the glass pole than the best he was able to do with the steel pole.

Beetle Battle

In the article *How Owners Rate Their Volkswagens Now* (page 77, Sept. *PM*), you covered everything with one exception—the nut holding the steering wheel.

For about \$1595, VW buyers not only receive a "pint-size foreign missile" but also complete ownership of all roads and highways.

I have been dodging and cussing those right-passing, speeding, beep-beeping, lane-jumping bugs for so long it's only a matter of time before my regular-size car is sporting a VW as a hood ornament.

One excuse for speeding is a poorly designed heater; driving 40 in a 30-m.p.h. zone may warm their feet, but it sure burns me up.

Metairie, La.

MYRON L. LOCKHART

I am snug and warm at 20 degrees below zero in my 1961 VW. In town I open the heater control all the way and nearly close it when cruising.

Edwardsville, Ill. CARROLL D. RAYBURN

My VW, a 1964 sedan, is my first. I traveled as a salesman for 34 years, using all kinds of cars, but I like my beetle better than anything I've driven.

The heater is more than adequate in our chilly Maine fall weather, vision is better than average, and I can walk away from other cars at stoplights.

Jim Whipple and the owners who talk of the battery being in an inaccessible place had better take a look. With one of my sons timing me, I had the cover off the battery in slightly less than 45 seconds. Bangor, Me. E. M. MACDONALD

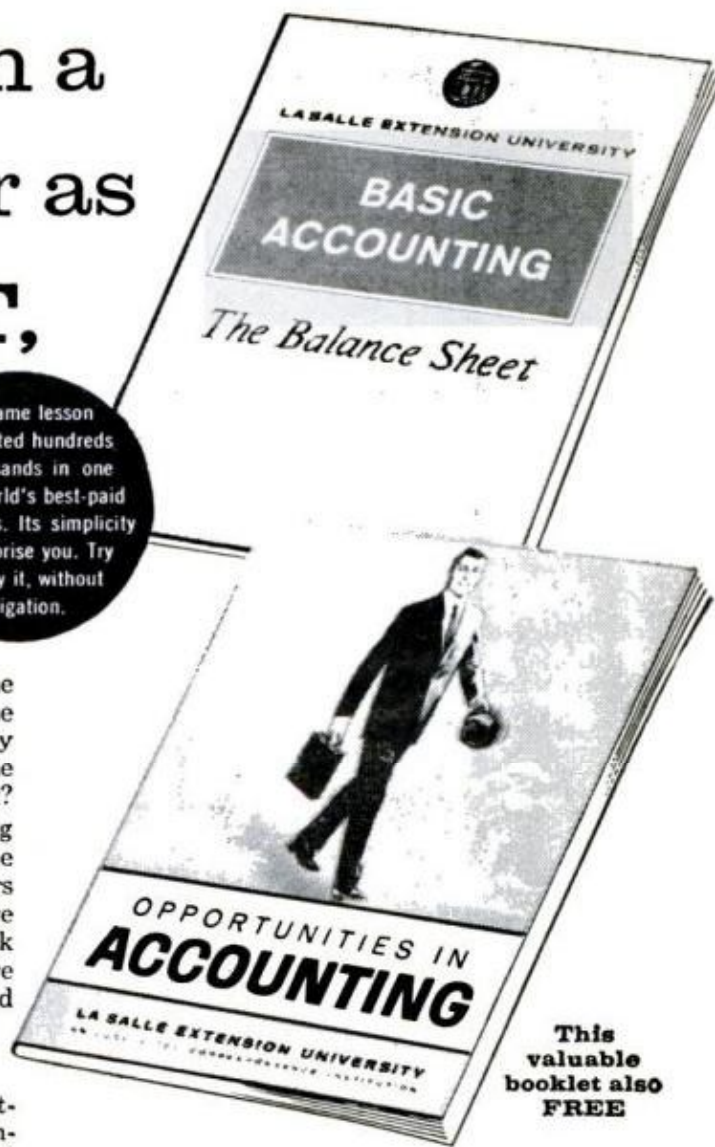
Maybe it was no problem on your bug, Reader MacDonald, but on our test VW, we had a devil of a time getting the battery clamp to clear the kick plate.

Seconds from the Sailors

I would like to support C. Clark Hale's request that *PM* print plans for a sailboat (*Editor's Desk*, page 10, Sept. *PM*).

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RIGID No. 457 for 45° flares, 1/8" to 3/4" O.D. (7 sizes)

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Plans for a catamaran, trimaran or sailer in the 18 to 20-foot category would be greatly appreciated.

Fort Worth, Tex.

DON BURNETT

I also have been waiting patiently for sailboat plans. And I second Mr. Hale's suggestion for an 18 or 20-foot sloop or catamaran, preferably the sloop.

Puerto Cortes, Honduras

ERNESTO FLEETWOOD

An overnighter with sails is a fine idea. Count this as one vote for it.

Thornton, Colo.

JAN BUWALDA

Give us sailboat enthusiasts something. Incidentally, please don't forget the head.

Miami, Fla.

LESLIE J. GRINER

Maybe even a Chinese junk?

Goodyear, Ariz.

MRS. R. E. WISNER

We hear you, sailors, and our boating editor says he'll make you happy—though we can't yet set a date for the publication of the plans.

Wake of the Junk

I read your article *Junket on a Chinese Junk* (page 102, Sept. PM). My boy read it. We discussed it over and over. Both of us have re-read it a number of times. You gave us the Junk Fever.

Please send the name and address of a company that imports junks.

Mobile, Ala.

OLIVER F. KUPPERSMITH

Your article was quite illuminating. I want to know where these craft can be purchased and all about Chinese sails and rigging. Are any books available?

Gloversville, N.Y.

DONALD YOUNG

The U.S. is filled with would-be junkies, judging from our mail. And at the risk of turning our harbors into semblances of Chinese naval bases, we'll pass along answers to some of the questions and also invite you to write our Bureau of Information for a list of books and articles plus current prices of junks.

First, the name of the New York importer (with whom Author C. P. Gilmore went junketing) is Art Peltz, 157-39 Tenth Avenue, Whitestone 57, N.Y.

Prices have been going up a little since Mr. Gilmore gathered information for the story. They now range from \$3000 for a 23½-foot vessel and \$5500 for a 29½ footer on up to \$21,950 for a 60-foot junk, writes Mr. Gilmore. He adds that delivery time is about 10 weeks.

*A recent book which has a section devoted to junks is *The Ship* by Bjorn Lindstrom (Doubleday, 1962).*

The Editor

POPULAR MECHANICS

Материал, защищенный авторским правом

Important news for the inexperienced man who needs a short cut to a better job, more money and greater security.

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... the exclusive CTI Learn-and-Practice method which enables many students to earn money in spare time — as they train for a top-pay job or their own business



You build an operating condensing unit

This Is Your "Home Training Shop"



REAR VIEW

25 Kits
20 Shop Projects

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Opportunities to go in business are available because air conditioning is one of America's two fastest-growing industries. Start in a small way working from your home, and gradually expand. In time, you may want to add a sales division. Manufacturers offer attractive franchises and aids to ambitious and qualified men. Many CTI graduates report they are starting repair shops.

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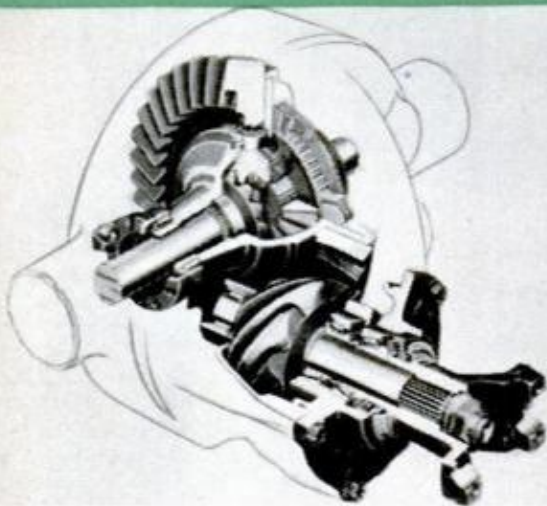
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Tune in on the Inventors

Meter readers may be a thing of the past. Patent 3,104,382 describes a device which hooks onto home meters and sends coded impulses to a central office as the dials of the meters turn. Inventors are Donald P. Morgan of Warren, Pa., and Donald D. Dalrymple of North Warren.

Football goalposts are padded for player protection in an invention filed by Leo A. Doyle of Spokane, Wash. Patent 3,104,875 shows the padding as resilient jackets held in place by springs.

Radiation may produce bigger and better grapes. In patent 3,104,497 Clarence J. Speas of Clinton, Tenn., and Paul L. Andrews of Oak Ridge, Tenn., describe how gamma rays from cesium 137 and cobalt 60 double the chromosomes in some grape varieties, producing much larger and better fruit.

To make the world safe for oysters, two Connecticut inventors have developed a chemical spray, Polystream, that will kill off the marine snails which prey on oysters. Patent 3,103,202 was granted to Victor L. Loosanoff of Milford and Clyde L. MacKenzie of Stratford.

Another inventor has beat the U.S. Tax Court. Ervin G. Bailey, a retired vice president of Babcock & Wilcox Co., sued to vindicate his right to deduct expenses incurred as an inventor from his income tax. Even though the inventions in question have never paid him a cent, Bailey won the case. Central to the court's ruling was the fact that he was an established inventor of long standing.

Patent searches are a costly necessity for inventors. Two developments that may simplify the task are now under way.

One is a plan to apply automation to the patent search. Computers specially designed and programmed for information retrieval are under study. The Patent Office and Bureau of Standards have set up Project Haystack to design information retrieval systems for rapid searches.

The other is a 75-volume patent catalogue now being published by Rowman & Littlefield, Inc., New York. Selling at \$50 per volume, the catalog will list all patents filed since 1790, foreign and domestic.

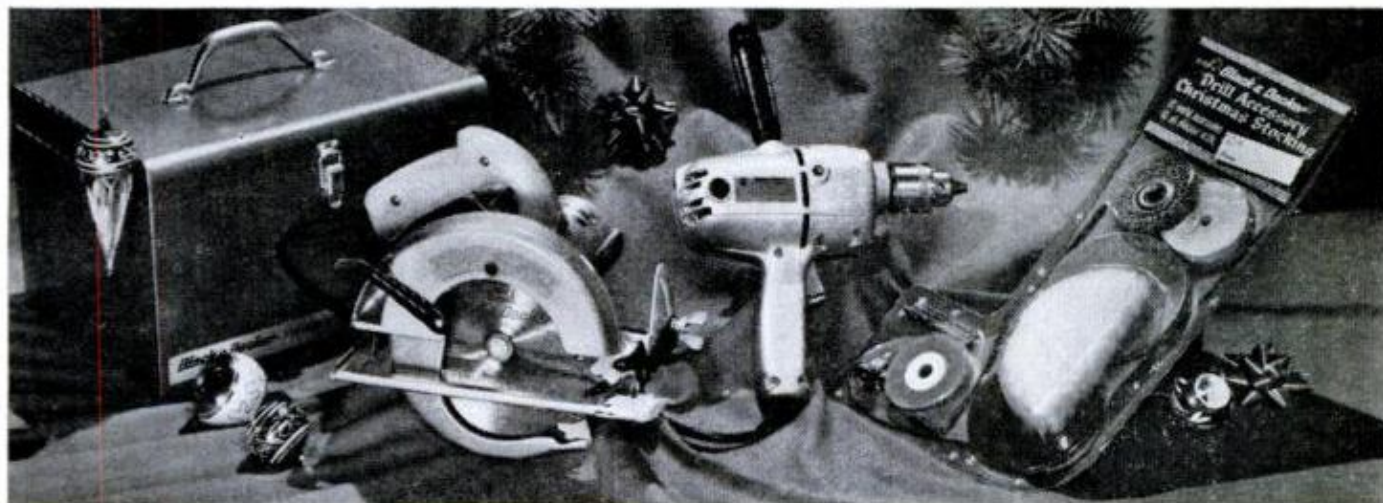
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Sidelights from the SERVICES

By William R. Kreh

Female astronaut candidates now have some scientific backing for their bid. Centrifuge studies by the Office of Naval Research show that hens are about seven times more resistant to long-term effects of acceleration than roosters.

Bugs in its fuel is bugging the Navy. It seems that whenever water gets into jet fuel, fungus begins to grow and this clogs up filters and strainers of planes and storage facilities, not to mention the damage done to the engine when the tiny organisms are burned.

The Navy's trying to find something that will kill growths in the fuel, but it's not having much luck. Some fuel-handling systems bring the problem on themselves by displacing the fuel with water. In underground tanks, water seeps in and bacteria begin to grow at the point where water and fuel meet. In planes the problem is bigger. Usually there's no single tank, but a number of connected cells where water can gather at low points, and these are practically impossible to clean.

Since it's so hard to keep all water out of a fuel system, the Naval Research Laboratory is looking for something to add to the fuel to kill off the bacteria.

Some Navy minesweepers are now carrying a spare tire. It's a new type of collapsible rubber fuel tank which increases the steaming range of ocean-going minesweepers by as much as 15 percent. Filled to its 2500-gallon capacity, the eight by seventeen by three-foot fuel cell looks like a large inflated air mattress. It's lashed in place on a minesweeper's fantail. It's inexpensive, requires no ship alterations and, best of all, can be folded and stowed when not in use.

Cold logic. The Army had to do some mighty tall convincing to some Eskimo National Guardsmen not long ago. A group of the northern guardsmen were to travel to southern Alaska for field training. The last lap of the journey was by train. But it seems these Eskimos had only traveled by airplane and dog sled in the past, and in both cases they wore seat belts for safety. So when it came time to board the train, they refused to go until given lengthy assurances by a harassed colonel that safety belts weren't needed.

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Items from All Outdoors

We are often asked if there are equipment manufacturers who will make things on special order, so we journeyed down to Camp and Trail Outfitters, 112 Chambers St., New York City, and put the question to Ben Siminow. "Funny you should mention it," he said, and produced a rough sketch sent to him by a geologist who wanted a special tent for the jungles of South America. "We're making this now," he said.

It was a tent completely enclosing an insect-proofed hammock so that the ends of the hammock were like net sleeves coming out from the ends of the tent. "We try to make anything a customer wants," Ben said. "We need a drawing or description and specifications of size and materials desired. Then we can discuss the problems by mail."

If you followed our suggestion (Sept. PM) and put bags of calcium chloride in your boat to collect moisture during stor-

age, you may not love us. While CaCl does attract moisture, in doing so it gives off a heavy, slow-evaporating liquid. It is necessary to have a container under the bag of CaCl to collect this liquid.

For fishing in difficult spots where it is absolutely impossible to cast, place your bait in a paper cup and float it out. A slight pull on the line and the bait will drop into the water where you want it.

Active participation in conservation of natural resources continues to gain ground all over North America. This year the state of South Dakota paid some \$10,000 to farmers for providing cover and food plantings for wild fowl. In Manitoba, Canada, 11 farmers received \$14,000 to preserve more than a thousand acres of prime waterfowl breeding grounds. And in line with the general program to save wilderness land, Michigan has announced the opening of a wilderness hiking trail that now runs 35 miles from Traverse City to Kalkaska. By July, 1964, it will cover 170 miles between Tawas City on Lake Huron and Empire on Lake Michigan.

STUART JAMES
Outdoors Editor

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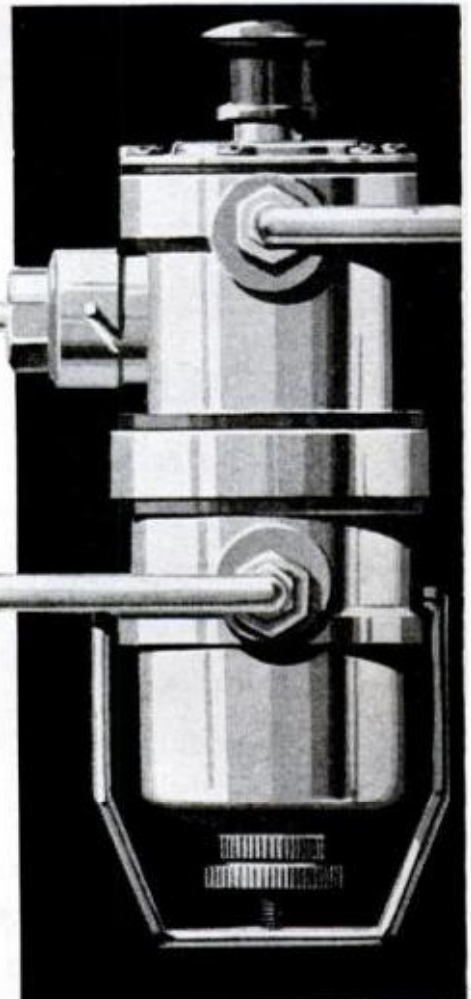


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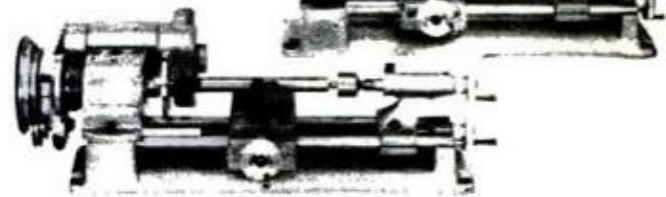
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Swedes will soon be able to choose a new surname dreamed up by computers. With so many Andersons, Johansons and Carlsons contributing to the national confusion, two computers were recently put to work to create some 50,000 new surnames. They'll be published in a catalogue from which the Andersons, et al., may choose a new family name.

Termites practically brought Honolulu to a standstill recently. Nine explosions and an underground fire rocked the downtown area, injured two people, wrecked store fronts and caused a massive traffic jam. Manhole covers were blown two stories high and plate glass windows tumbled like ninepins. The trouble came, Hawaiian Electric Co. officials said, when termites chewed through plastic insulation, causing a short circuit.

An atomic squeal may soon be aiding ships at sea. The Atomic Energy Commission is testing an atomic sound beacon in Chesapeake Bay that will have an underwater range of 20 miles. Heat from radioactive strontium, formerly a nuclear waste product, will operate a hydro-acoustic transducer to produce a squeal that can be picked up on ships' listening devices.

Transplanting teeth from one person to another may be done by the family dentist during routine office visits in the not too distant future. Dr. Ralph Mezrow, one of the leading investigators in this field, told *PM* that hospital facilities won't be necessary for the operation.

"So far," he said, "our work has been done only with teeth from living donors, but we are trying to make arrangements to obtain teeth from recently deceased persons. Also, we have established a tooth bank." To date Dr. Mezrow has transplanted more than 40 teeth from one person to another, all of which took root.

All of Dr. Mezrow's work at The Albert Einstein Medical Center has been done on

youngsters from 11 to 20 years of age. But, he says, "we feel the technique will work with older people, depending on their physical condition, but not as uniformly well as with younger recipients." Tooth transplants have also been made from one part of the mouth to another in the same person.

Headaches on purpose are being created at the University of Oklahoma Medical Center. Volunteers are fitted with a headband that is inflated to produce enough pressure to bring on pain that's typical of a tension headache. Researchers, studying the causes and cures of migraine headaches, then try various pain-killing drugs on victims.

Studying bubbles in the laboratory and then at a muddy spring has led a Japanese astronomer to believe that the moon's craters were formed by bursting bubbles of gas under a thin layer that was formed while the moon was cooling.

Rocket troop carriers could be a reality by the 1970s. The new commandant of the Marine Corps, Lt. Gen. Wallace M. Greene, said that a rocket landing craft could transport 1200 Marines from Camp Lejeune, N.C., to Central Africa in just 80 minutes.

Mocking birds are well named. Two researchers at Ohio State University say they imitate the songs of other birds so well that only an electronic audiospectrograph can tell the difference. One bird tested could mock 39 bird songs, 50 bird calls, plus frog and cricket sounds.

Morphine addicts may find it more difficult in the future to get supplies of their nemesis. A non-addicting substitute for morphine developed at the National Institute of Health in Bethesda, Md., has been hailed by medical specialists as a pain killer and cough depressant. Called Pentazocine, it should reduce the medical demand for morphine.

Pine needles are an accurate indicator of atomic fallout, according to a Polish scientist who has spent the last five years studying them.

Brains can be kept alive isolated from the body—monkey brains, that is. Scientists at Western Reserve University report that they kept the brains of five rhesus monkeys alive for from 30 to 180 minutes while retaining full biological activity.

(Please turn to page 22)

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Science Worldwide

(Continued from page 21)

The brains were removed from the animals and hooked to outside donor monkeys for blood circulation and nourishment. It was said to be the first time primate brains had survived as an isolated organ.

Video for the blind may be a future possibility, predicts TV pioneer Dr. Allen B. DuMont. He says it may become possible "eventually to feed electrical waves directly to the human brain. . . . In other words, we will electronically bypass the human eye."

An eye bank, said to be the first of its kind in the world, is now in operation in England. Deep-freezing will enable the donated eyes to be kept for up to six weeks in perfect condition. With present refrigeration methods, an eye won't last much over four days.

Putting coins under the mast of a new ship, an ancient good luck custom still in use, apparently dates back at least as far as the first century. The hulk of a Roman ship found in England's Thames River had a bronze coin under the heel of its mast. The coins bore dates from the time of Domitian, emperor from 81 to 96 A.D.

Alaskan Eskimos have levels of body radiation three to 80 times higher than people in the U.S. Eskimos eat caribou and reindeer which feed on radioactive lichens, contaminated in fallout from nuclear bomb tests.

Social pressures in modern society may be partly responsible for the growing incidence of hardening of the arteries. A Pennsylvania professor of pathology bases this opinion on the results of an eight-year mammal study in Philadelphia's zoo.

The only change in the animals' environment has been an increase in population density, resulting in more complex social relationships. And, for the first time, he says, deaths from heart attack have begun to appear in the zoo population.

Cheaper rain. A Japanese scientist has found that a simple chemical named metaldehyde is a cheaper and better substance for seeding clouds to produce artificial rain than the silver iodide crystals.

John P. McNeel
Science Editor

POPULAR MECHANICS



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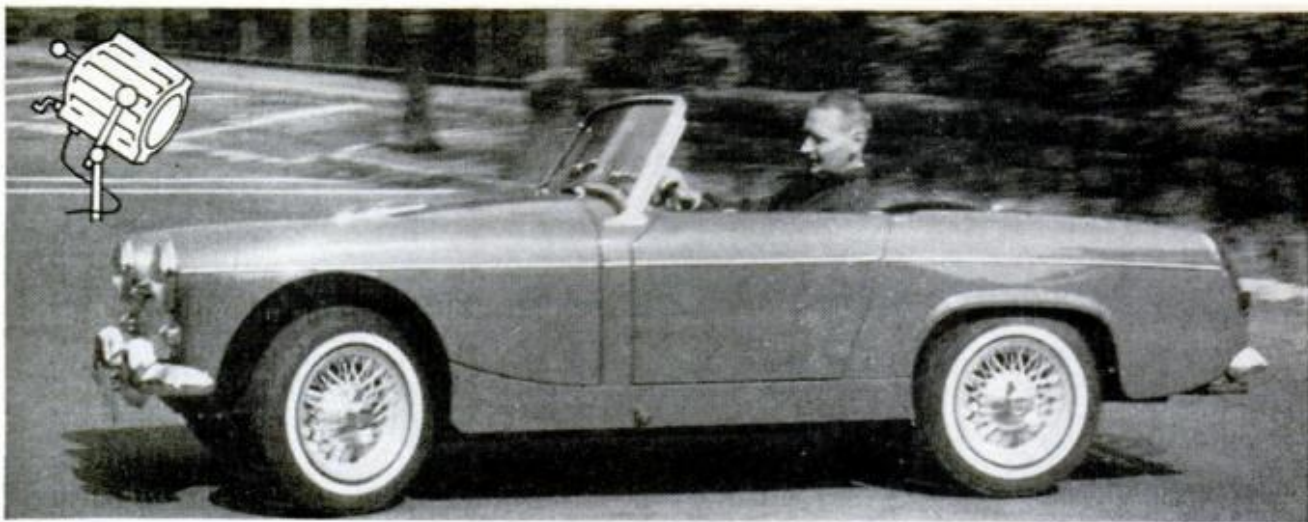
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Spotlight on the MG Midget

This 90-m.p.h. sports car with disk brakes costs less than the price of a poke-along compact

By Jim Whipple

TO PRODUCE a genuine sports car for less than \$2000, British Motors Corp. used as many off-the-shelf passenger car components as possible. Thus the Midget has the engine, transmission, steering, axles, clutch, and brakes used on a number of Austin and Morris family sedans.

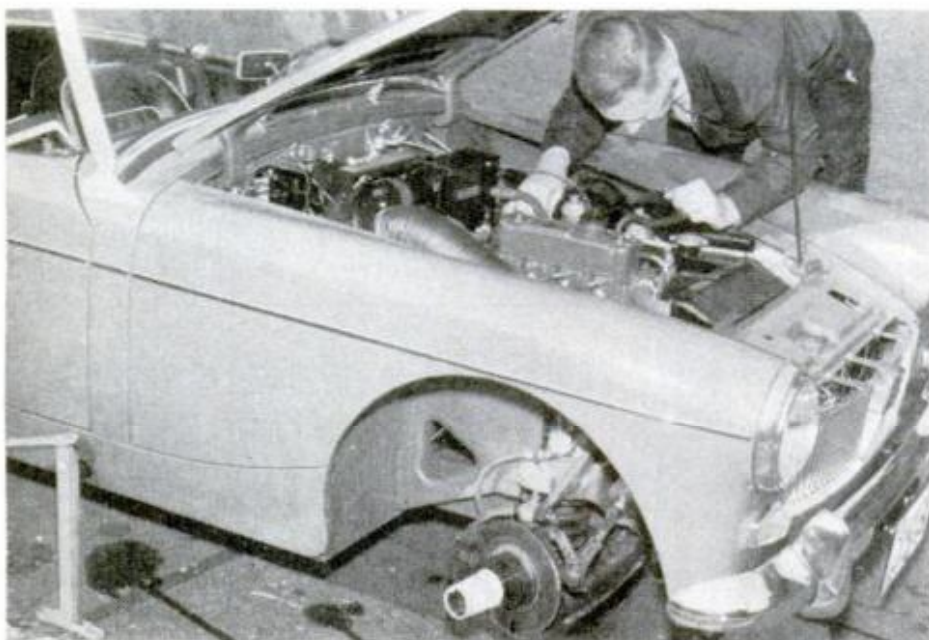
The secret lies in so locating these "family car" components that they result in a 1456-pound two-seater which can perform like a sports car.

To get the maximum performance from its 67 cubic inch overhead valve pushrod four-cylinder engine (bore and stroke 2.54 x 3.29) Midget's designers have provided just enough body room to accom-

modate a six-foot (or slightly taller) driver, with the seat set back against the rear wheel housing and the driver's left foot pressing a panel only three inches from the front tire. This makes for a short car (137½ inches) on a wheelbase of 80 inches—a favorable "square" ratio for stability, with a front and rear tread of 45 and 44 inches. Locating the seat cushions on the floor and dropping the floor itself between the frame rails of the unit body results in a low center of gravity.

Passengers sit amidships where they are least disturbed by the tossing of front or rear ends of the car. The ride is surpris-

(Please turn to page 26)



MIDGET'S ENGINE gets its go from 8.9:1 compression ratio, and twin SU carbs. Wide hood opens to make routine work easy for do-it-yourself owners. Note wire wheel has been removed to show access to front caliper disk brake



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Although the engine is small (it was recently raised from 49 to 56 horsepower) it's willing and vigorous. And, if you take the trouble to coordinate clutch and throttle and make the most of the transmissions' four speeds (top three synchromesh), you can manage good acceleration (0-60 in 16 seconds) and keep rolling up hills at 60-65, which is about tops in third gear (keeping just below the 5500 r.p.m. redline on the electric tachometer). Forward ratios are workable compromises at 3.20:1 1st, 1.91:1 2nd, 1.35:1 3rd and 1.0:1 4th; with rear axle ratio of 4.22.

Top speed is a shade under 90, at which point the Midget feels very light and the wind drumming on the vinyl top and removable sliding plastic side windows makes conversation impossible. But at a true 70, the miles slide under the short, downsloped hood quite painlessly and the car is rock steady.

We can't praise the brakes too much. With the recent addition of 8¼-inch caliper discs on the front wheels, you merely lean on the little suspended pedal and bring the Midget down to a smooth straightline stop from 70 mph just short of losing tire adhesion.

The interior is snug but comfortable with good seating angle and properly shaped bucket backrests. When the top and demountable side windows are in place and the fresh air heater is going, you are draught free and comfortable. There's room for a large suitcase behind the front seats, and a couple of overnighters fit in the trunk with the spare. ★★★

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CLINIC FOR HOMEOWNERS

Q Late last summer I papered two rooms in our new home and ever since we've been troubled with an objectionable odor which apparently comes from the paper or the paste. We used a prepared wheat paste. At times there appears a slight discoloration in spots and these discolored areas seem to be slightly damp. What could be the cause of this? And the remedy? —K.H., Mich.

A You do not say how old the home was at the time of papering, but we would guess right away that the cause is moisture in the plaster, that is, the walls were not thoroughly dried out at the time of papering. This is a common trouble where walls (plastered) are not permitted to dry thoroughly before any covering is applied. In time, of course, the moisture in the plaster will dissipate, but in the meantime there isn't much you can do about the condition. It may be advisable to remove the paper, wash the walls to remove paste residue and allow the plaster to dry out before repapering. If this is done you should experience no further trouble.

Q I have several older dining chairs having hardwood frames and backs. All the joints seem to be loose, causing the chairs to squeak annoyingly when in use. What's the best way to repair these—take them apart and reglue all joints, or is there some simpler way?—P.K., Ga.

A The best way is to take the chairs apart and reglue all the joints, as you suggest. This is quite a chore, as each joint, either the doweled or tenoned type, must be opened and the parts cleaned to remove all old glue before regluing and clamping until the glue has dried. Another method makes use of a simple glue injector having a nozzle which is inserted into a small hole drilled into the joint. The injector plunger is then tapped with a mallet or hammer to force the glue into the space around the dowel or tenon. This method of injecting glue is quite effective, more especially when used to reglue tenoned joints. Parts must be clamped tightly until the glue dries.

Q I have a leather-upholstered chair which is old but still in good condition. The leather shows some wear around the edges of the cushion and on the tops of the armrests. There are no wide cracks or other defects. Isn't it possible to re-finish this leather with a dye or paint? —F.H., Calif.

A Yes, there are both special dyes and paints, or enamels, available which are made especially for use on leather. The dyes act more as a stain while the enamels, being opaque, tend to conceal any surface defects more effectively. Both should be available from your paint dealer. One important step is to thoroughly clean the leather before applying either a dye or enamel. This usually can be done with a mild soap suds, drying the surface immediately after washing. Avoid wetting the leather more than necessary to get it clean.

Q The blower on my furnace (horizontal) seems unusually noisy this season. There seems to be nothing visibly wrong, although it appears to me that the fan runs faster than heretofore. How can I reduce the speed of the fan? Wouldn't this tend to reduce the noise?—I.S., Ohio

A On most furnaces of the type you describe the fan motor is fitted with a variable-speed pulley. Although it seems unlikely, it could be that the moveable half of this pulley has shifted—or has been shifted—inward, giving the effect of increasing the pulley diameter. This would increase the speed of the fan, as you have mentioned. Usually the moveable half of such a pulley turns onto a threaded sleeve, which is a part of the hub, and is held in place with a set-screw. If you loosen this setscrew and back off the moveable half of the pulley you will reduce the fan speed proportionally. If this is done it is likely that the motor will have to be re-adjusted on its base to give the proper belt tension. We suggest you investigate this possibility. Of course, there are other sources of abnormal fan noises such as partially clogged cold-air intakes (registers), fan incorrectly positioned in its compartment, a loose fan bearing, loose pulleys and so on. Perhaps you should investigate these possibilities also.

As a service to Popular Mechanics readers in solving the hundreds of problems pertaining to a home—inside or out—you are invited to present your problems to The Clinic Editor for his helpful advice. Address your questions to The Clinic Editor, Popular Mechanics Magazine, 575 Lexington Ave., New York 22, N.Y.

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Sidelights on

AVIATION

Speaking of sidelights, one of the oddities produced in researching the article on the *Skyway Crash Preventers* (page 106) is that the first radio aid to aerial navigation was produced by an auto manufacturer, the Ford Motor Co.

It should have been no surprise, considering that the first airplane was built by two bicycle makers from Ohio. Ford's entry into aviation navigation, however, was not that abrupt. It had already entered radio in 1920, and in 1924 began building Ford-Stout Tri-Motors, perhaps the first commercial airliners.

Commercial aviation began to grow so much that Ford set out to develop a radio device to help planes fly from one point to another. The result was the low-frequency radio range, familiar to all World War II pilots. Some of these ranges still exist and, up until 1952, constituted the backbone of civil airways.

For those unfamiliar with them, the LF ranges sent out Morse-code A (·—) and N (—·) signals. The A-signal went into two opposite quadrants and the N-signal into the other two. Where the dot-dash of the A met the dash-dot of the N, they blended to form one continuous tone. This was the "radio beam" along which pilots flew in the romantic days of aviation.

Ford never accepted any royalties on its development, although at one time LF ranges saturated the country. Now being phased out, the LF range is one of the few existing reminders of the time when a aviation was young and pilots wore goggles and leather helmets.

Great-Horned Owls are being used to keep Air Force hangars clean. Plagued by droppings from roosting pigeons and sparrows, the Air Force imported some owls to scare the smaller birds off. Thousands of man hours had been wasted cleaning up after the unwanted birds.

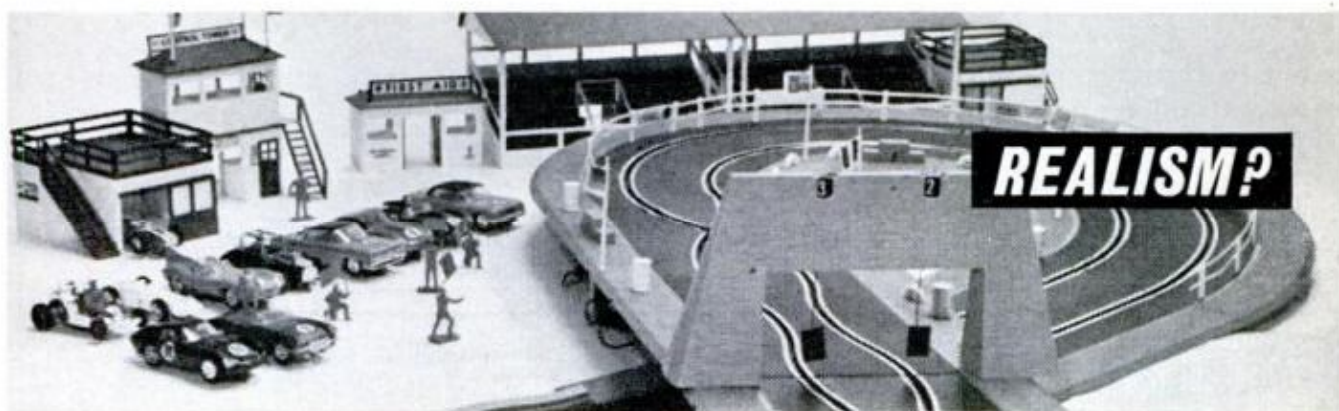
Bejabers! Would you believe it, while most airlines exist only with government subsidies, the Irish International Airlines are turning a grand profit every month. They average nearly 90 percent of capacity on trans-Atlantic flights, while others average less than 60 percent full. Leprechauns, perhaps?

Kevin V. Brown
Aviation Editor

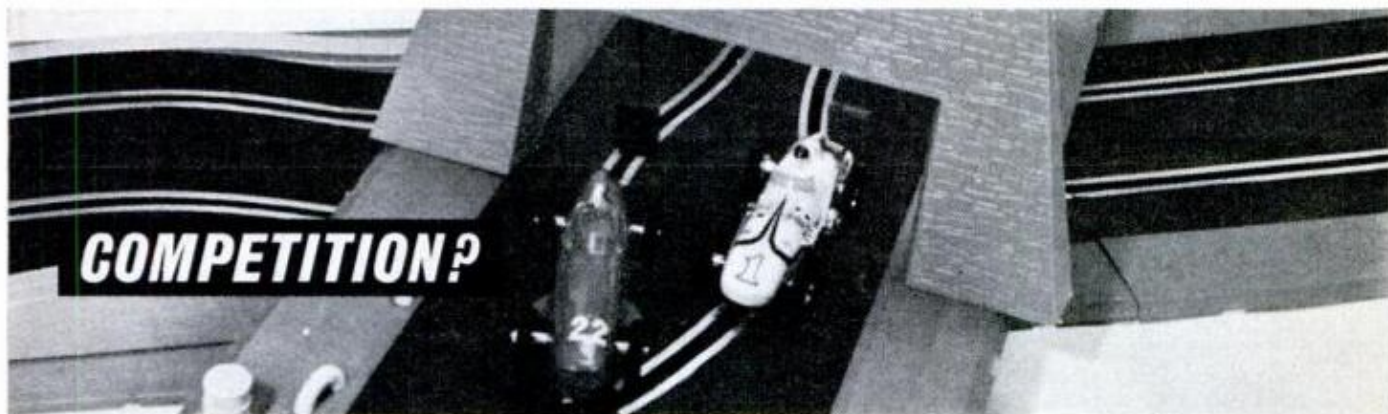
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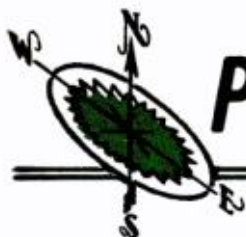
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Popular Mechanics Shopping Guide

Worth Writing For

Christmas decorating and gift making become pleasant do-it-yourself projects with the use of colored spray enamels. "The Colors of Christmas," a 10-page booklet put out by the Tester Corp., 620 Buckbee St., Rockford, Illinois, is filled with illustrated ideas for making unique tree ornaments, cards, place mats, centerpieces and wall hangings. Copies are free upon request.

Peace and quiet around the home or workshop often de-

pend upon wall construction. Remodelers have the chance to sound condition an existing wall without demolishing it—using insulation board, gypsum wallboard, and conventional construction techniques. This and other systems developed by IBI and tested at independent research labs are described in detail with working drawings in the brochure, "Noise Control with Insulation Board for Homes." It's available at no cost from Insulation Board Institute, 111 West Washington St., Chicago, Ill.

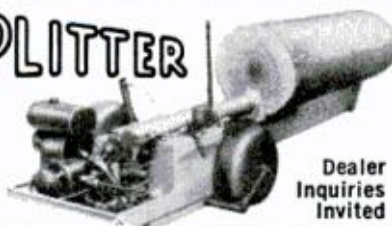
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popular worldwide, and now you can build your own board. "The Surfboard Builders' Manual," by Steve Shaw, a book written on construction of surfboards, offers comprehensive illustrations, step-by-step directions, template facts, design and repair tips for do-it-yourselfers. Forty-eight 8½" by 11" pages, bound for clipboard use, also contain purchasing hints for materials and a concise glossary of terms. Copies are three dollars each from Products Unlimited, Box 314, La Mesa, Calif.

(Text is continued.
Please turn to page 38)

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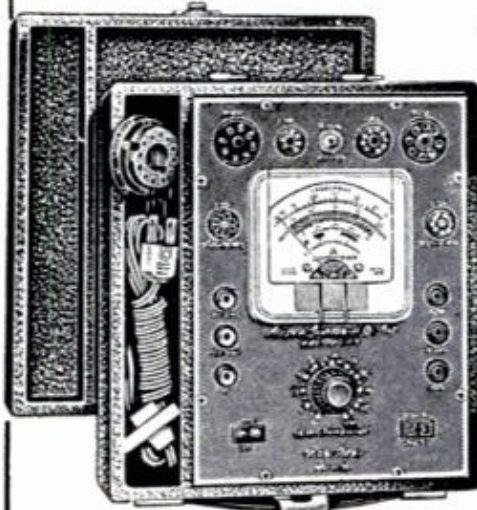
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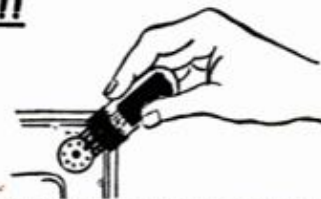
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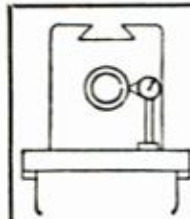


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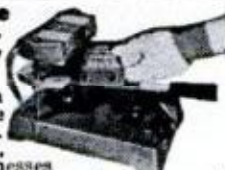
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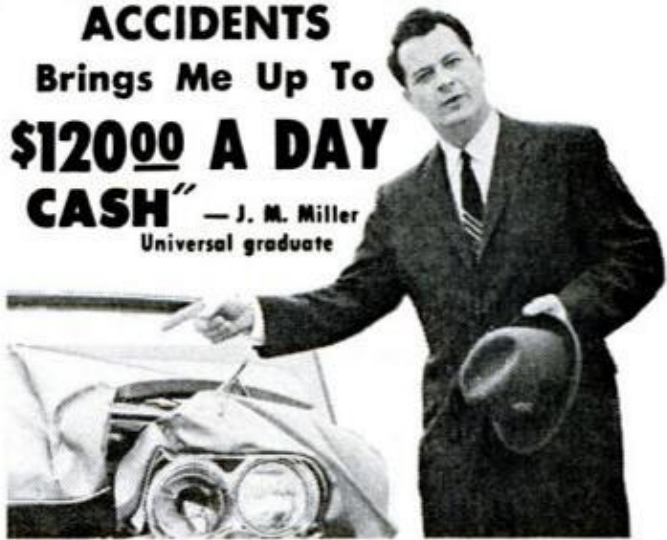
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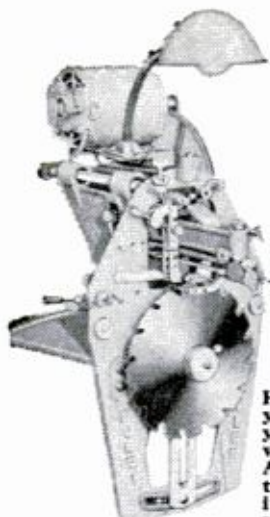
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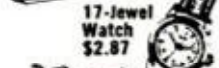
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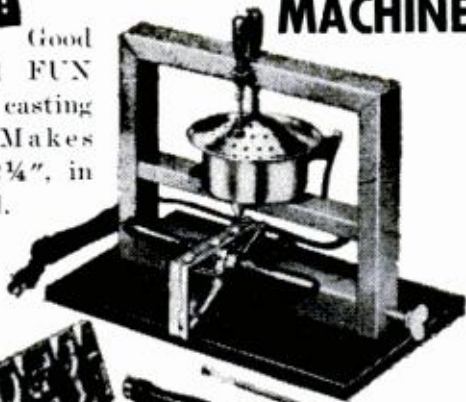
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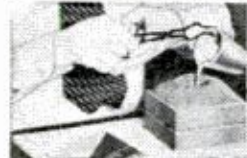
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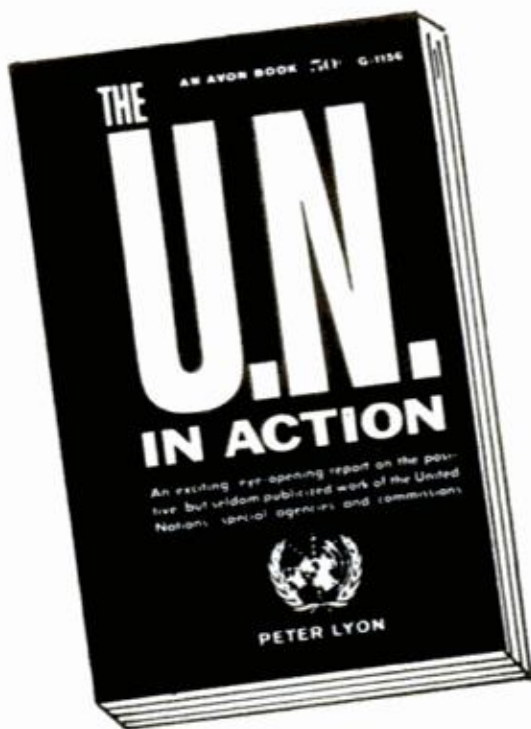
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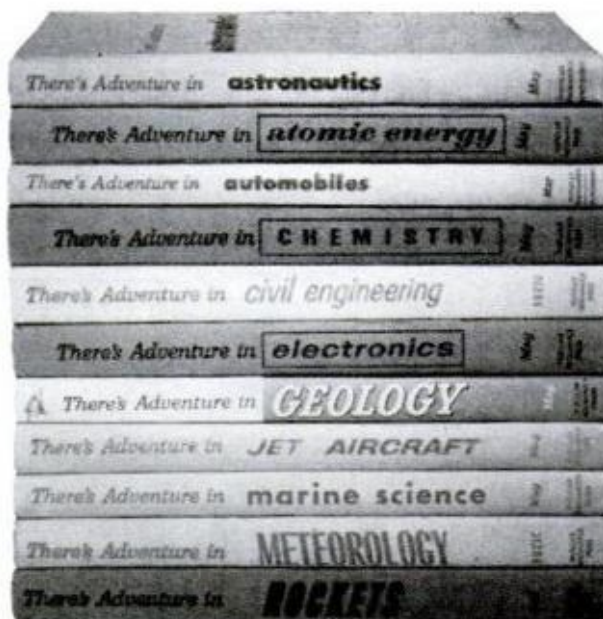
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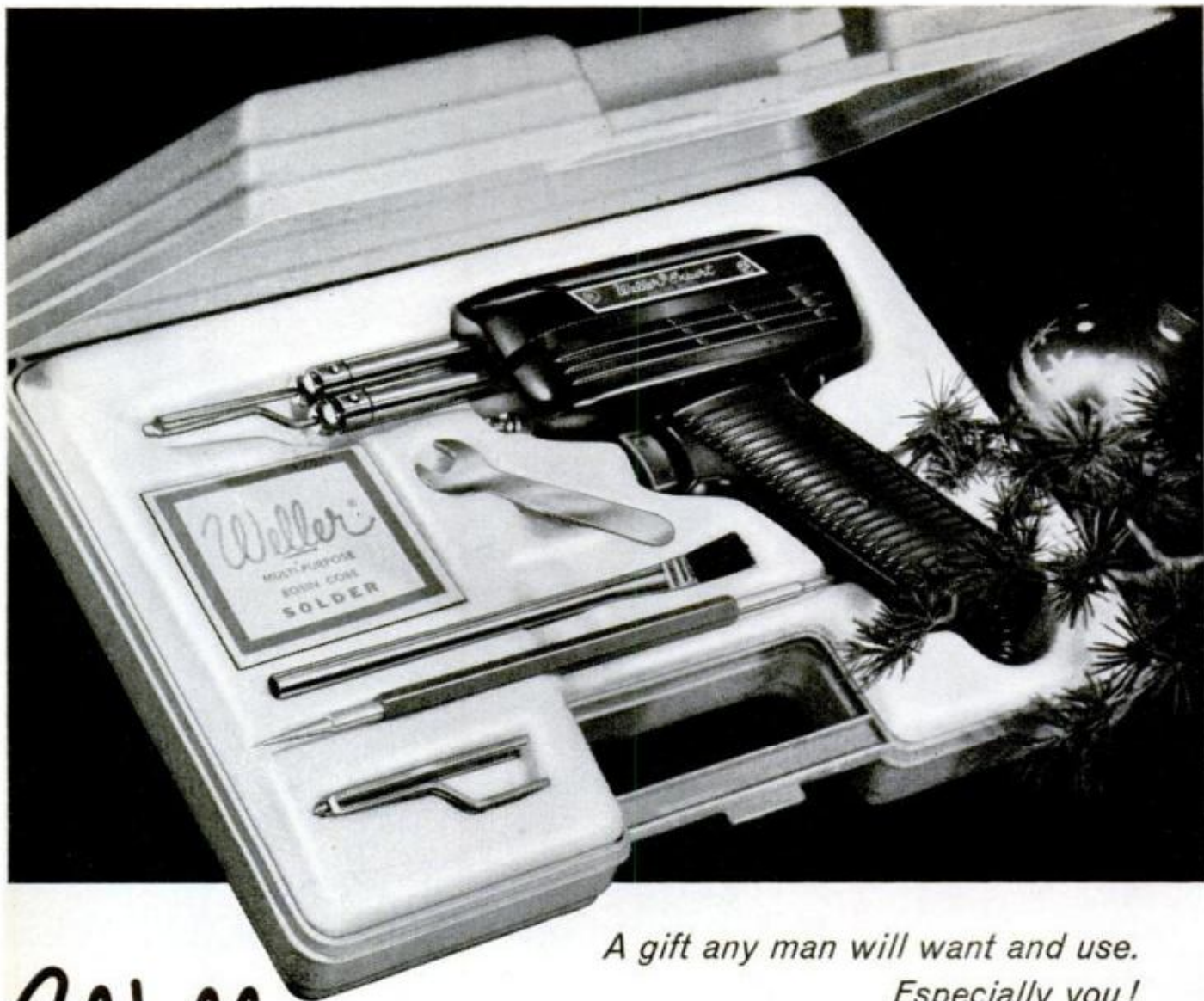
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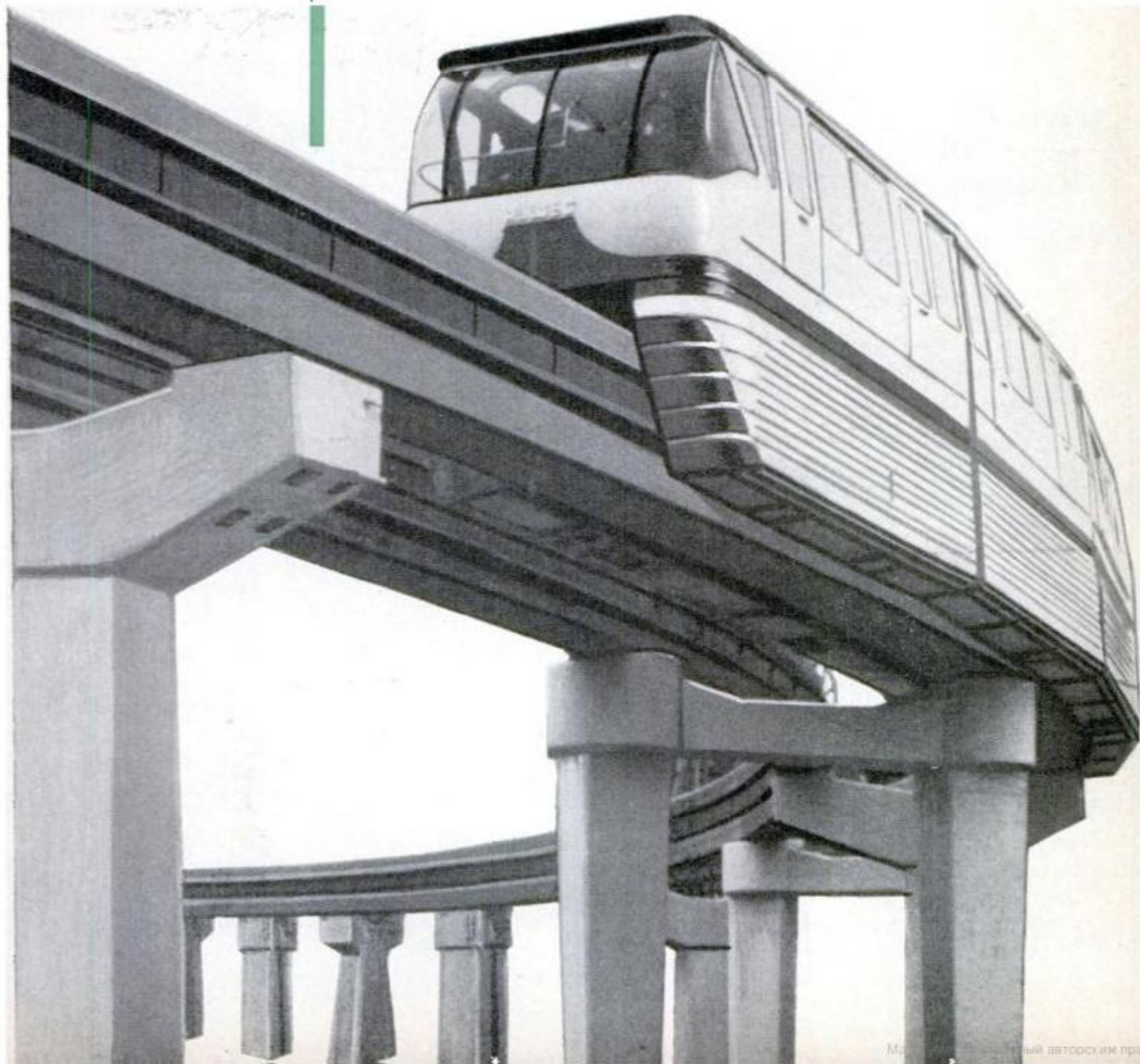
“Why hang railroads from lampposts?” ask the critics. Monorail backers have some answers

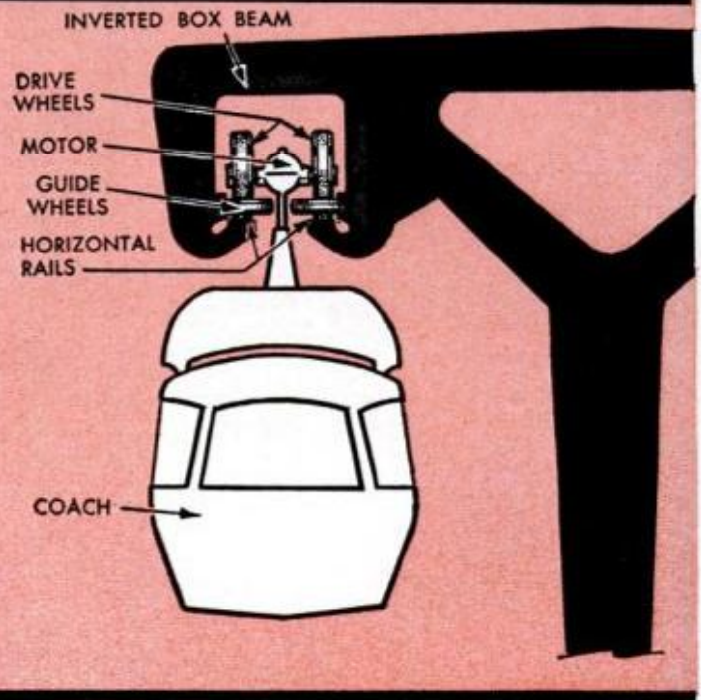
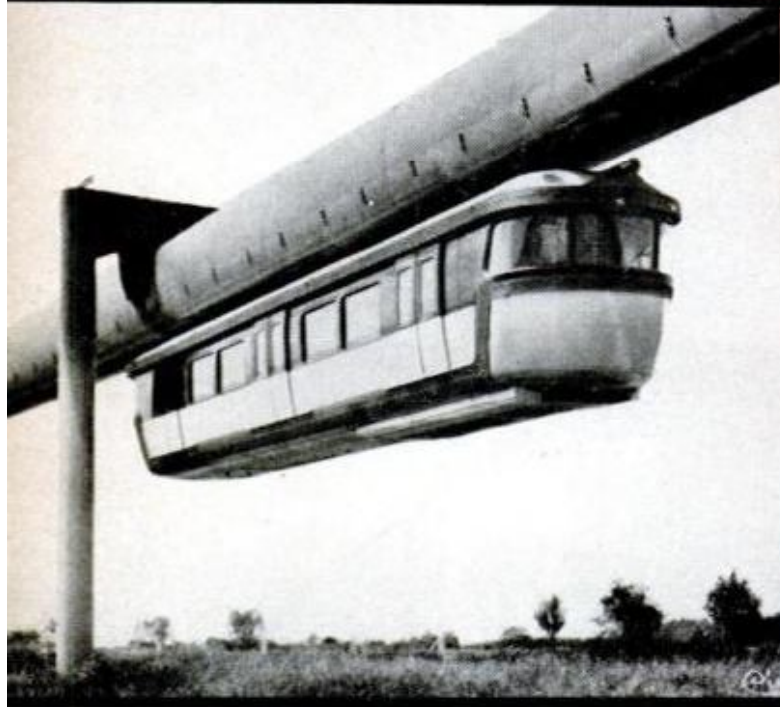
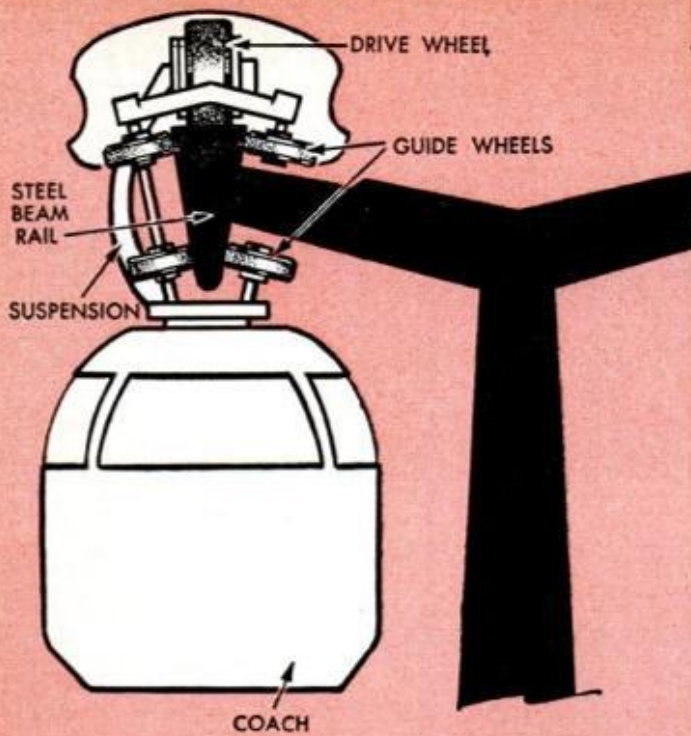
By Joseph N. Bell

WHY TURN A RAILROAD upside down—or suspend it on lampposts—when there’s no evidence it will operate better that way?

So argue the opponents of monorail transit systems. And what do monorail advocates have to say in its defense?

- We can erect monorail systems faster than you can build





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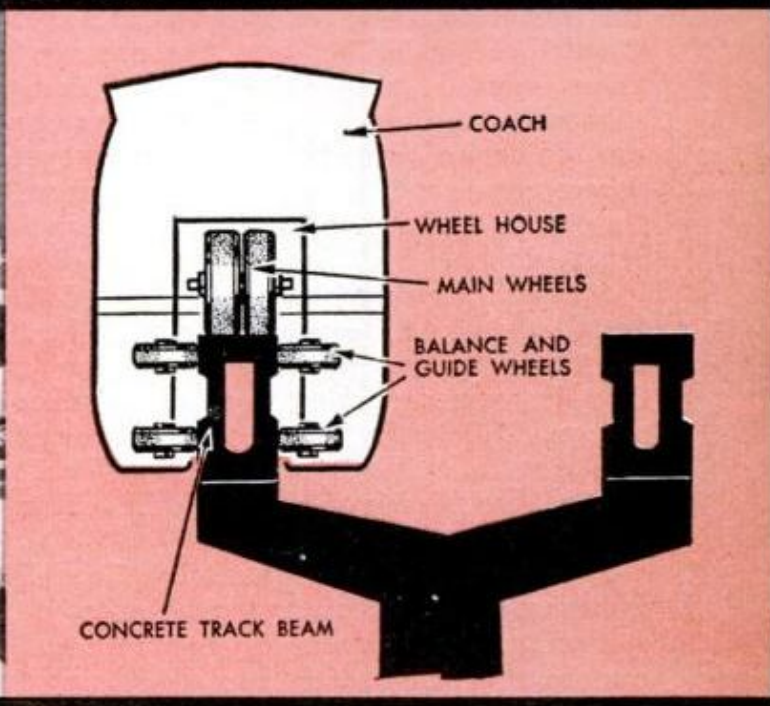
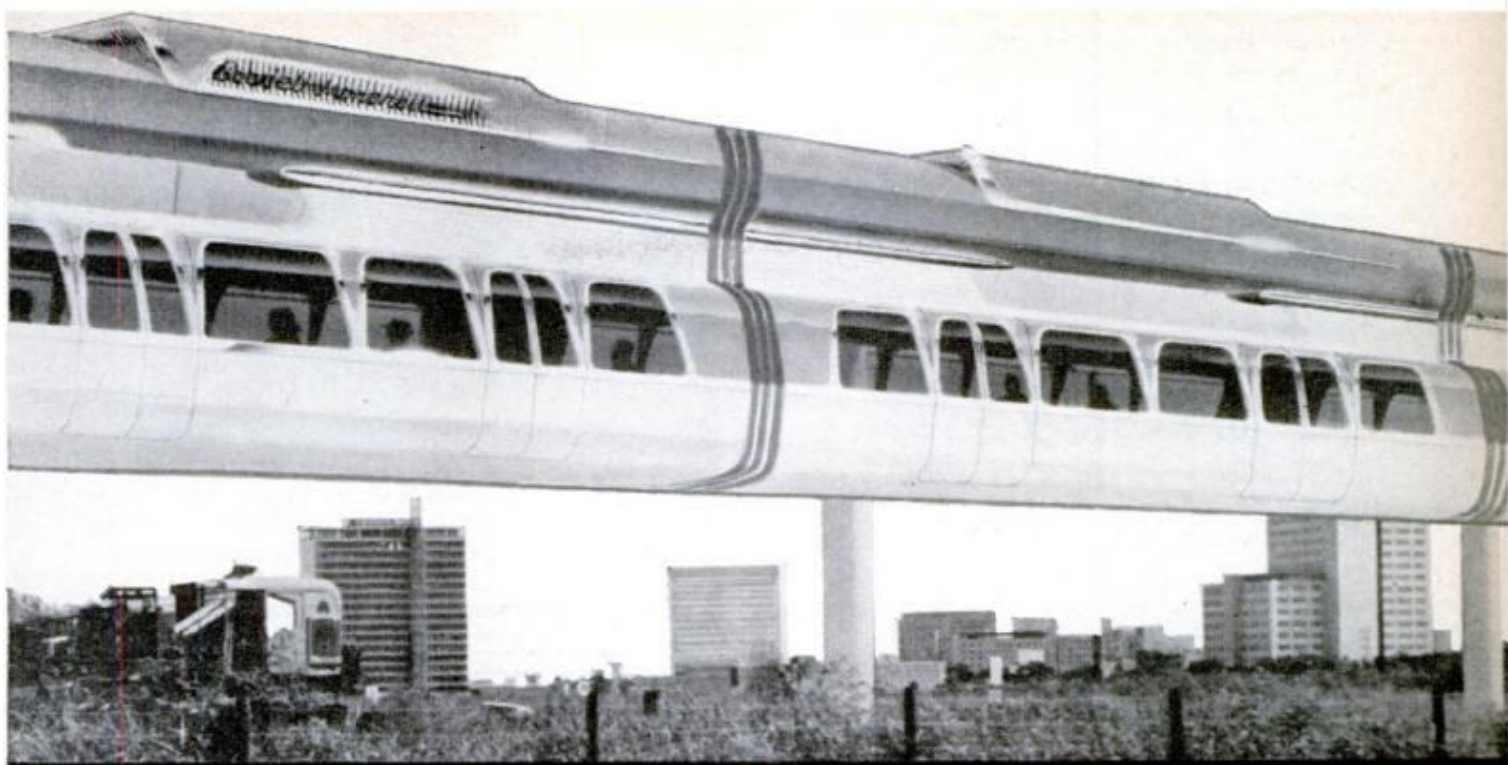
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- We can build at a lower cost.
- We can offer a city safe, swift and comfortable transportation—and we can serve outlying areas with greater speed.

But to date, the critics have successfully derailed the plans of monorail builders to set up their trains in U.S. cities. Monorails have not yet been allowed to show what they can do as a full-fledged mass-transit system, carrying shoppers and commuters to town, or travelers to an airport.

The few monorails that have operated in the U.S. in recent years have been either experimental setups or installations of relatively short rides to or within expositions and amusement parks.

What's holding back the monorail—which proponents contend will rapidly help solve the strangling traffic problems of big cities? And why should monorails, which by definition are simply one-track railways, have any advantages over the conventional subway, elevated, or bus transportation system?



SAFEGE suspended-type monorail (below, left-hand page) is AMF's high-speed system; box rail is 6 by 6-foot hollow steel or concrete beam. Alweg (above) has its supported system in Seattle; tires run on a 3 by 5-foot concrete beam.

The "one track" is generally not just the familiar steel rail. In the case of the Alweg monorail, for instance (Alweg built the train systems for Disneyland and the Seattle World's Fair), it's a 3 by 5-foot concrete beam.

Vehicles using the monorail track are either the *suspended* type, hanging from the rail above, or the *supported* type, riding atop or straddling the rail.

But, the critics contend, when you hang a train from a single rail—or beam—it tends to sway, and its coaches are buffeted

as the trains pass in opposite directions.

PM reporters riding both the Alweg straddle-rail system in Seattle and the Goodell suspended system in Dallas noted no sway problem. Both systems, however, were running at substantially lower than the capacity speeds which presumably would be a maximum test of sway tendencies. They reported both rides to be surprisingly smooth and far quieter than conventional subway rides.

Alweg officials insist that claims of buffeting between passing monorail cars have

been completely disproved by the operation of the Seattle monorail. And a PM reporter riding the train found that there is no buffeting as trains pass.

"There is no buffeting or tilting of passing cars in Seattle, even at high speed," an Alweg spokesman said. "The distance between passing trains is about 2½ feet, permitting trapped air to escape both upward and downward, resulting in a minimum of tilting. Stabilizing wheels also minimize the tilting motion of Alweg trains." In the New York subways, the widest cars (10 feet) pass within two feet of each other.

The stabilizing wheels of the Alweg trains have also served to neutralize the sway problem—at least at speeds that are compatible with city operation.

Do Suspended Types Sway?

What about sway and buffet problems on the suspended type of monorail? Murel Goodell of Goodell Monorail Systems says, "Our inertial guidance system entirely eliminates the sway problem. It operates on the same principle as a gyroscope, where you can't have sway and where long-term undulations are simply counteracted."

(Goodell personnel have built three U.S. installations and Goodell Monorail, Inc., currently has an active proposal for a 17-mile system serving the Los Angeles airport. The design shown on the cover of this issue is, in fact, one that Goodell will exhibit at the New York World's Fair next year.)

PM reporters' rides of the Dallas Goodell system could establish no facts concerning buffeting inasmuch as only one train was running. When trains run both ways, Goodell says, there'll be a minimum of four feet between passing cars.

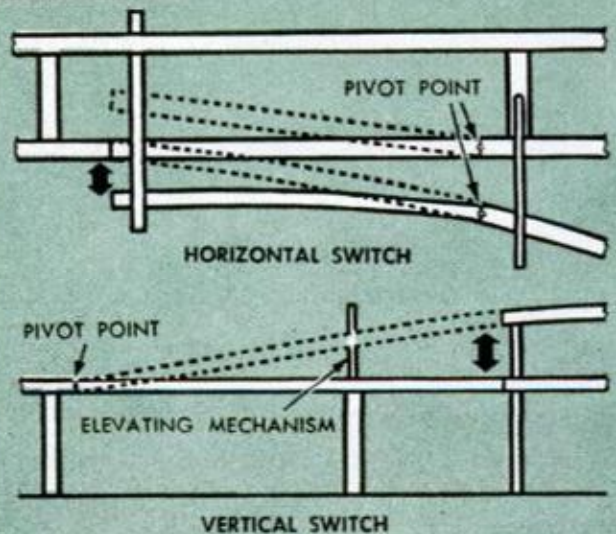
However, the maze of guiding and stabilizing wheels on modern monorail designs has given the critics an opening for an argument about semantics. The term, "monorail," insist many transit engineers, is a misleading misnomer.

Look at a system that has six lines of wheels, commented one engineer. "If they used rails, they would need six, and that isn't monorail to me. This system is just an electric bus running on top or beneath a concrete beam."

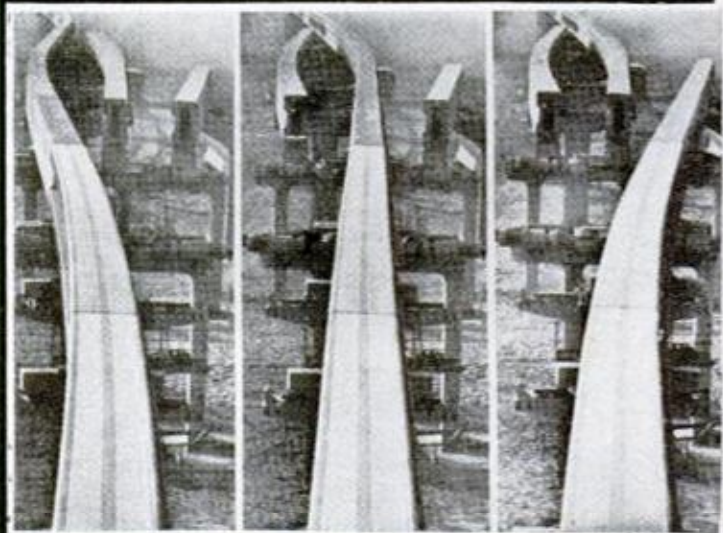
Whatever the number of wheels, some say, monorails don't go fast enough on them to gain a speed advantage.



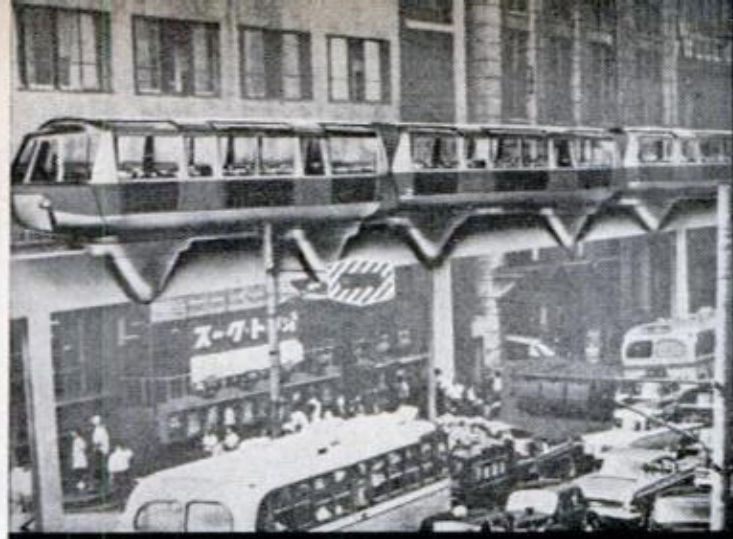
IT CAN HAPPEN—as it did at Los Angeles County Fair when a bolt snapped. However, suspension system isn't type used on fast mass-transit train



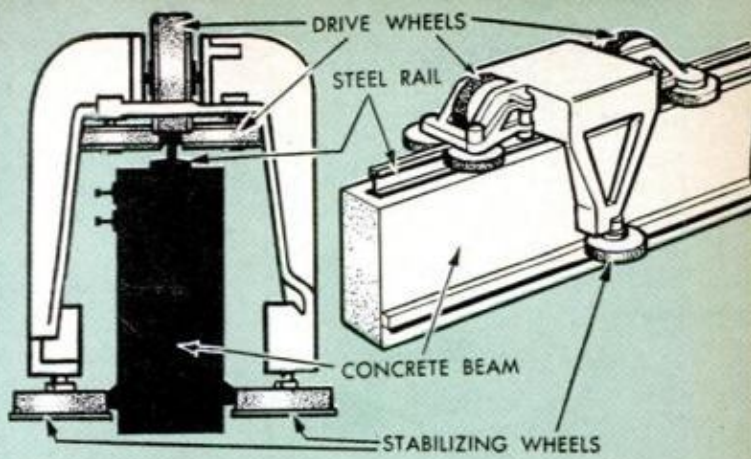
GOODELL HORIZONTAL SWITCH (top) is an 80-foot section that moves into place as main line swings out. Vertical switch is section that rises



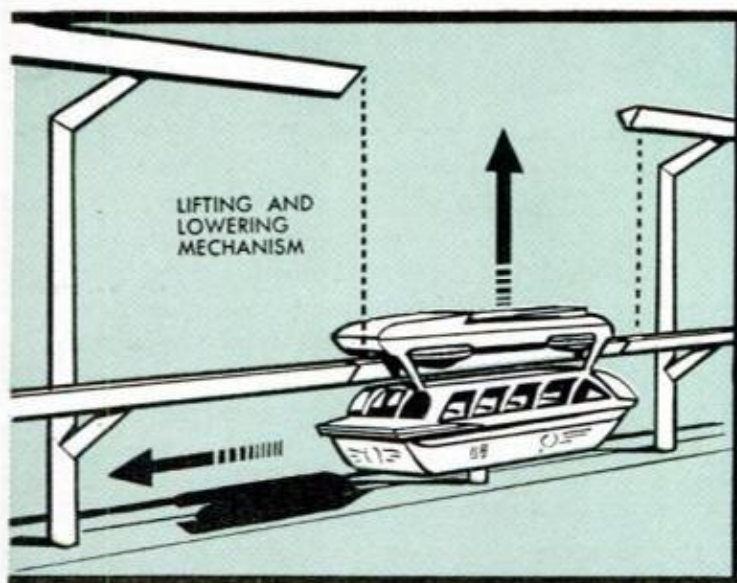
HIGH-SPEED SWITCH for Alweg system is a flexible aluminum beam 140 feet long. Beam flexes to side in seven seconds to allow coach to switch



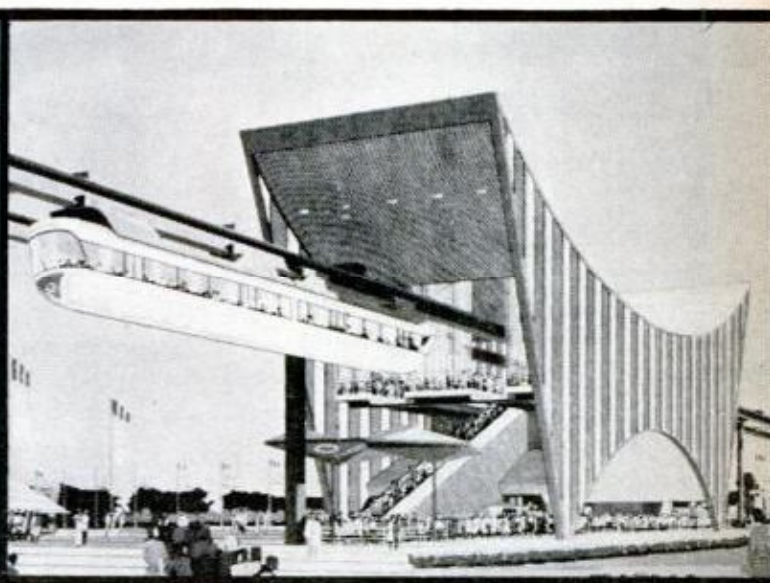
NIHON-LOCKHEED system is one of several in Japan. Electrically powered train has pneumatic system to keep floor level and align it with passenger platform



DUAL DRIVE WHEELS (two in-a-line on each bogie) carry Nihon-Lockheed coaches on single steel rail mounted on concrete beam. Lower wheels stabilize car



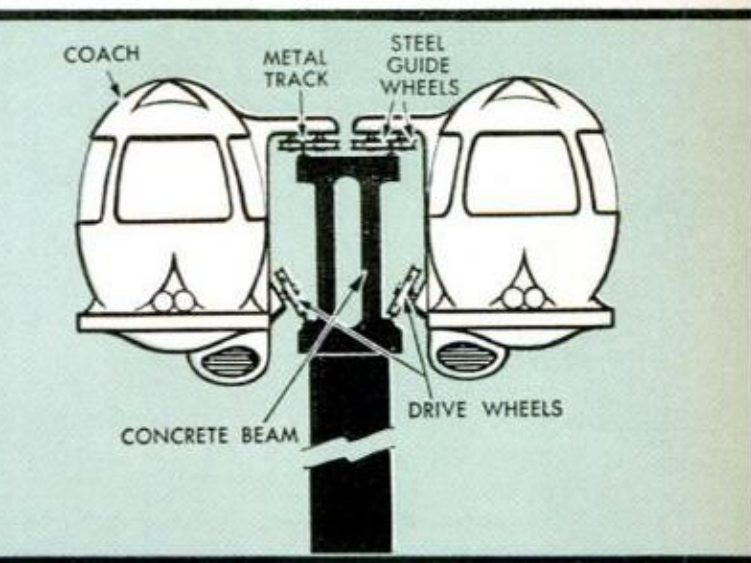
COACHES of Goodell system are taken off the main line for storage or repair by lowering a section of main line and driving coach off onto a "siding"



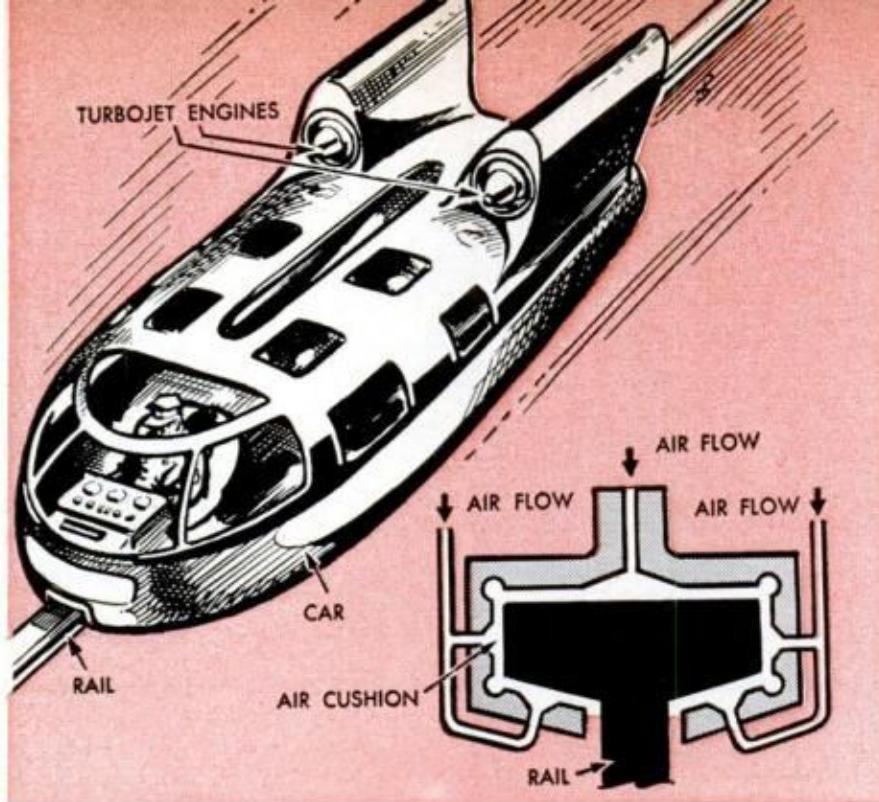
WORLD'S FAIR RIDE, being built by American Machine & Foundry Co., will be in use in New York next year. It runs on lower flange of a 4000-foot I-beam track



PRECAST CONCRETE COLUMNS of Alweg system hold both beams for two-way train traffic but still allow surface traffic to flow easily. Rail height is 25 feet



SCHERER MONOBEAM is new concept. Main feature is two-way traffic on single concrete beam, with wheels running on steel rails. The structure stands 23½ feet



FOMOTION is a monorail design by Ford Motor Co. It would slide on a single rail, supported by a thin cushion of air. Two turbojet engines propelling the car would also supply the air flow for "levapads" in the slipper (support) that holds the car on the rail

"The speed capability of monorail is no greater than standard rapid-transit equipment in normal urban and suburban service," says the Institute for Rapid Transit.

Serious monorail builders have perhaps been handicapped by the comparisons between attainable speeds and the 200 miles-per-hour speeds often loosely tossed about in "dream" systems.

Such high speeds can be attained only where there are no intermediate stops.

Virtually the same speeds can be achieved on two rails as on one, since speed is a function of horsepower in relation to weight. Under a city's stop-and-start conditions, only a greatly improved rate of acceleration and deceleration could speed up service—and monorails do not accelerate or decelerate faster than two-rail cars of the same power and weight.

Alweg expects to average 35 m.p.h. in a proposed 43-mile Los Angeles system and says it has averaged that speed with its Seattle monorail. The Seattle trains, on a 1.2-mile track, are designed for a top speed of 70 m.p.h. The monorails' in-city speed is slightly higher than the 30 m.p.h. averaged by surface trains in Cleveland and subway trains in New York City.

The monorail that Goodell has proposed for Los Angeles faces a different circumstance. The line is almost a straight shot from downtown 17 miles to the airport. The coaches, capable of 90-m.p.h. speeds, will be scheduled to cover the 17 miles in

12 minutes—an average speed of 70 m.p.h.

(Goodell feels that monorails can best be used in such an airport-to-downtown run. With few intermediate stops, the train can achieve high speeds. Another important use, the firm believes, would be from automobile parking lots in fringe areas to the center of a city.)

The granddad of operating monorails, the Wuppertal system in Germany, offers a sidelight on average speeds. Its trains sustain 25 m.p.h. on their 9.3-mile run. That's a respectable average for the old-timer (a suspended-type monorail), which has been in commercial service since 1901. The maximum speed allowed the coaches is 31 m.p.h.

Those trains of the Cleveland Rapid Transit—regarded as one of the best double-track transit systems in the nation—serve 14 stations on a 15-mile route while maintaining their 30-m.p.h. average. The Cleveland system is a surface line with 88 electric cars.

Subway trains in New York, equaling that 30-m.p.h. average, have a top speed of 45 m.p.h., says the City Transit System. Buses in New York average 9 m.p.h.

Admitting that the arguments so far don't give the monorail any sort of spectacular operating advantage, proponents move on to the question of the original cost of a transit system. Here, they feel, a clear-cut advantage appears.

(Please turn to page 191)



Soft Ride on a Gull Wing

FRANKLY, I was quite impressed with Evinrude's new 16-ft. "gull-wing" hull after wringing it out last September. In spite of its sleek ski-boat appearance, this hull takes to rough water like an old salt.

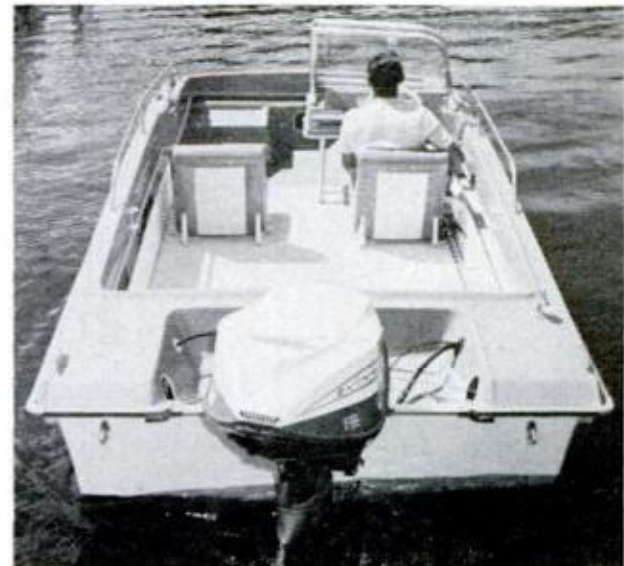
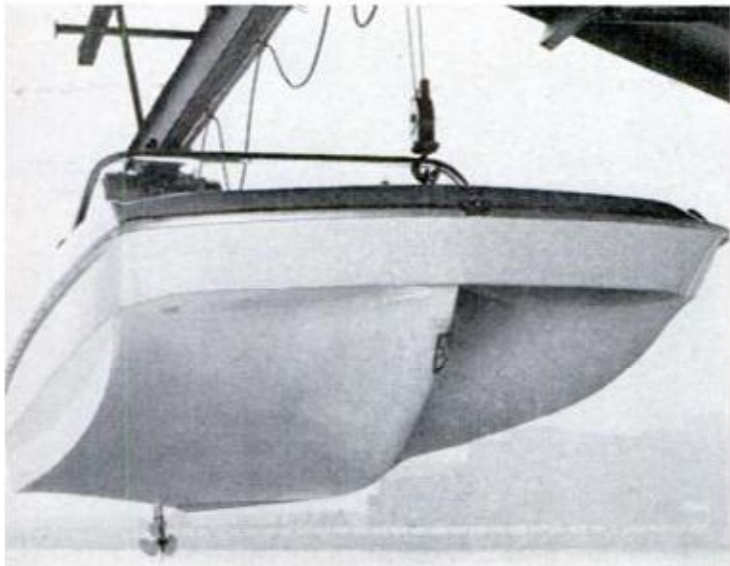
It works like this: When the deep bow knifes through a wave, water is channelled up around semi-circular troughs and back down toward the surface at the stabilizing chines. This smooth flow of water off the bow not only supplies lift but also acts as a variable-strength shock absorber to cushion the hull. Since the water isn't de-

flected downward until reaching the chines —Evinrude calls them sponsons and that's a pretty good description of their function —the effect is to minimize roll. And in addition to stability, this provides a dry ride in any but the most extreme conditions.

Available in either open or runabout topsides with your choice of outboard or OMC's 88-hp. two-cycle stern-drive propulsion, prices range from \$1500 for the "Sport 16" outboard to \$2950 for the "Sweet 16" stern-drive version, all F.O.B. Milwaukee. —Art Mikesell

BOW-ON VIEW of gull wing's soft-riding lines. The hull is braced with 25½ cu. ft. of rigid polyurethane flotation between cockpit floor and bottom

SPORT 16 has big 56-sq.-ft. cockpit with seating for four—two buckets plus two step seats molded into the bow. Folding windshield is an accessory



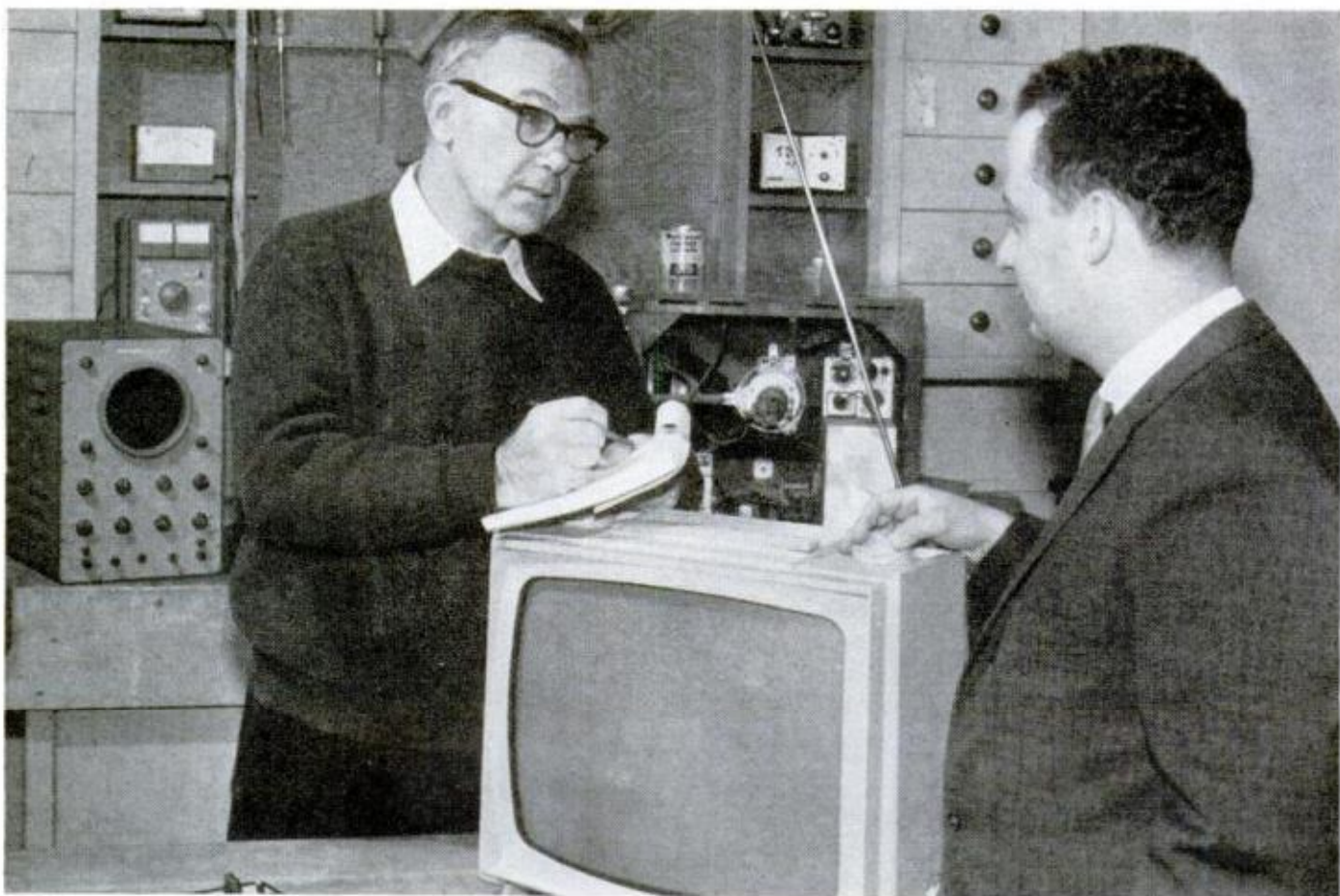


How to Find

Of twenty-eight repair shops we tried, seven were dishonest. Here are tips on how you can find reliable service and avoid being taken by the unethical serviceman

By Larry Steckler

WITH THE SET UP on the bench we'd explain to the listening repair technician that the set had gone dead the night before and we couldn't get any picture or sound. Then, unknowingly, he played his part in our TV service inquiry



Honest TV Service

IF YOU'RE AN AVERAGE TV viewer, your set has broken down at least once in the past year, and possibly two or three times. This is to be expected. But were the bills you received also expected? Do you feel they were too high? They well may have been.

Popular Mechanics decided to run a first-hand check on the reliability of TV servicing. Our purpose was not to prove that cheats and dishonest repair technicians exist—but to show you how to stay out of their hands and get an honest, competent technician to keep your set working right.

We started out by renting a conventional 19-inch portable TV. When it arrived we

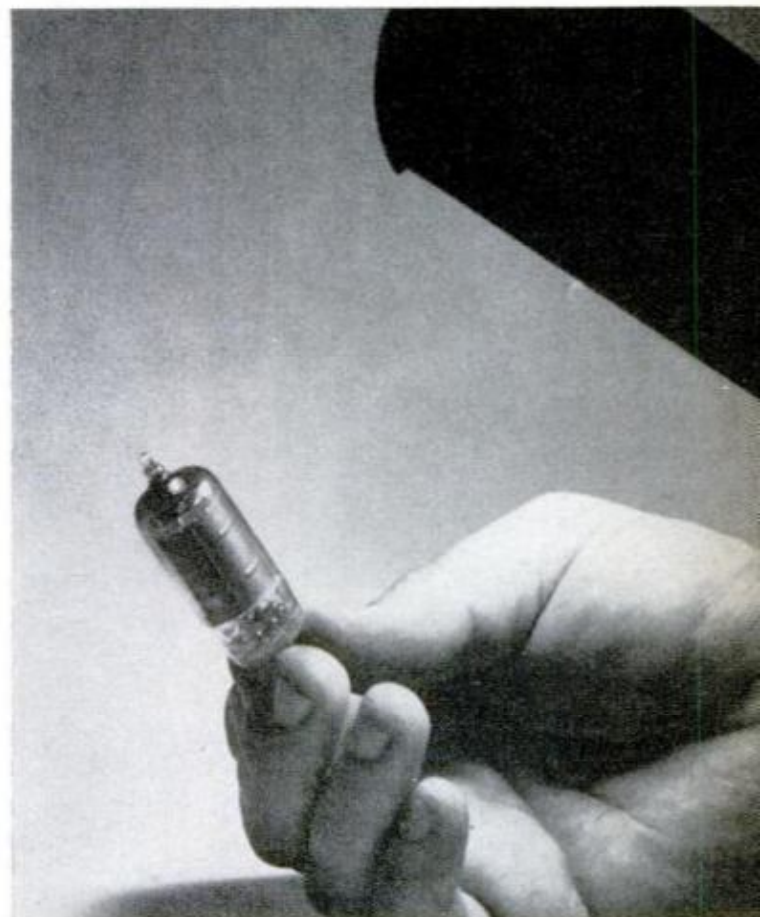
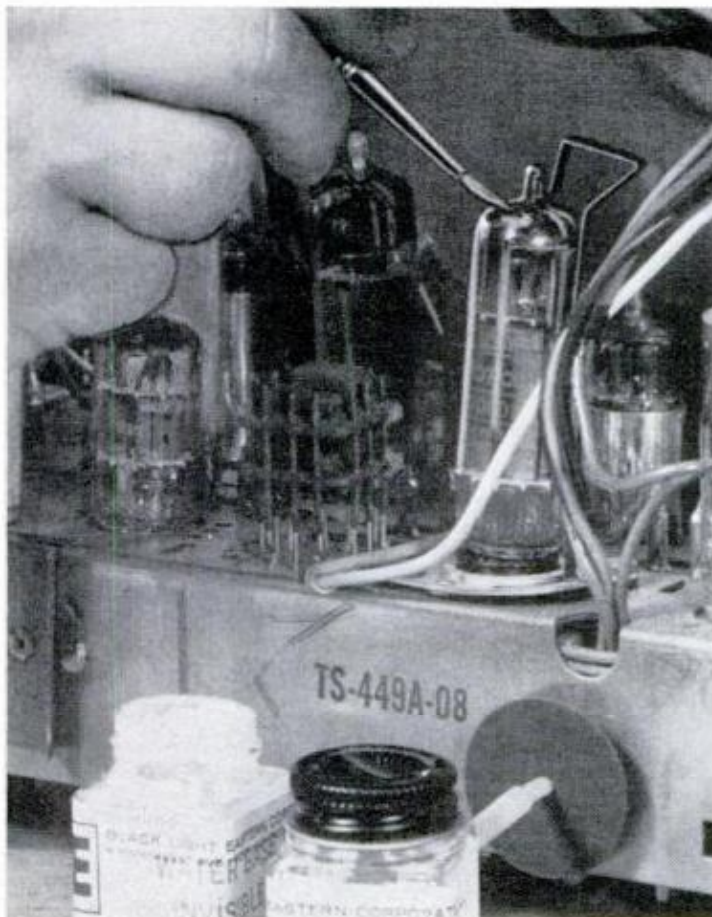
gave it a complete overhaul and put it into first rate operating condition. We cleaned the tuner, adjusted the controls, and got every circuit working to "specs." Then we set to work marking every component in the set (tubes, resistors, capacitors, transformers, etc.) with an invisible drop of ultraviolet paint. You can't see this paint under ordinary light, but the rays of an ultraviolet lamp make it glow clearly.

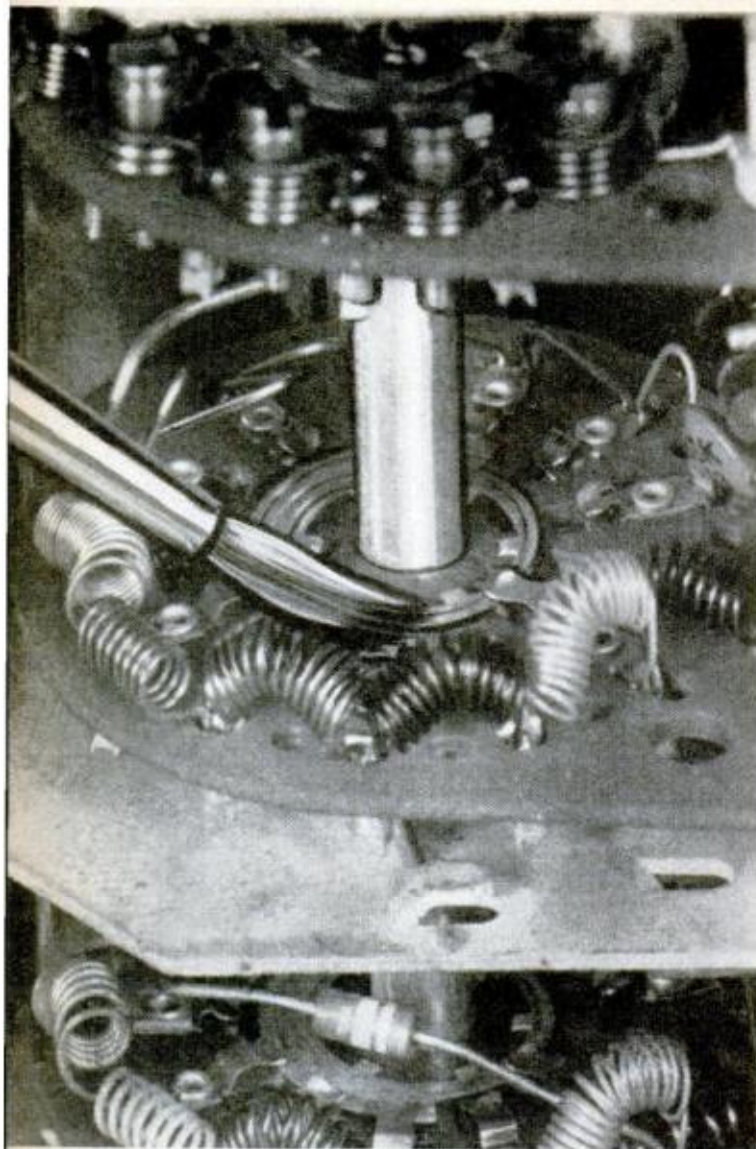
Now we were ready to introduce one simple fault into our perfectly operating receiver. We removed the sound-detector tube and burned out its filament. Then we replaced the tube in the set. The TV was ready and so were we.

In all, we took the set in and out of 28

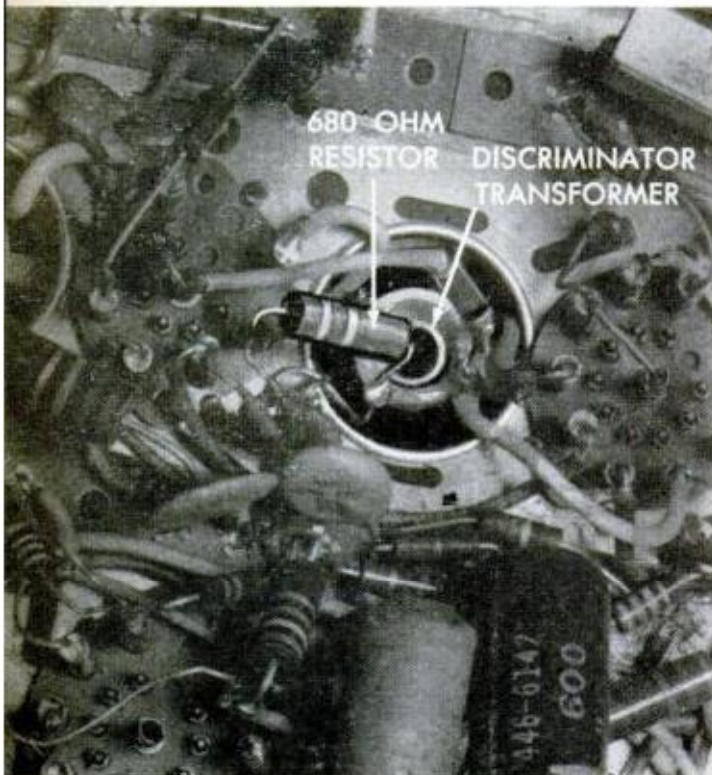
EVERY PART in the set was marked with a drop of invisible ultraviolet paint. This gave us a sure fire check on whether parts had really been replaced

UNDER THE ULTRAVIOLET lamp in our offices that invisible spot glowed green if the tube or other part had not been replaced. This trap caught two cheats





HERE IS A CLOSEUP look under the chassis of our test receiver. The arrows indicate parts claimed to be replaced, but that had not actually been changed



repair shops—big ones, small ones, main street and back street. The results were repair bills that ranged from a substandard \$4 to a very excessive \$18. We saw technicians at work. Most of the time we got honest service; sometimes we didn't.

A typical repair shop visit went something like this. I'd walk into the shop totting the set. Then I'd swing it up on the all-too-high counter and tell the man behind the counter, "The set went out last night and hasn't played since."

The repairmen's technique varied widely. In almost every case an attempt to find the trouble right on the bench was made. When the technicians recognized the trouble as a bad tube (as they did 21 times) it took them only a few minutes to find the bad one, make a quick replacement, and hand me a bill ranging from \$4 to \$5.25. (Cost of the tube \$2.15 and a minimum service charge.)

When trouble was "suspected," we were asked to leave the set for repairs. Here is where the price went up. One technician replaced three tubes although there was only one bad one in the set.

BEFORE WE TOOK the set out to be repaired we cleaned and adjusted it thoroughly. At the left you can see how tuner switch contacts were carefully cleaned

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TELEVISION SERVICE CALL TICKET 226853

NAME *Larry Buckner JR* DATE *9/7/63*

ADDRESS *41-16-181st Street* DELIVERY PROMISED

CITY *Bayside* REPAIRED IN HOME SHOP

PHONE *5787* DELIVERY GUNE PICK UP

ESTIMATE

CUSTOMER'S COMPLAINT

| DETAIL OF CHARGES | | PRICE |
|-------------------|--------------------------|---------------------|
| QUAN. | PARTS, TUBES, MATERIALS | |
| 1 | <i>6DT6</i> | <i>2 15</i> |
| 1 | <i>Disc Coil</i> | <i>1 75</i> |
| 1 | <i>Resistor 560 Ohms</i> | <i>35</i> |
| | | <i>4 25</i> |
| | <i>Labor</i> | <i>15 00</i> |
| | Total | <i>19 25</i> |

Paid



AS A FINAL CHECK we set up our test receiver on a pattern like this and adjusted all controls to give a proper picture without any distortion or misalignment

about \$2 to \$3. A house call will rarely go for less than \$5.

Insist that the technician look at the set while you are there. If he says he's too busy and will call you back later—walk out with the set and try another shop. The first serviceman may not be dishonest and may truly be busy, but out of four technicians who asked us to leave the set because they were too busy to fix it right then, three took us for an expensive ride.

Watch the man as he removes the back. Does he seem familiar with the tools he is using? If he suggests that more than a tube or two will be needed, try another shop. Again, he may not be dishonest, but \$2 or \$3 to doublecheck the need for an underchassis repair can save \$20 and up.

Look for name brand tubes and parts to be used as replacements. One technician who didn't care to use such expensive parts had to replace the bad tube twice before he found a tube in his stock that worked. A later check showed that this one was weak with a much shorter life expectancy than a quality replacement.

Should you rely on a recommendation from a friend or neighbor who has already found a reliable repairshop? The answer is yes, providing you learn a little more than whether he's been satisfied with the service. Find out how large the last five or six bills have been. One handy technique used by the cheat is to handle the first two repairs honestly, keeping charges to a minimum. The third time around, however, you're told about a serious repair running not less than \$50. By this time

you're ripe and accept the charges as proper. So protect yourself. Whether it's the first or the fifth time a particular shop is doing a repair job for you, if extensive shop work is called for (such as replacing a picture tube or a flyback transformer) double check with another shop first.

When extensive shop repairs are called for, get an itemized bill. An honest repair will list at least \$10—\$15 in labor. A long list of replacement parts and a small labor fee are warning markers. It takes time to replace parts and nobody will spend that time without charging for it. The itemized bill also helps when one of the replaced parts fails within the guarantee period, as it shows which parts were replaced and are covered.

Try to pick a shop that is a member of a local technicians' association. While this in itself does not prove honesty, it does give you an additional channel of complaint if the repair doesn't work out. Most associations will force a member to rectify an improper repair.

Above all, don't be baited. Nobody is going to examine your set for free, or come into your home and charge only a dollar or two to look at and repair your set. Any repair technician who comes to your home must make *at least* \$3.50 if he is to break even. This covers his cost in getting to your house and back to his shop. If the call is "free" or only a dollar or two, you'll probably find a diagnosis or labor charges added on—starting from the moment the man entered your home. You're also likely to find yourself buying several tubes you don't need.

You can cut the risks still further by doing some basic checking yourself, before you go looking for professional help. Make sure the set is plugged in and the power is on. Test the outlet to be sure that a house fuse hasn't blown. Take the tubes out and check them on a do-it-yourself tube tester at a local store, then make sure you return them to the same sockets from which you extracted them. Check to see that someone hasn't turned down the brightness control or disconnected the antenna. Then, if you haven't already repaired the trouble, call the technician.

Remember, honest service won't keep your set from breaking down and it won't limit you to one service call per year. It will give you a fair return for whatever money you do spend. Select with care—the dollars you save are yours! ★★★

Boiling the Brier

Pipe smokers can renew their briars with a steam cleaner that removes tars and nicotine in five minutes.

Water heated in a glass globe forces steam through a rubber tube into the pipe stem and bowl. The Steamex Pipe Purifier sells for \$3.85 from FM Products, Box 727, Norwalk, Conn.



Fold-Flat Camper

Nestled flush with a truck bed during travel, the Compact Camper unfolds in a minute to make a comfortable living space.

Folded down for travel, it doesn't block the driver's vision or add to crosswind problems.

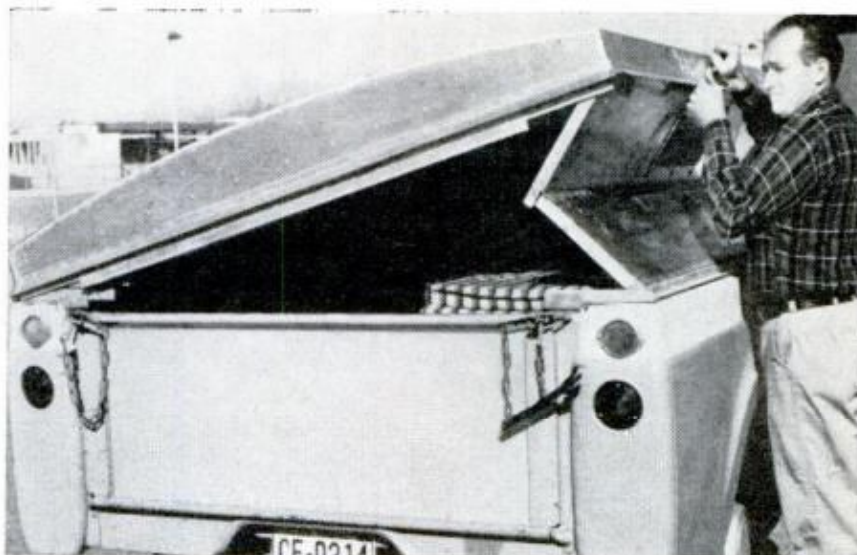
Made of lightweight aluminum with a mahogany interior, the camper body weighs 150 pounds and is six and a half feet long and five feet, eight inches high; allowing ample headroom for seated occupants. It will sleep a total of four persons.

Two screened plexiglass windows provide ventilation. A combination slide-out bed and studio couch (bottom photo) is 40 inches wide and 6 feet long. A mattress is added for sleeping. There is also a folding table and food storage cabinet.

Attached to the truck body with stove bolts on each side, the camper unit can be easily removed from the truck by two men for storage when not in use.

Lighting is provided in the camper with battery-powered lamps.

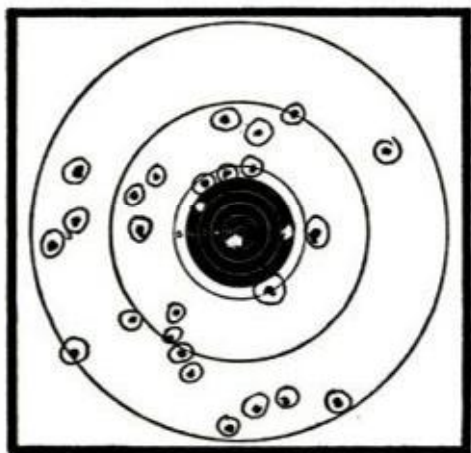
Made in two sizes for long and short-bed pickups, Compact Camper is priced at \$350 and \$395. It is built on order by Adrian Shute, Phoenix, Ariz.



Duffer to Sharpshooter

Whether trap shooter or pheasant hunter, almost anyone can become expert using George Carson's surprisingly simple methods

AFTER JUST ONE HOUR of sight-shooting practice, a 10-year-old boy took 30 shots at the paper target (below) from 10 yards, without aiming, and placed every shot within scoring rings



STANDING with back to target (drawing below), shooter pivots on left foot and turns from the hips to fire. The gun stock (photo right) is held firmly to the chin, rather than the cheek



in 90 Minutes

WITH "SIGHT SHOOTING," a novice can become an excellent wing-shooter in just 90 minutes.

Developed by George Carson, a St. Louis, Mo., marksman who has taught more than one thousand people to shoot, sight shooting is based on the principle that aiming a shotgun is the same as pointing your arm at an object.

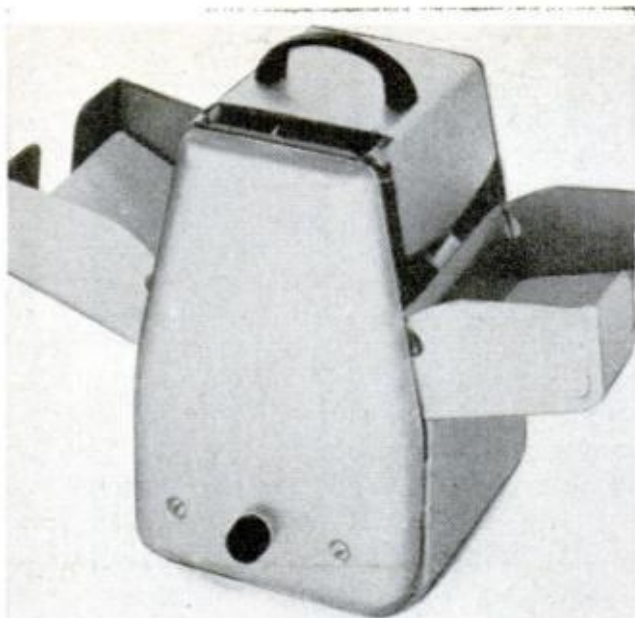
His method incorporates only two basic rules: (1) The gun is held with the stock touching the chin (rather than in conventional cheek position), and *must* be held in the same position for each shot. It is moved instinctively, in effect, as an extension of the body. (2) In sighting a target *with both eyes open*, the shooter looks slightly above the target. To make it even simpler, the practice weapon is a BB gun.

Using targets such as Necco wafers hanging on thread, ping-pong balls and official 50-ft. paper targets, *PM* tried the method with a 10-year-old who had never fired a gun. He shot from 10 yards, standing with his back to the targets and turning for each shot. His first shots were wild, but instinctively he began to zero in. We repeatedly reminded him of Carson's two rules. After one hour he used a new target, fired 30 shots and put every one within the scoring rings. He then broke six out of 10 candy wafers, and in another 30 minutes was easily hitting paper plates sailed into the air.

When we switched to a .410 shotgun and hand-thrown clay targets, he broke 17 out of 25. That's respectable shooting on any trap range.—George X. Sand

WHEN A SHOOTER has enough confidence in sight shooting to be able to hit a small wafer thrown into the air, instructor George Carson switches him from a BB gun to shotgun for the real thing. He throws clay targets into the air, and when a student consistently breaks doubles he has graduated





New Deal for Playing Cards

Playing cards are said to last longer when they are shuffled automatically in an electric card shuffler that adjusts to any size card. A deck of cards is put in one side and in seconds they come out the opposite side fully shuffled.

The shuffler is priced at \$14.95 (battery operated) and \$16.95 (electrically operated) from Merritt Williams, 300 Montgomery Ave., West Pittston, Pa.

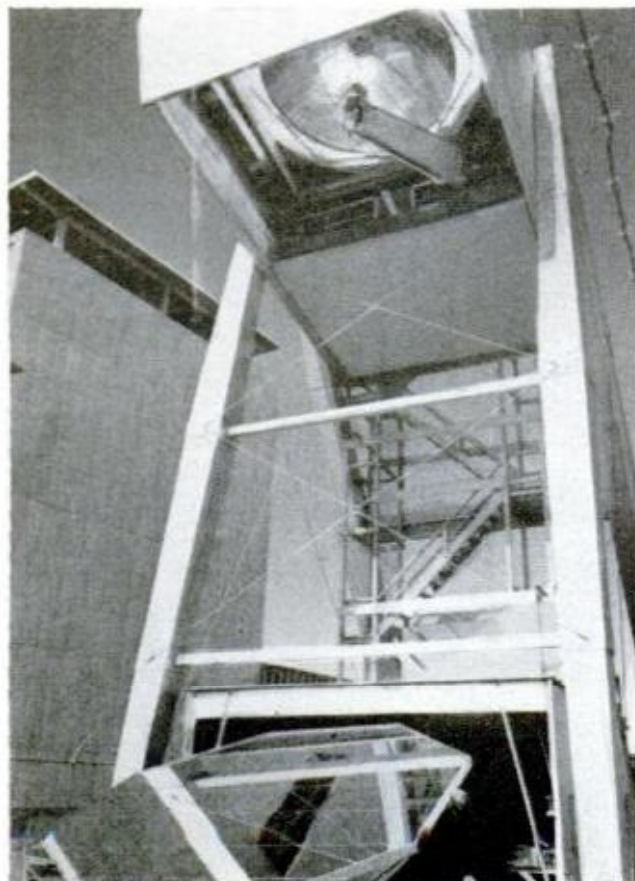


Drive-In Water Control

A water-control box for an irrigation system can be assembled in less than an hour with interlocking aluminum "planks."

The planks are driven into the ground with a sledge hammer, and the spillway is bolted in place.

The Porta-Plank system is a product of Wesco Products, Inc., 725 Sixth St., Clarkston, Wash. The structures range from \$8 to \$1700, depending on size and design.



Hot Spot

Test materials can be subjected to temperatures of 5000 to 6000 degrees F. in a solar furnace at the University of New South Wales, Sydney, Australia.

A flat heliostat mirror close to the ground reflects sunrays almost vertically to a paraboloid mirror 50 feet above. The paraboloid concentrates heat on a small target area. The targets are generally refractory metals and alloys.

Pushbutton Tilting

A pushbutton on the dash controls the power-tilting feature which is standard on all 1964 MerCruiser stern-drive power packages.

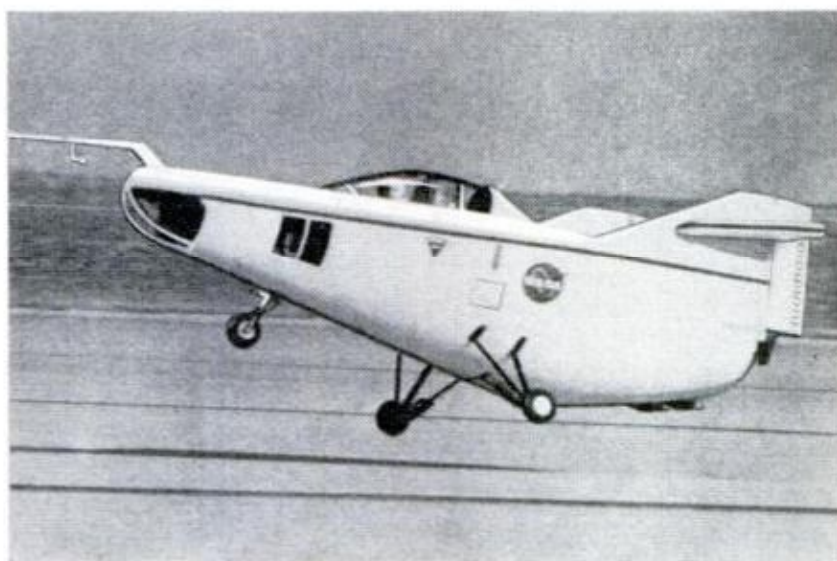
On larger models it's accomplished by applying pressure to the dual shock absorbers; smaller models have dual hydraulic jacks operating independently of the shocks. Tilting can be regulated for shallow-water maneuvering.



Bathtub for Space

Future astronauts may return from space in craft like the M2 "flying bathtub." Pilot Milton O. Thompson recently landed the 20-foot-long vehicle after being towed to 13,000 feet behind a cargo plane.

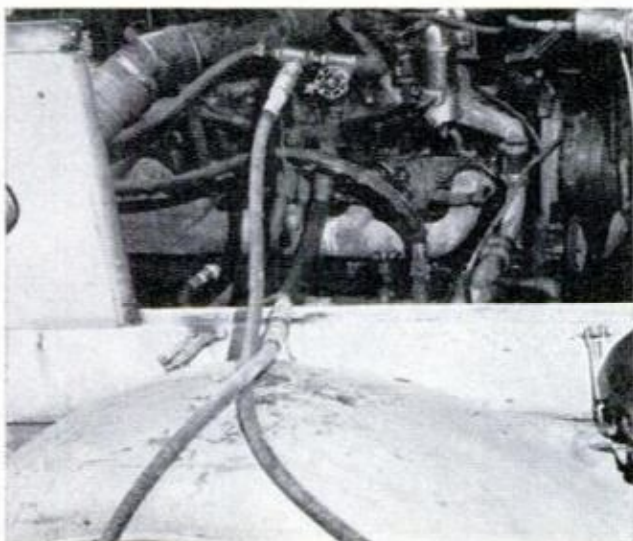
The M2, wingless to reduce air friction, gets lift for limited maneuvering from its rounded bottom. The pilot cuts landing speed by lifting nose at last minute.



Hot Transfusions for Cold Engines

Immediate starting in severe Arctic cold is no problem for Garrison Fast Freight Lines, Anchorage, Alaska. The company heats anti-freeze in a natural-gas furnace and circulates it through the blocks of its idle diesel trucks. Hoses are connected to

quick attach-detach couplings which re-close automatically when a joint is parted. Besides eliminating the time normally wasted while drivers warm up the engines, this trick also saves a lot of fuel, plus wear and tear on the cylinders.



The Incredible

SOARING 630 FEET over the city of St. Louis, America's newest national monument will be completed in 1965. Trains will lift visitors inside arch's hollow legs



Gateway Arch

America's Mightiest National Monument

By Clifford B. Hicks

THOMAS JEFFERSON would have loved it, mountain men would have stroked their beards in awe, and sodbusters would have rubbed their eyes as they gawked at it.

Their 20th Century descendants will do all this and more when they view the Gateway Arch of the Jefferson National Expansion Memorial.

The Arch is America's newest and highest national monument, and certainly its most unique. It is now taking shape (and what a shape!) on the riverfront in St. Louis, the very spot where the mountain men and the sodbusters *did* gather.

It is indeed an incredible structure. It is also one of the most challenging construction projects ever tackled. An error of a mere $\frac{1}{64}$ -inch in pouring the foundations, for example, would mean that the towering legs, two years later and 630 feet higher, would never meet.

The majestic monument in gleaming stainless steel will be such a dominant landmark that it inevitably will come to symbolize St. Louis, just as surely as the Washington Monument means Washington, D.C., the Eiffel Tower means Paris and St. Peter's means Rome. Rising 630 feet out of the flat prairie land, it will be 75 feet taller than the Washington Monument and a whopping 479 feet taller than the Statue of Liberty. The gracefully soaring structure will be as high as a 62-story building: only 16 skyscrapers in all of the United States will be taller. Its two legs will spraddle a distance the equivalent of two football fields.

Into the Arch will go 17,246 tons of material including 5119 tons of steel and 6238 cubic yards of concrete. Its skin, which weighs 886 tons, represents the largest order ever placed for stainless steel. The foundations of the two big legs are sunk



60 feet below ground, 30 feet into bedrock.

Sometime in 1965, the keystone section of the great structure will be slipped into place high above those foundations, and the Arch will become a new mecca for American tourists. An estimated 3,000,000 visitors a year will enter a museum buried between its legs, where they will view the record of America's most beloved and exciting story, the push to the West. Then, climbing aboard a unique "train," they will rise up inside either hollow leg of the Arch.

At the top of the trainway, they will climb a few steps to a glass-lined observation room 65 feet long. There they will look east across the mighty Mississippi and on for 40 miles across the rich prairies from whence the frontier folk came. Turning, they will look west across the city toward the grasslands that lured the sod-busters, toward the mountains that lured the trappers, toward half a continent that, thanks to Tom Jefferson, lured any man with vision.

The story of the Arch started 30 years ago with three men of vision. In 1933,

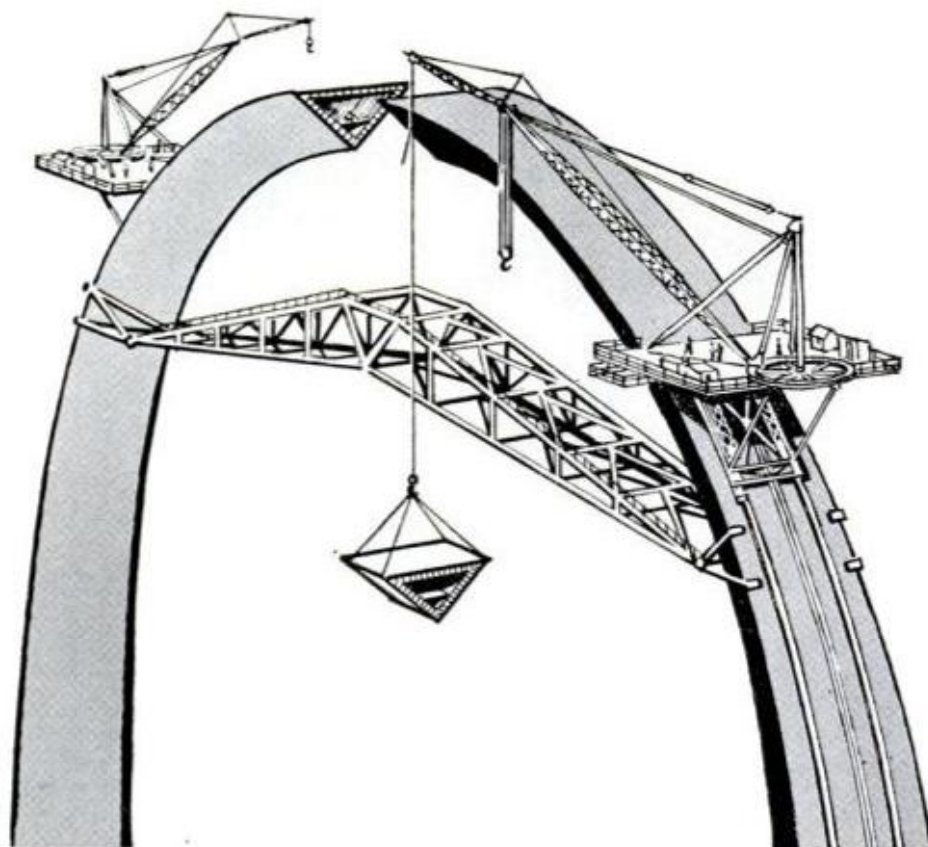
Mayor Bernard F. Dickmann of St. Louis was returning by train from a business trip with two other civic leaders when the conversation turned to the Lewis and Clark Expedition that had scouted the country beyond the Missouri.

"We should memorialize that expedition," said one of the men. "Matter of fact, we should memorialize the whole story of westward expansion, and we should do it right in St. Louis, the gateway to the West."

Within days, the three men were hard at work on a project that was to be consummated 30 years later, more than 600 feet above the St. Louis riverfront. Throughout those long years there was a determination to make the Memorial something unique on the face of the Earth. In order to find a suitable design, the Arch's Memorial Association in 1947 sponsored a nationwide competition. The late Eero Saarinen, one of the world's greatest architects, won the prize with his magnificent design for an arch, symbolizing the gateway to the West.

Saarinen conceived the graceful structure as an inverted, weighted catenary

CREEPING DERRICKS fastened to sides of arch lift wedge-shaped sections of arch in place. Here they are working the last (keystone) wedge up into position. Creeping scaffold support in center is temporary building brace



curve. A catenary curve is the form a chain assumes when it hangs freely between two supports. When inverted, it is also the strongest possible configuration for an arch because all the thrust passes down through the legs and into the foundation. In all other arches, much of the pressure tends to push the legs apart. The Gateway Arch is *weighted* because the legs are larger than the upper portion. Indeed it is weighted, for the hollow walls will be filled to the 300-foot level with 12,127 tons of prestressed reinforced concrete, which will make the Arch so stable that the pinnacle will deflect only 18 inches in a 150-mile-per-hour wind.

In 1959, the contract for the Arch was awarded to the MacDonald Construction Company. At that time, a 32-year-old construction man named Art Pritchard was helping MacDonald build missile bases. He and another man, even younger, were destined to become keystones in the construction of the Arch. Twenty-seven-year-old, crew-cut Ken Kolkmeier was also building missile installations, but he was working for the Pittsburgh-Des Moines

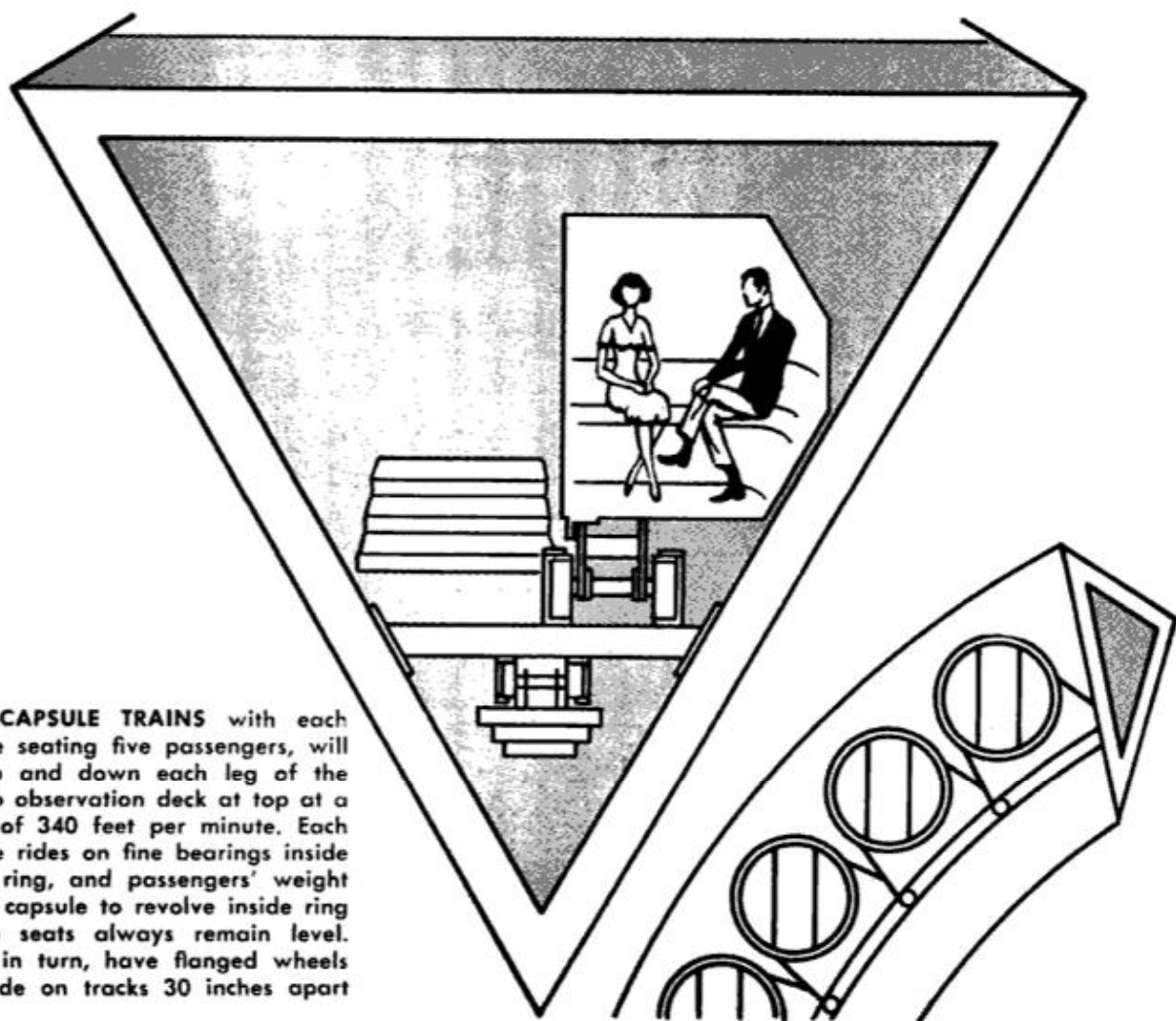
Steel Company. Subsequently Pittsburgh-Des Moines was awarded the steel contract for the job.

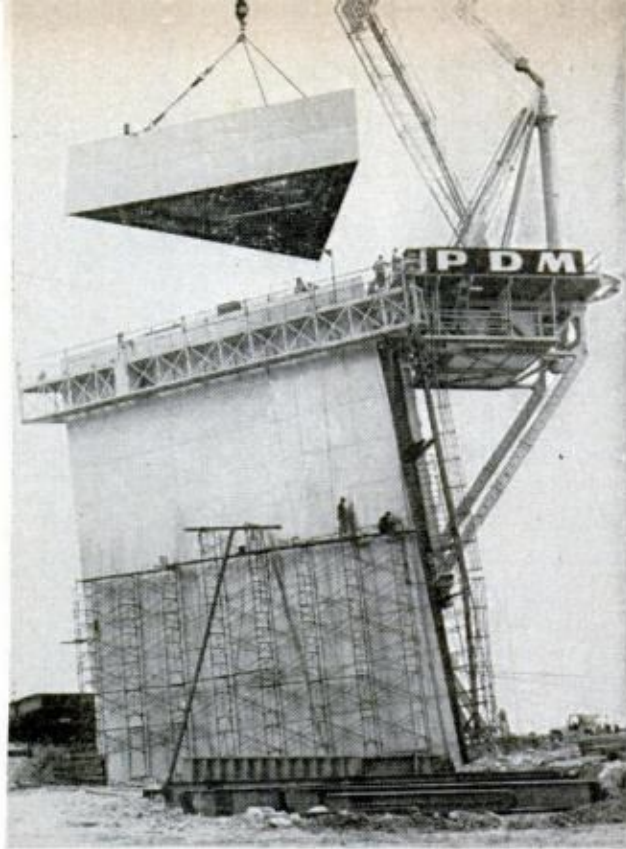
Early in 1962 the two remarkable young men met for the first time, and found themselves in surprisingly similar circumstances. Each, despite his youth, had been chosen by his company to supervise the \$11,500,000 job. It was more than a great responsibility; it was also a tremendous opportunity.

"The most difficult job I had," says Kolkmeier, "was not only to train my men, but to train myself. I was so impatient to do the job that I had to force myself to work out all the *little* details instead of plunging ahead on a make-do basis. Any construction technique that has bugs at ground level will become a nightmare at 600 feet."

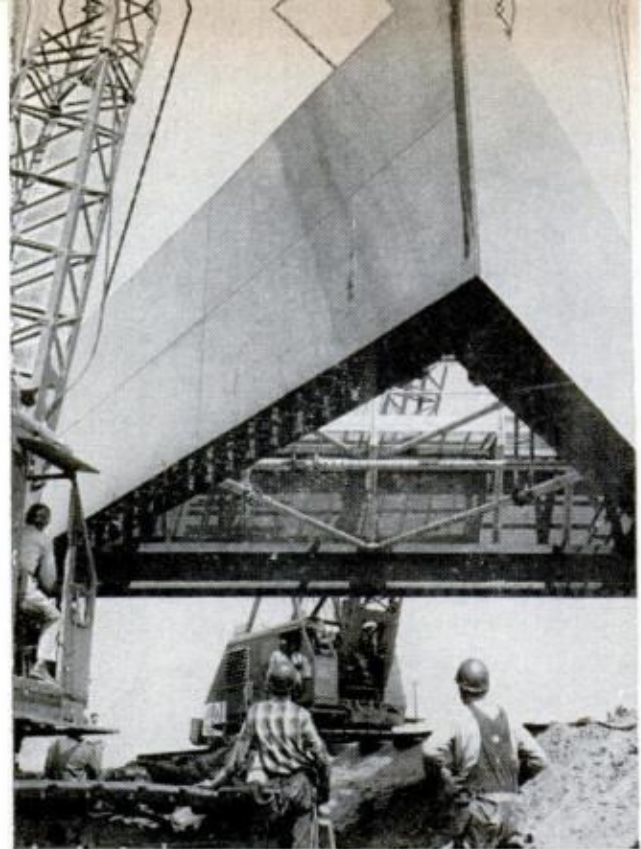
By 1965 when the keystone section slips into place (and the two young men have confidence that it will fit perfectly), Pritchard and Kolkmeier probably will have acquired some gray hairs, and certainly will have acquired the supreme satisfaction that they developed new

EIGHT-CAPSULE TRAINS with each capsule seating five passengers, will run up and down each leg of the arch to observation deck at top at a speed of 340 feet per minute. Each capsule rides on fine bearings inside a big ring, and passengers' weight causes capsule to revolve inside ring so the seats always remain level. Rings, in turn, have flanged wheels that ride on tracks 30 inches apart





WEDGE-SHAPED SECTIONS of arch fit one on top of the other like stacked cheeses. Each 45 ton section is lifted by creeping derrick itself weighing 80 tons



TRIANGULAR SPACE inside each section will taper from 48 feet at base to 15½ feet at crown of the arch. Into it will fit a train, stairway and elevator

methods to solve construction problems that are unique in the history of the building industry.

No other arch even approaching this size and shape has ever been built. Each dimension is absolutely critical.

Take the possibility of a 1/16-inch mistake in the foundation of either leg, which could keep the two legs from meeting high overhead. It isn't a difference of 1/16-inch *between* the legs that is critical, but the precise angle of the top of each foundation. A mistake in this angle would be multiplied as the two probing fingers reached toward the sky, multiplied into a catastrophe when they failed to meet 630 feet overhead. The possibility isn't humorous to Pritchard and Kolkmeier.

"Dimensions are so critical," points out Kolkmeier, "that we even do our surveying at night when the temperature on all three steel walls is equalized."

In cross-section, each leg of the Arch is an equilateral triangle measuring 54 feet along each side at the base, and tapering to 17 feet at the top.

Basically, the method of construction is to stack prefabricated sections on top of each other, like stacking wedges of cheese. The curve of the Arch plus its taper means that no two sections of a leg are identical. The sections arrive from Pittsburgh on

special flatcars and are hoisted into place by derricks.

About 12 feet high, a section consists of a triangle within a triangle, with the two walls held apart by welded rods. The outer wall is made of gleaming stainless-steel panels 1/4-inch thick. The inner wall is made of carbon-steel panels 3/8-inch thick. After a section is hoisted into place, the space between the walls is filled with reinforced concrete. This leaves a triangular space inside each leg measuring 48 feet at the base and tapering to 15½ feet at the crown of the Arch. Into this small space will be fitted a stairway of 1076 steps, a 12-passenger elevator to the 372-foot level, and an eight-car train.

Last summer each leg, soaring skyward right on schedule, reached the 72-foot level, when work abruptly halted. The derricks no longer were tall enough or strong enough to lift the next 45-ton sections into place. It was an anticipated halt, of course, while a weird rig was installed on each leg.

Two huge tracks were bolted up the outside of the leg, held away from the polished stainless steel by cushions. Then, on each set of tracks, Kolkmeier's men assembled an 80-ton derrick.

The derrick consists of a big wheel (for

[\(Please turn to page 200\)](#)



Tenting, Boating and Toting—All in One

Resembling an oversize ice-cube tray, an aluminum cartop carrier converts to a pleasure boat or a tent (on the car or on the ground) in a matter of minutes.

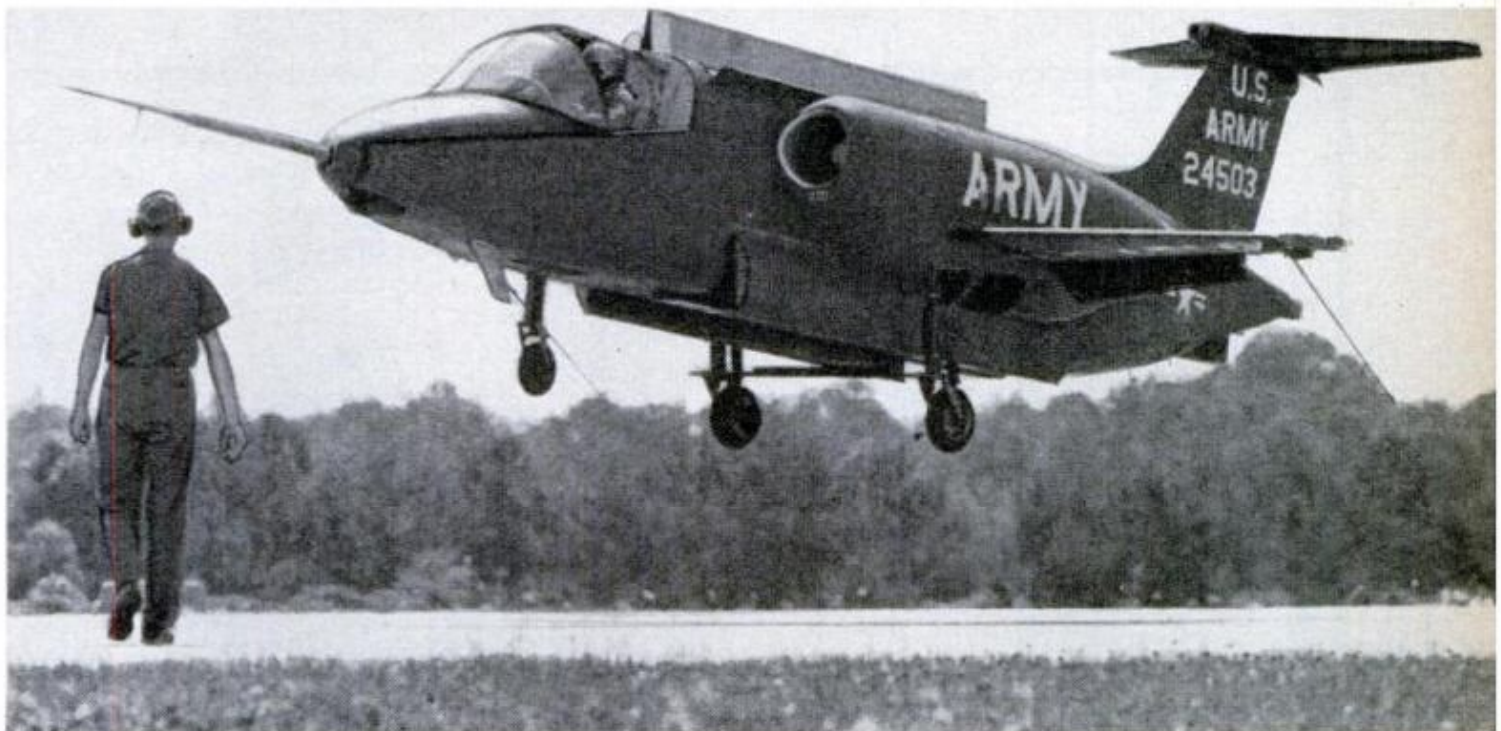
Made by Go-Go Industries, 1509 Chicago

St., Omaha, Neb., and priced at \$199.50, Handy-Andy is 8½ feet long and four feet wide. With tent frame attached it sleeps two adults, and with seats installed it becomes a convenient pleasure boat.

Hummingbird for the Army

Demonstrating a vertical takeoff, an Army VTOL craft, the XV-4A Hummingbird, hovers over a field during tests at Marietta, Ga. Created by Lockheed-

Georgia Co., the jet aircraft takes off and lands like a helicopter, but can attain forward speeds up to 500 m.p.h. The Hummingbird is described as a research craft.

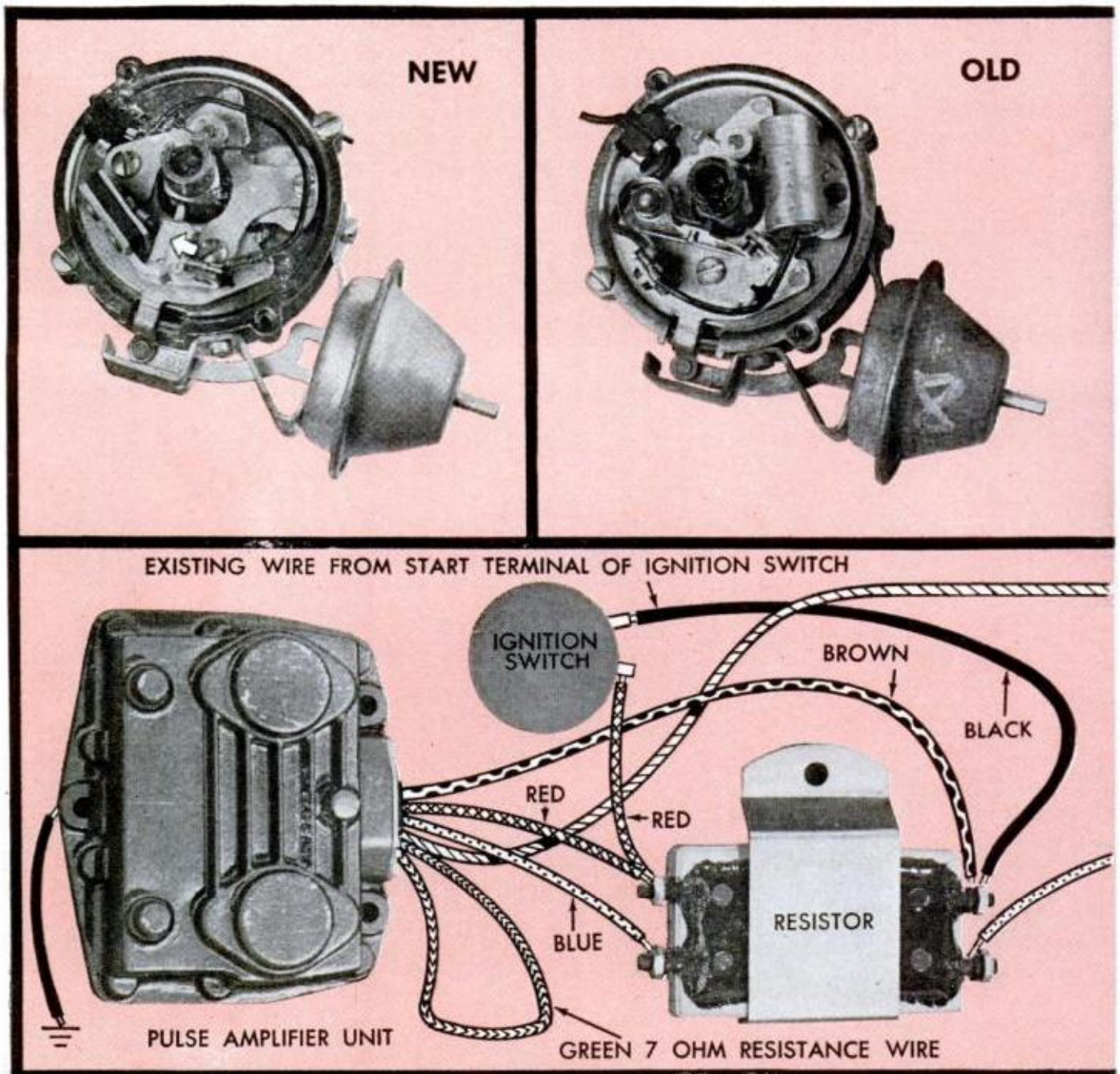


Electronic Pulse Ignition

This do-it-yourself conversion kit for your car seems to give easier starting and smoother power. It also eliminates the breaker points and reduces ignition tuneup to a simple plug change

By Jim Whipple

COMPARISON of new contactless ignition (left) and a conventional distributor (right) shows the tiny coil (arrow) that replaces points and condenser and makes the distributor shaft and the rotor the system's only moving parts



BREAKER POINTS have been one of the weakest links in automotive ignition systems for 60 years.

Even with the advent of transistorized circuits (p. 172 Sept. '63 PM) which greatly reduce the amount of current in the primary wiring, contact points making and breaking the circuit tens of thousands of times every minute, are still a major stumbling block on the road to trouble-free ignition.

Recently, as a natural follow-up to the invention of transistorized systems, the electronics industry developed pulse-triggered ignition.

Pulse ignition, which must be combined

with transistor circuitry, eliminates mechanical contact points completely.

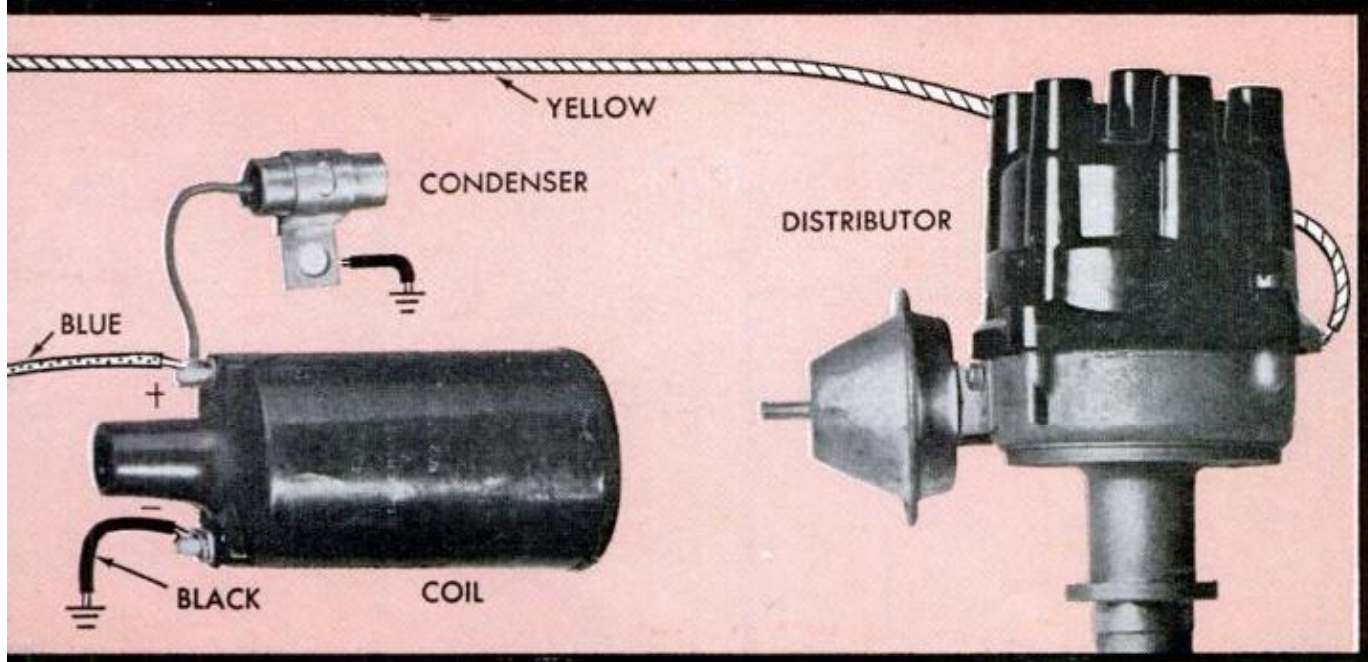
Here's how it works: A small pickup coil wound around an iron core (or pole) replaces the contact points on the breaker plate of the distributor.

The tip of the coil's iron core protrudes slightly from the windings. This tip is spaced a critical few thousandths of an inch from the lobes of the distributor shaft which formerly activated the breaker arm of a conventional contact system.

As each cam lobe passes the sensitive pickup coil it induces an infinitesimal surge of current in the small coil.

You've probably seen the electronic

DYNAMOMETER TESTS carried out on relatively low-powered Chevy II, top, showed that conventional ignition matched pulse-transistor system under constant load. The Holley Pulsetronic system is shown on pages 92-93



effect of the proximity of iron if you've ever used a stud finder whose magnetic needle responds with unerring accuracy to the nail hidden in a wall.

The tiny current induced by each passing lobe on the steel distributor shaft flashes to a transistor-activated pulse amplifier which in turn switches off the primary current to the coil's primary windings. When this occurs the collapse of the magnetic field induces the high voltage surge in the coil's secondary winding; this surge goes to the distributor and thence to the individual spark plugs.

Up to now pulse-triggered ignition has been a factory installation involving a specially modified distributor.

Ford Motor Co. developed its own system for the top performance 427-cubic-inch engines available as limited options on Fords and Mercurys. GM's Delco Division has developed a system which involves a special distributor. It's available on high performance Pontiacs.

Bendix, Motorola and Autolight have also worked out similar pulse systems. But as of this writing Holley Carburetor Co., of Warren, Mich. has the only commercially available system that can be installed on any car without replacing the original distributor.

PM therefore obtained a Holley system kit for testing purposes.

The advantages of pulse triggered transistor ignition are well known in the field of high performance racing engines firing at 7000 or more r.p.m., and under the

higher compression ratios of 13.5 and up.

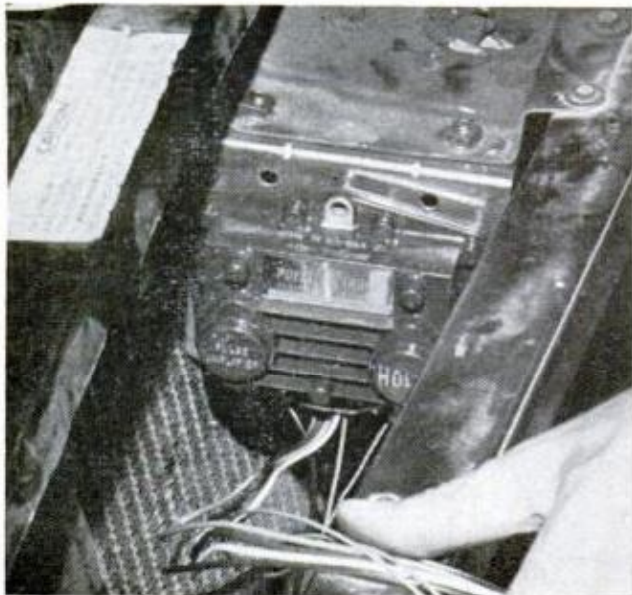
But how would pulse triggered transistorized ignition work out on a strictly bread and butter family vehicle? To find out, we picked our own family car—a 1962 Chevy II Nova station wagon with six-cylinder engine (194 cubic inches, rated horsepower 120), and some 16,000 miles on the odometer. Because the car had gone approximately 5000 miles since its last complete tuneup and installation of new spark plugs, we took it to a Chevrolet dealer for a standard tuneup consisting of new points and condenser, cleaning and gapping of plugs, carburetor adjustment and timing check.

We then took the car to a Clayton Chassis dynamometer and pulled a maximum horsepower (at full throttle) reading of 56 (at rear wheels) running in high gear at 43½ miles per hour and exactly 2500 r.p.m. Manual transmission eliminated slippage in the driveline.

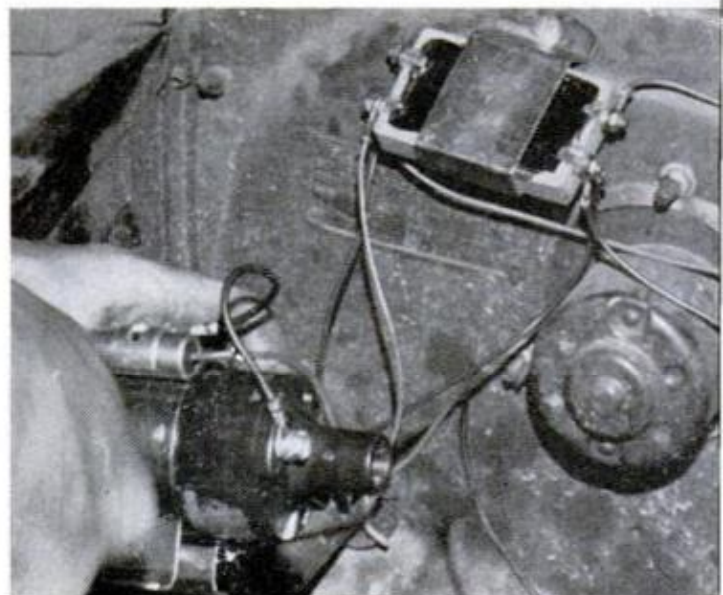
Leaving the load set in the dyno, we installed the Holley Pulsetronic System, and after a warm up, went back on the dyno and ran up to full throttle. With the identical load we obtained identical horsepower at the same r.p.m. and road speed. Timing had been carefully set for correct point dwell with the stock contact system and for correct degree of advance with Pulse-tronic installed.

Out on the road the Holley system behaved beautifully for some 1200 miles. We noticed effortless starting on cold mornings, and smooth lugging in high gear

PULSE AMPLIFIER permits tiny impulse current from pickup coil to switch off primary and trigger spark. It's mounted behind grille to avoid engine heat



RESISTOR BLOCK mounts on firewall. Its job is to step down 12-volt current for special coil and the pulse amplifier. Coil mounts on side of engine block



from 15 m.p.h. The engine seemed to rev up more quickly both under load and with the car in neutral. But in a series of comparative acceleration runs—with and without the Pulsetronic system installed, we obtained the following averages:

| | Pulsetronic | Conventional |
|---------------------|-------------|--------------|
| 0-60 | 12.8 secs | 13.0 |
| 40-60 | 8.2 | 8.1 |
| 50-70 | 9.1 | 9.2 |
| 30-60 (2nd gear) | 9.2 | 9.0 |

These results pretty well bear out what the dynamometer results implied, that in a car with a relatively low compression engine with low speed r.p.m. ranges of 2400 to 4400 r.p.m. the Pulsetronic system will neither hinder nor improve acceleration times.

Fuel economy gave the Pulsetronic system a slight, but not very decisive edge. With PM's fuel meter hooked up running at a steady 40 miles per hour and averaging two-way runs, Holley's Pulsetronic gave us 23.9 miles per gallon while conventional ignition on the same run averaged out to just over 23.8 m.p.g.—again very nearly a stand off result.

Balanced against a conventional breaker point ignition system in top state of tune on a conventional, low performance passenger car, the new transistorized pulse-triggered ignition seems to offer but negligible gains in performance and economy. What this system *does offer* the average motorist is nearly a permanent state of top tune.

By doing without breaker points, all contact-point ills such as rubbing block wear (which changes dwell) and dirt, moisture and oxide formation, all of which impair smooth operation, are eliminated.

Even high-mileage wear in the distributor bearings which would produce run-out or wobble and affect contact alignment cannot change timing with pulse triggered ignition. True a slight variation in air gap between pickup coil distributor shaft may alter the amplitude of the pulse but it will not change its timing.

Using a pulse-triggered system such as Holley's, replacement of points and condenser, plus truing points and setting timing every 5 to 10,000 miles, is eliminated. There's also no cam to lubricate.

Ignition tune-up then consists of spark-plug cleaning and replacement, plus a very infrequent (20-30,000 miles) replace-

ment of the distributor cap and rotor.

Installation of Holley's \$98.50 Pulse-tronic involves attaching the pulse pickup coil to the distributor base plate using the same screw holes that held the old contacts. Then mounting the pulse amplifier ("Black Box").

Next comes the special coil which fits in the standard coil bracket, followed by mounting of the resistor block. After tapping a hot line from the ignition switch and wiring up the four units, set timing with a timing light and drive away.

For the low-performance family car like the Chevy II, pulse triggered ignition provides continuously smooth top-tuned efficient ignition. For many, the convenience and satisfaction of continuous top performance (as long as plugs are new or deposit-free and carburetor stays in tune) will be justification for the \$98.50 cost of Holley's Pulsetronic kit.

For the high performance car with an engine that turns in the high r.p.m.s, 7000 to 10,000 and fires under high compression, pulse triggered ignition is really valuable. It played a considerable part in keeping the Lotus Ford cars of Jimmie Clark and Dan Gurney at top performance through 500 miles of all-out 7000-8000 r.p.m. racing at Indianapolis last May 30th. Even transistorized ignition with its lower voltage, which minimized pitting and burning of contact points, can't keep up at high revs because the rubbing block of contact points begins to bounce off the distributor's cam and interrupt firing. ★ ★ ★

EARLIER VERSION of Pulsetronic pickup on Chevy V8 distributor required laminated pulse wheel on shaft. Model PM tested took impulse direct from cam lobes





20 Tips for

Single or double stage? Three or six horsepower? Hand-pushed or wheel-driven? Here are guidelines to find the type you need

By Jackson Hand

WITH A SNOWBLOWER, you can shovel a path through snow a foot deep at a speed about half as fast as you normally walk.

The snow doesn't end up next to the sidewalk, where it can cause drifts. Instead, it is blown 20 to 30 feet away—farther if it's downwind—where it can't bother you again. All you did was pull the starter cord. Less, with an electric starter.

Even if you are not too lazy to shovel a walk by hand, you may be interested to learn that studies of physically exhausting chores place shoveling near the top of the list—harder work than running up and down stairs carrying a load, or harder than pushing a wheelbarrow full of dirt. As one medical authority has said: any man over 40 who doesn't walk a mile a day *regularly* should drive a nail in the garage wall and hang the snow shovel on it *forever*.

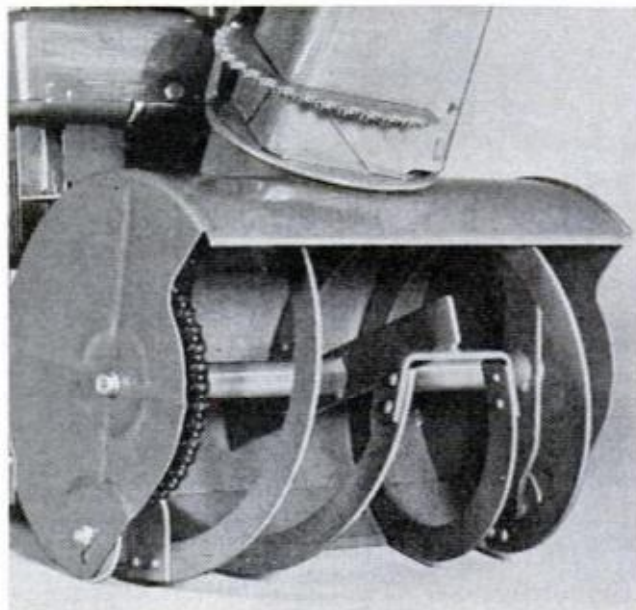
A snowblower, to get to basics, is a wintertime yard machine engineered to pick up snow from where it's a nuisance and blow it where it doesn't bother anybody. There are two basic designs: single stage and double stage, which we'll discuss later. Most are power driven forward and backward. Some are self-contained units. Others are add-on implements for yard tractors or other power units you own.

A small snowblower may clear a path 15 inches wide, more or less. The largest practical for typical home and farm use might run 36 inches wide. With proper engineering and powering, the difference would be only the path width. In other words, the 16 inches of snow is blown the same distance as the 36 inches. The smaller machine is not as fast, that's all.



SNOW REMOVAL is easy with the right size blower working at perfect efficiency. With chute at the proper angle, snow is blown across cleared area

SPIRAL BAR is one popular type of auger. The paddle in the center blasts snow out of the opening in the housing through the chute at the top of the blower



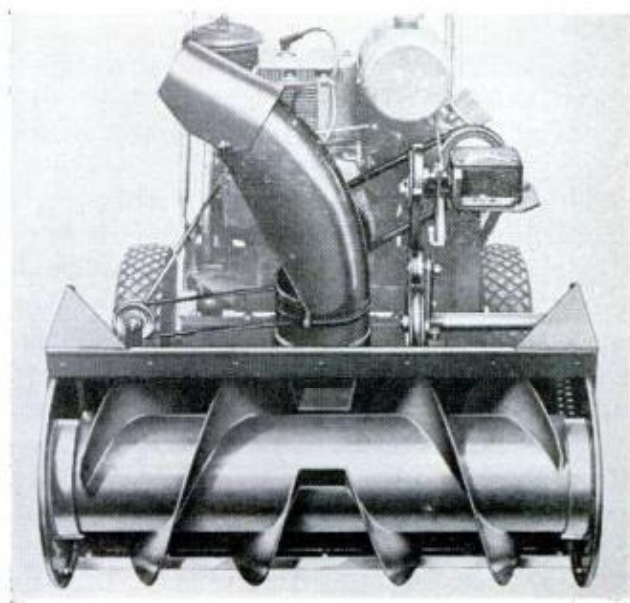
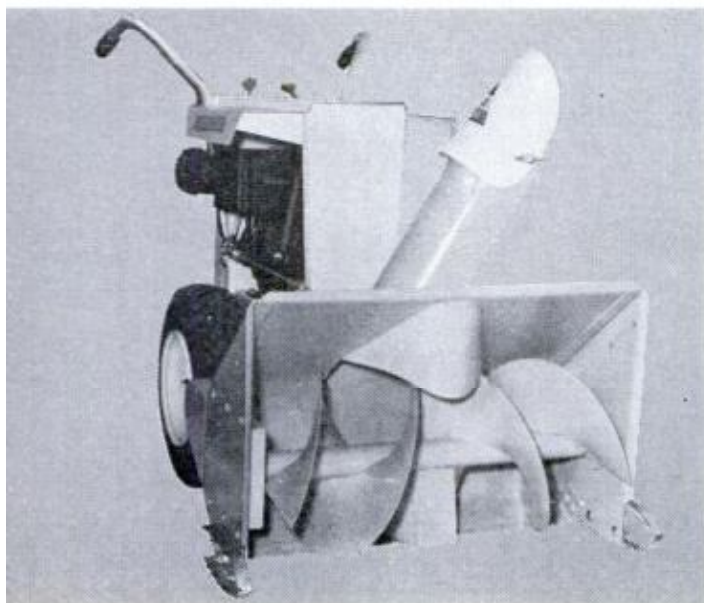
Snowblower Buyers

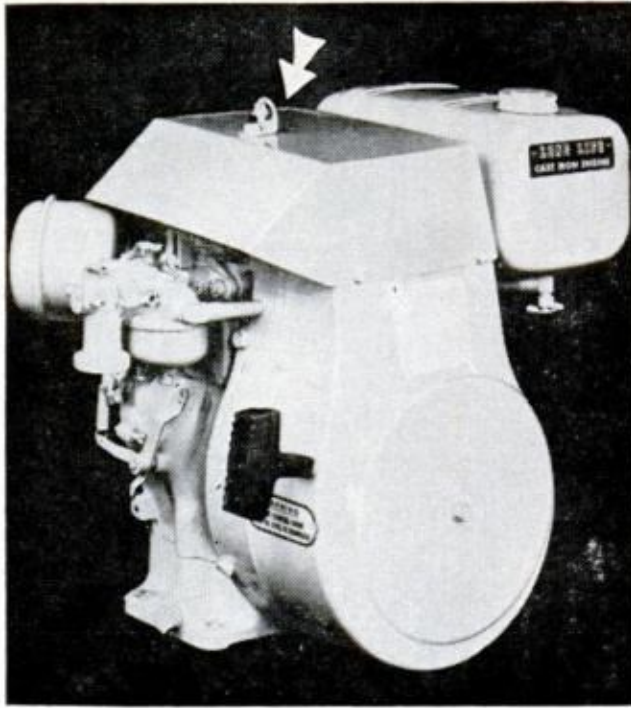


LARGE BLOWERS, such as this 36-inch model, can be attached to the garden tractor. Some tractor motors may require winterizing with special shrouds, covers and gaskets—if the tractor is not already equipped for winter work

GENUINE AUGER around a central shaft. Notice the skids under the front corners of the scoop. Wheels or scoops are okay, just so they sink through snow

HEAVY BLOWERS may have auger spiraling around a larger core. In all but the smallest machines, snow is always gathered into the center for propulsion





WINTERIZED ENGINE is enclosed with metal shrouds (arrow) that are fairly weathertight. In most models, heat from exhaust pipe warms the carburetor

Is there a way to determine what size is adequate? If you have a city lot with a short sidewalk and a small driveway, you can clean it in short order with the small size. But if the same sidewalk and driveway happen to be sunken or flanked with shrubbery—so that snowdrifts magnify the job—you might want to step up a size or two. Always keep in mind that the small machine will be more maneuverable.

Snowblower manufacturers say that the best selling units are those that scoop about 20 inches, this being perhaps the "average" size. Actually, power and quality are more vital, since you may have occasional unseasonable drifts to buck.

Many feel that a small snow machine need not be wheel-driven. If you have shoveled enough snow to be much interested in a snow blower, you know that pushing the shovel into the snow is not hard. It's the lifting that breaks your back.

Thus, you can very easily push a small snow machine at its optimum speed while it blows the snow away. Of course, there is economy in the you-push-it machine, since its smaller engine needs to drive only the much simpler gathering-blowing mechanism.

Big models need wheel drive, because they are too heavy to push. But if they need forward, they need reverse, too. Since it is easy to move ahead faster than the machine can gulp up the snow, you

need two, three or four speeds forward on big machines. Some makes have two or more speeds in reverse also.

If a machine is wheel driven, look for wide traction wheels and provisions for chains—which are standard in some makes.

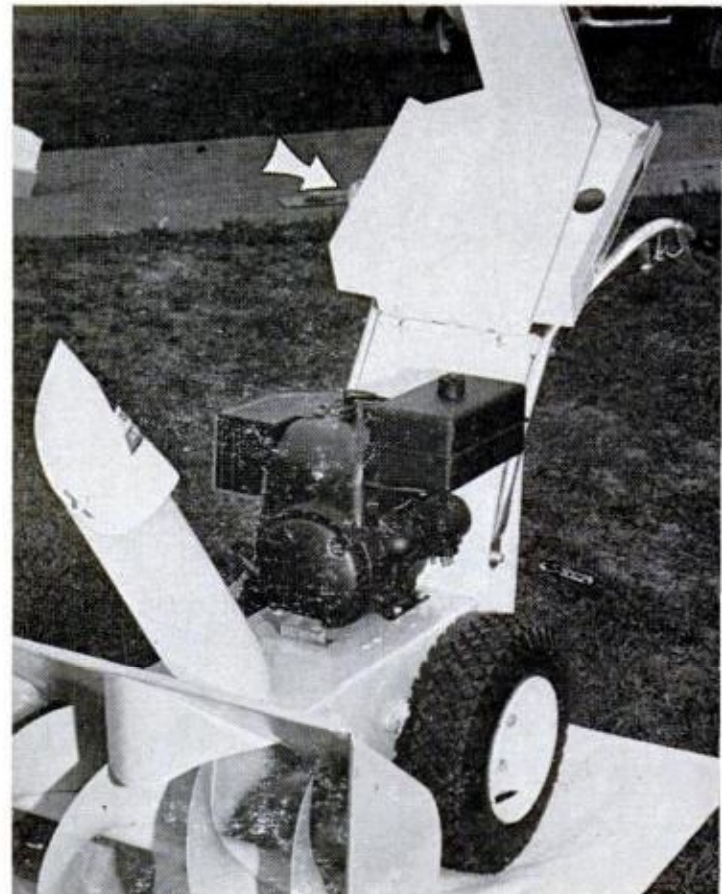
What is the starting price? About \$90. And that isn't bad, considering the work you get out of the machine. (The price, of course, is for a nonpropelled 15-incher.)

But unless you live on a farm or a suburban estate—or at least a wide-drive-way two-car lot, this minimum machine may be your proper choice.

What is the single-stage versus double-stage question? More fuss is being made about it than would seem necessary. Sidewalk machines were first patterned after highway-size models, which have two stages: a gathering device that delivers the snow to a propelling device that blows it galley west.

You can blow snow away with either the single or the double. The single-action machines are usually more compact. They may require less horsepower. Their direct-action, straight-line snow blowing usually handles the vagaries of snow—wet,

ELECTRIC STARTER on this model is enclosed to protect it from the cold. Housing (arrow) is folded back for servicing. Cold-weather warmup is a must



dry, powdery, slushy, crusty, corny—with better versatility than the doubles. That's because a self-propelled two-stage machine may deliver more snow to the blower than it can handle. Clogging may result.

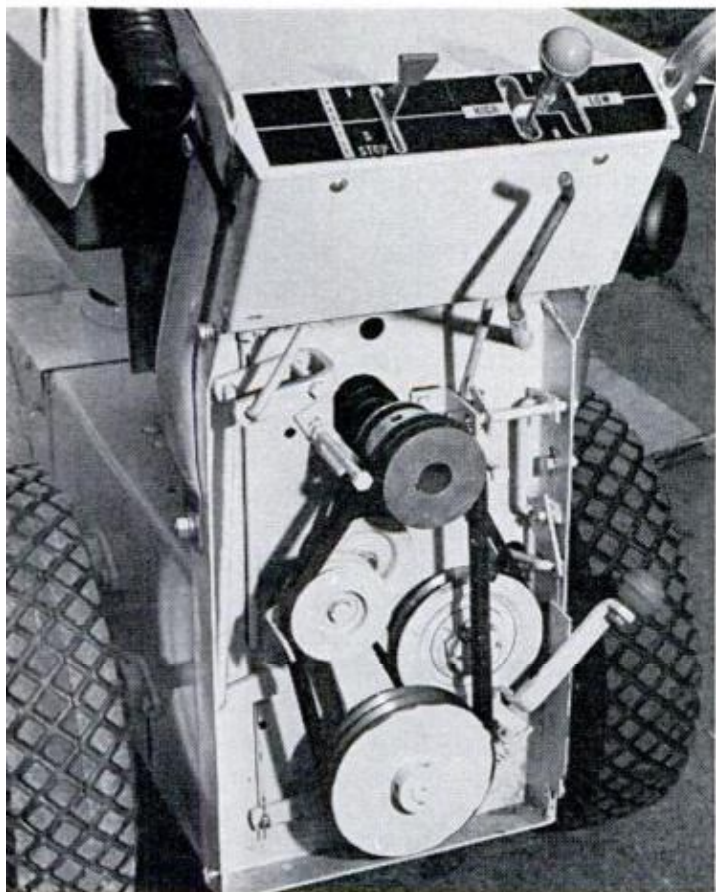
The high-speed blower of the two-stage units may pulverize dry snow so fine that it can't be controlled, causing it to drift back over the cleaned area. But the slow rotation of the gathering device may lead to clogging with wet, sticky snow. Straight-line machines move snow to the delivery chute and blast it out in a more or less uninterrupted ribbon.

Two-stage equipment is best in very deep snow. The gathering mechanism in some models will pick up snow a couple of feet thick; straight-action machines need a couple of swipes at snow that deep.

What are general features to look for? Winterized engine, variable direction of throw, adjustable front wheels or skids are a few. Also, traction in driven models, easy to reach controls, enough power, and sound engineering and construction.

Get sufficient power. You need a three hp. motor on a 20-inch machine; up to 24 inches, four hp.; up to 36 inches, six hp.

BACK COVERPLATE on this model comes off to reveal the belt-powered takeoff from the engine and the clutch system. Blower prices start at about \$90



DECEMBER 1963

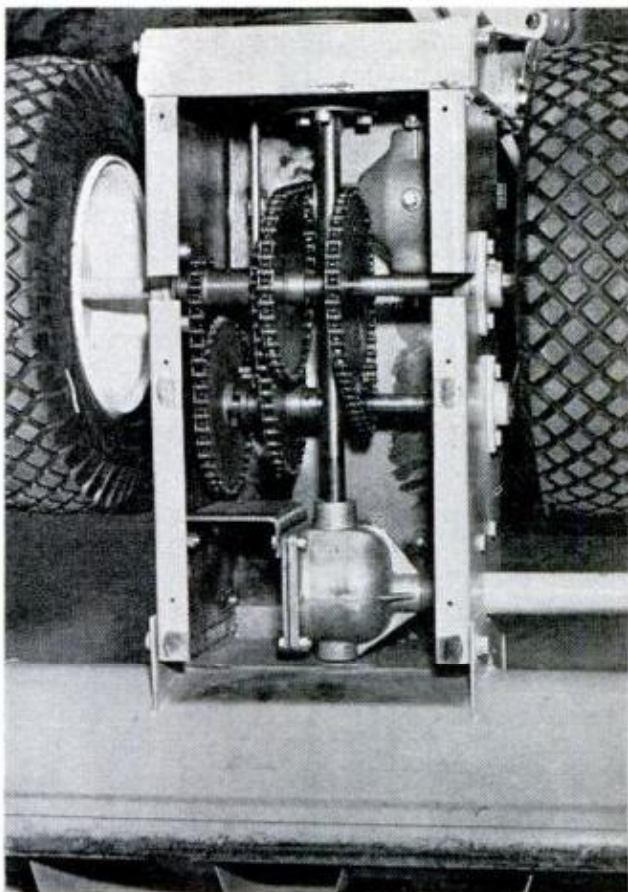
What is a winterized engine? A problem with small engines in cold weather is getting them to run hot enough. A typical engine may require a 10-minute warmup at 30 below or two minutes at freezing. This is even with a winterized model which has special shrouds and covers, protective gaskets and shields. These confine some of the heat and prevent blown snow from hampering operations. Some of the smaller models should have a hood for further protection.

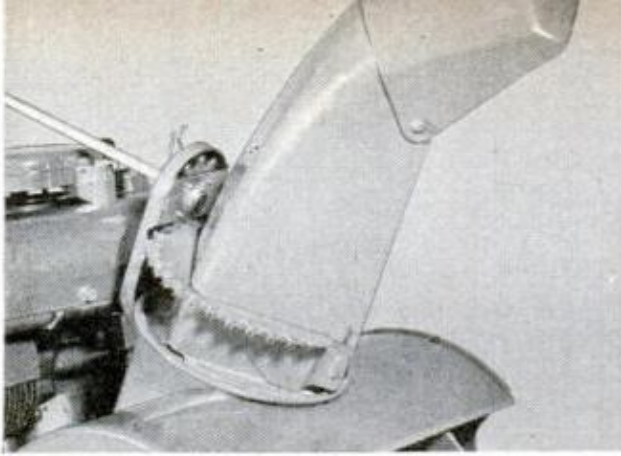
Check out such essentials as carburetors warmed by exhaust and closely enclosed starters, which can ice up and give you starter trouble next time.

The machine should channel exhaust past chains and pulleys to reduce icing. One model blows the exhaust directly on the chain, both warming and lubricating it.

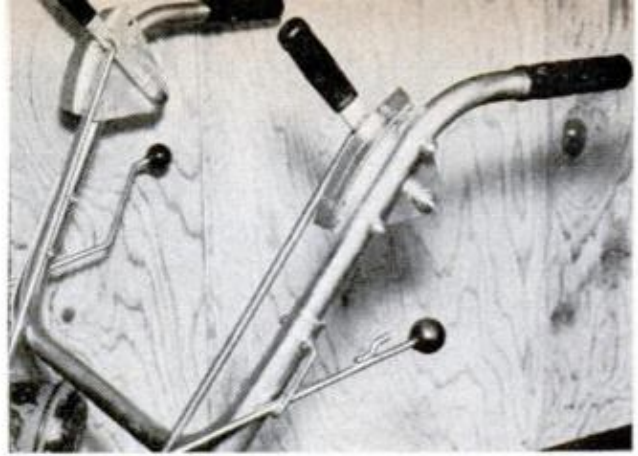
Is there a preference between two-cycle and four-cycle? Usually, four cycles are all you can find on the bigger units. Two two-cycle engines are made by two leading lawnmower manufacturers. Generally, an engine works less at snowblowing than at mowing. The better-known makes run better and are serviced more readily.

BOTTOM PLATE covers the bevel-gear box and chain drive system. The shaft housing extending to the right carries drive to the gear which powers rotor





BLOWER CHUTE on this model rotates on a 240-degree arc to eject snow in any desired direction. This permits snow to be tossed over most obstructions



MITTEN-SIZE CONTROLS permit easy disconnects, such as when you're crossing a cleared area. Try to avoid small controls which must be handled bare-handed

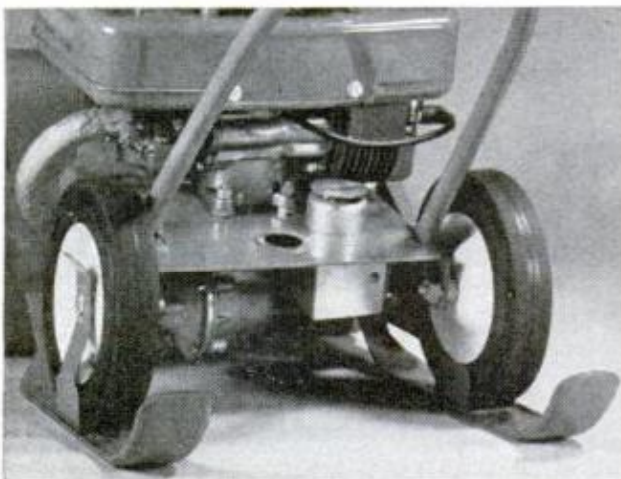
An oversize gas tank is an advantage. Downtime in sub-zero weather is no fun.

Which is best, a chain or belt? Most machines are a combination of chain and belt. Chains are used where the links and cogwheels will be in the snow—which would glaze pulleys and belts and make them worthless. Belts are used where engine heat or housings prevent glazing.

Movable spouts are handy. They permit you to eject snow in any desired direction, to the right or left, at 45-degree angles, or even at any angle. Thus, you can take advantage of wind directions or throw snow over obstructions—and avoid throwing it on the front porch.

The front end, whether it rides on skids or wheels should be strong enough to carry the entire machine when you lift the drive wheels off the ground. On smooth paving the scraper blade rides the surface, but on rough ground or gravel the scraper is raised to prevent machine-gunning the neighborhood with stone projectiles.

METAL SKIDS, or runners, may make for easier pushing with hand-powered blowers; in certain weather conditions, skids are also efficient on power models



Handle height should be at a comfortable pushing attitude even for power models, which must be manhandled in tight quarters.

Disconnects should be easy to reach, easy to operate—and mitten size. Even with power-driven units, at least one manufacturer provides clip-on steel runners for the back wheels to be used in hand push conditions. In a light snow it's convenient to turn off the rotor and let the machine drive itself until the scoop is full before turning on the blower. Some makes have disconnects for drive and rotor independent of each other. This way you can hand-push and blow, and you can go across cleaned areas without blowing.

Disconnects mean clutches of one kind or another. Check the machine you buy for a clutch appropriate for the weight and power involved. Ratchets are common on larger equipment; idler pulleys may do the job on lighter machines.

Basic design features to look for are a short wheelbase and sleekness of design. Clean design means fewer places for snow to catch, melt and cause rust. Snow caught in the chute cakes easily and causes clogging. The short wheelbase makes for easier movements.

Balance is also an important factor in blowers. A machine at rest should have its front wheels or skids firmly on the ground. But you should be able to push down on the handles to raise the front easily. This permits you to attack drifts with a rocking motion. With forward power off, the blower can be pushed into the top of a drift, then can be hit again at ground level.

Finally, look for a shear pin or slip-drive to save costly repairs if the blade hits an immovable object. ★★★

Oil Finder

A gas-explosion chamber held to the ground by an 18-ton vehicle is taking the place of the "shot-hole" technique for finding oil deposits.

Echoes of shock waves sent into the earth are recorded on geophones in the Sinclair Oil unit.



Rough-Sea Copter

A new helicopter developed for Britain's Royal Navy has a special undercarriage which enables it to land on a rolling deck.

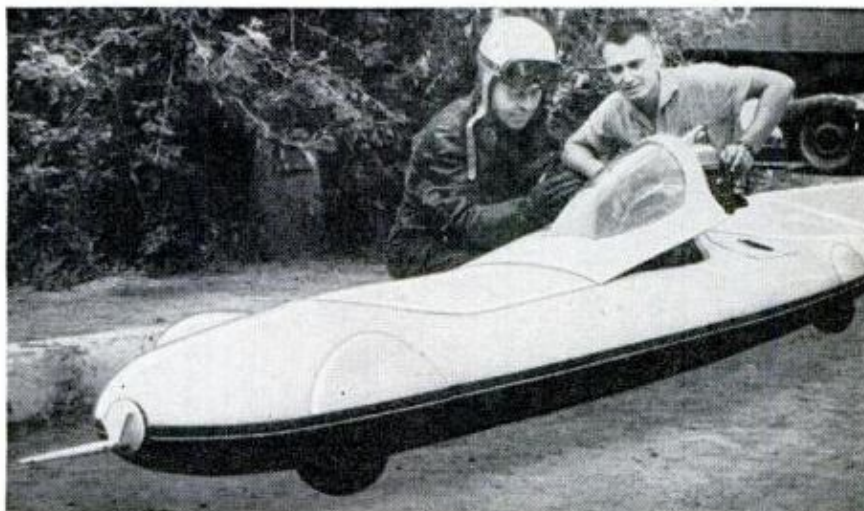
In a recent demonstration, the five-seat Westland Wasp came down successfully on a 24-square-foot test platform that was tilted by an electric motor to an angle of four degrees.



Flat-Out Racer

With a body so small the driver must lie down inside it, the Hadi-3 is claimed to be the smallest racing car in the world.

Russia's Kharkov Highway Institute, which built the car, reports that a 500-c.c. motorcycle engine can push the sleek little vehicle along at speeds which range up to 160 miles per hour.



Lion-Proof TV

This lion has not captured himself a man. The man is riding a miniature "auto" encased in a cage, to determine the lion's reaction when a car is driven inside the lion's den.

A hand-held TV camera relays the animal's movements to a screen outside. Test showed lions, frightened by engine noise, won't attack driver.





Animalport

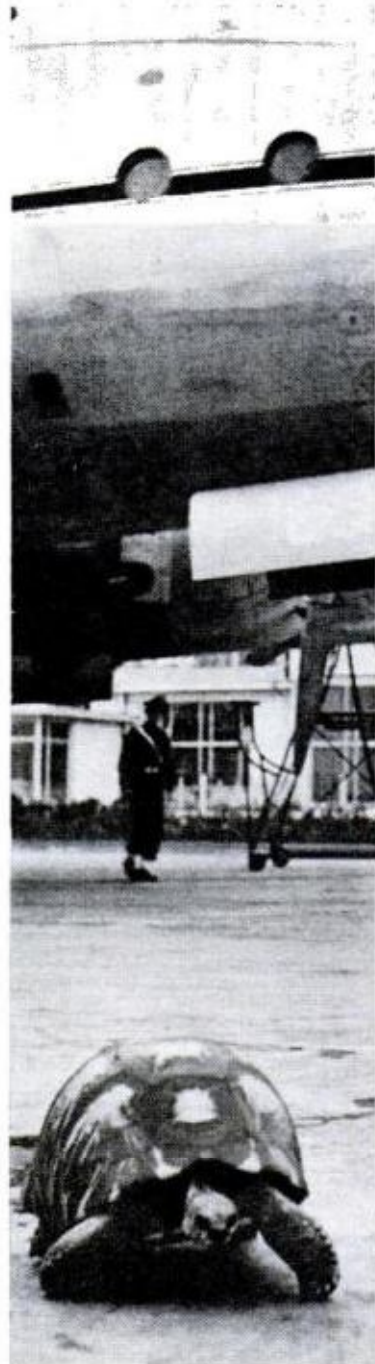
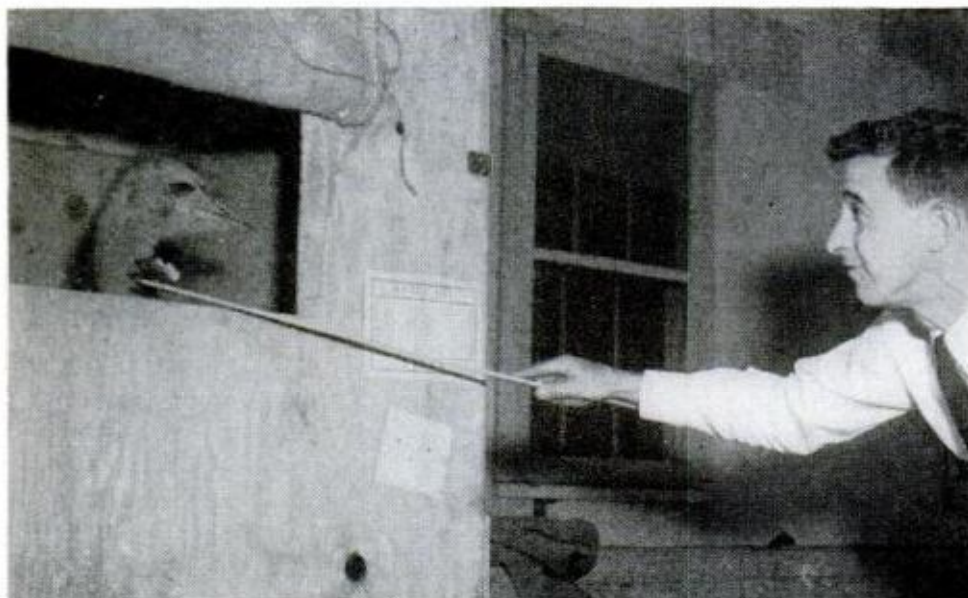
Whether he swings from trees or crawls on his belly, a guest gets the royal treatment at this zoological spa — the Jungle Hilton

By Charles Mathis

FORSAKING THE OCEAN ROUTES for a taste of jet travel, a trio of performing porpoises get a sponge bath from an attendant. Caught in the Gulf of Mexico and trained in Florida, talented dolphins will perform at Philadelphia Aquarama



TRAVELING IS WEARISOME, and an occasional guest at Animalport arrives in a state of irritation. Refusing to leave her crate, an ostrich casts a baleful eye at an attendant who is careful to coax her with food from a safe distance



IN NEW YORK there is a small exclusive hotel where the guest register reads like a page from *Winnie the Pooh*.

Ponderous pachyderms in from Ceylon enroute to Akron, Ohio. The Diving Horse on her way to Europe after a successful season at Atlantic City. A lady chimp in from Texas to make her bow on television. Monkeys and mice, parrots and porpoises, all members of the animal "Jet Set"—just stopping over.

Animalport, a \$300,000 animal hotel operated at New York International Airport by the A.S.P.C.A. has been host to more than 150 species of animal, bird, rep-

JET AGE TORTOISES lumber across the apron at New York International Airport on their way to lodgings during a layover in their trip to a zoo in the U.S.

tile and fish since its opening in 1958.

Shipping animals by air has grown in popularity along with the growth in size and speed of cargo planes since the end of World War II. It proved economical to have animals moved quickly, eliminating much sickness and death of valuable cargo. But along with the popularity came more problems. An elephant might have a three-day wait in New York for a cargo plane heading for New Orleans, and it was difficult to care for an elephant in a baggage room—to say nothing of a king cobra or 1500 wild monkeys.

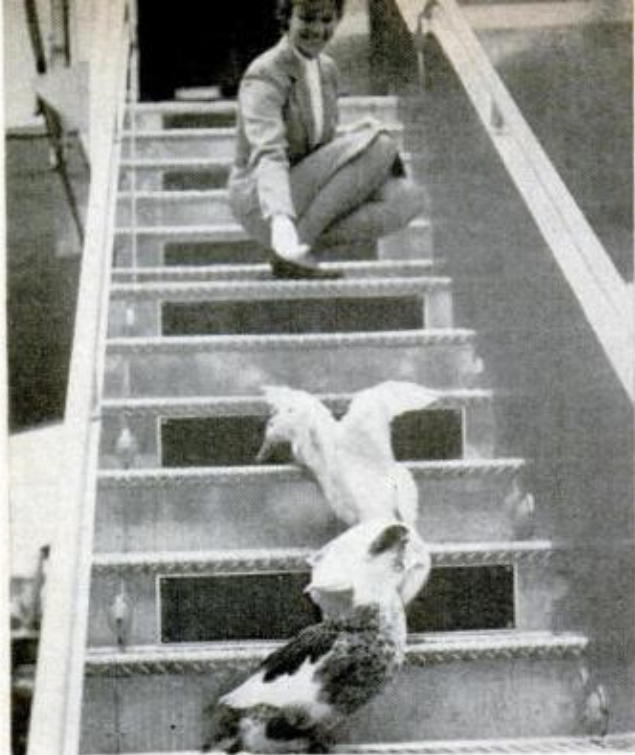
There was need for creature comforts at

THOROUGHbred RACE HORSES are frequent visitors to Animalport. This group arriving from Europe will receive usual VIP treatment for visiting royalty



LIKE AT ANY HOTEL, there is always a guest with a prickly disposition. This grouchy fellow reacts to the ASPCA's general policy of affectionate care





AFTER A PLEASANT STOPOVER at Idlewild, a pair of ducks board a jet airliner to head south the easy way. These two are valuable trained performers

Idlewild Airport, and when Animalport was opened the guests arrived by "leaps and bounds." The facilities are so swank it was once referred to as the "Jungle Hilton." For a polar bear there is special air conditioning, and for tropical birds, temperature and humidity control. There are outdoor exercise areas and Veterinarians are on duty at all times.

The kitchen has its problems. When a pair of temperamental pandas turned up their noses at the usual menu, calls for help went out to the Bronx Zoo and the New York Zoological Society: Soon the Pandas ate a hearty meal of special bamboo shoots—found in a Chinese restaurant.

When a shipment of squirrel monkeys is coming in, the kitchen has to stock up on orchids, the only thing they'll eat. Eagles and lions like raw horse meat, but polar bear cubs have to be fed dried milk, oleomargarine and dog food.

Room rates at Animalport range from fifty cents a day for pheasants, ducks, turkeys and geese, to seven dollars a day for a horse or an elephant. Boxes of mice, chinchillas, raccoons or skunks get the dormitory rate of one dollar a day. Dogs are charged according to size. Rabbits have the best deal. Two dollars a day per box and no extra charge if they multiply during their stay.

Like any hotel for transients, Animalport has the occasional problem guest. George Bauer, manager of the shelter, tells of a lion that was shipped in from



A PAIR OF PRETTY GIRLS arrive in New York. This Queen of the Jungle will get the \$7 a day Royal Suite at Animalport, complete with room service

Europe. "The sign on the cage said you could take him out, but it neglected to say you'd have trouble getting him back in." The lion was in a room with eight pounds of raw meat, and when it finished eating no one could get near him. He proceeded to knock over a can of detergent, then managed to turn on a water faucet. By the time enough men arrived to subdue him, the lion was rolling in a mountain of suds.

And there was the time a big chimp broke loose from his cage. "I was in the waiting room filling out the forms for a woman who was waiting for her dog," explained Bauer. "Suddenly the woman said, 'My God, what's that?' I looked up and there was this big chimp sitting in the chair across from the woman. I was startled, but I didn't want to alarm the woman. So I got up and walked over to the chimp. I nudged him on the arm and snapped, 'G'wan, get back to work!' The chimp got up and left the room, and I just went back to the paperwork. I still wonder what that woman really thought."

For the most part this zoological hostelry operates without mishap, taking every possible precaution for the well-being of its guests.

"We have a nice place here," said Bauer, who was a New York City mounted policeman until his retirement. "Our clientele might seem a bit strange," he added with wry humor, "but you should see the hotels in town." ★★★



HILLMAN'S NEW, 82-inch-wheelbase, four-passenger, two-door goes from 0 to 60 m.p.h. in 23.2 seconds

Wringing Out an Imp

WARLINGHAM, England—Road handling of the new Hillman Imp is extraordinarily good, although the car is touchy in gusty side winds and on bumpy curves. Then the swing-out action reminds you that 62 percent of the weight is on the rear wheels.

Nevertheless, with rear tires at 30 pounds and fronts at only 15, the car is so skillfully set up that the tail-heavy feel common to most rear-engine vehicles is almost canceled.

Steering is fast, light, accurate and virtually neutral, with gently controllable understeer under heavy acceleration in spite of the super-sensitive pneumatic (that's right, air in a hose!) throttle control. The turning circle is only 28 feet across.

The Imp's all-synchro, four-speed gear box is one of the fastest and smoothest I've tried. True, its rear axle ratio won't let you attack steep hills vigorously, but

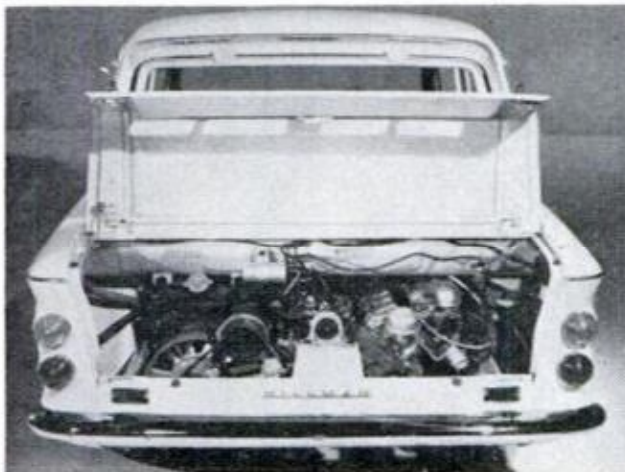
transmission ratio spacing is good. Top speeds through the gears, by the Imp's speedometer, were 23, 45, 70 and 78 m.p.h.

Although driven hard through PM's test, the Imp averaged 33.2 m.p.g. (U.S.). The average driver can expect 33 to 38.

For comparative accelerations against a BMC Mini, I averaged four runs at each speed. The 1540-pound Imp ranged from a second ahead in the 0-30 to five ahead (13.8 seconds) in the 0-60 runs. Doing 20-40 in high, the Imp was 3.4 seconds faster. Its engine showed no strain at 5000 r.p.m. where its power peaks. It cruised at 70 without fuss and reached 78 as top. But steering tended to vibrate at high speeds and there's considerable road noise on bad surfaces that can be irritating.

The U.S. price, at press time, was unannounced, but it's expected to be priced somewhere between \$1500 and \$1600 east coast POE.—*Michael Priestley*

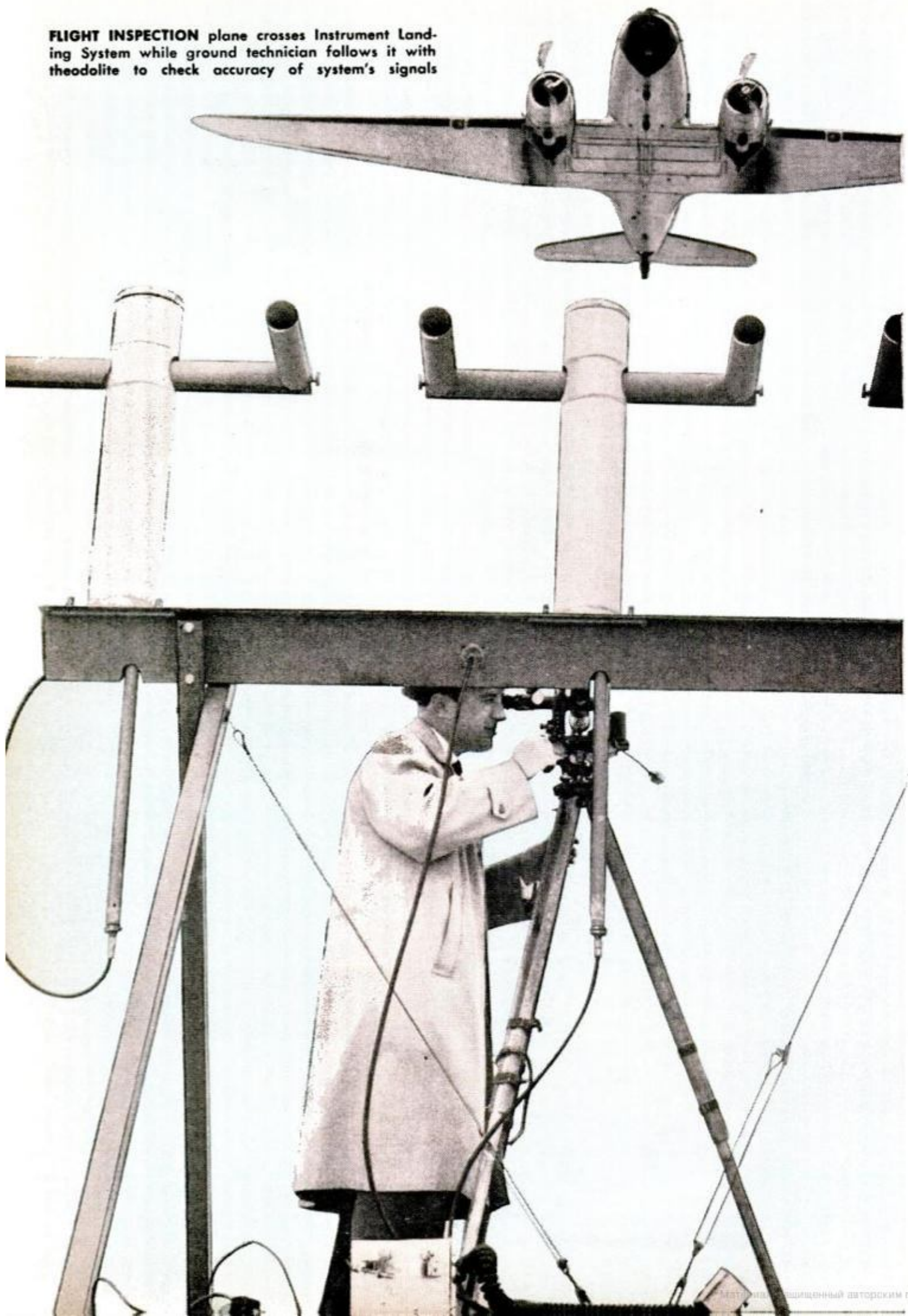
IMP'S 42-HP. ALUMINUM rear engine has 10:1 compression ratio, is canted 45° to control body roll



TAIL-GATE LOADING via the swing-up back window with fold-down back seat gives station wagon utility



FLIGHT INSPECTION plane crosses Instrument Landing System while ground technician follows it with theodolite to check accuracy of system's signals



Ride With the Skyway Crash Preventers

Could that accident be repeated? Are those aerial thruways clear and well-marked? FAA's airborne detectives will soon find out

By Kevin Brown

IT WAS THE MOST disastrous crash in aviation history. A DC-8 jetliner and a piston-engined *Constellation*—one bound for New York's Idlewild airport and the other for nearby La Guardia airport—collided in zero visibility 5000 feet above Staten Island on a foul December day in 1960. Pieces of the planes and the bodies of 128 persons aboard were scattered over a wide area of the Island and Brooklyn.

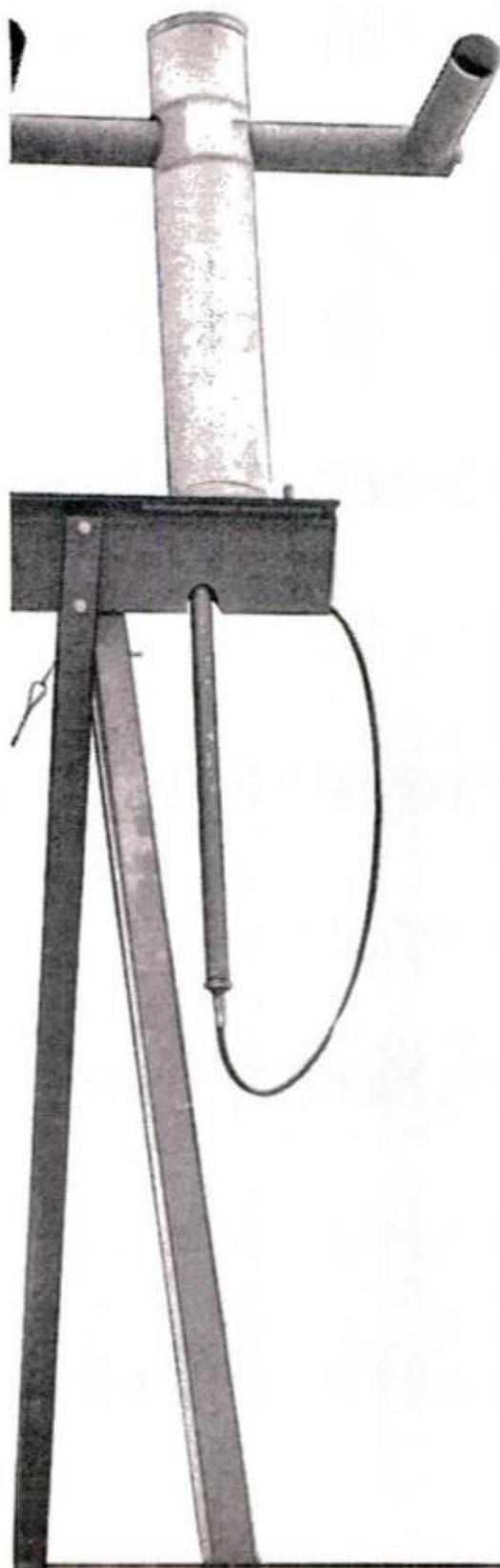
Thirty minutes later, after the flight plans of both wrecked planes had been studied, a DC-3 with Federal Aviation Agency markings and a crew of FAA technicians took off into the gloom. Their grim task was to fly the same approach routes taken by the planes up to the moment of collision. With supersensitive instruments and precise recording equipment, they checked the radio and radar ground facilities used by the planes to see if any were at fault.

They found nothing amiss. Six months later the official report substantiated their findings. The DC-8's flight recorder showed that it had flown past its assigned holding point into the path of the slower *Constellation*. The *Connie* and the ground navigation aids were blameless.

The flight that day by the DC-3 involved a sort of aeronautical "autopsy." The plane was one of an FAA fleet that includes propjet Convair 440s and purejet Boeing C-135s. Its assignment was one of the more dramatic operations of a little-known wing of the United States government—the flight inspection service. Almost daily, these craft are in the air quietly flying less spectacular but necessary routine missions along the air lanes used regularly by private, business, military and commercial aircraft.

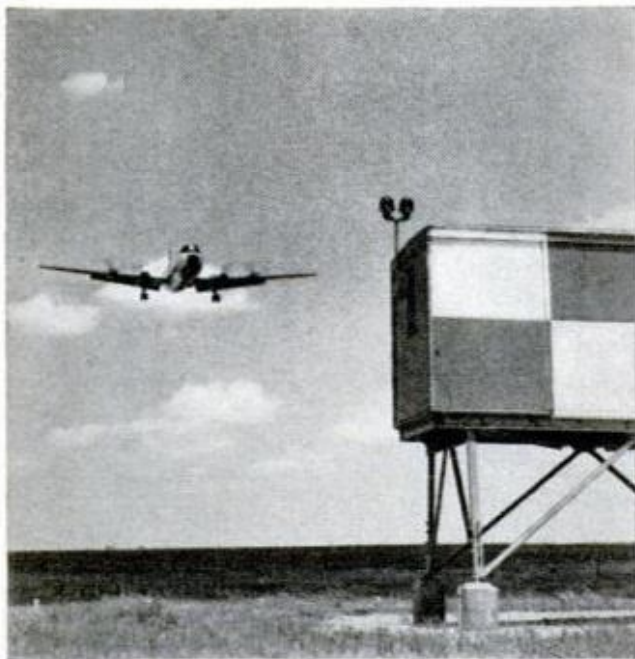
Flight inspection's principle duty is to keep a constant watch on the "roadways" in the sky to make sure they are safe to fly. In effect, they see that the "white lines" are "on straight." The job is one of preventive maintenance—continually checking each piece of navigational equipment to make sure it is functioning properly. The service's goal is perfection. Not a single air crash in this country has ever been caused by a failure of any part of the navigational system.

Recently, *Popular Mechanics* asked the FAA if it could ride along on a flight-inspection mission to





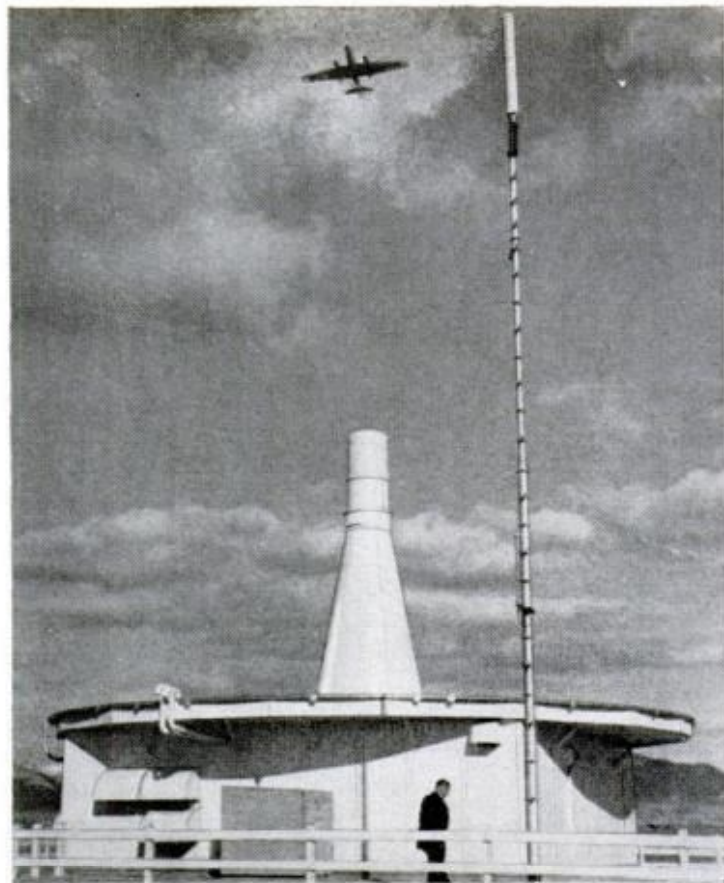
SURVEYOR'S THEODOLITE is set at predetermined angle and technician with mike tells pilot which way to fly to keep plane lined up in its crosshairs



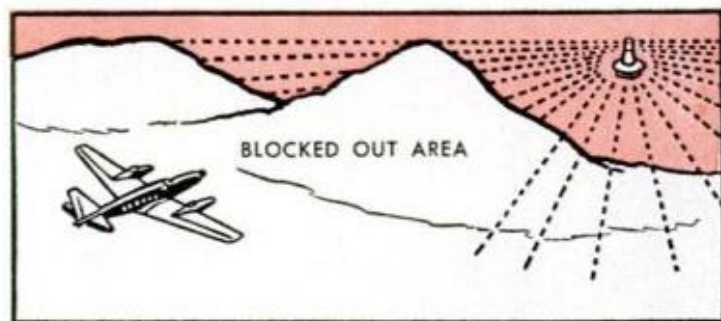
LANDING APPROACH is made over ILS housing (right) on clear day. In zero visibility, however, pilot would depend on ILS signals, hence constant checks

see how such perfection is maintained.

Basically, flight inspection is divided three ways, corresponding to the three levels of air usage. DC-3s check the low-level routes commonly flown by private aircraft. More important, they do most of the inspection of navigational aids around airports, and they trouble shoot any kinks in the system that may be found by the other two fleets. The Convairs inspect the air lanes at medium altitudes up to 24,000 feet. These are the routes flown by prop-driven commercial airliners and some business aircraft. The C-135s (military version of the Boeing 707) fly the jet lanes above 24,000 feet—the skyways



VORTAC STATION, one of major en-route navigational aids, has typical overhanging roof to keep signals from hitting ground or other rough terrain



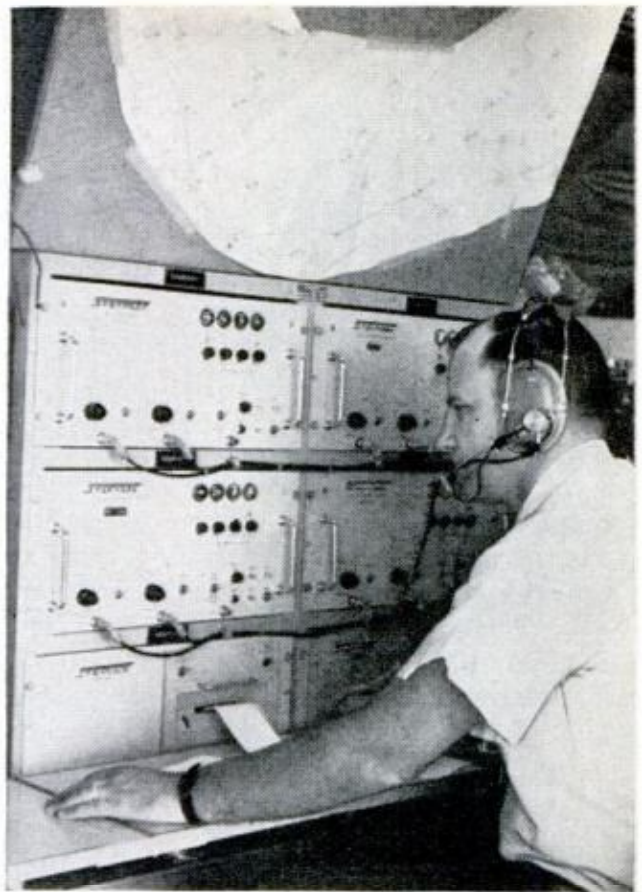
NATURAL INTERFERENCE can affect ground signals. Trees can cause rough signals, and mountain peaks can block out signals to planes flying behind them

flown by jetliners and most military aircraft. There is some overlap because the same navigational facilities are used at all three levels. However, because of the peculiarities of the equipment itself and the terrain that surrounds it, the same facility may produce a different signal at different altitudes. Hence, the three checks.

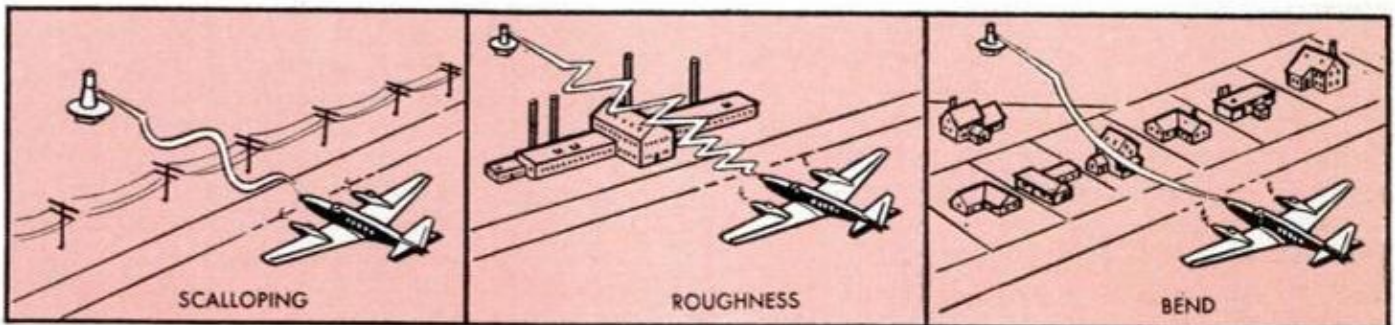
We chose to go on one of the jet flights. Starting from FAA headquarters at Oklahoma City, Okla., we flew south to Brownsville, Texas, on the Mexico border, then winged westward to California, and finally north to Seattle, Wash., near the Canadian border. The mission involved a total of seven air hours and



RECORDING EQUIPMENT (foreground) keeps record of inspection flight made by author. Technician mans panel which receives signals from ground stations



POSITION PANEL records exact position of plane at any instant along flight path. On author's flight, more than 1800 instants were "frozen" for analysis



MAN-MADE INTERFERENCE can be caused by power lines, industrial machines or metal surfaces such as roofs. Effects include scalloping, or twisting signals into rhythmic pattern; roughness, a jagged pattern; or bending, a curve

2989 air miles. Next day we reversed the course, double checking 22 "on-course" facilities and 28 additional facilities located left or right of our course. After two days we had recorded 1800 separate items of information about all of them.

Our jet flight had been mapped out well ahead of time. The routes are chosen because of periodic inspection (all facilities, depending on type, must be checked every 30 days to 6 months), because of requests from either pilots or FAA ground personnel, because of installation of new equipment or resumption of service of some facility shut down for maintenance, or to establish new air routes.

Our crew consisted of three pilots and a flight engineer, who handled the flight itself, and four electronic technicians, who handled the inspection. After take-off, Jack Fowler, the chief technician, sat down and explained what they were going to check and how they were going to go about it.

The major navigation facilities for aircraft, he said, can be divided between en-route facilities used in flying from one airport to another, and terminal facilities used at the airports.

The major en-route facilities include:
VOR Stations—(Very-high-frequency Omni-direction Ranges, 108-118 mega-

cycles). These are the backbone of civil airways. They send out homing signals and an infinite number of beams. For practical purposes, however, only 360 beams (now called radials) are used, corresponding to each point on the compass. A pilot can dial into the VOR station and it will tell him what radial he is on and whether he is flying to or from the station. Or he can pick another radial, and the station will tell him whether he is left or right of this radial and how far. The FAA selects certain radials from each VOR station and they are marked on maps as airways, and given names and numbers the same as U.S. Route 66 and other highways. The DC-8 mentioned earlier, for instance, was flying Victor Airway 123, the 62-degree radial of the Robbinsville VOR station in New Jersey.

TACAN Stations—(Tactical Air Navigation ranges, operating on ultra-high-frequency channels from 962 to 1213 megacycles, with some gaps). These are the military equivalent of VOR stations, with the addition of distance-measuring equipment. The DME measures the distance the plane is from the station, whether flying toward or away from it.

VORTAC Stations—These are combinations of VOR and TACAN stations, serving both civil and military aircraft.

Air Route Surveillance Radar—Radar sites that track all aircraft, keeping them safely separated and helping them avoid bad weather.

The major terminal facilities are:

Airport Surveillance Radar—Perform the same function as ARSR, except they are separating aircraft that are taking off or landing.

ILS—Instrument landing system, probably the most critical of all facilities because they are bringing aircraft down into contact with the ground. These must be checked every 30 days.

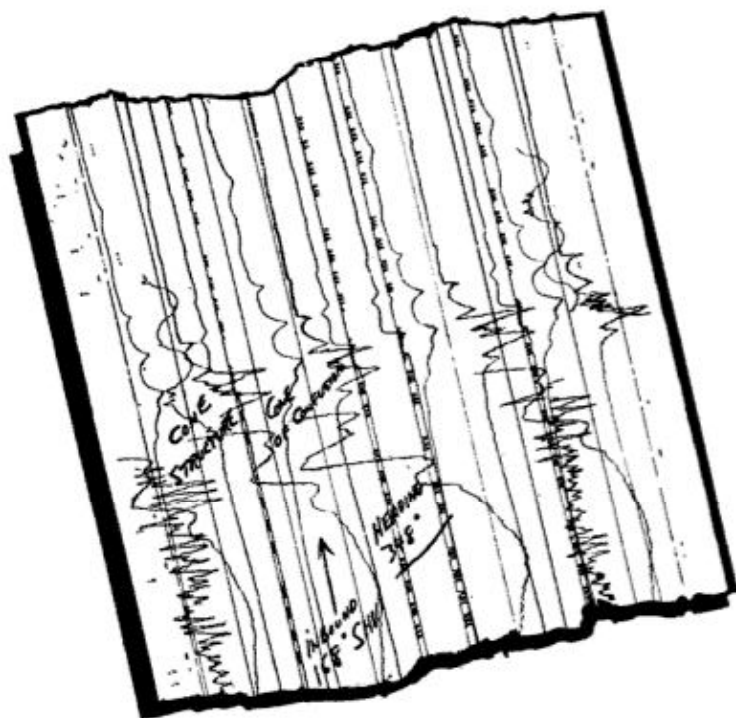
In addition, radials from some VOR and VORTAC stations, where they cross radials from other stations, are designated as intersections for turning from one airway onto another, or as reporting points where planes are required to announce their position to traffic controllers, or as holding fixes. The ill fated DC-8 was to hold at "Preston intersection"—the crossing of the 50-degree radial from Robbinsville VOR and the 346-degree radial from Colts Neck VORTAC. The two radials met above Preston, N.J., but the DC-8 missed it and flew on to tragedy.

After describing the facilities, collectively referred to as NAVAIDS (navigational aids), Fowler showed us the equipment that does the checking.

"The first panel," he explained, "records the route of flight, checking the stations and all their component structures, including intersections, reporting points and holding fixes, to see that they're all where the maps say they are.

We moved behind another technician. "The second panel records the stations to either side of the route of flight, as many as six at one time. He takes 10-degree cuts, checking radials from each station at intervals of 10 degrees. If every 10th

[\(Please turn to page 194\)](#)



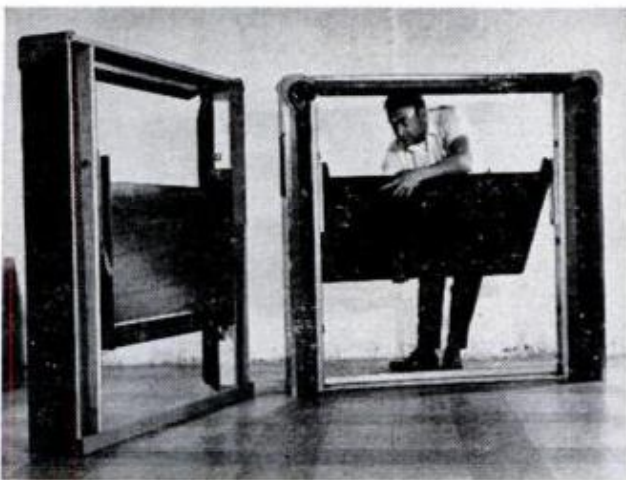
ACTUAL RECORDING taken from flight record made on author's trip. Tracings show plane flying over Shreveport VORTAC. Wild scribbles were made as plane passed directly over station and signals were momentarily blocked out. Tracings are later analyzed by computer

Magnetic Mixer

Magnets do the stirring in a new electric beverage mixer.

A plastic-coated magnet (arrow), dropped in the drink, whirls when the glass is placed on the electric Magno-Mix base. The magnet's rotation, which creates a whirlpool effect, can be regulated for gentle or vigorous mixing.

Made by Consolidated Industrials, Magno-Mix—with four mixing magnets—sells for \$29.95 from Zofer & Co., Box 5301, Richmond, Va.



Portable Billiard Table "Breaks" in Two

Pocket-billiard fans can now set up a regulation size table in a basement or playroom without the frustration of removing doors and walls to get it in.

The nine-foot table comes in two parts with folding legs to permit easy storage

when extra floor space is needed.

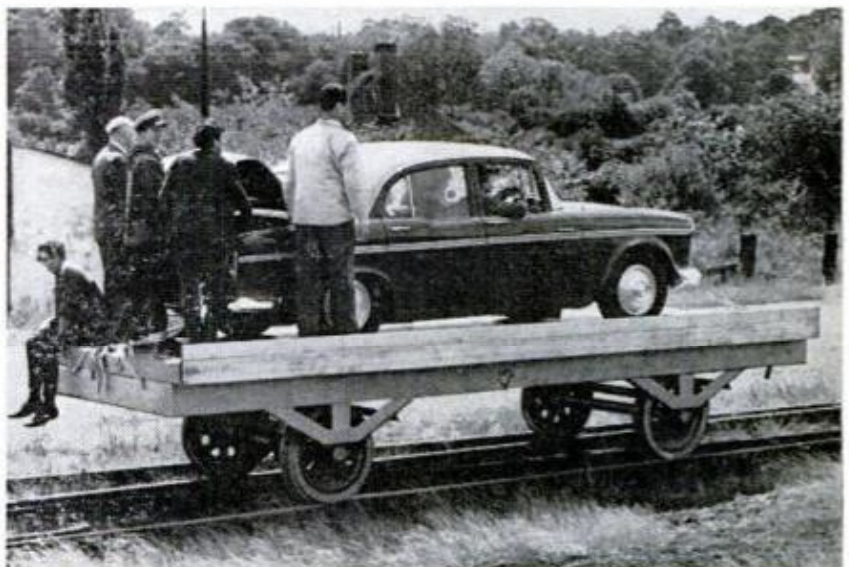
Manufactured by Superior Industries Corporation of West Haven, Conn., the table retails for \$300 and comes equipped with billiard balls, cue sticks, score beads, triangle and cue chalk.

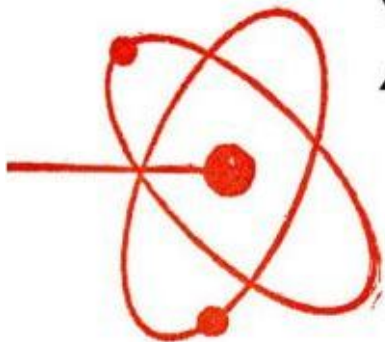
Rail Roller

Abandoned railroad tracks may offer pleasure drivers relief from over-crowded highways with the development of a trolley truck for carrying an automobile.

The car's back wheels rest on rollers which drive a chain to the trolley wheels.

Invented by an Englishman, Charles Prescott, the trolley is geared so that a car speedometer reading of 60 m.p.h. means the trolley is travelling at 30 m.p.h.





X-Raying Atoms

New trickery that lets scientists "see" atoms may lead the way to weird plants, animals, supermen

By Martin Mann

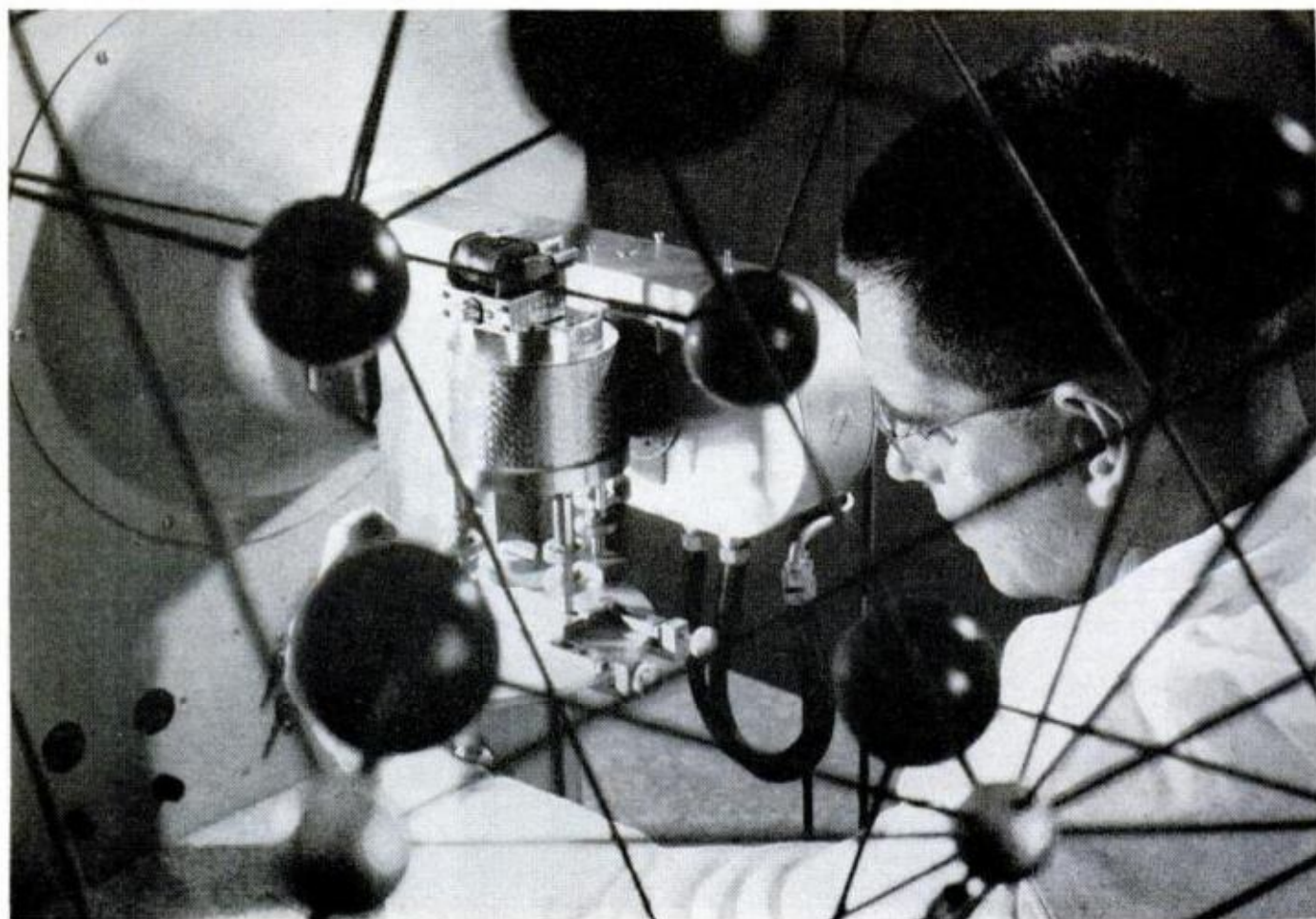
STRONGER STEEL, reliable transistors, new synthetics, and now the ultimate secret of life itself—all these are the payoff from a scientific trick. No sleight-of-hand, this trick requires a lab full of apparatus, great mathematical skill, and sometimes an electronic computer. But it pulls off the "impossible": It lets you "see" the atoms that make up molecules, even though atoms—paradoxically—are really too small to be seen.

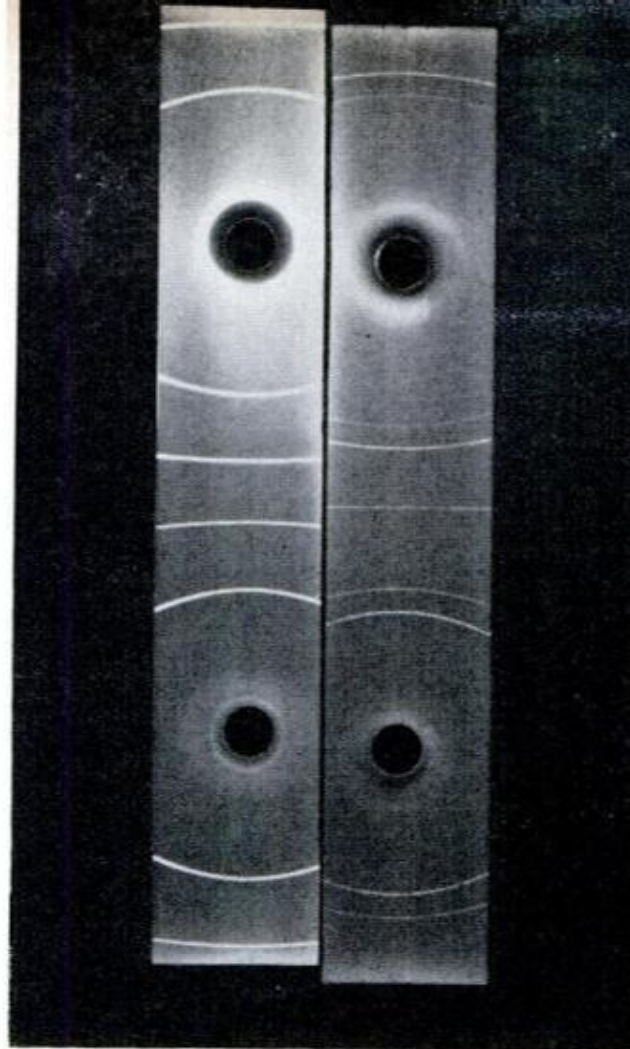
The trick of seeing unseeable atoms uses X rays, but not the way your doctor does. It's not new. But it is becoming increasingly important as scientists probe deeper into nature's most intimate secrets.

BUSINESS END of a super-power X-ray machine at Westinghouse research laboratories can look into the heart of crystals and "see" arrangement of atoms

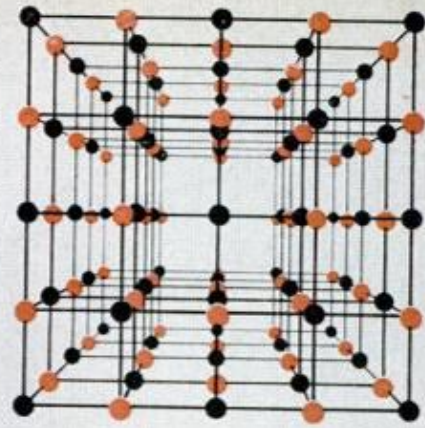
Last year two Nobel Prizes went to scientists whose mastery of this intricate technique, called X-ray diffraction, deciphered key molecules of life: Two body-engine chemicals named myoglobin and hemoglobin, and the all-important "thread of life," the strange DNA that carries your heredity and makes you what you are. The consequences of the DNA discoveries alone are awesome to imagine. Now that this molecule's design is known, its atoms might be juggled to change heredity. Inherited diseases could be corrected. Totally new plants and animals, undreamed of before, might be evolved in test tubes. Conceivably, an injection of souped-up

PRETTY DESIGN, opposite page, is from X-ray diffraction of an ice crystal. Actual atom arrangement in the ice can be deduced from these reflections

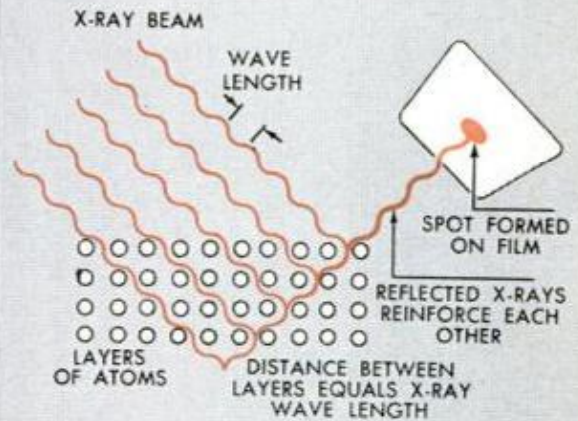




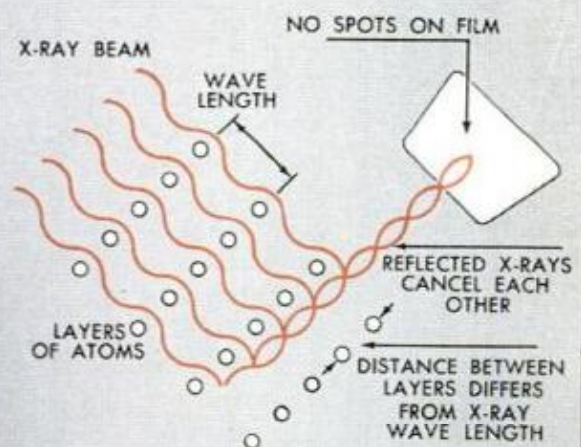
DIFFERENT ATOMIC PATTERNS inside a piece of steel indicate changes in arrangement of atoms as temperature hits 1335° F. Hot pattern is at right



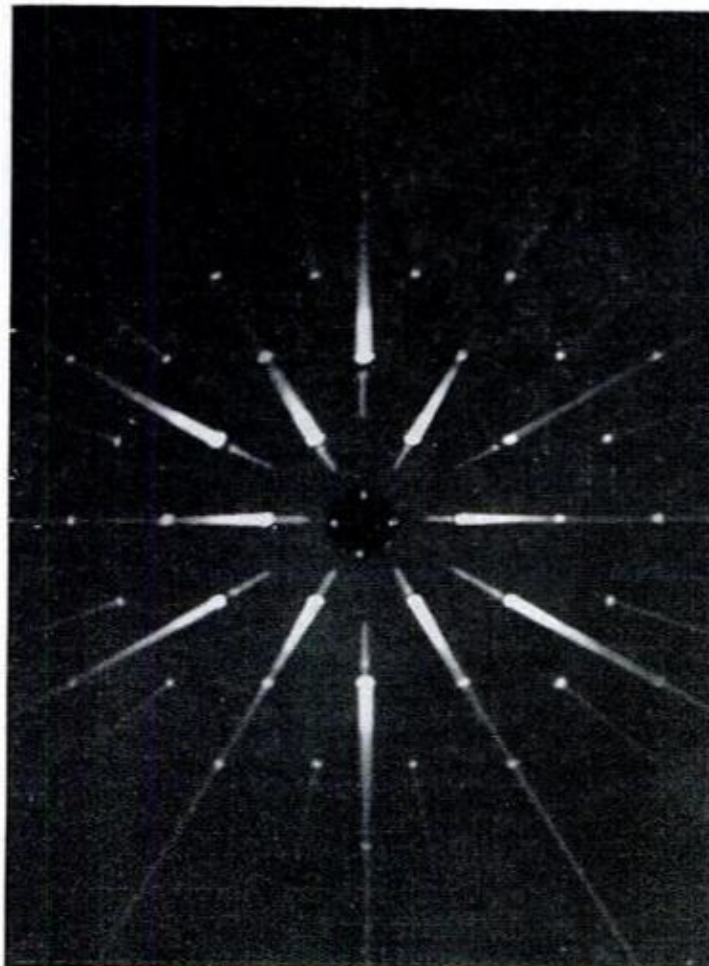
ATOMS IN SOLIDS are set in rows and in layers as shown in this diagram of a rock salt crystal. X rays passing through reflect only when they hit the center of any one atom

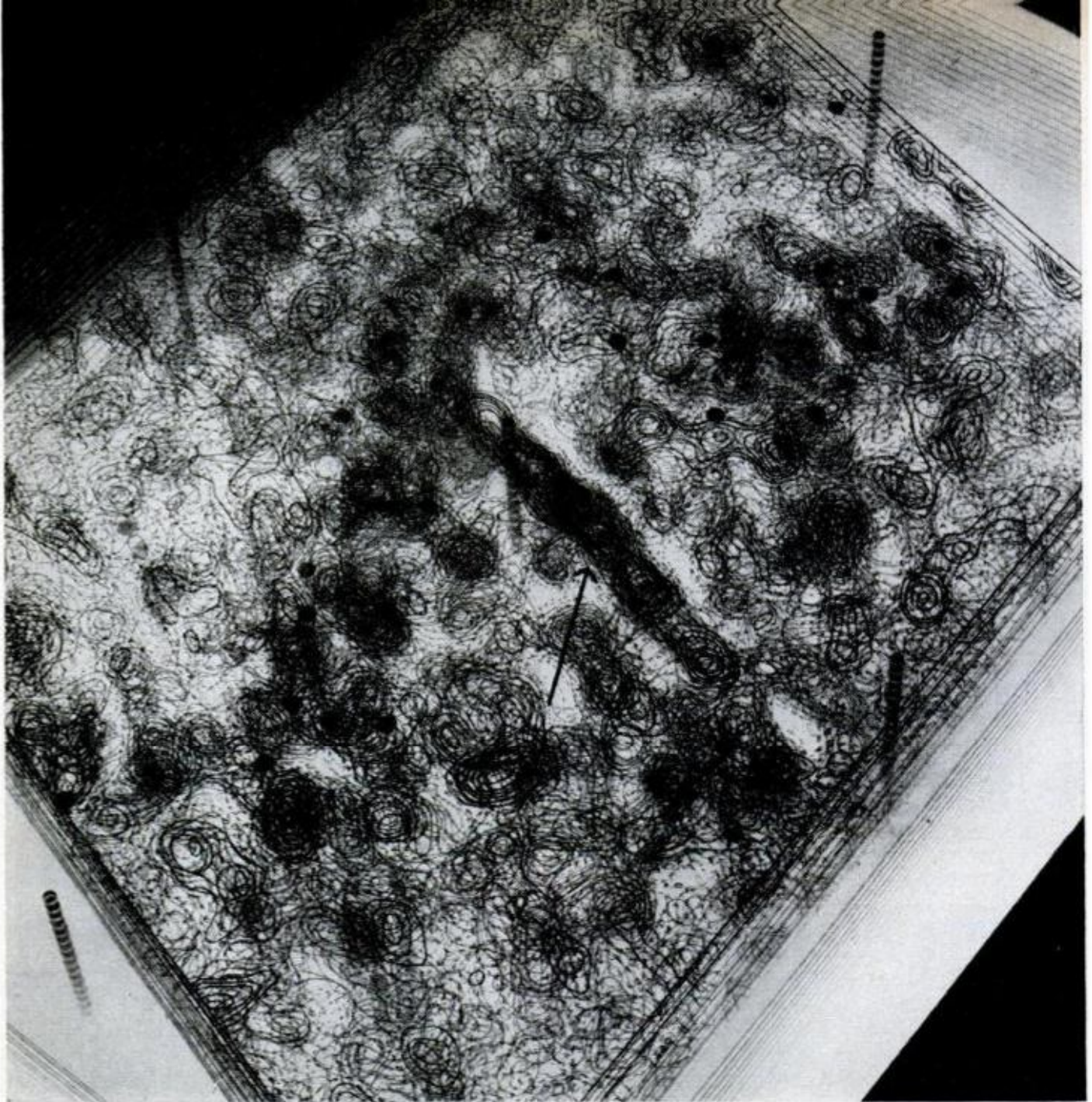


PATTERN OF SPOTS appears on film when X rays reflected from different layers come out "in step". In such instances, their layer-to-layer path matches their own wave length



AS CRYSTAL TURNS it changes the angle and therefore the path length. Spot disappears. Further turning will alter the path to a length that will make the spot reappear





PLOTTED on tiers of transparent plates, mathematical analysis of X-ray diffraction dot measurements produces a three-dimensional diagram of the molecule. Groups of closed lines indicate atoms. Arrow points to blood heme

DNA could convert a man into a superman—or a docile slave.

Less fanciful results of the X-ray view of atoms and molecules are routine today. Steelmen get an X-ray look at atoms as they group, twist, and line up during heat treatment. Transistor makers count the "dope" atoms added in delicate proportions (sometimes one to a hundred million). Diamond growers use X ray to prove that their arrangement in synthetic crystals is a true diamond arrangement.

It takes a trick to visualize an atom because the atom is smaller than the length of a wave of light. The light wave cannot pick out an atom, any more than a pipe wrench could pick up a watch screw. X

rays are shorter than light. But you still can't make an X-ray shadow picture of atoms inside molecules like the X-ray shadow picture of bones inside a human body. There are too many atoms, too small, and piled too close together.

The trick is trickier than that. It works because of the way all solid things are made. Their atoms are packed evenly in rows and layers, like eggs in a crate.

Back in 1912, when Max von Laue invented X-ray diffraction, this neat habit of nature was presumed, but not known for sure. Von Laue did not care very much about atoms; he was hot for X rays, then still a deep, dark mystery. But one day he dropped in on a bull session debating

the presumed atomic pattern. Someone guessed the spacing between atom centers ought to be, as physicists say, "on the order of" 1/250,000,000-inch.

Inside von Laue's head the light bulb went on. Inspiration struck. For von Laue thought that X rays might be waves just about that long. He had his assistants perform an experiment.

They shined X rays straight through a crystal onto photographic film. They got a pattern of dots, a rather pretty pattern like a design for surrealistic embroidery. This historic picture proved von Laue's point: X rays *are* waves. They made visible the atomic architecture of matter, led to astounding discoveries, and now are solving the greatest mysteries of life.

Von Laue's pattern was caused by reflections of X rays. What happens is this:

Most of the X rays pass between atom centers. But some rays are bounced back by individual atoms. These reflections come at regular separations: One X ray may be reflected by an atom in one layer; the next reflection cannot occur until another X ray crosses between layers and bounces off an atom in the next layer.

This is where the similarity between the length of an X-ray wave and the spacing between atom layers comes in. Sometimes the distance an X ray travels from

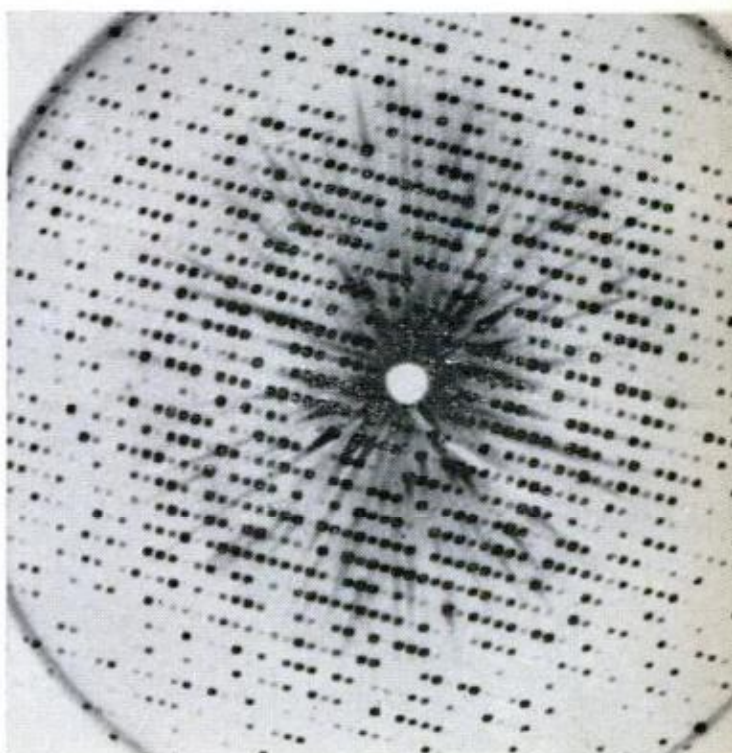
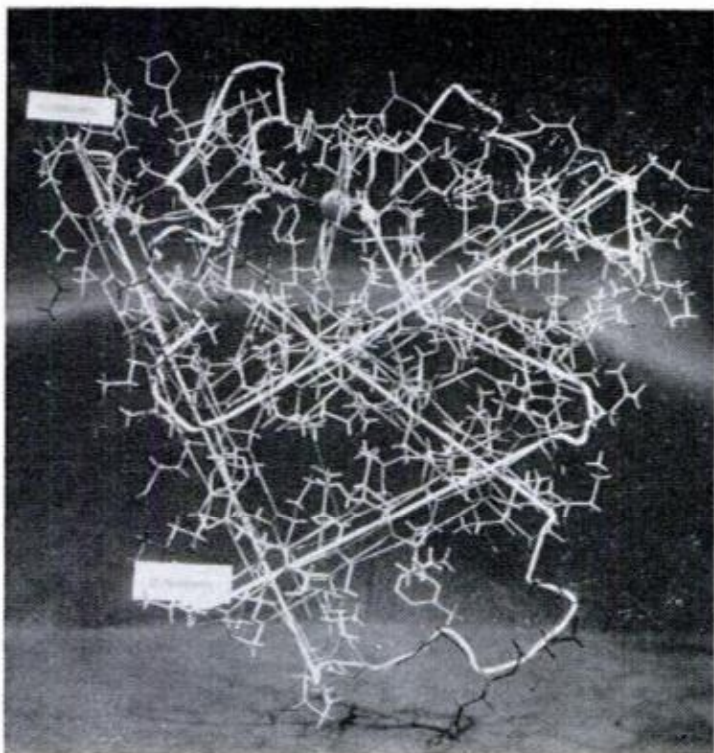
one layer to the next just equals its wavelength. If it is reflected at the second layer, it must travel the identical distance back out past the first layer. When it goes past the first layer, it will be right in step with another X ray reflected by the first layer. That means reflected ray No. 2 adds onto reflected ray No. 1 and strengthens it. The same thing happens at other atom layers through the solid crystal. So, when things are lined up correctly, you get a strong X-ray beam reflected back out of the crystal. When things don't line up just right, you get a weak, diffuse reflection. This creates the pattern of spots on film.

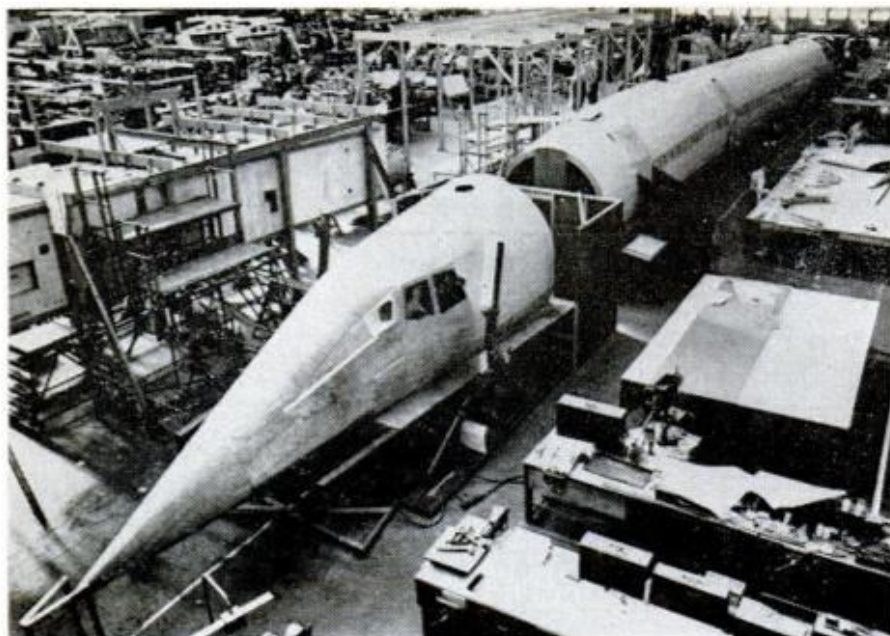
It sounds as though a few measurements of the spot pattern would allow you to plot the layout of the atoms. It's not that easy. For one thing, some X-ray reflections are "retarded" more than others—they travel farther inside the crystal, past more atom layers, before they are reflected back out. So, you can't pin certain spots to certain layers. The scientist must first guess at the plan of the atoms, then calculate the pattern which his plan would create, and see how his calculated pattern matches the one he got on film.

For the complex molecules of life, such as DNA, deducing a reasonable picture of the atomic layout takes real genius (and a big electronic computer.) ★★★

FINAL MODEL of a hemoglobin molecule in wire and string depicts groups of atoms twisting around (white cord) iron atom (gray ball). It was deduced from a mathematical diagram like the one opposite

PORTRAIT of blood compound myoglobin by X-ray diffraction gives clue to atom locations, but Nobel prizewinners who took it had to measure light values of 250,000 dots to get true atom structure





Supersonic Airliner in Mockup Stage

Moving toward supersonic speeds in commercial air travel, the first mockup of the Concord Anglo-French airliner has been built by British Aircraft Corp.

To simulate landing attitude, the cockpit of the model can be raised and lowered hydraulically. Shown in raised position, the cockpit visor of the new aircraft is retractable, as it would be in supersonic flight to reduce drag.

Air Force Gets Its First All-Jet Transport

First all-jet cargo transport for the Air Force is the C-141A StarLifter built by Lockheed. The craft, capable of flying 550 m.p.h., weighs 316,000 pounds and can carry a load of 90,000 pounds for short distances. It can haul a 50,000-pound payload 4000 nautical miles.

On hand for roll-out ceremonies was a tiny Wright Flyer (right), described as the world's first military transport.





Airborne Water Skier

Literally riding on air, a water skier flies two feet above the water on Dynafite hydrofoils attached to his skis. Made of aluminum in the shape of airplane wings, the hydrofoils start lifting a skier out of the water at about eight miles an hour and can carry him up to 35 miles an hour.

◀ Tank Driver Lies Down on Job

Operated by a driver in prone position (inset) who sees through a periscope, the British Army's newest tank is a 50-ton dreadnaught sporting a 120-mm. cannon. Protected against radiation, the Chieftain is amphibious, runs on multi-fuels, goes 25 m.p.h., has infrared lights for night fights.

Ring for Long Calls ▶

Capable of communicating to earth from an orbiting spacecraft, a tiny ring-shaped antenna fits inside an astronaut's helmet.

The new Northrop antenna allows the wearer to carry a self-contained transmitter-receiver without a projecting whip antenna. It also eliminates the need for a connecting cable to the space vehicle's communication system.

Known as the Directly Driven Resonant Radiator (DDRR), the antenna handles all radio frequencies.

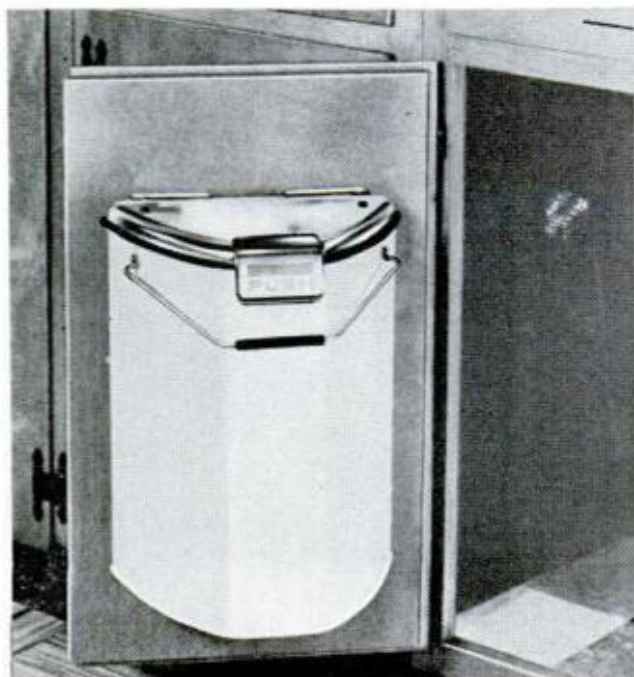


New for Your Home



BENCH STORES papers or magazines in bundles. When bench is full, tie up bundle, remove it, restring "tie-dy" (in 15 seconds) and start over. Finished unit (12 by 15 by 18 inches), scissors and cord costs \$14.95. Yield House, N. Conway, N.H.

WASTE CAN rests under sink, attaches to cabinet door out of sight. Pushbutton opens tight lid. Rubber gaskets insure silent operation. Price: \$7.98 in enamel; \$10.98 in stainless. By Beautyware, 225 42nd St., Brooklyn, N.Y.



UNDERGROUND HOME-PLUMBING kit protects pipes from corrosion. Magnesium anodes are buried in ground; wire from anodes is clipped to outside faucet for cathodic protection. \$18. Corrosion Services, Sand Springs, Okla.





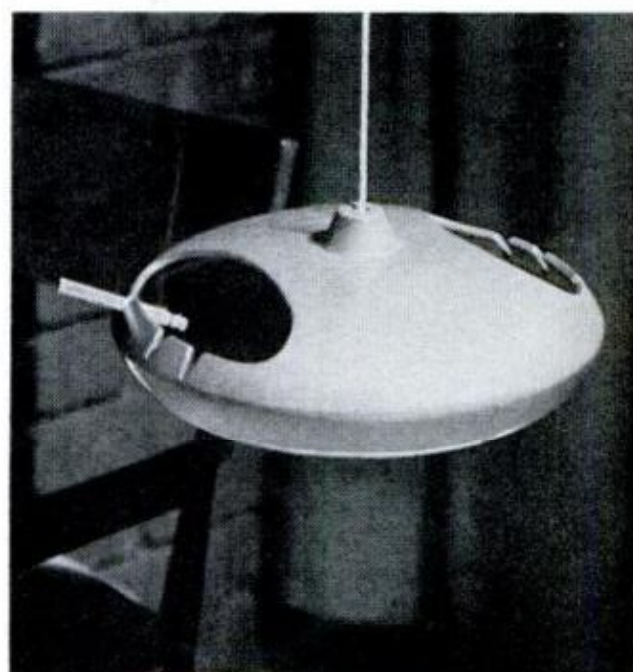
FREEZER-REFRIGERATOR in furniture finish becomes room divider with bookcase or desk attached to back of frostless unit. Its glass doors slide open easily, and cutting board folds down into snack bar. Refrig. (top): 13 cu. ft.; freezer (bottom), 10 cu. ft. Studebaker, South Bend, Ind.

HOME WATER-CONDITIONER central control has vacation bypass lever to shut off water soft process when family's away. 24-hour cycle time dial sets day or days for regeneration. The Lindsay Co., 1381 Marshall Ave., St. Paul, Minn.



VACUUM CLEANER weighs but five pounds, features high-speed revolving brush and built-in cord storage hooks. Disposable bag, finger-tip on-off switch and nylon rollers for carpet or bare-floor use provide easy mobility. The price is under \$19.95. By Sunbeam, Chicago, Ill.

HANGING ASHTRAY of durable ceramic saves surface space, but hangs within reach. 12-inch diameter hooded design adapts to outdoor use as planter or feeder. Price: \$11.95; Shopper's Window, 1230 Barott Rd., Lafayette, Calif.



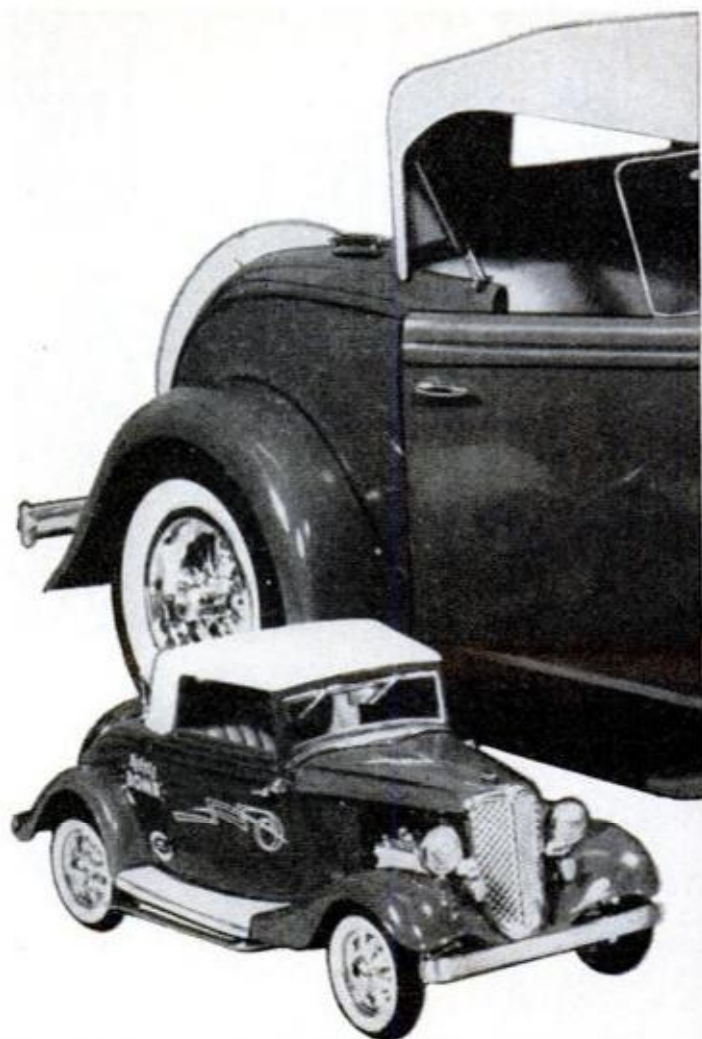


Army's Ski Slide

Army arctic troops, wearing skis and carrying snowshoes, packs and rifles, now rappel from a helicopter when they want to down in a hurry. This avoids the "blizzard" created by a copter landing in snow.

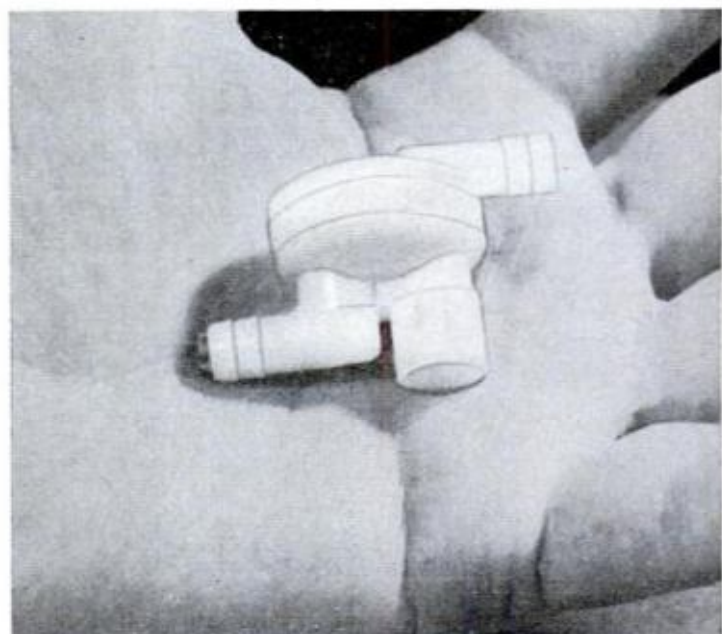
Any Time, Anywhere

If you need 19 simultaneous readings of times around the world and tides and stars, the Spilhaus Space Clock is for you. It's a perpetual calendar, too, giving the day and month, time in major U.S. cities and local, World and Universal time. Price is \$150; Edmund Scientific, Barrington, N.J.



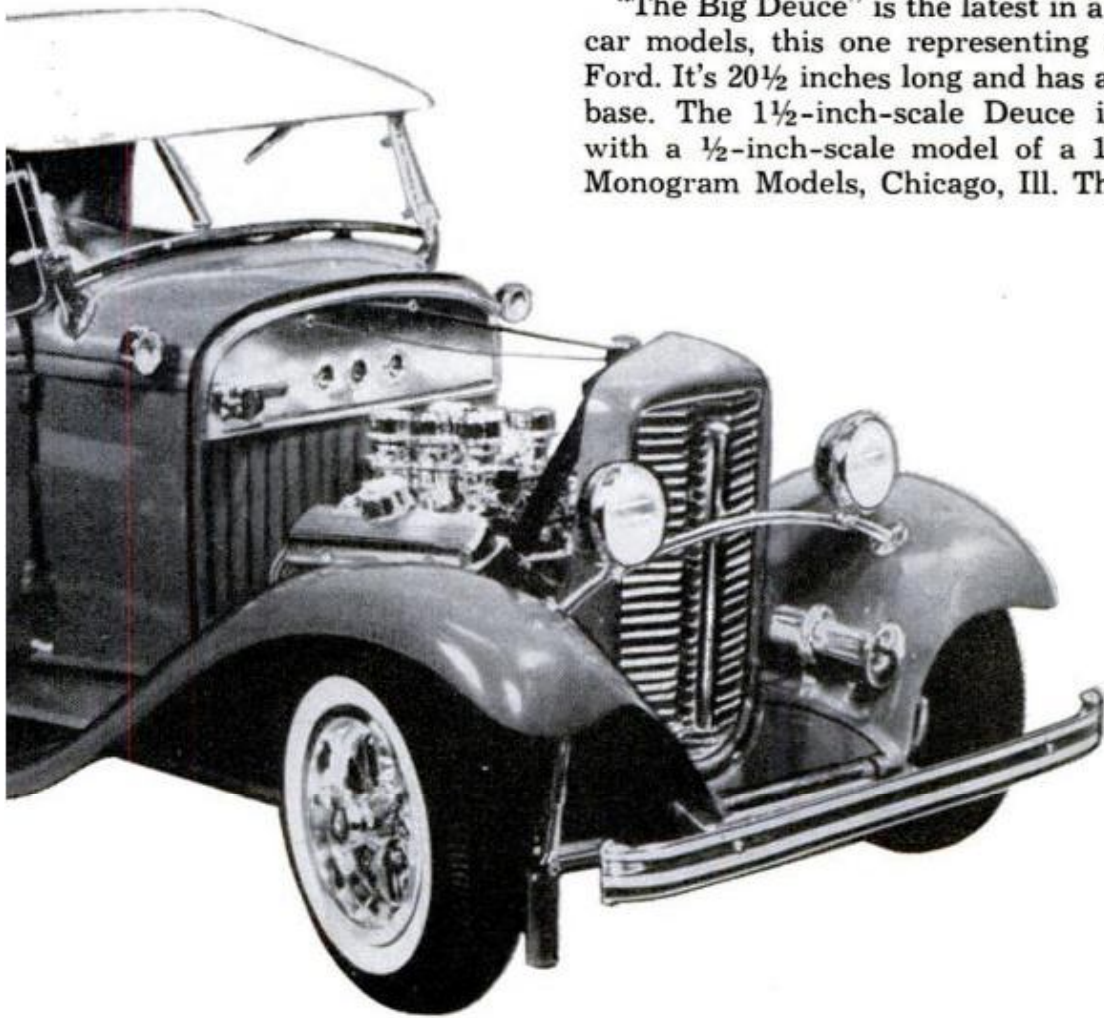
Half-Dollar-Size Fuel Pump

Small gasoline engines, such as those on lawn mowers, chain saws and marine engines, can be equipped with a tiny fuel pump the size of a 50-cent piece. The ACF Industries unit needs no elbows or special fittings. It operates from engine pulsations and can function in below-zero weather.



One Size Larger and You Can Ride 'Em

"The Big Deuce" is the latest in a line of large-scale car models, this one representing a customized 1932 Ford. It's 20½ inches long and has a 13¼-inch wheel-base. The 1½-inch-scale Deuce is contrasted here with a ½-inch-scale model of a 1934 Ford, also by Monogram Models, Chicago, Ill. The kit costs \$14.98.



Tire Cleats for Snow

Heat-treated eighth-inch steel cleats are a quick answer to snow or mud traction problems. They're mounted on web straps that pull up extra tight as the buckle is closed. The cleat sets are offered at \$4.95 a pair by Master Craft Products, 1900 Euclid Avenue., Cleveland 15, Ohio.

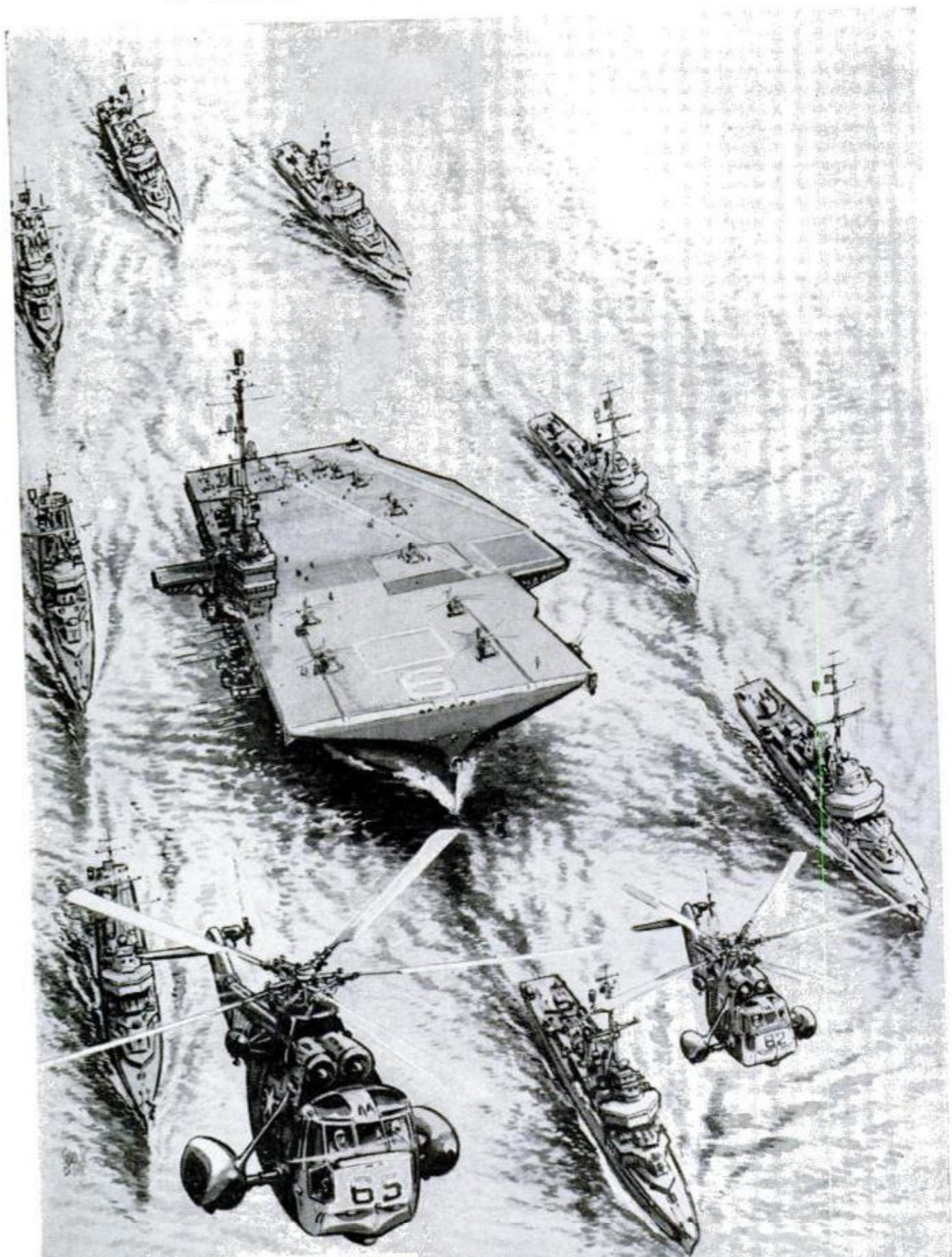


Kitty Has a Sidecar

Passengers or groceries can ride in the sidecar that comes as an option with the Skat-Kitty scooter. The scooter is priced at \$169.95 with a two-cycle engine and \$179.95 with a four-cycle. The sidecar is \$49.95 extra. Made by Projects Unlimited, 1926 E. Siebenthaler Ave., Dayton, Ohio.



The Silent War in



THE HELICOPTER is the most potent search-attack addition made to hunter-killer (HUK) groups since World War II. In an actual ASW tactical formation, surface, air and sub-surface search units are spread wide over the sweep area

Liquid Space

Aircraft carriers steel for a new role as our hunter-killer force sharpens its claws in the deadly cat-and-mouse game with Russia's subs

By John P. McNeel



KILLER SUBS like the atom-powered USS Tullibee use powerful new sonar devices to search out missile-firing enemy craft lurking in the ocean deeps. Transducers projecting from both ends distinguish killer from attack subs

LOOKS LIKE a definite contact this time, sir."

The tired sonarman peered anxiously at the revolving sonar repeater in the carrier's CIC, or Combat Information Center. Eerie red and yellow lights glowed from the radar and sonar screens. Voice radio receivers crackled with a dozen incoming reports from the sub hunters—destroyers, helicopters and patrol planes.

Beside the sailor, a lieutenant in rumpled suntans listened intently into earphones, a grease pencil poised over the screen of a radar repeater. Quickly, he made a few notations on the screen, turned and gave the control officer on the raised dais behind him a summary of the data.

Then he turned to the sonarman. "Looks right," he said, "but you never can tell with sonar. It may be only a couple of whales mating."

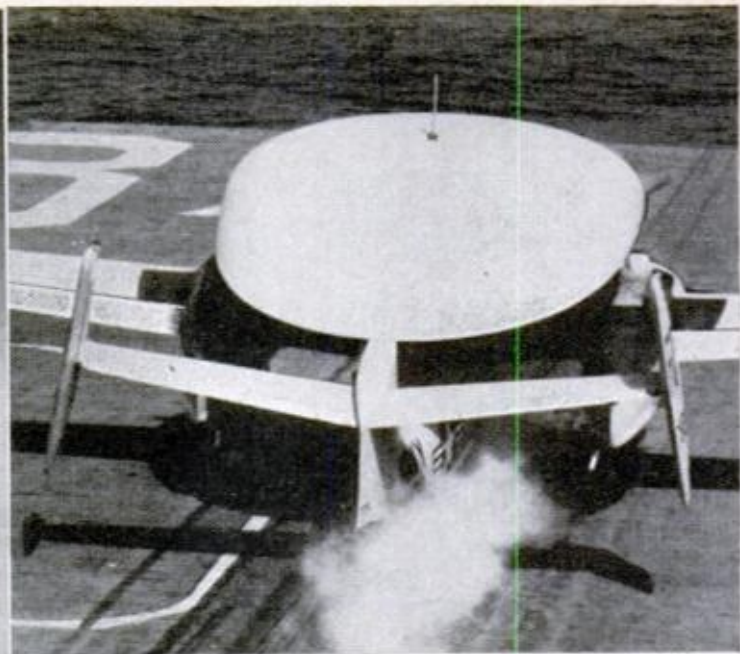
Tension was mounting in the overcrowded CIC room. For eight and a half hours the task force men had been straining every nerve to track down a lurking submarine. A half dozen "wolves" (unidentified underwater objects) had been reported by patrolling helicopters and S-2D Trackers; all of them had dribbled out into nothing. This time it looked like a solid contact, now 15 minutes old.

Some 95 miles in front of the carrier, a patrolling E-1B Tracer plane, circling at 1500 feet altitude, was acting as a standby CIC. Impulses from its odd-shaped "umbrella" radar dome had been the first to pick up the new contact. In the inky blackness of the predawn watch, *something* had surfaced. True, it could be a couple of amorous whales. Or it could be a sub's periscope.

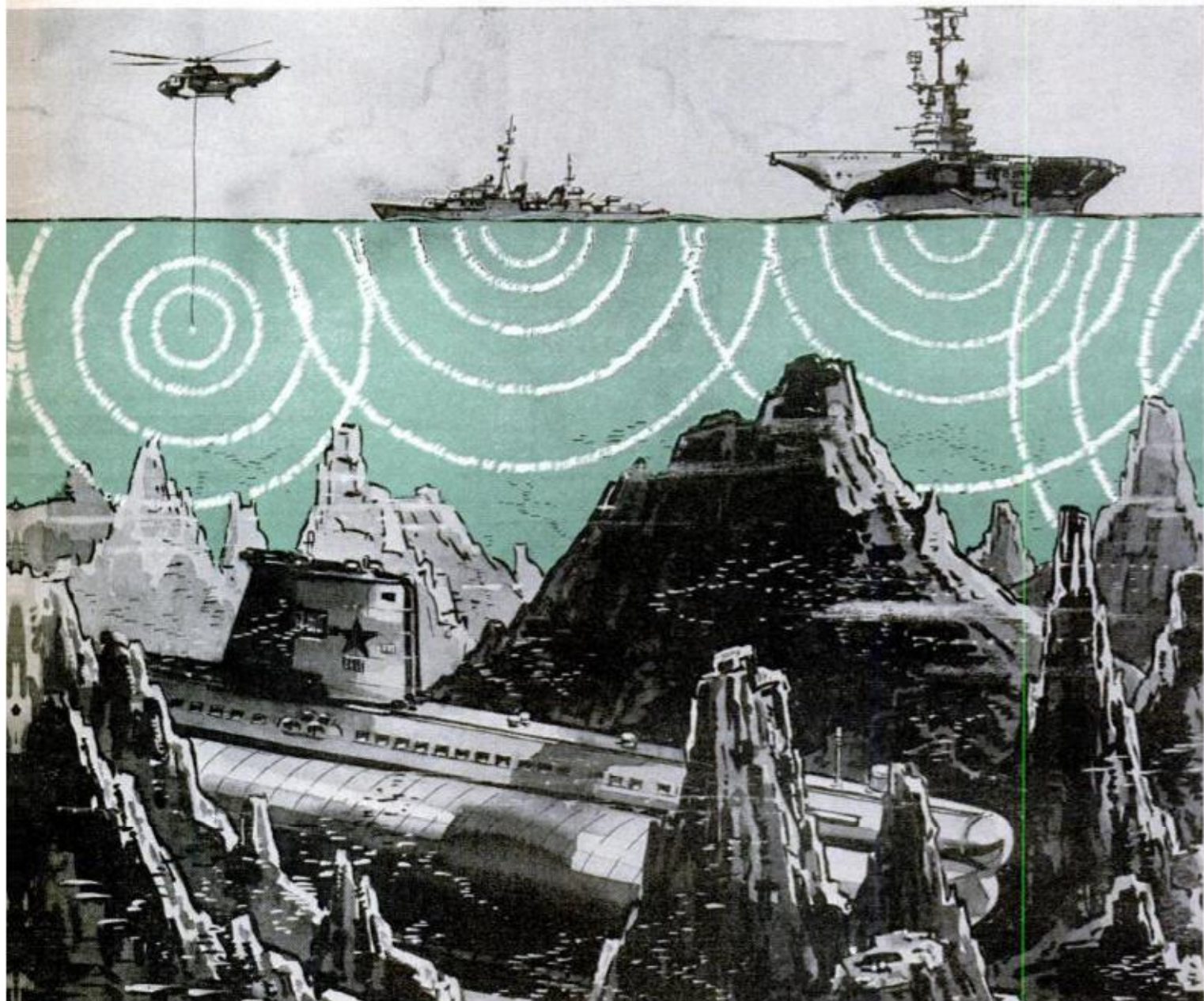
Not having any sonar apparatus or at-

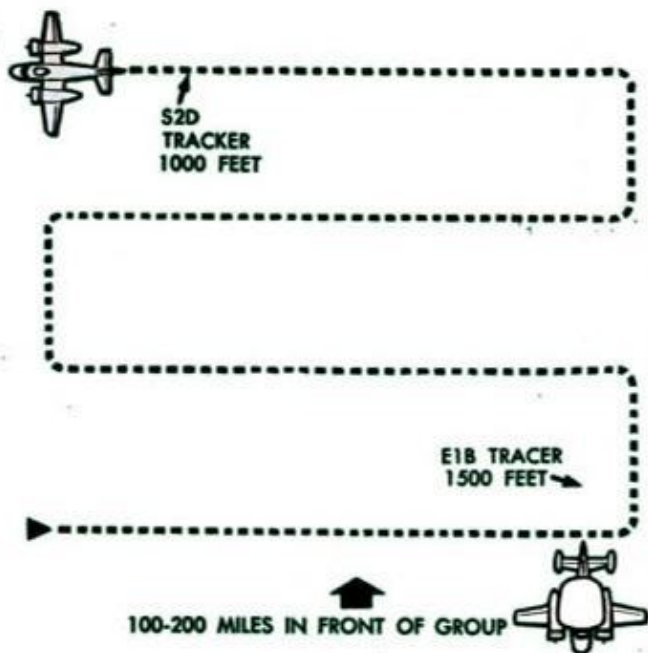


S-2D TRACKERS armed with conventional torpedoes, bombs, rockets and nuclear depth bombs cruise at 140 knots and can stay on patrol for several hours



E-1B TRACER is a search craft only. It has no weapons but its long-range umbrella-shaped radar system can pick up sub periscopes at great distances





TRACKER AND TRACER aircraft fly varying search patterns, often one on top of the other. In a pinch, E-1B's can act as a roving CIC directing operations



tack capabilities, the E-1B pilot had ordered the nearest helicopter into the contact zone. Lowering a sonar transducer (sonobuoy), the 'copter men made almost instant contact with whatever lay beneath the surface. Confirm. But was it a sub? They couldn't be sure.

Quickly, the pilot asked Carrier CIC to send in an S-2D Tracker plane. If its MAD (magnetic anomaly detector) boom sensed a disturbance in the earth's magnetic field, the contact was almost certainly a submarine. He recommended that destroyers stay clear of the contact zone. Their noisy screws might alert the sub and interrupt air contact.

Back in the carrier CIC, the control officer flashed the E-1B's plan to the admiral on the flag bridge. FlagPlot concurred. This would be an air kill.

Thus, another "enemy" submarine was tracked down and "erased." The planes and copters were from the USS Essex, oldest carrier in the fleet, but the newest in anti-submarine warfare (ASW) capabilities. Her vital function in tactical warfare is leading the way for many other fleet carriers that soon will be switched from strategic to tactical missions under a recent, dramatic Pentagon decision.

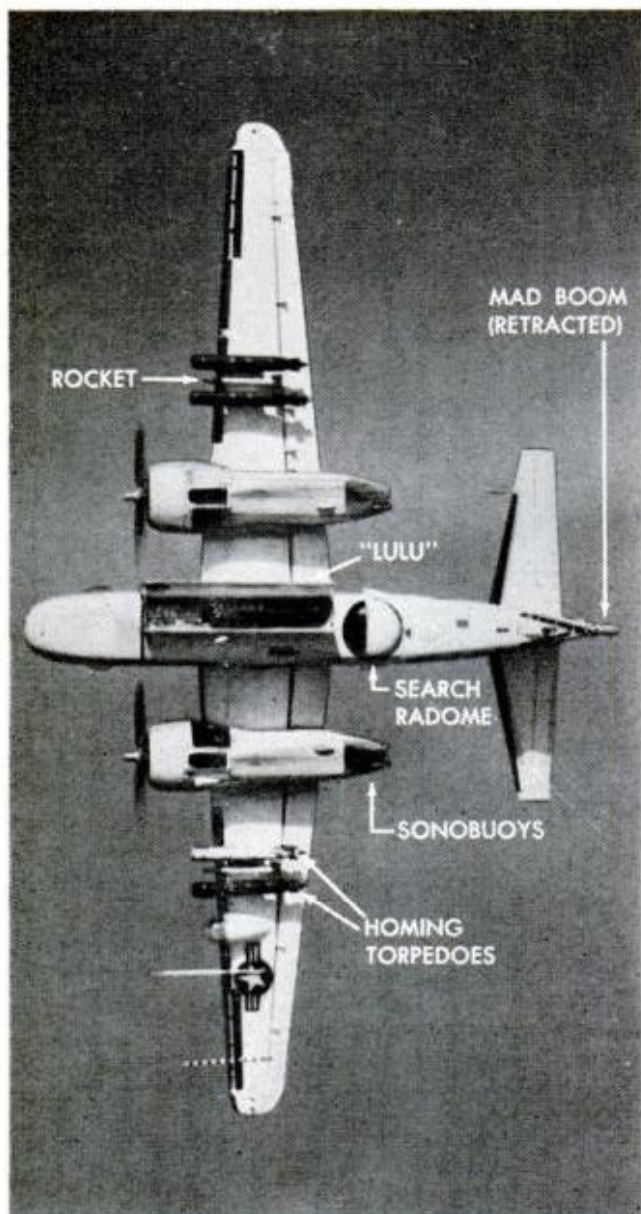
Recently, I spent six days at sea on the Essex watching her complement of destroyers, planes and helicopters hunt down submarine "intruders"—in this case friendly subs in ASW exercises.

We steamed out of Norfolk on a gray March day, headed for deep water. For two days and nights, the carrier pilots carried out carrier qualification landings on a round-the-clock basis. Looking from the control tower like giant insects, the squat E-1Bs and sub-killing S-2D planes lined up to be flung off by catapult at one-minute intervals.

All day long and through the night we could hear the grating roar of the arresting cables being dragged back into place across the deck after a landing. Swift SH-3A attack helicopters (ASW men call them helos) lifted off the deck and were soon mere dots in the distance.

On every horizon, dim moving shapes would suddenly materialize into speedy destroyers knifing through the water like leaping dolphins. On the third day out,

ATOM-POWERED SUBS can lurk indefinitely in deep-sea canyons, behind submerged peaks or in thermal layers, virtually immune to searching sonar signals

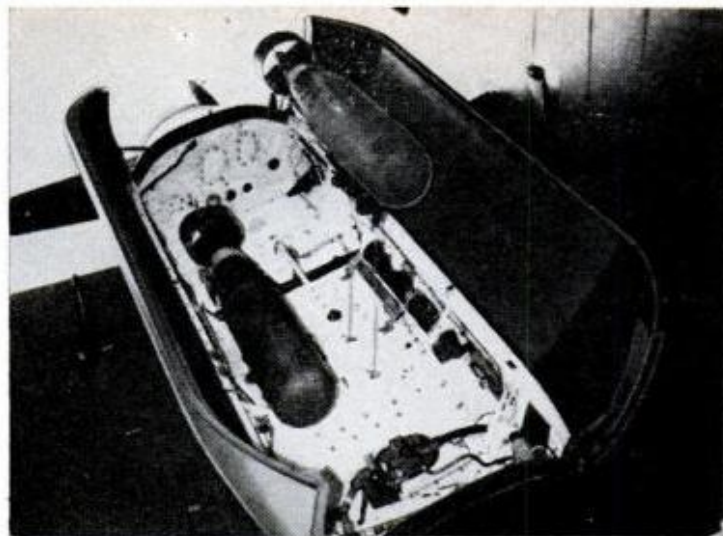


TRACKER planes, armed with a full range of search and attack weaponry, extends the HUK group's potential submarine-killing range by hundreds of miles

tiny jet fighters came barreling out of the sky from shore bases to practice carrier landings and takeoffs. This was a show that brought out even hardened Navy veterans; every deck on the island superstructure was jammed with spectators. The reason was soon obvious.

Every landing by a jet on a moving carrier is a heart-stopper. Unlike prop planes, the jets have to hit the deck full throttle. Otherwise, if they miss all five arresting cables, they can't resume power soon enough to take off again. They'd probably just dribble over the bow into the water.

Next day the big carrier, scarred veteran of many a Pacific battle, steamed into the 12,000 square-mile zone where a fleet submarine lay in wait. Eight destroyers, radar and sonar apparatus pinging, took up battle stations around the horizon.



LULU, the Navy's lethal atomic depth bomb, can be handled by nearly all fleet aircraft. Its tremendous kill range gives subs little chance to escape



NEWEST ADDITION to ASW team is DASH, drone anti-submarine helicopter. Stationed on destroyers, it can be sent winging to undersea targets by carrier CIC

The ASW problem was set to start at 1900 hours (7 p.m. to landlubbers). In the darkened CIC room, nerve center of the entire hunter-killer (HUK) group, junior officers and enlisted men manned sonar and radar repeaters. The first group from the carrier's 20 S-2D Tracker planes and four E-1B Tracers lined up on the catapult ramp. As each plane reached its patrol area 100 or so miles in advance of the ship it reported in by voice radio. Helos, working closely with the destroyers, did likewise. (An ASW carrier has 12 to 14 Sea King helos.)

Somewhere in this vast expanse of darkening water, the sub lay hidden. The only way to find it was to steam slowly back and forth in wide searching sweeps, with helos and destroyers working close-in, and Tracers and Trackers cruising in



SUBROC, or submarine rocket, is the killer sub's Sunday punch against enemy undersea raiders. The rocket is fired while the killer is submerged. Its actual range is classified; the Navy will only say that it is "long-range"



RUSSIAN SUBS, like the one being tailed by an American helicopter above, were extremely active during the Cuban crisis. Some 20 contacts were reported with Soviet craft, but the Navy has never revealed the actual number

pre-arranged patterns far in advance.

The E-1Bs were at 1500 feet to give their powerful radar beam wide scope. At a somewhat lower altitude were the Trackers, which have full search, detect, track and destroy capabilities. They carry close-range radar, MAD gear, expendable sonobuoys which can be dropped in the water to monitor underwater sonar contacts and other gear for communicating with submerged killer subs.

The Tracker is armed with conventional torpedoes, bombs and rockets and nuclear depth bombs. Its cruising speed is about 140 knots and it can stay on patrol for several hours. Doppler navigation gear simplifies the navigator's chore in getting the plane back to a dimly-lighted carrier deck after nighttime patrols.

The E-1B is solely a search aircraft. It

has no attack weapons and no sonar. But its long-range radar system can pick up submarine periscopes at great distances.

The new SH-3A attack helos give the HUK group great flexibility. With speeds ranging from Mach 0 to 150 knots, a helo can hover motionless over a trapped sub, or it can speed to an advance contact area. Dropping its powerful sonar transducer into the water, the Sikorsky Sea King can quickly check out a radar contact. It can climb more than 900 feet a minute and can hover either skimming the waves, or at 8000 feet for sight search.

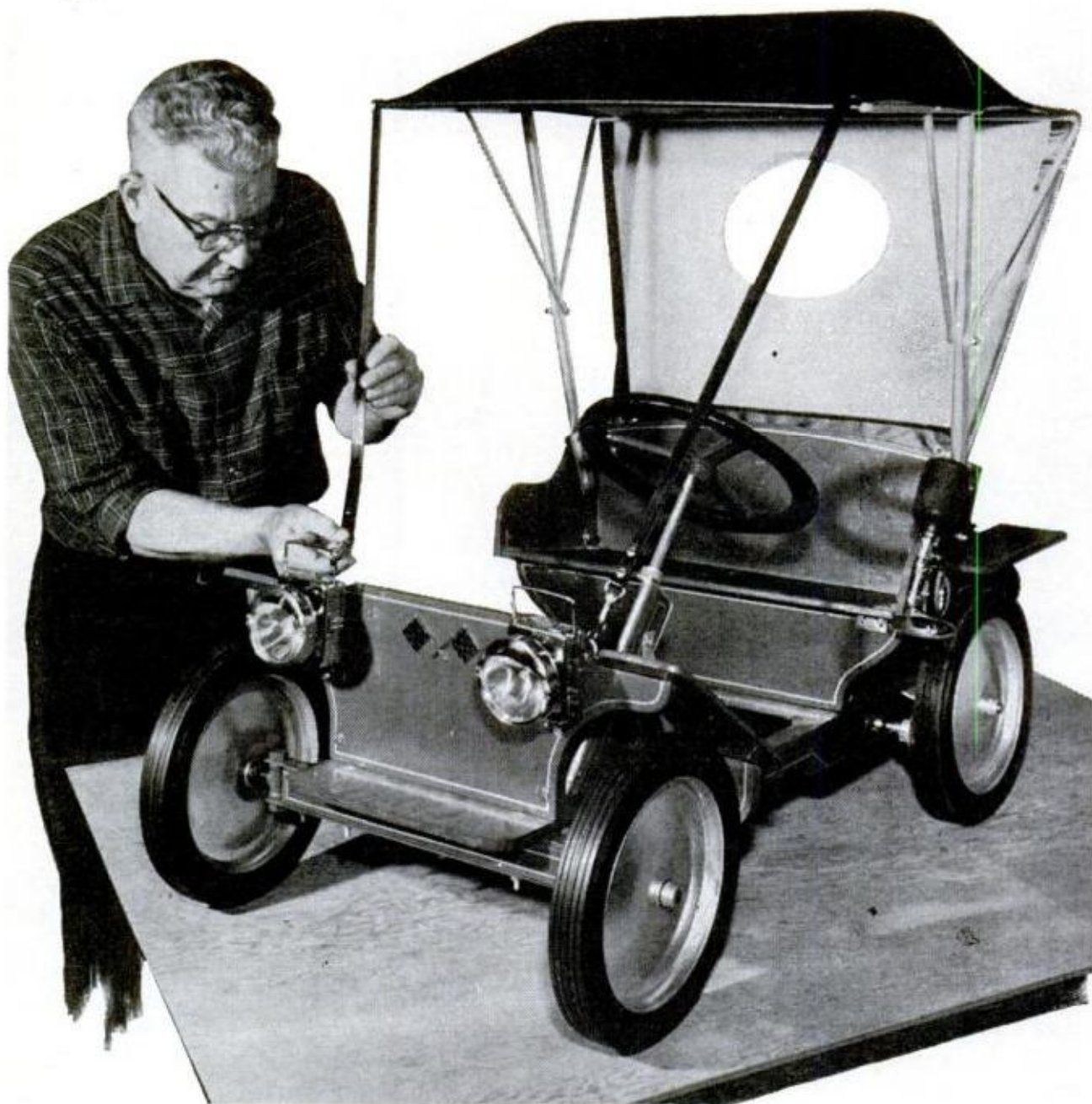
The first possible contact was reported to CIC by a patrolling helo at 2120 hours. Swiftly, FlagPot ordered a second Helo and two destroyers into the contact area. Other elements of the group moved

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

Classic

Designed by Robert Woolson

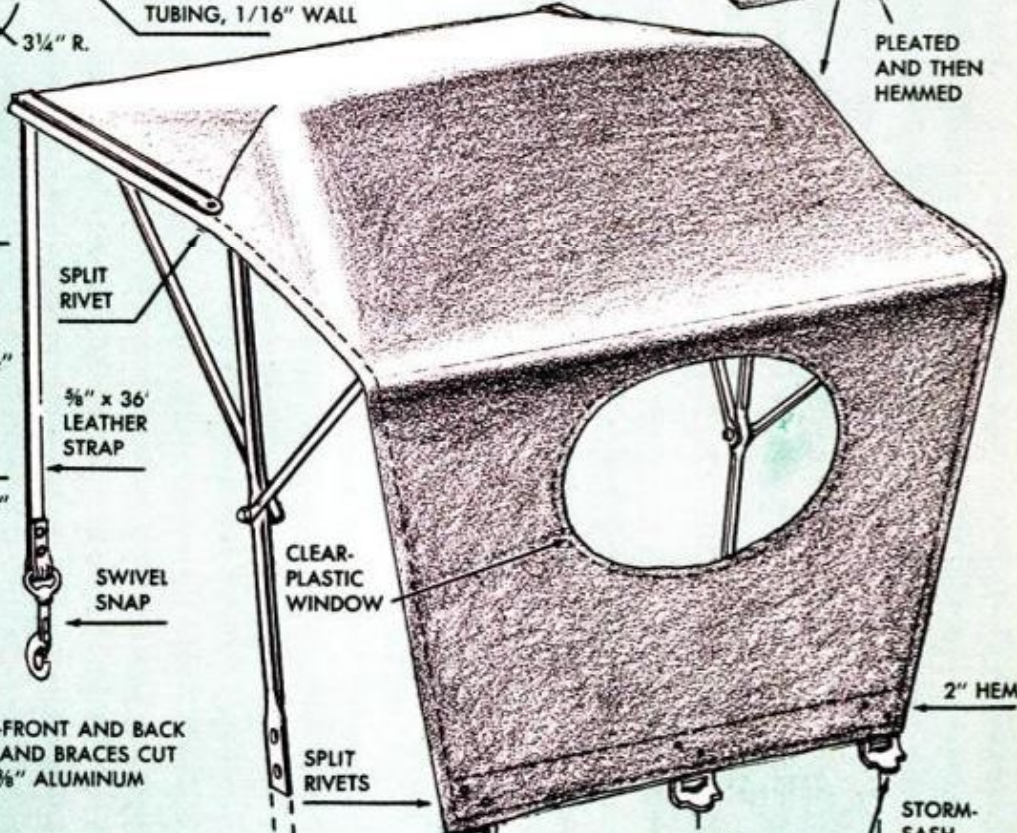
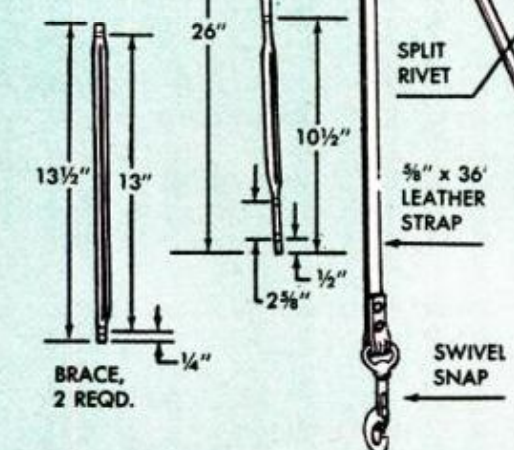
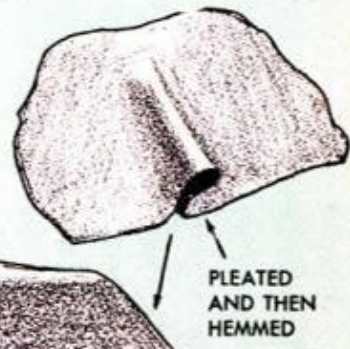
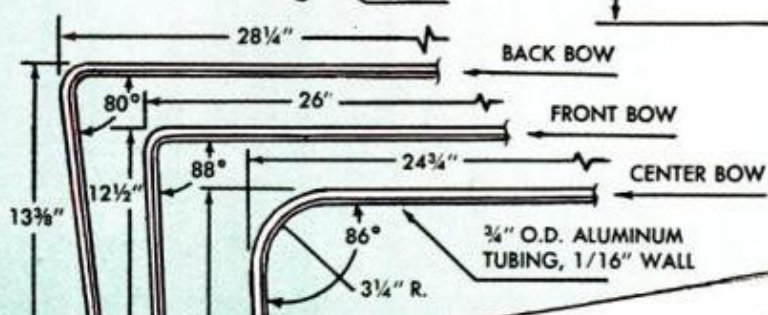
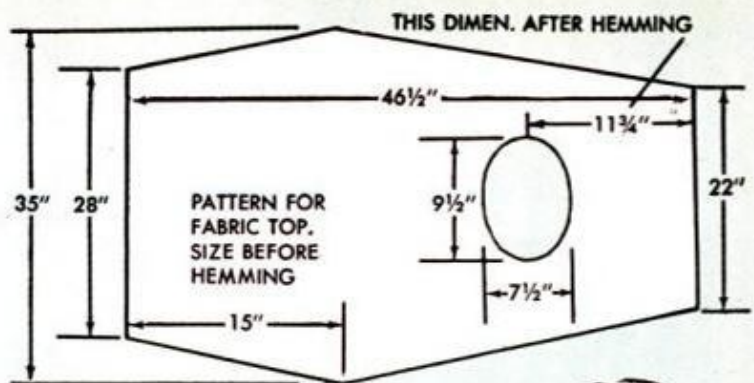
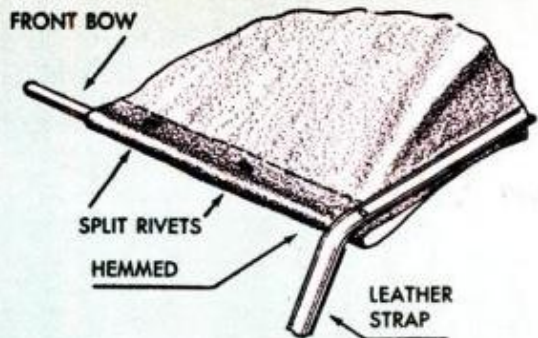
Conclusion



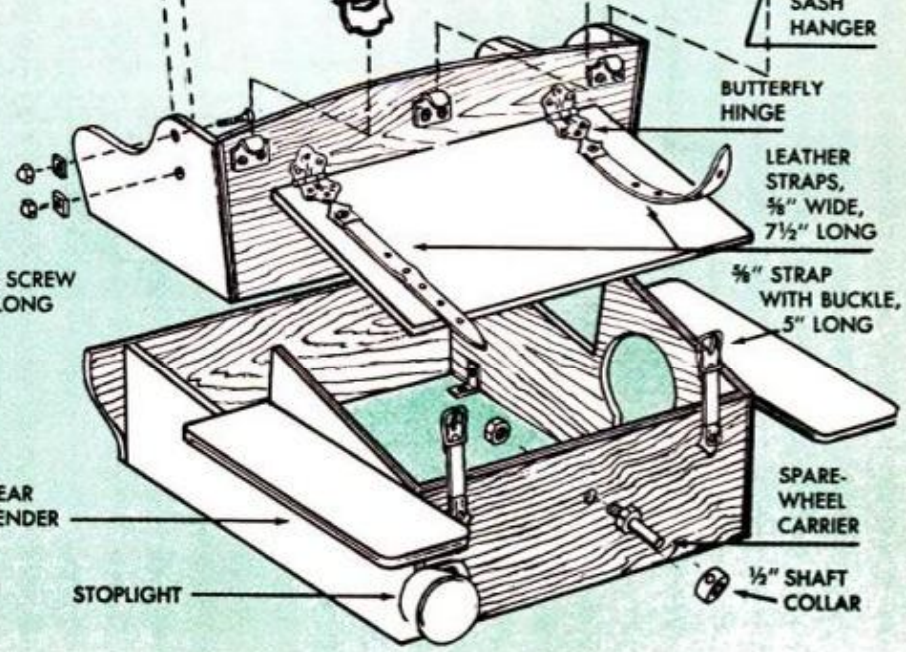
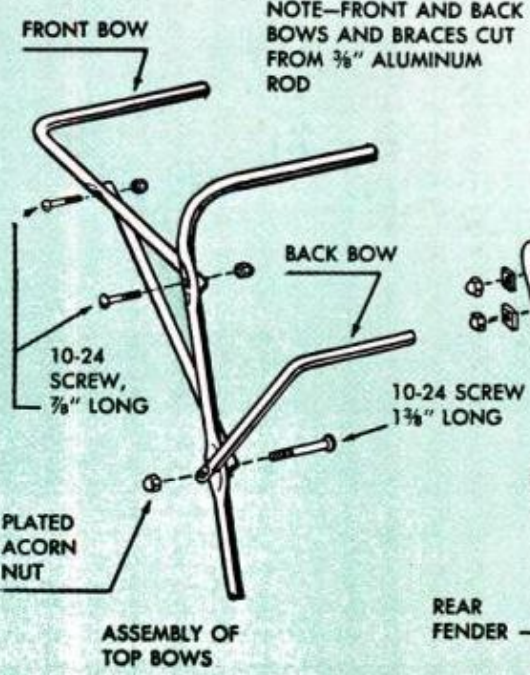
SWIVEL SNAPS riveted to ends of straps hook into screweyes turned into holes in top edge of dashboard

CONTINUING THE BUILDING of the sidewalk classic presented last month, all you have to do is add the top and install the wiring. The top consists of a metal frame covered with an artificial-leather fabric, the pattern for which is given on page 129, with over-all measurements before hemming. One measurement it will be noted is given after hemming. Don't cut the fabric until after you have made and as-

sembled the bows and braces. Although you can bend the center bow by hand you'll do better by borrowing an electrician's conduit bender for this job. After bending, flatten as indicated and drill holes for the bolts. Then bend the front and back bows, flatten the ends slightly and drill for bolts. Holes in the front bow for the bolts holding the upper ends of the braces are located and drilled after a trial assembly.



NOTE—FRONT AND BACK BOWS AND BRACES CUT FROM 3/8" ALUMINUM ROD



FINAL ASSEMBLY of top before placing on car. Metal frame, consisting of front, back and center bows and braces, is made from Do-It-Yourself aluminum rod and tubing available in local hardware and hobby stores



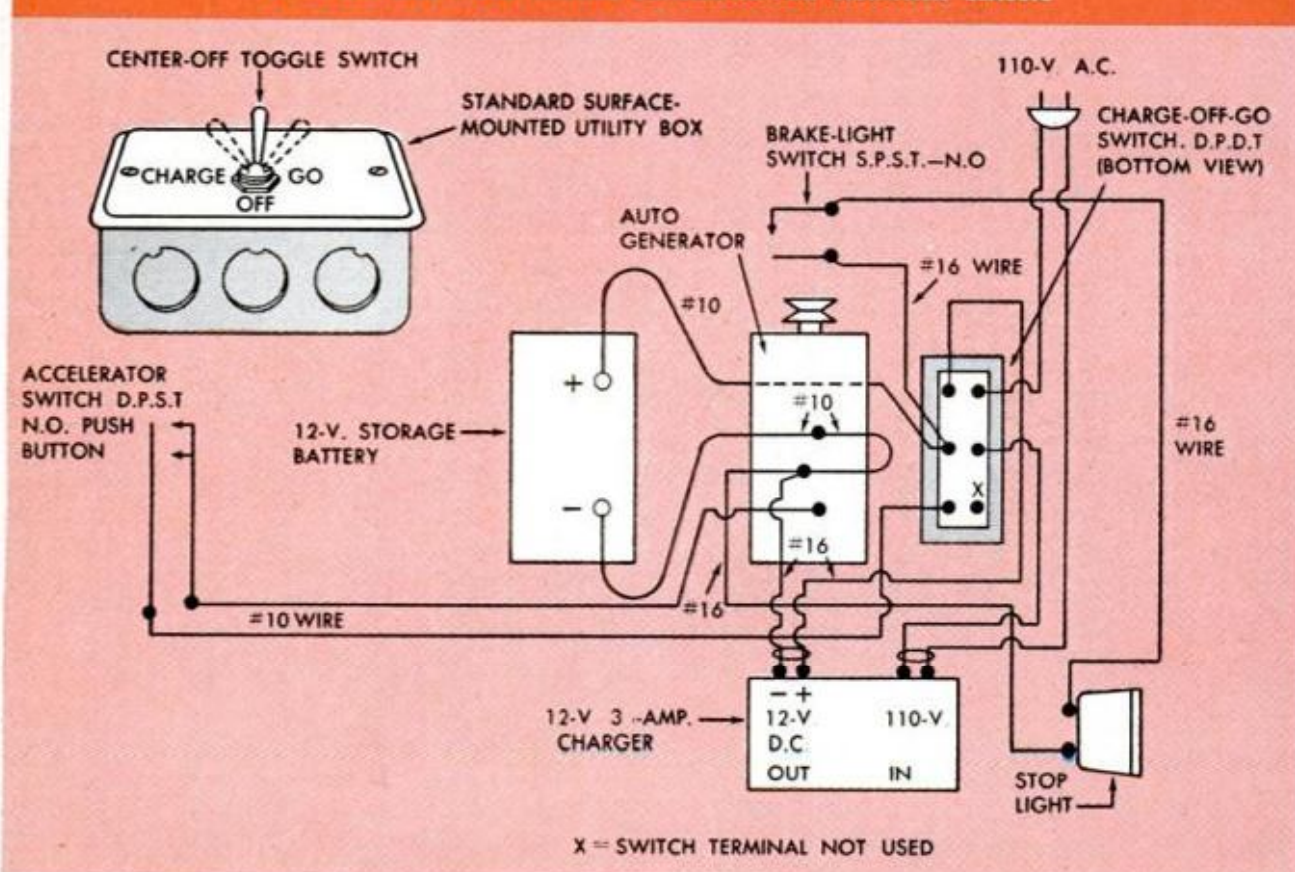
Now refer to the drawing on page 129 for the location of the holes for the bolts holding the center bow to the ends of the seat. Drill these holes and mount the assembled bows temporarily so that you can more easily fit the fabric top. Lay the fabric over the bows and determine the location of the pleats, or tucks, and the amount to be turned under for the hems. This done, sew the hems all around, making the pleats as you go. Cut the opening for the rear window. Cut thin, clear plastic about 1/2 in. larger all around than the opening and sew in place. After pleating and hemming, fold the forward end of the fabric around the front bow and fasten with split rivets. Note that the leather straps are attached to the top with split rivets at the pleats and at the front edge of the fabric. Attach a swivel snap to the free end of each strap, fastening with split rivets.

The back drop, or flap, of the top attaches to the back of the seat with three storm-sash hangers. Note that the sash half of the hanger is riveted to the lower edge of the fabric, while the other half of each hanger is attached to the back of the seat with 10-24 screws and hex nuts.

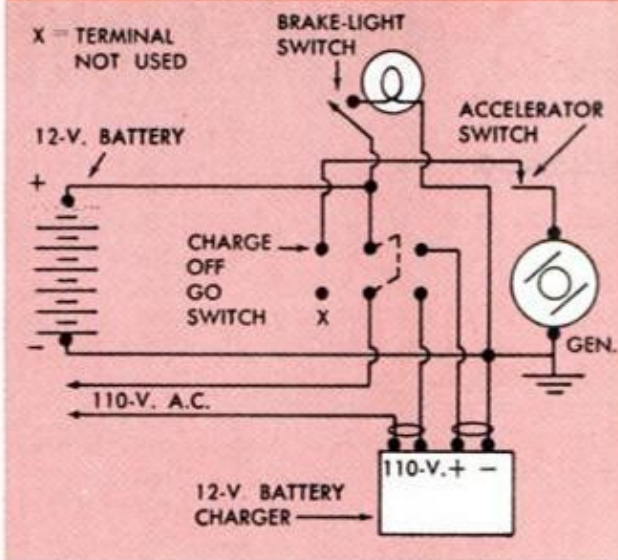
Note that when everything is assembled the hinged seat, deck and top tip forward to give access to the electricals, motor, battery, charger and the off-run-charge switch. The exact location of the switch and charger is of no importance; just place them so that there is easy access to each.

THE TOGGLE SWITCH which controls the battery charger is housed in an outlet box of type shown below. A blank cover must be drilled for the switch

COMPLETE ELECTRICAL WIRING SCHEMATIC FOR SIDEWALK CLASSIC



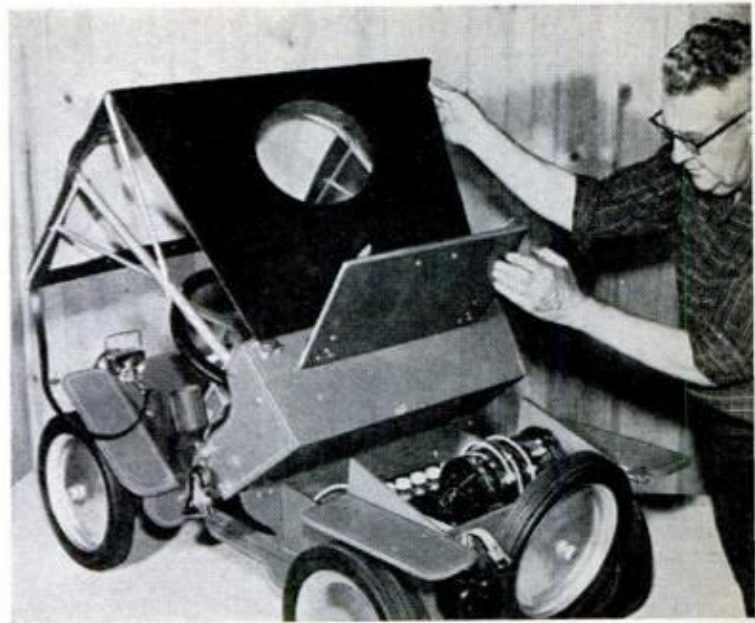
CHARGER WIRING SCHEMATIC



When wiring, follow the wiring diagram which gives the wire sizes to use. Wires from the start-stop, foot-controlled switch and to the stoplight switch are stapled to the underside of the frame. Before making the test run, be sure you have the correct tension on the driving V-belt and that all nuts and screws have been properly tightened. The fifth, or spare, wheel pictured is optional. The carrier is simply a threaded $\frac{1}{2}$ -in. stud and shaft collar installed on the back body panel. Brackets for the headlights (the brackets come with the units) are screwed to the dashboard as shown.

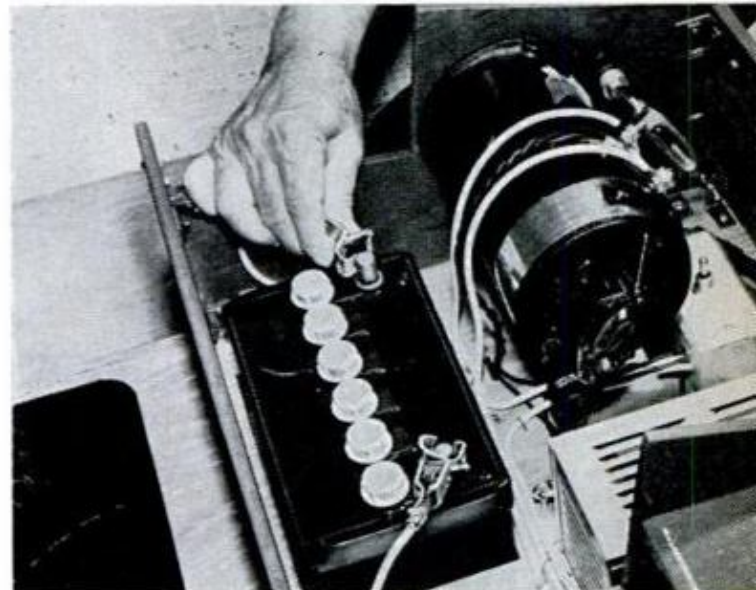
Paint colors are optional. The original pictured was painted a bright red with a silver striping, an attractive combination. The top of the plywood frame was finished in natural color. The disk wheels were sprayed with silver paint. ★ ★ ★

BACK DROP, or flap, of fabric top is attached to back of seat with common storm-sash hangers. Oval rear window is fitted with sheet of clear plastic

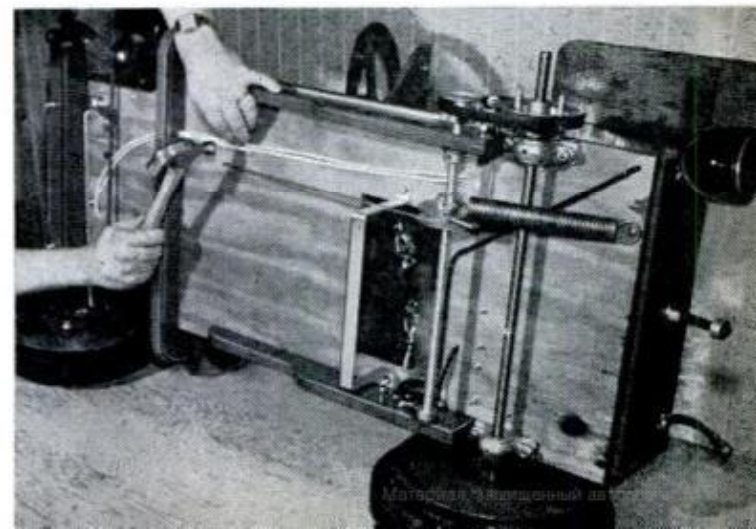


HINGED SEAT, top and hinged deck tilt forward to give ready access to electricals—battery, motor, switch and charger. Seat is held down with a hook

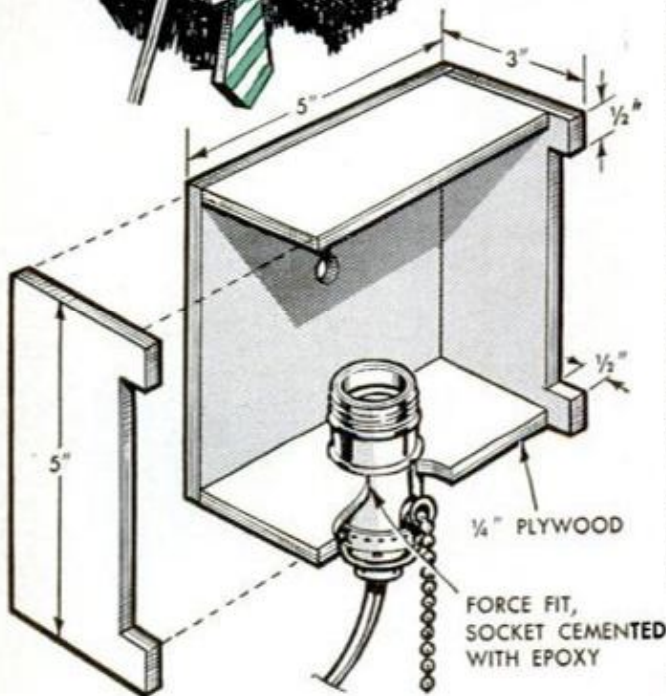
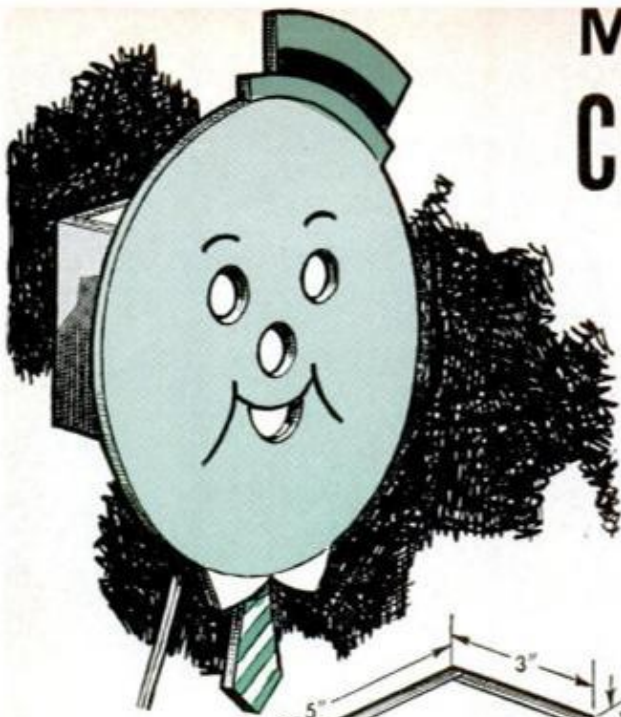
ELECTRICALS are housed in body with battery in well under seat. Note position of charger and the off-go-charge switch, also the snap-on terminal clamps



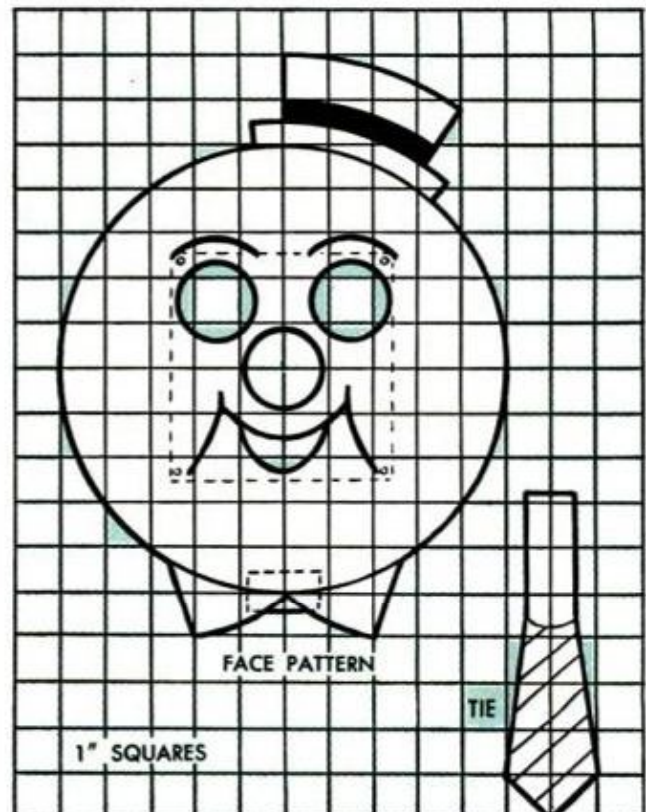
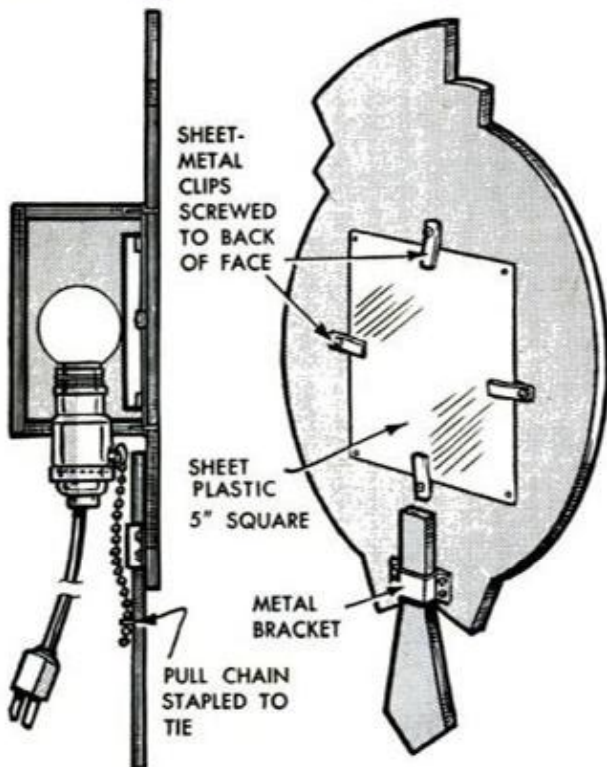
WIRING from foot-operated switch and stoplight switch is stapled to underside of frame. Wires pass through holes in approximate positions indicated



MAN-IN-THE-MOON Child's Night Light



THE BEDTIME HOURS will hold no fear for your children if you make this night light for their room. Construction starts with the drawing of the face, using the graph pattern. The eyes and nose are cut quickly with a hole saw and the mouth is formed on the jigsaw. After that, a square piece of opaque sheet plastic is attached to the back of the face with four metal clips. The lamp box is made as indicated in the drawing; all pieces are joined with glue and brads. A standard pull-chain socket is inserted through a hole in the center of the bottom of the box. After making certain that the chain hole is in front and below the bottom of the box, the socket is cemented in place with epoxy. The next step is to cut out the tie which slides inside a U-shape bracket and serves as a pull for the switch. It is necessary to allow enough travel within the bracket so that the switch may be tripped. Ordinarily a 1-in. pull is sufficient. The bracket is screwed in place and the chain attached with a staple or screw eye just below the bracket. Sand all surfaces carefully before painting, then hang the light on the wall by the keyhole slot in the back and plug it in.—Merton H. Slutz

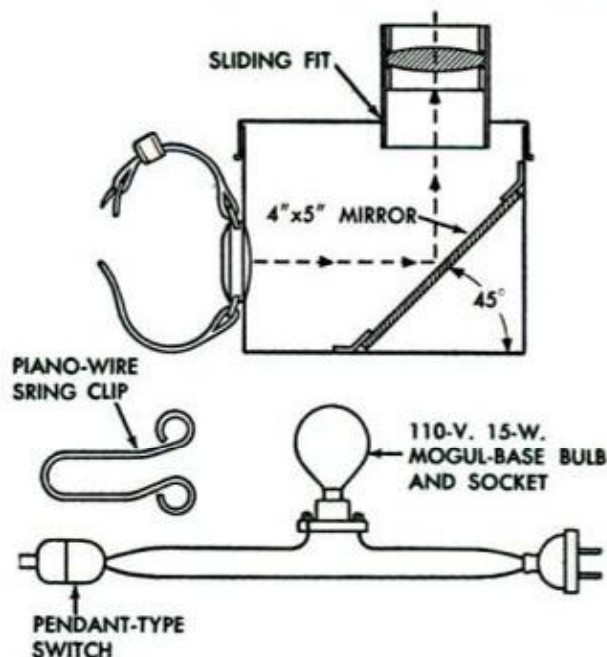
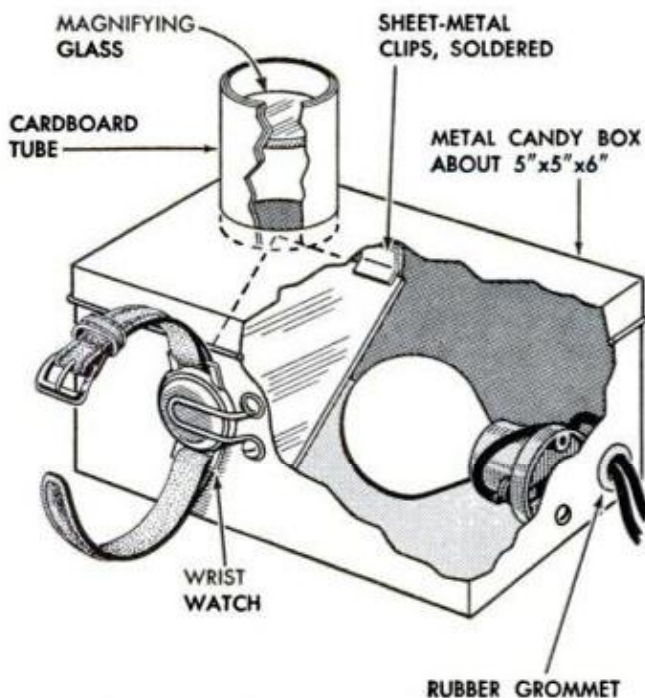


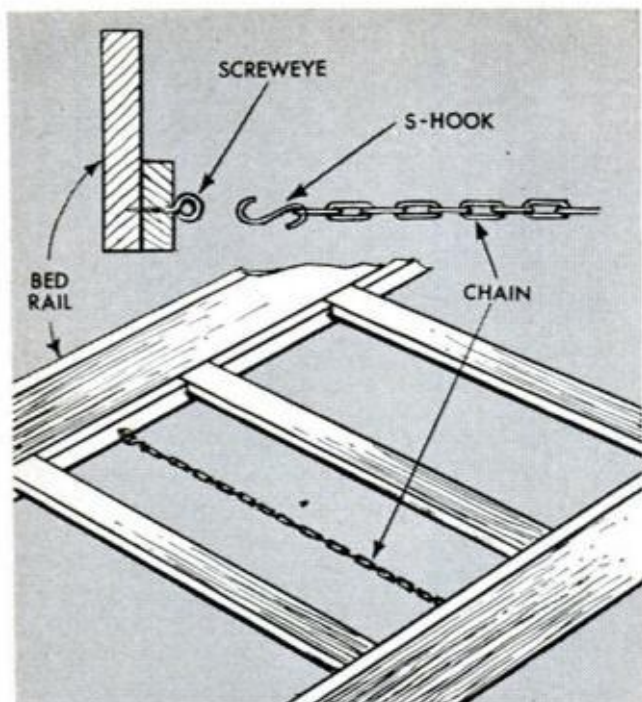
TIME PROJECTOR

SITTING on the nightstand next to your bed, this small opaque projector will project a giant 1-ft. image of your wristwatch dial on the ceiling at the touch of a button. Even if you don't care what time it is, the light given off by the ceiling image can serve as a subdued night light which won't wake anyone else in the room. And you can build it in an hour or so, it's that simple.

The lamp housing used in the pilot model was a metal candy box measuring 5 x 5 x 6 in. However, these dimensions aren't critical. Any container will work, so long as it's shiny inside and provides enough room to hold the components in the positions shown.

After mounting the 15-w. lamp socket, cut a hole in the side of the box for your watch and attach a piano-wire spring clip next to it to hold the watch in place. Any low-cost mirror may be used in this projector. Solder sheet-metal clips to the box to hold it at the proper 45-deg. angle. Next, cut a circular hole in the lid for the lens tube, locating it directly over the image of the watch. You can make the tube by rolling thin cardboard into a cylinder the proper diameter to hold the lens, using retaining rings made of the same cardboard to hold the lens in place. A magnifying lens must be used, or the ceiling image will be reversed.—Fred Johnson



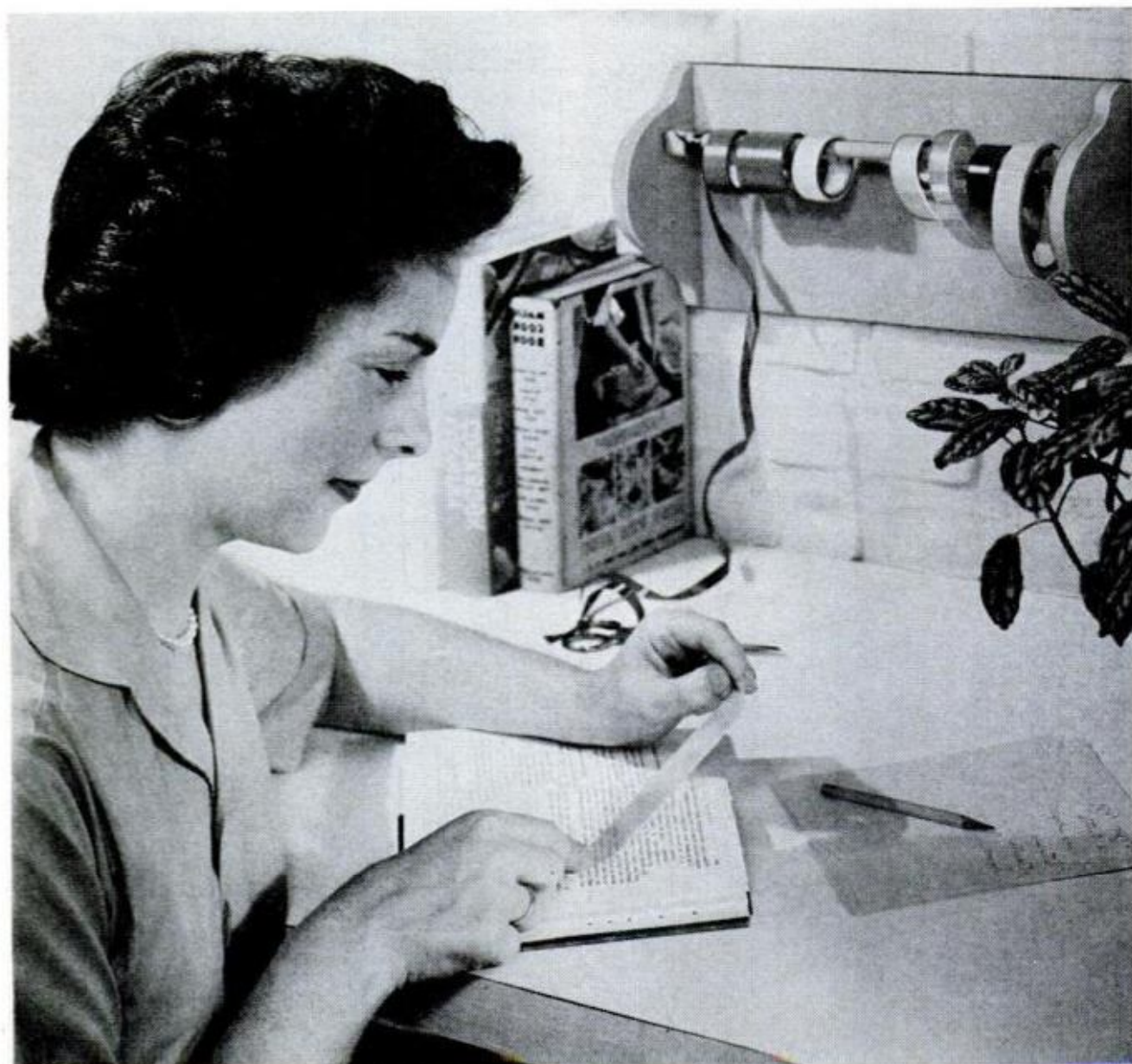


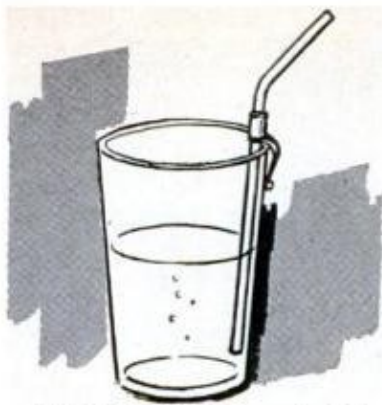
Solving

HOME PROBLEMS

BED SLATS won't slip out of the notches in the side rails if you pull the rails inward by linking them with a length of chain or heavy wire. Just drive a large screweye part way into each rail near center and attach chain or wire to these with S-hooks made of No. 11 wire, then tighten screweyes

KITCHEN TAPE FILE is a simple step-saver that your wife is sure to appreciate. Mount a towel rack or similar home-made holder in a convenient location and use this to store all the various kinds of tape used in the home. When a cookbook gets torn, a roll of mending tape is right there to mend page





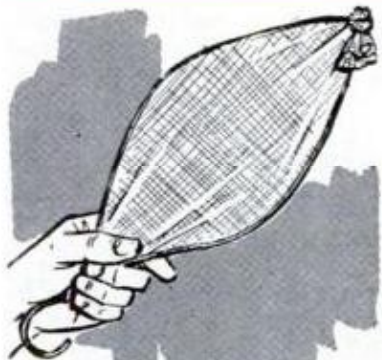
SICKROOM GLASS used with a curved drinking straw will be much easier for the patient to handle if the straw is attached to the glass with a common pencil pocket clip. The clip will prevent the straw from sliding around the rim of the drinking glass



STAINS and grime which tend to accumulate in recessed spaces between bathroom tiles can easily be removed by rubbing with an ordinary typewriter eraser. Abrasive in the eraser acts as scouring powder, so no other cleanser is required



LOOSE HANDLE on a plumber's friend takes only a minute to tighten. Just remove the handle from the force cup and nail a bottle cap over the end. The sharp edges of the cap will bite into the rubber and hold the handle securely in its socket



POOL SKIMMER for backyard pool requires only a coat hanger and an old nylon stocking. Cut off the stocking and tie a knot at the ankle, then pull hanger into an oval, slip stocking over it and make another knot at the handle

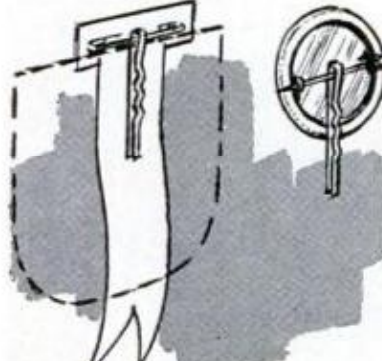


SKEINS of yarn won't tangle when stored if they are bound with half-lengths of pipe cleaners. A single wrap and twist of the cleaner wire will bind the skein, yet the binding can be removed just as easily. Pass the idea on to your wife



TO MAKE a heavy-duty paring knife that holds a good edge, grind down the blade of a quality putty knife. However, be especially careful not to overheat the metal while shaping and grinding since this will take the temper out of the cutting edge

BOBBY-PIN CLIPS make it possible to attach badges or club ribbons to your breast pocket without pushing the pin through the fabric. When secured by this method, the badge may be removed and replaced without damaging the cloth



DOG'S DISH made from a discarded stew pan is tip-proof, can't be carried away. Bend the handle up into a vertical position so that it will engage a screw hook driven into the side of the doghouse. Use two pans, one for food and one for water



PAPER TAPE often sticks to itself in hot humid weather, making it difficult or impossible to use. To solve this problem, store your paper tape in a wide-mouth jar of the type in which peanut butter is sold. This will protect it from moisture



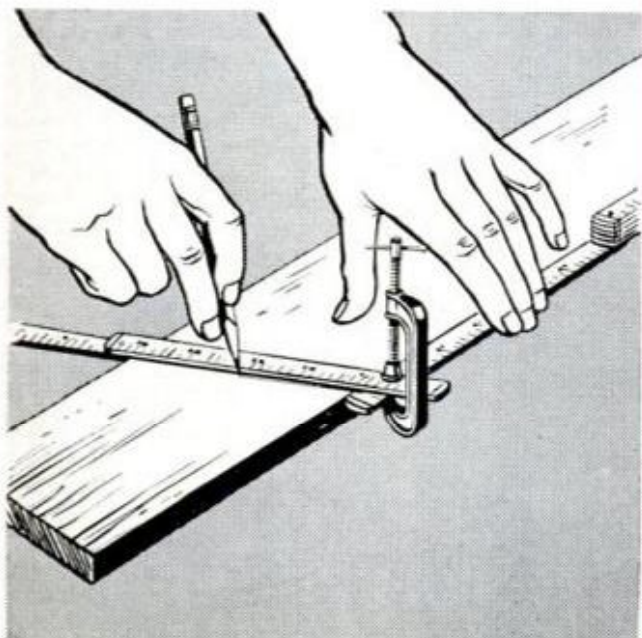


Improved Tracing Table

On a table or in your lap, this simple light-table arrangement will enable you to make neat accurate tracings without eyestrain. Just put a small lightbulb inside the cover of a portable typewriter and place a picture frame approximately the same size (with the glass still in it) upside-down over the cover.

Makeshift Bevel Square

When you need a bevel square but don't have one handy, you can make a good substitute from a folding rule and midget C-clamp. Simply fold the rule to the desired angle and tighten the small C-clamp over the joint to lock it in place. It's an old carpenter's trick that comes in handy when you're working outside and find that your bevel square is back at the shop.



1. **TAPE CARTONS** shut with heavy paper tape so that they form rigid "building blocks." For added stability, you might stack some newspapers in the two boxes which will make up bottom tier of the bar

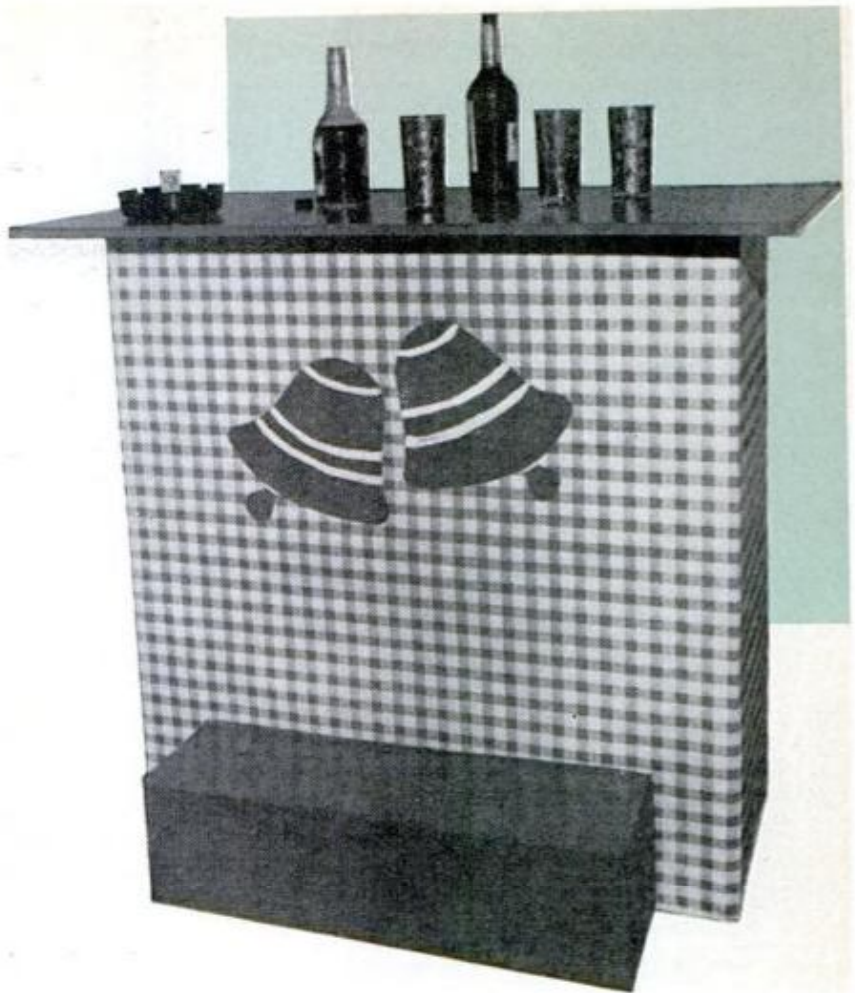


3. **AFTER CUTTING** a length of checked oilcloth to fit completely around the assembled cartons, lay this out flat on the floor and apply wallpaper paste to back. Be sure paste is smooth and free of lumps





2. ASSEMBLE CARTONS using plenty of wallpaper paste on all contacting surfaces. Be sure that all edges are aligned so seams won't show

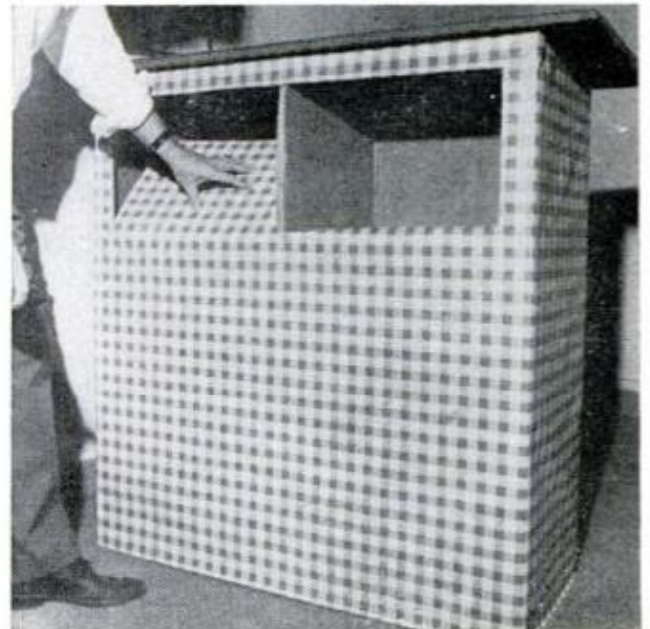
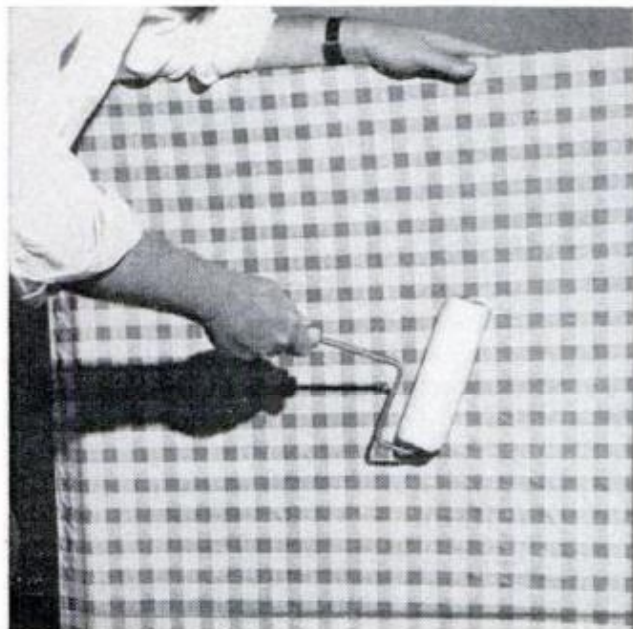


FOR A ONE-NIGHT STAND, you can't beat this colorful cardboard-carton bar covered with oilcloth. Materials cost almost nothing—7 cardboard cartons, a large length of checkered oilcloth, a couple of smaller pieces of solid-color oilcloth and a

small sheet of plywood for the top. You can make it in an hour or so, and it's light enough to be set up anywhere in the house. Comes the morning-after, carry the whole bar up to the attic and store it until next year. Or simply throw it away.

4. WRAP OILCLOTH around the bar and smooth out any wrinkles or air pockets with a clean paint roller. Next, cut and apply oilcloth covering for plywood bar top and footrest (a long low cardboard carton)

5. FINALLY, CUT access holes in the rear of the bar so that the sides of the top two cartons will fold down against their bottoms to form oilcloth-covered shelves for holding glasses, bottles, etc.





MAKE YOUR YARD A *Christmas Card*

By **Dave Swartwout**

New batch of clever cutouts to compete for top prizes in local lighting contests. PM's popular Project-a-Plan transparencies make it easy to enlarge the patterns giant size

ADDING the Christmas spirit to the outside of your house is becoming as popular as decorating the inside, but coming up with something different from the rest of the block is not always easy. You may find just what you are looking for here. They're fresh new ideas which could very well place among the winners in any locally sponsored Christmas decorating contest. The comical ones are bound to

bring a chuckle from passersby.

If you saw the cutouts in the December issue last year, you know all about PM's new Project-a-Plans. If not, you're in for a treat, because this new simplified method of enlarging magazine patterns eliminates the old-fashioned, time-consuming method of enlarging them by the graph-square method. Now it's as simple as clipping out the paper transparencies given on page

141, coating them with clear nail polish, inserting in regular cardboard mounts and projecting them with a 35-mm. projector directly on your construction panel. No need to make a separate paper pattern and then trace it off on your work. You simply trace the blown up outlines of the transparency pattern.

What do you do if you don't have a slide projector and can't borrow or rent one? You go back to the method of enlarging a square at a time, following the grid patterns given.

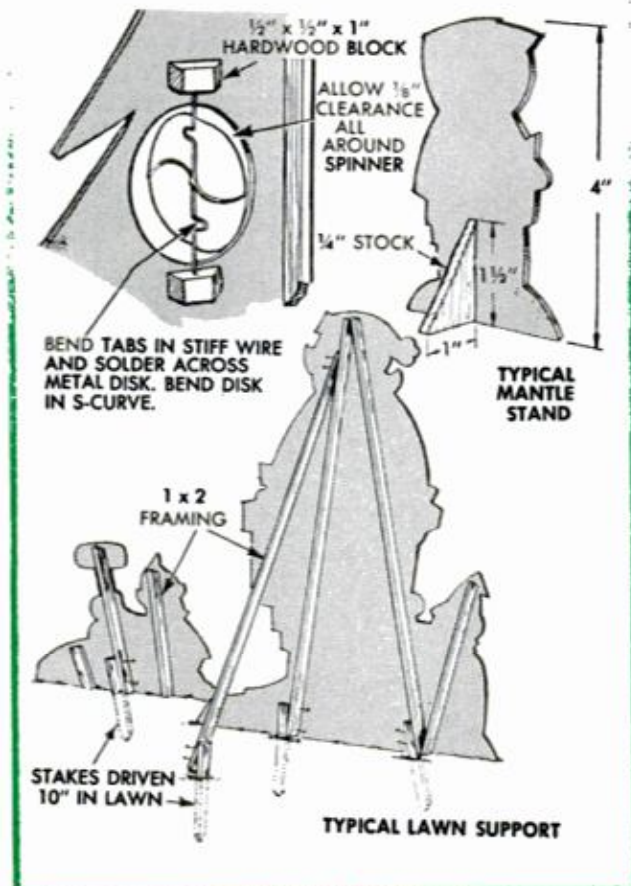
Besides an embarrassed Santa who has become stuck in a chimney and has to be freed by his elves, and the bewildered St. Nick who is perplexed on how his trusty coursers have beat him inside, there's a third comical display among the group which is animated, in that the "ball" ornaments rotate in a breeze. When spotlighted, the shiny twirling ornaments are most effective and eye-catching. On still nights, a fan hidden by a mound of snow could be used to create a breeze to spin the disks.

Except for embarrassed Santa, all the designs are presented as complete patterns which enlarge proportionately to fit 4 x 6 and 4 x 8-ft. panels. To make room it was necessary to present the pattern for one of the elves in two parts. In drawing the complete pattern, you simply join the parts at points A and B. The cutouts are designed to be cut from 1/8-in. tempered





HEAVIER LINES give Nativity scene look of leaded window. Cut from tempered hardboard and backed with several colors of cellophane, effect is of stained glass when panel is set in window of lighted room



hardboard, but there is no reason why you cannot use other material if you wish. Unless you can buy prime-coated hardboard, the regular brown-colored board will have to be painted white before you can trace your pattern on it. Use a flat enamel undercoater for this: it dries fairly fast and goes on quickly with a roller.

While designed primarily for large displays, some of the cutouts can be used in smaller form if you wish. The carolers, for example, could be made a size to decorate a mantel. Likewise, Mary, Joseph and the Christ child could be enlarged to fit a window where room light from behind would provide illumination.

While embarrassed Santa is most appropriate when mounted and spotlighted on the roof, he and his elves can be staked out on the lawn. Details on this page show how they should be braced to withstand strong winds. Similar bracing could be used on the roof but nailed to cleats weighted with sandbags.



Dove of peace: If projected full panel size, it's just right for a roof gable or chimney face. Frame the back so that it stands 1 1/2 in. or so out from the wall. Paint the bird white, leaves dark green, berries red and outline the head and eye in dark gray or black. When enlarged to a wing spread of only 3 ft., the dove makes an ideal above-the-fireplace display.

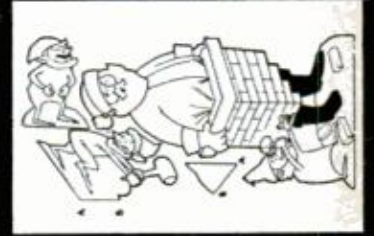
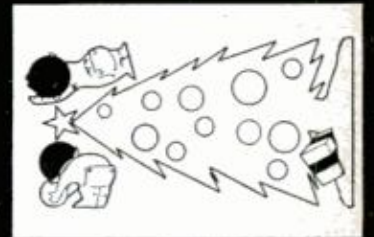
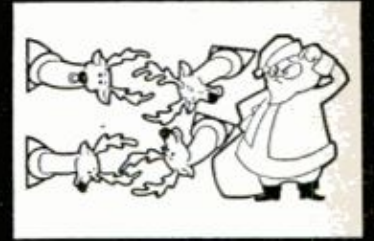
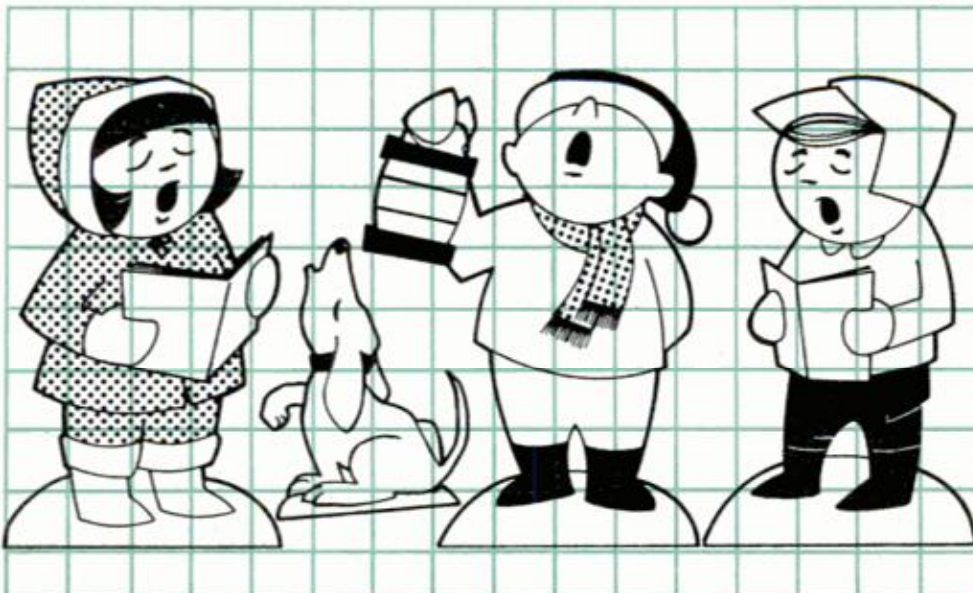
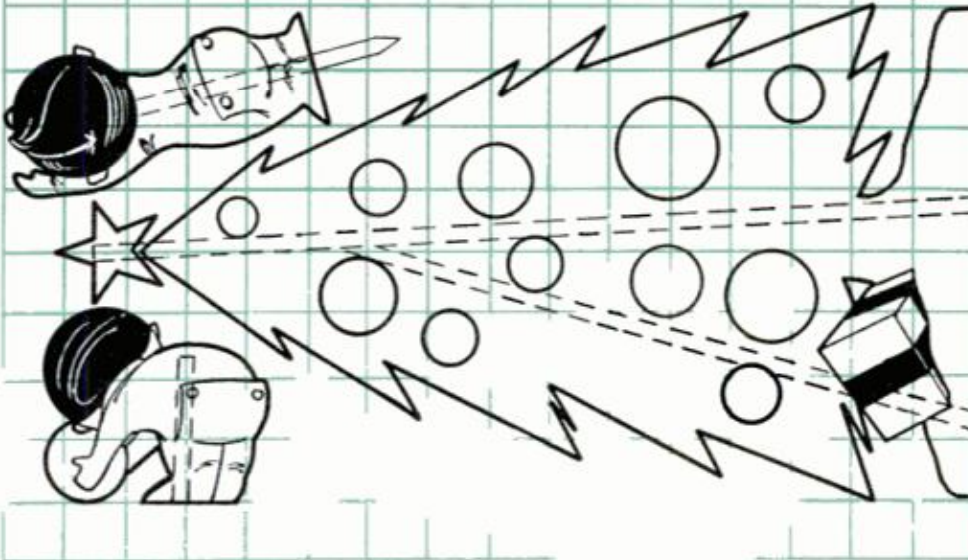
Santa and Reindeer: This cutout is best suited to homes having picture windows. Place Santa on the lawn about 10 ft. from the house and fasten the deer to the windows as if they are inside looking out. If you have storm windows, place the heads between the panes.

Little Carolers: These cutouts are cute any size; 12 in. for a picture window, 24 in. for indoor use around a tree or 48 in. for out on the lawn. For night display, you can substitute a real lantern in the boy's hand.

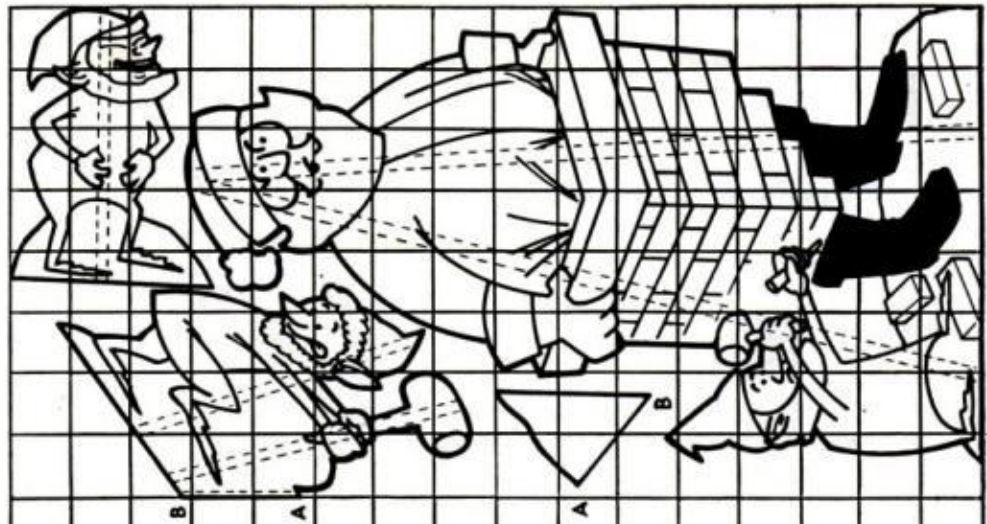
Mary, Joseph and Jesus: For a window display, enlarge the pattern to fit the particular window. Use 1/8-in. tempered



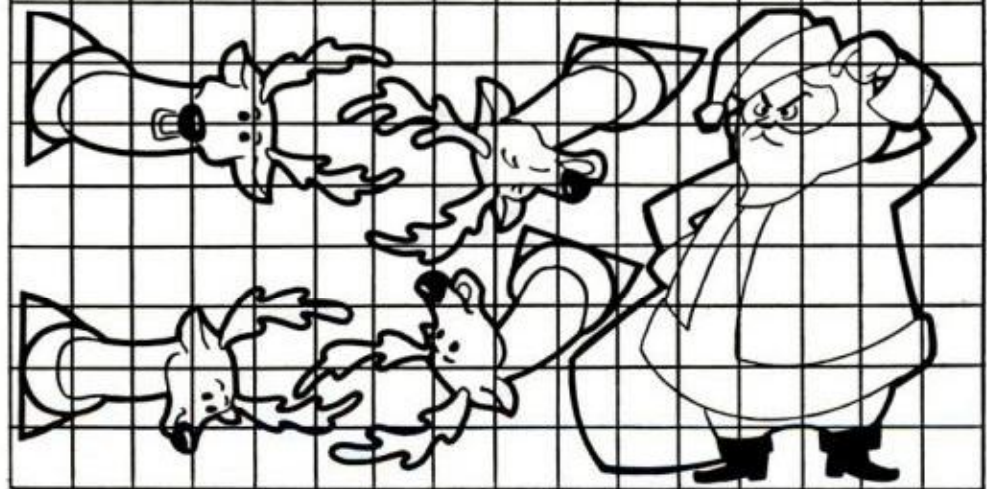
DOTTED LINES SHOW POSITION OF 1 x 2 BRACES AND BODY



SEE REVERSE



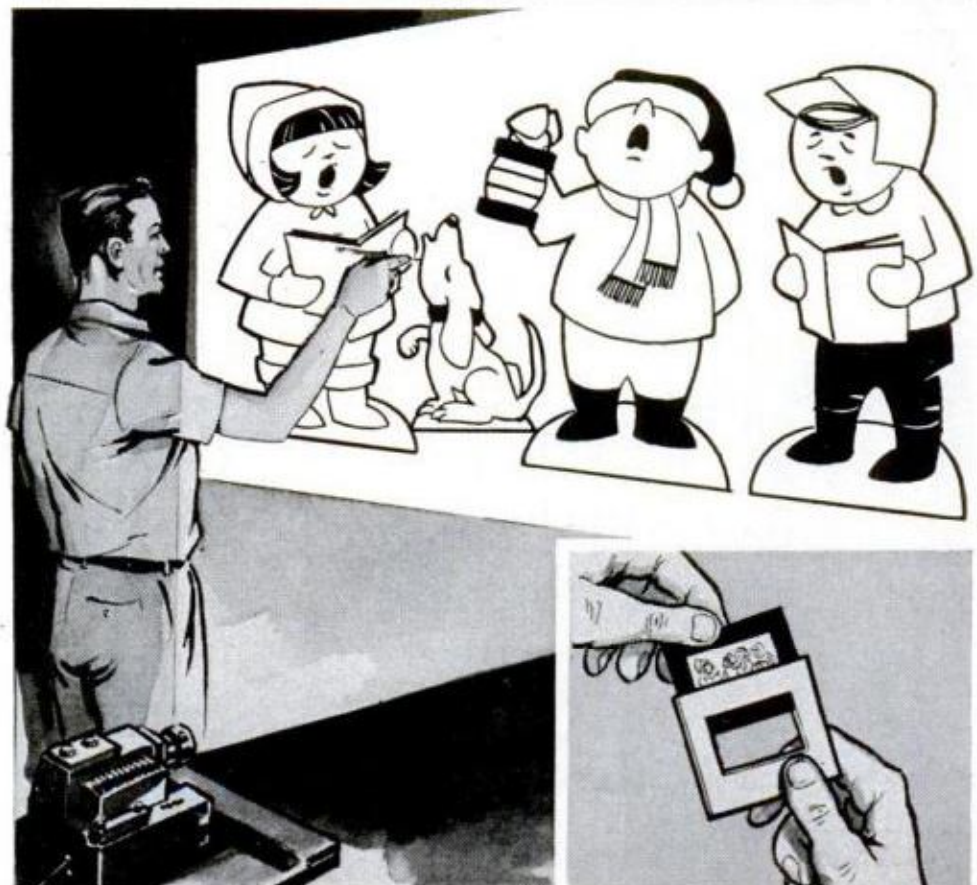
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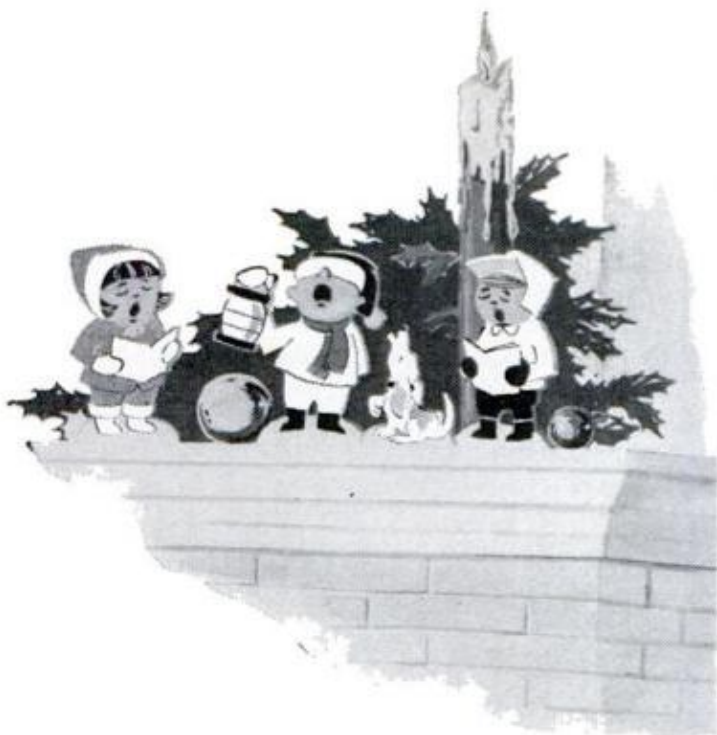
FOR CLIP-OUT

EACH PAPER TRANSPARENCY is designed to fit a standard metal or cardboard slide mount. Before inserting them in the mounts, coat them with clear fingernail polish to make them more transparent and produce crisper outlines

PROJECT-A-PLAN



TRANSPARENCIES



hardboard to keep the display lightweight. If you like to jigsaw, you can saw out all the openings. Otherwise, just saw out the arch above the heads and suspend the star on copper wires from the points, to form the rays.

Kids and Tree: This display moves to catch the eye. The wind spins ornaments made from disks of shiny tin. Solder wires across the center of the disks, then bend the disks "S" shape to catch the wind. Holes in hardwood blocks will do as pivots, but for a better bearing, drive a finishing nail in a hole drilled in each bottom block, so the head is set about $\frac{3}{8}$ in. below the surface.

Santa Caught in Chimney: This comical display is most appropriate when mounted on the roof and anchored to the existing chimney. If it's not feasible, add braces to the back and anchor with sandbags. Do not cut out around Santa's boots; let the area represent a patch of snow or paint it to match the roof shingles.

Tips on Painting: You will need five colors of outdoor enamel: red, yellow, blue, black and white. From these you can mix most any color you desire in finishing your display. One part red to one part yellow mixed thoroughly (making orange) will give you various shades of brown merely by adding small amounts of blue.

Orange is also the base color for all flesh tones with the addition of white. Use the colors straight for the red on Santa's suit and the blue and yellow on the elves. Also, you can make different shades of green by mixing blue and yellow. ★★



Easy as Pie

Here's an idea which will start you saving aluminum pie pans. A family in Denver collected 182 of them and used them as reflectors in decorating a 40-ft. spruce. With blue bulbs, the effect was spectacular.

Yule Door Chimes

"Save it—it might come in handy" also holds true for bleach bottles. One type looks like a bell when you cut off the bottom, and a cluster of these tied with ribbons rings the bell as a door decoration.



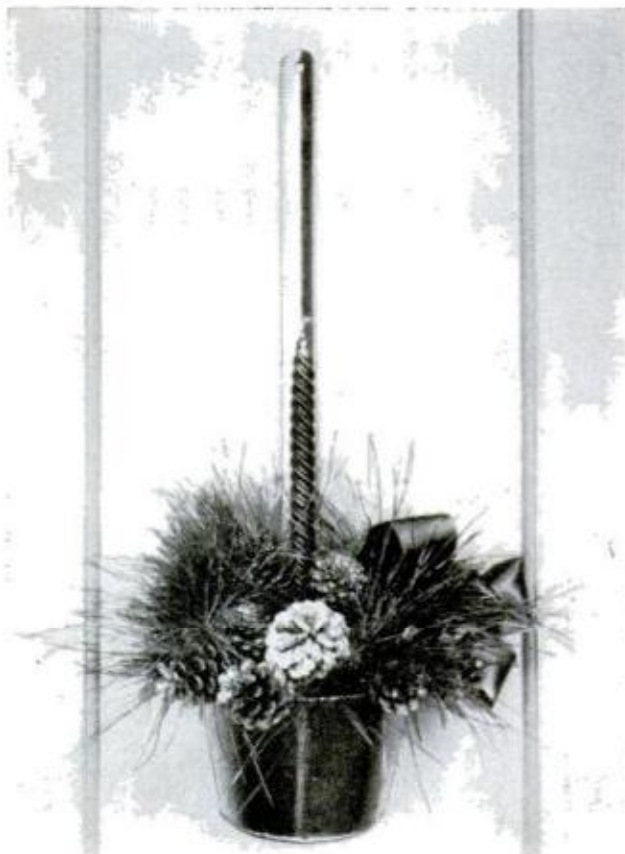


Cheese-Carton Xmas Bells

You'd never guess it but these bells are made from cottage-cheese cartons of either the cardboard or plastic variety. If yours are cardboard, just cut a slot in the bottom to accept three $\frac{1}{2}$ -in. ribbons. For plastic cartons, heat a knife blade and gradually work a slot through. Then spray the carton with gold enamel. The rim is coated with glue and sprinkled with fragments of Christmas-tree balls. These may be broken safely if they are put in a bag and crushed with a rolling pin. The ribbons are run through the slot and knotted about 6 in. from the end so they will not pull out, then the ornaments are attached.

Holiday Wall Plaque

It takes only minutes to make this decorative plaque from a 10-in. dinner plate and two 14-in. white plastic doilies. Cut out one doily so that it overlaps the sunken part of the plate. Thread a red ribbon about 1-in. from this cut edge and tie the ends into a bow. Next, thread the doilies with green ribbon, insert the plate and finish threading, then tie a bow. Turn the plaque over and attach a loop of ribbon to the uncut doily so that the plaque may be hung. Glue an ornament to the plate.

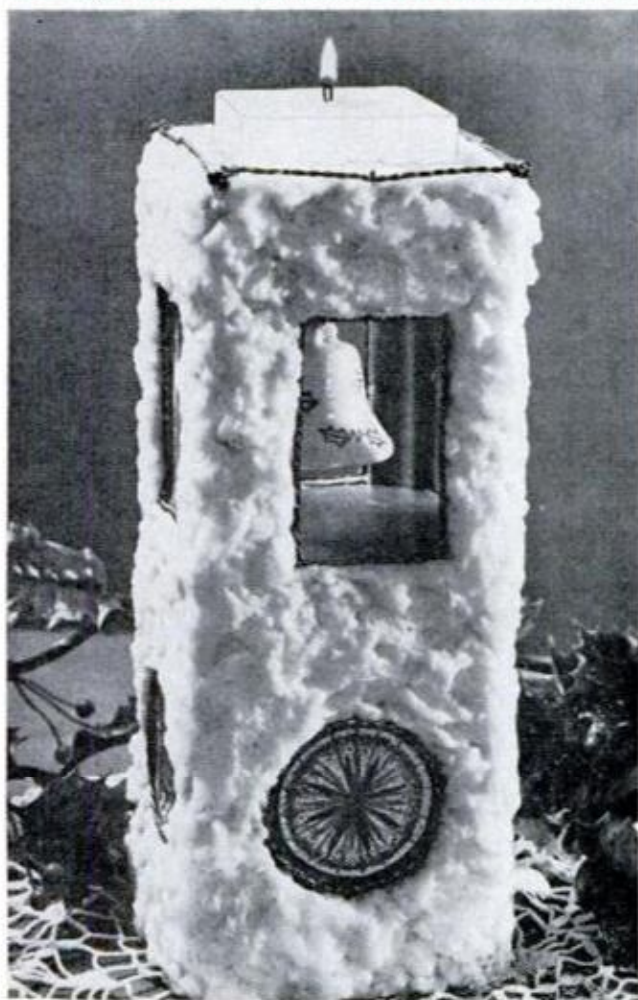


Milk-Dipper Door Ornament

Dress up your door for the yuletide season with this unusual decoration. It's made from a long-handled milk dipper, which can be obtained at a farm supply store or second-hand shop. The first step is to spray the dipper and handle with gold enamel. When dry, cut a piece of plastic foam about 3-in. thick and glue it inside the dipper. When the glue dries the foam will provide a base for gluing on the pine cones and pine needles. The cones are held together in a pleasing group by a length of fine wire. The sprigs of long-needle pine may be tucked into the spaces between the cones, particularly at the base. Spray this assembly with gold paint; then tie $2\frac{1}{2}$ yards of 2-in. red ribbon into a bow and fasten to the handle with fine wire.—*Marguerite Engles*

HANDSOME Gift Candles

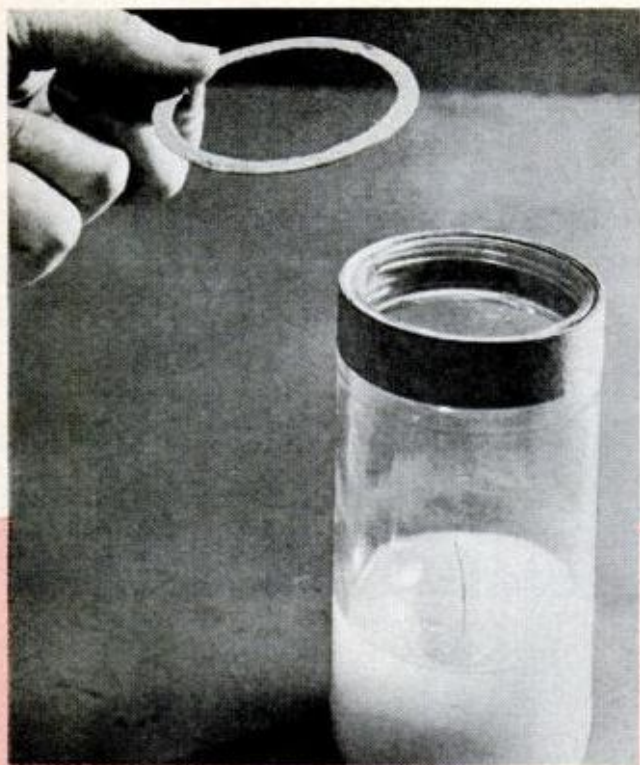
By Willard and Elma Waltner



NEXT TO THE TREE itself, the most traditional item for Christmas décor is the candle. When electricity—and prudence—banished candles from the tree, most families were reluctant to give up the glow entirely. And so, massive sideboard and centerpiece candles became a part of the Yule season. They're so popular, now, that they make ideal gifts—except for the price-tag.

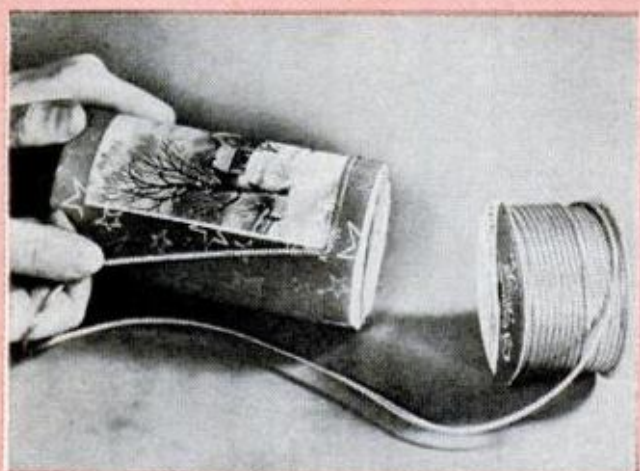
But what could be more appropriate than a personalized gift candle you make yourself? Turn the page for details on how these two beauties were created. You'll get ideas for designs of your own.

For the illuminated-picture candle, above, you'll need a wax with a low melting point (specially made for pouring in glass containers) and some wire-core wicking. This combination lets the candle flame burn all the way to the base instead of drowning in a well of hot wax. The bell tower, left, requires glo-type wax for both the replaceable candle block and for the whipped "frosting" that coats the tower.

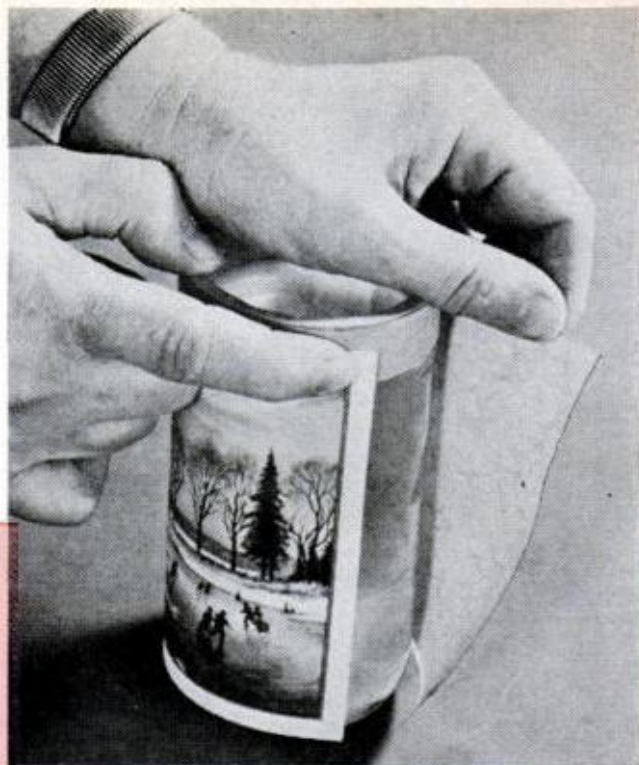


POUR JAR $\frac{1}{3}$ FULL of melted wax. Slip cardboard collar over threaded neck to bring it flush with shoulder; glue on cardboard ring to cover rim of jar

FRAME PICTURE and conceal butting edges by gluing on gift-wrap braid. You may not need it along the bottom if foil strip (below, right) will mask it off



SPREAD GLUE ON RIM and roll it in gold glitter, heaped on waxed paper. Wet glue will pick up coat of these particles, sold at card and art stores



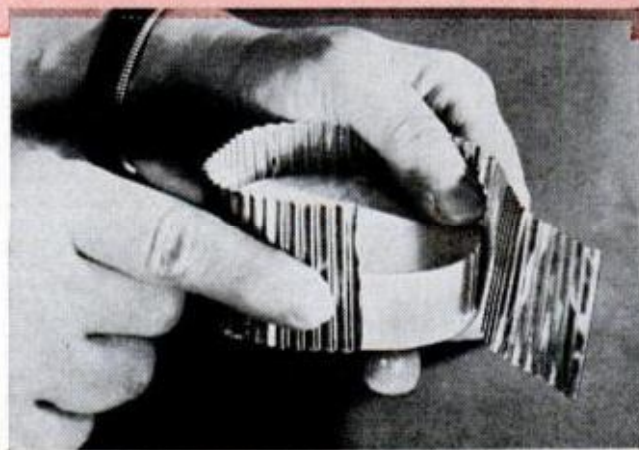
CHOOSE PICTURE from large Christmas card and glue edges to jar. It probably won't be exactly right size, so mask off rest of jar with fancy opaque paper

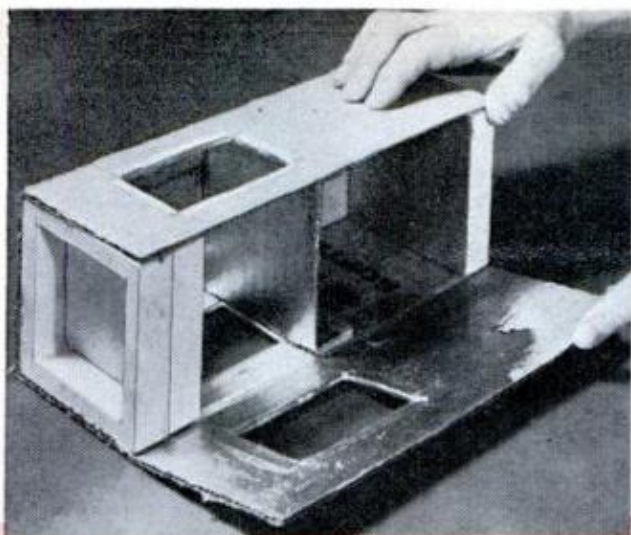
ILLUMINATED PICTURE

You'll need a cylindrical jar, without taper, $5\frac{1}{2}$ to 6 in. tall and about 3 in. in diameter. If the jar's too tall in relation to its width, the candle won't burn well.

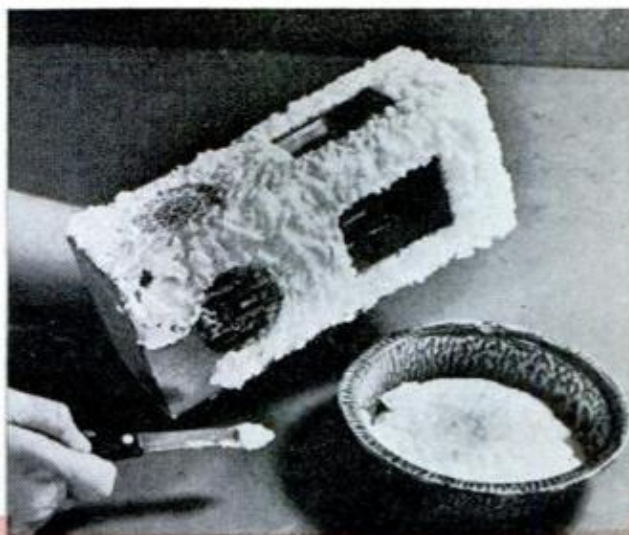
Thread wire-core wicking into a metal wicking base and wrap the free end around a pencil laid across the mouth of the jar so the wicking base just touches the bottom. Bend a pouring lip in the rim of a clean tin can, shave wax into the can and set it in a pan of hot water over a low flame. When the poured wax hardens, clip the wick $\frac{1}{2}$ in. above the wax level. To make the picture translucent, rub it with a dab of cotton dipped in cooking oil.

GLUE CRIMPED FOIL around edge of $\frac{3}{4}$ -in. pine disk, cut to jar's outside diameter and equipped with three wooden feet. Glue jar bottom to top of disk





FOLD THE FORM for the tower from corrugated cardboard, scored with a dull knife for sharp bends. Brush gold paint on exposed interior areas before gluing around end blocks and cardboard belfry floor

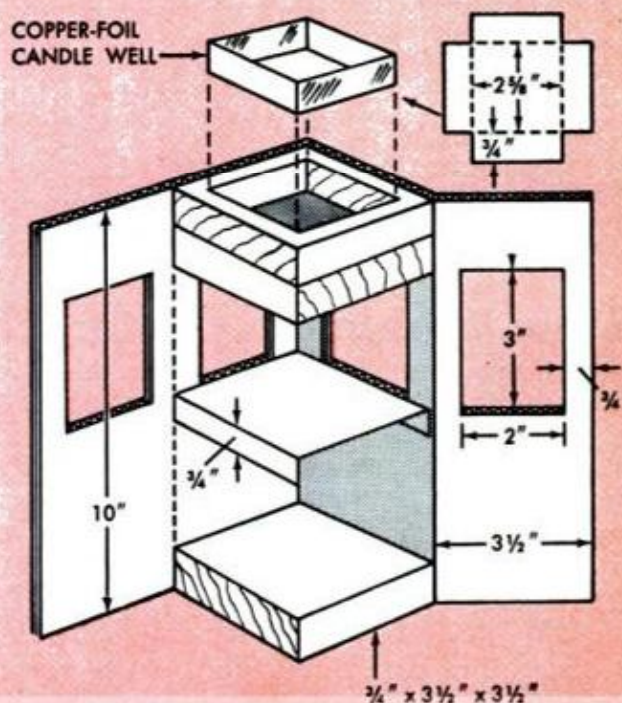


FROST THE FORM with beaten wax, using a knife blade to dab wax over cardboard. Work carefully around openings, decorations and candle cavity. If wax gets too hard to stick, remelt and beat it again

BELL TOWER

Though its wax frosting makes it look like a candle, the tower is really just a holder that you can save for reuse, year after year. The replaceable candle nests in a recess at the top. It's just a block of wax with a wick threaded through a hole drilled at its center.

Fold masking tape around the raw edges of the belfry openings before gilding the inside surfaces. For the lower designs, paste on four round motifs cut from Christmas cards. For frosting, shave candle wax into a can set into a pot of water over low heat. Let melted wax cool until a thick skin forms over the surface, then whip it with a rotary egg beater until it froths like egg white. Hang a small ceramic bell from a screw-eye turned into the bottom face of the second block.



GLUE GIFT-WRAP BRAID inside edges of openings and around decorations after wax frosting has set

FOIL CANDLE PAN fits inside top block's well. From block of candle wax, cut piece to fit holder

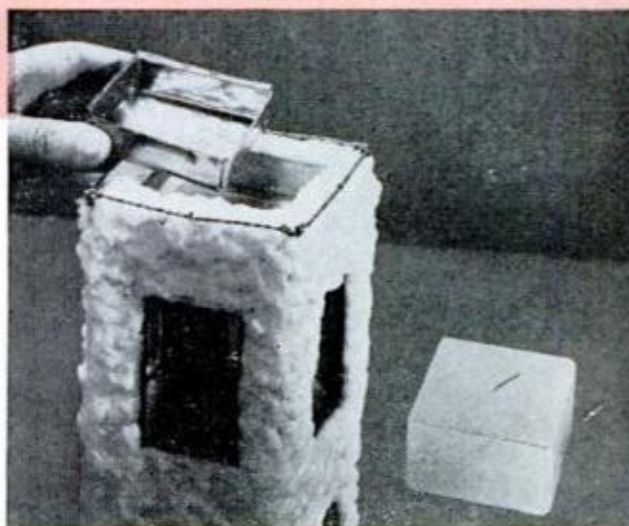
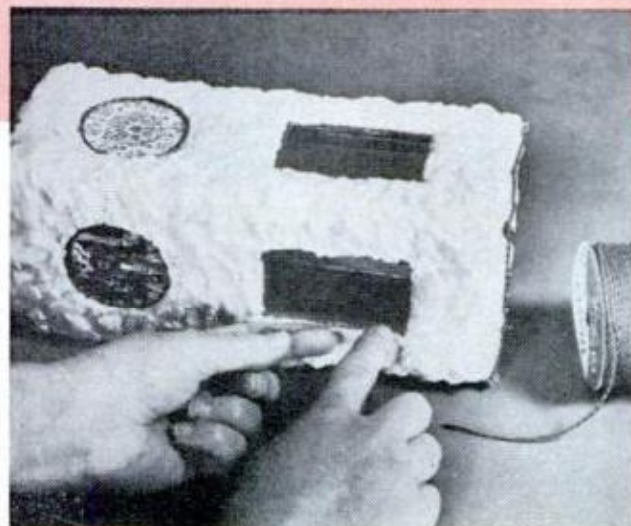


PHOTO HINTS



Blow Bubbles for Better Child Portraits

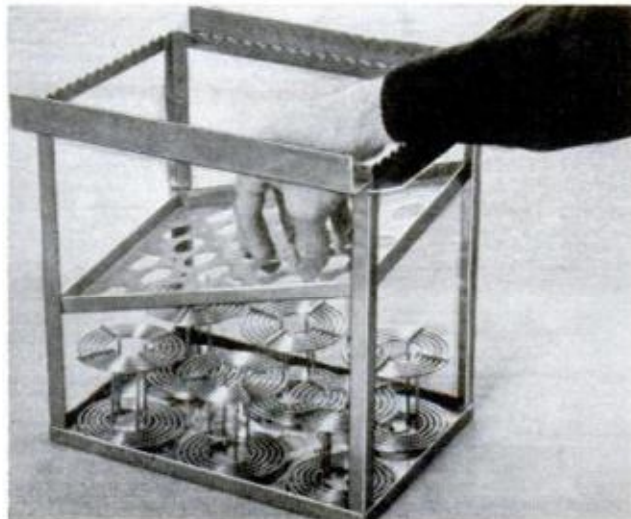
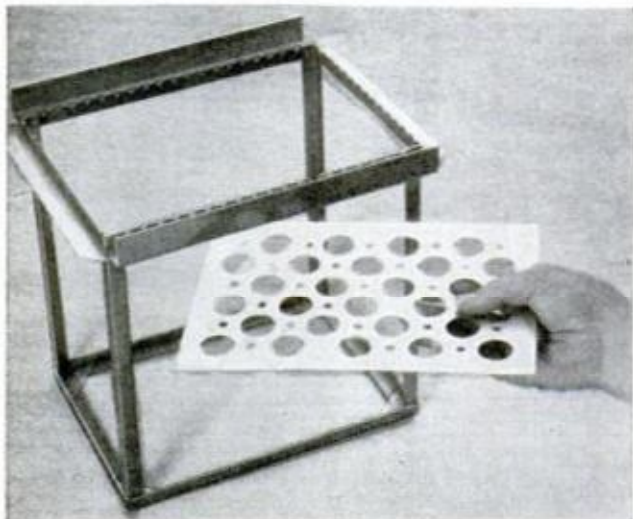
Professional child photographers have a bag of tricks intended to relax their subjects. One of the most effective is to blow a few bubbles toward the child. He will react with an animated expression and as he looks at or reaches for a bubble, the

picture may be taken. In order to avoid missing the picture, the camera and lighting equipment should be positioned and ready so that all that remains to be done is to snap the shutter. The bubble liquid is available at any toy shop.—Ken Patterson

Film Rack Serves to Hold Twelve Rolls at One Time

This film developing technique gives mass production speed when you have a large batch of roll film to process. An ordinary sheet film developing rack is used. The rack is not modified in any way and

may be used for its original purpose. A piece of sheet aluminum drilled as shown in the photo at the left serves as the bottom shelf. The second shelf is made with a lip to keep the reels from sliding off.





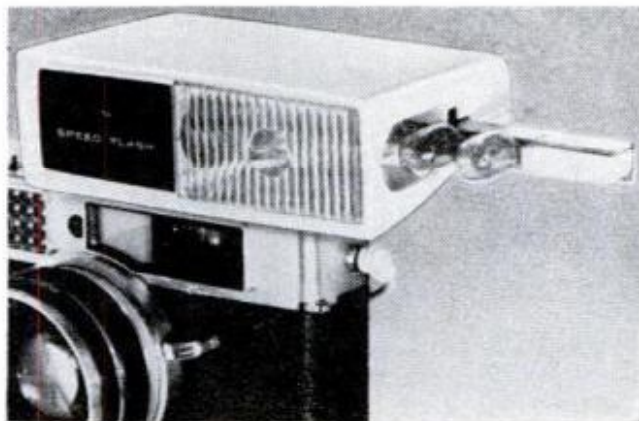
New for Camera Buffs

By Arthur J. Maher

◀ **AUTOMATIC BROWNIE** is probably the lowest price (under \$35) camera with a cadmium sulphide exposure control (arrow). Lens openings range from f:8 to f:22. Two-point focusing system is coupled to the diaphragm, automatically gives correct flash exposure. Uses 127 film. Kodak, Rochester 4, N. Y.

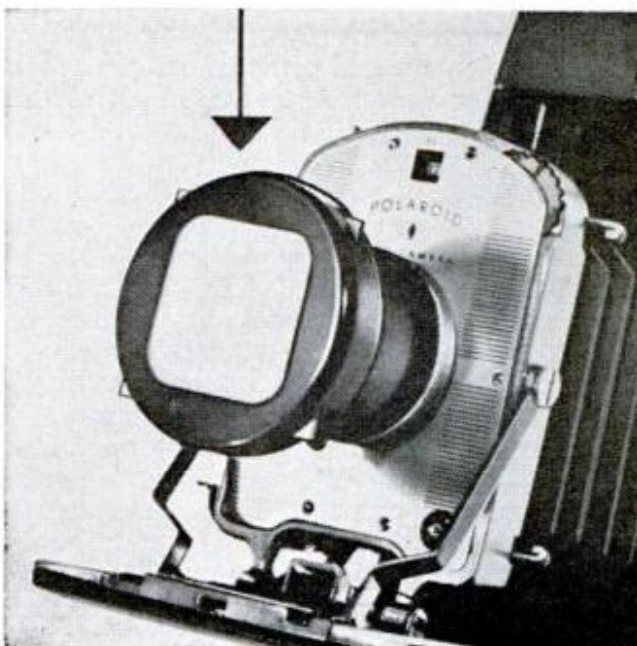
RAPID-FIRE FLASH GUN: Manufacturer claims this unit can be fired faster than any electronic flash, as it doesn't need time to recycle. Called the Ricohlite V, it holds a refillable cartridge of 5 bulbs. Retail for \$12.95. Extra cartridges cost \$2.95. Ricoh Ind., U.S.A., Inc., 432 Park Avenue South, New York 16, New York

NEW 135-MM TELEPHOTO, when tested by *PM*, gave surprisingly good results for a lens selling at only \$39.95. It's a rangefinder-coupled f:3.5 that fits all screw-mount Leica and Leica-type cameras. Also available for M-series Leicas, at \$44.95. Spiratone, Inc., 135-06 Northern Boulevard, Flushing 54, N.Y.

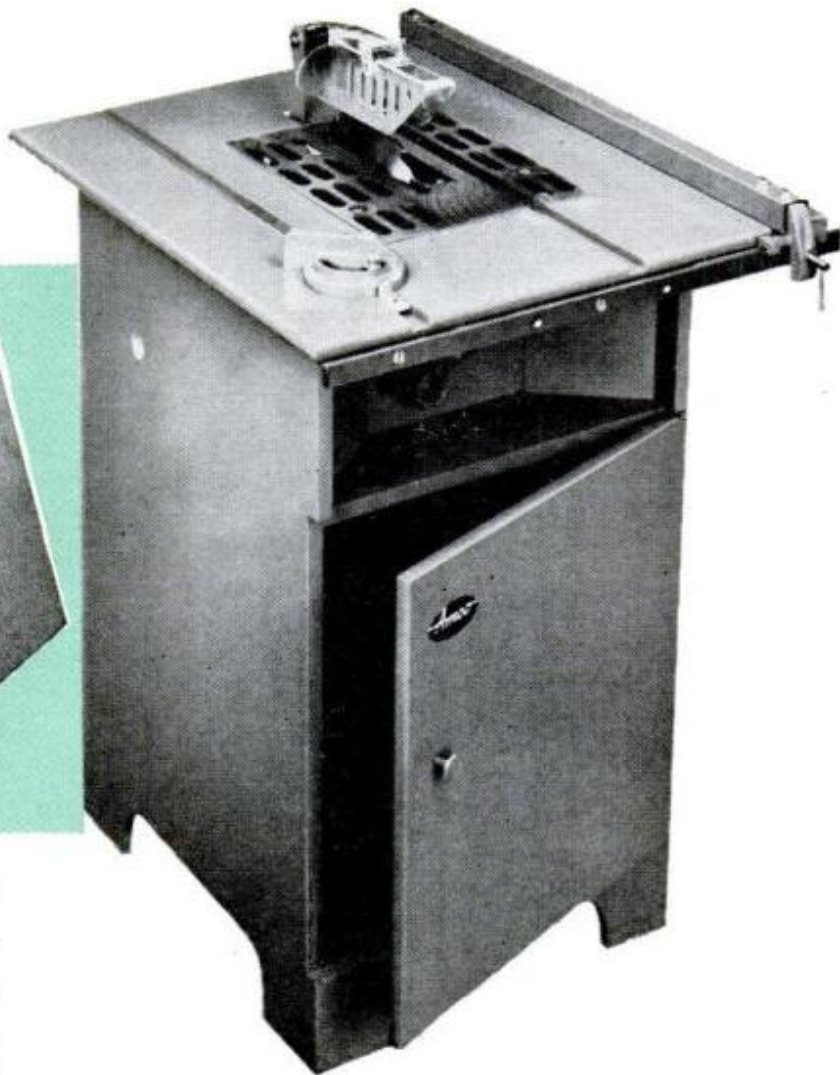


NEW COLOR-PRINT SERVICE: For \$9.95, you get an attractive 11x14-in. enlargement of any 35-mm, 120 or 620 color slide or negative. The laboratory applies a linen-textured plastic coating that is washable and tends to keep colors from fading. Frame included. Salesart, 720 5th Ave., New York 19, N.Y.

MAKE ENLARGEMENTS, in black-and-white or color, from your 35-mm color slides. The L-P6 duplicator attaches to all Polaroid cameras by means of a series VI adapter ring. Blows up slide to fill entire Polaroid frame. Works with all Polaroid films. Costs \$11.95. Electron Development Co., Box 1743, Springfield, Ill.



Little **BIG** Saw



What does a big saw have that a small one hasn't?—a big table. Now your little saw can have a big table, too

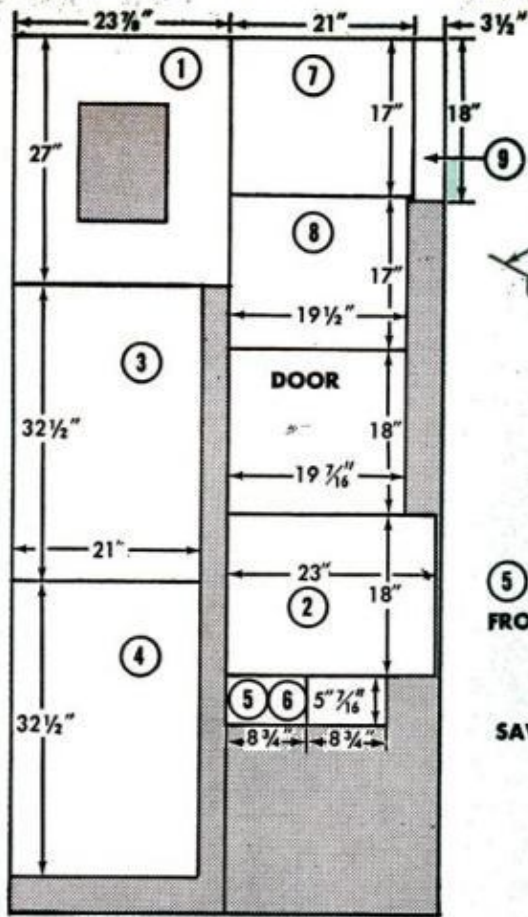
WISH YOUR SAW had a bigger table? Set flush in the top of this cabinet base, any pint-size saw becomes king size with a table measuring almost 24 x 27 in. All it takes is one sheet of plywood which, when finished with several coats of gray enamel, looks as sleek as the steel cabinets of the big commercial floor models.

You can adapt these plans to suit any small rear-drive bench saw although the dimensions given are specifically for an 8-in. tilting-arbor saw made by the American Machine and Tool Co. The door-fitted compartment in the base can be used as tool storage or as a bin to catch sawdust. In the latter case, an opening would be cut in the shelf directly under the saw.

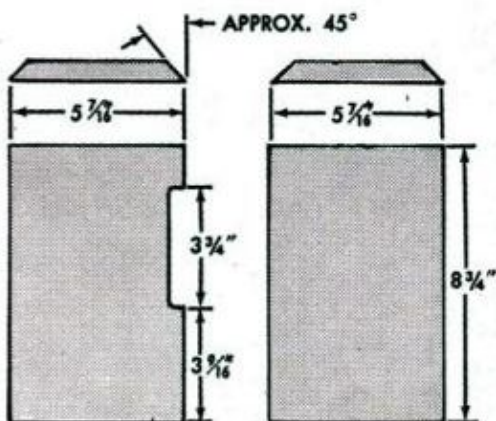
The conversion lets you use the original miter gauge but you'll need to replace the rip fence with a longer one. This part is available as an accessory, along with the front track to which it clamps. The layout diagram shows how parts can be nested on a 4x8-ft. sheet of $\frac{3}{4}$ -in. fir plywood.

If your miniature saw is the only power tool you own, it can build its own house—that's why the design was kept simple. It would be easier, of course, to cut the miter-gauge grooves with a portable router, but you can even manage these cuts by fastening another piece of the plywood to the saw as a temporary table and making repeated passes until the grooves are wide enough to provide a slip fit for the gauge tongue. Don't lay out these grooves until you've cut the center opening, so you can set the table panel over the saw's table.

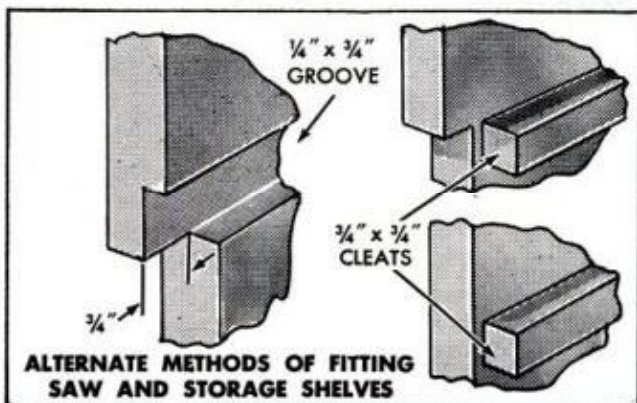
In converting the particular saw shown in the photos you will find it necessary to bore a $\frac{3}{4}$ -in. hole in the left side of the cabinet to provide clearance for inserting the rod on which the motor hangs. The motor cradle of your particular saw may not require this—or the hand-clearance notch shown in part 5. Before painting, apply a sealer to the plywood, such as Firzite, followed by two coats of semi-gloss machine-gray enamel.



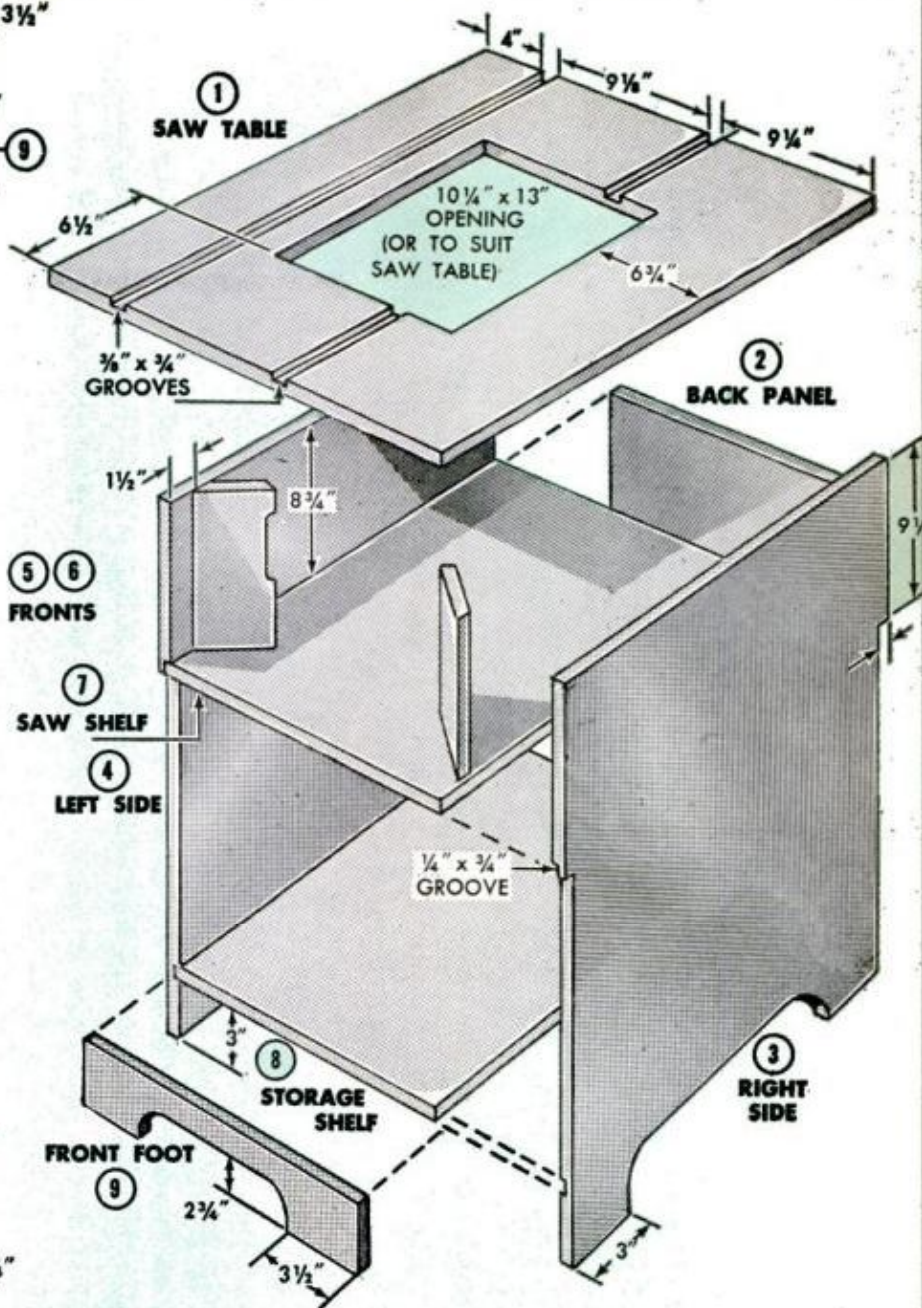
MINIMUM-WASTE LAYOUT FOR 4' x 8' SHEET

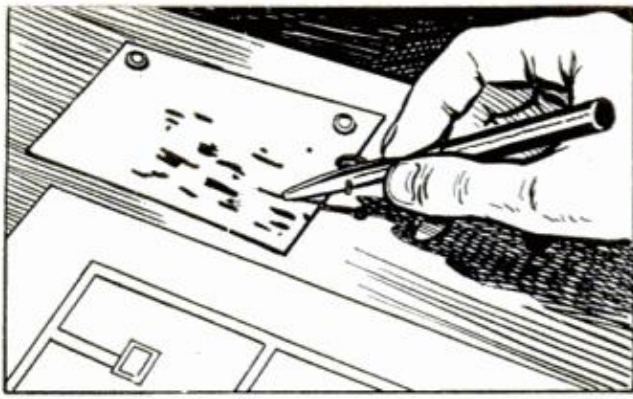


YOU HAVE A CHOICE of fitting top and bottom shelves in dados or battening the members and reinforcing with glue cleats. With butt joints, the shelves are cut $\frac{1}{2}$ in. shorter. Glue and nail the sides to the shelves first, then add the back. Use the plywood top to position the saw on its shelf, but wait until last to attach the top with countersunk screws. Skip glue here, since you may want to remove the saw later



ALTERNATE METHODS OF FITTING SAW AND STORAGE SHELVES





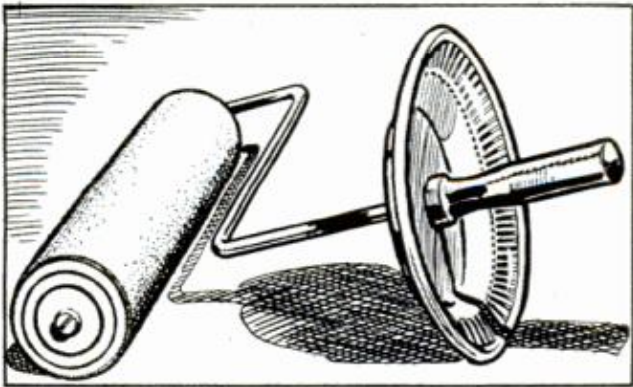
Starter Primes Drawing Pens

Tack a small blotter to your drawing board and you'll have a durable absorbant surface for "starting" ruling or drawing pens. Just one quick stroke across the blotter is usually sufficient to bring the ink to the tip of the pen and make it ready for use. This blotter will eliminate the need for keeping a loose piece of scratch paper handy to start pens. It also makes it unnecessary to draw starting lines on the drawing board itself.



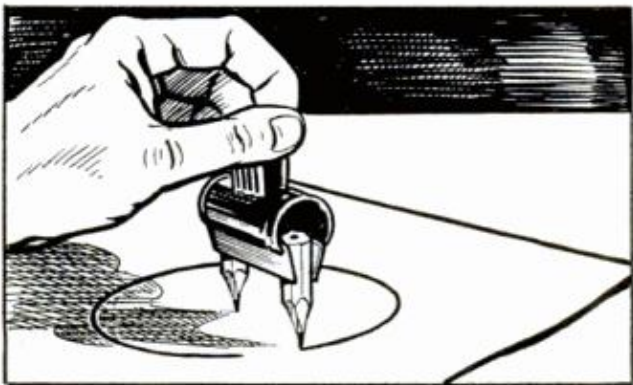
Joint Knife Shaves Cement

That broad knife used to apply dry-wall joint cement also makes a good tool for shaving off ridges and high spots in the cement. Once the cement has dried, simply grasp the knife with both hands and use it like a chisel. You'll find that you can shave off as little or as much cement as is necessary by varying the pressure on the blade.—*Duane C. Honsowetz*



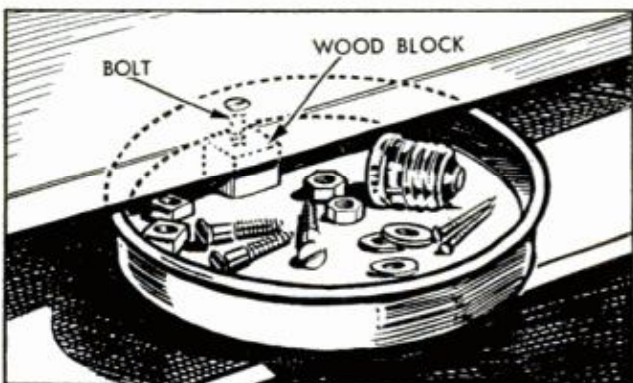
Hand Guard for Paint Roller

Even those modern dripless paints will spatter when applied with a roller to an overhead surface. To protect yourself from this fine mist, cut a slit in the center of a paper plate and slip this over the handle of your paint roller. Mounted just above the handle, the plate will shield your paint hand and arm from the paint mist. It makes clean-up easier.



Make a Spring-Clip Compass

It's not absolutely accurate and you certainly wouldn't want to use it for most drawing operations, but a spring-clip compass is fine for many rough jobs. It also makes a great drawing toy for the kids. To make one, just clamp two short pencil stubs in a standard spring paper clip. Use it as you would a regular compass, moving just one pencil to vary the circles.



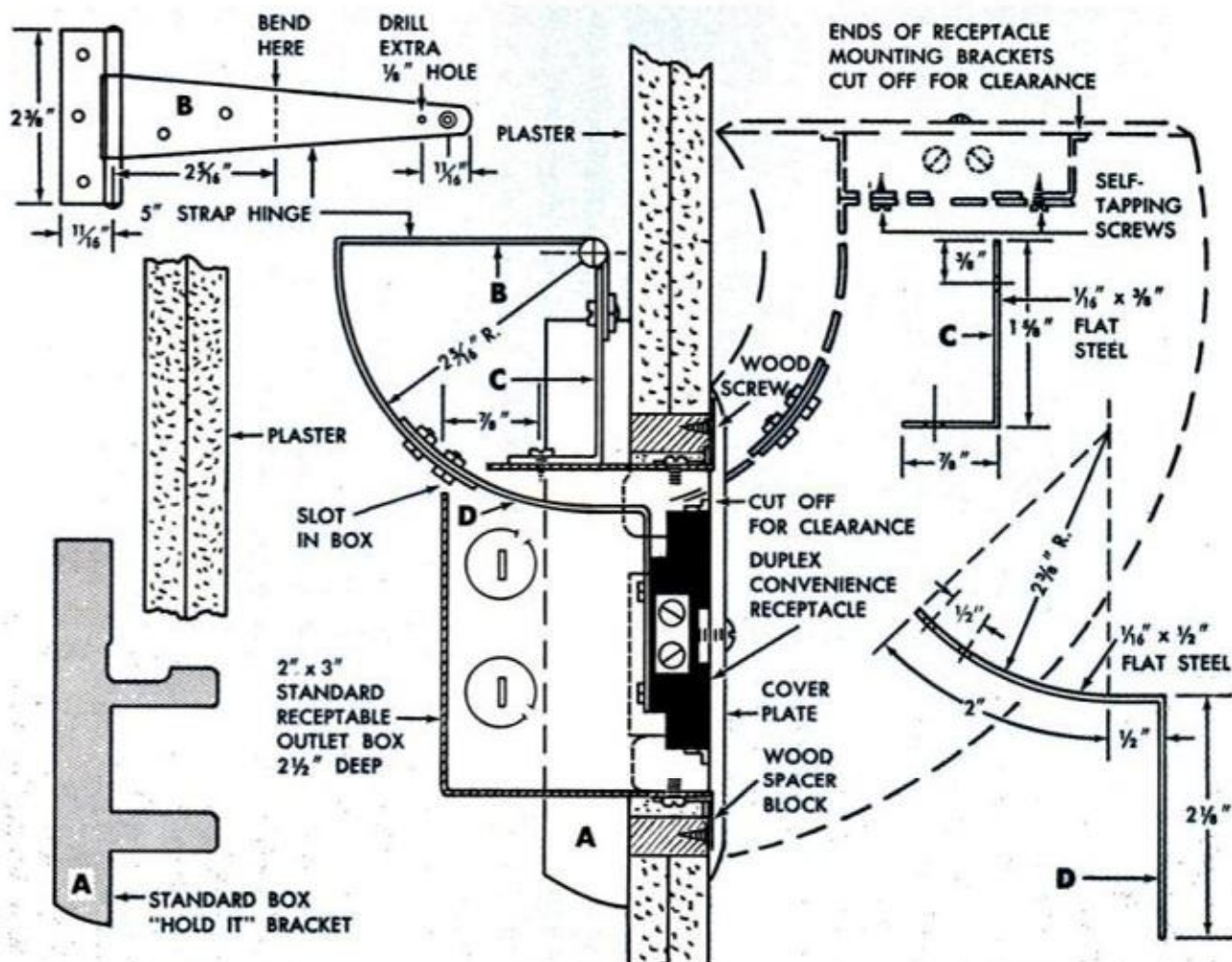
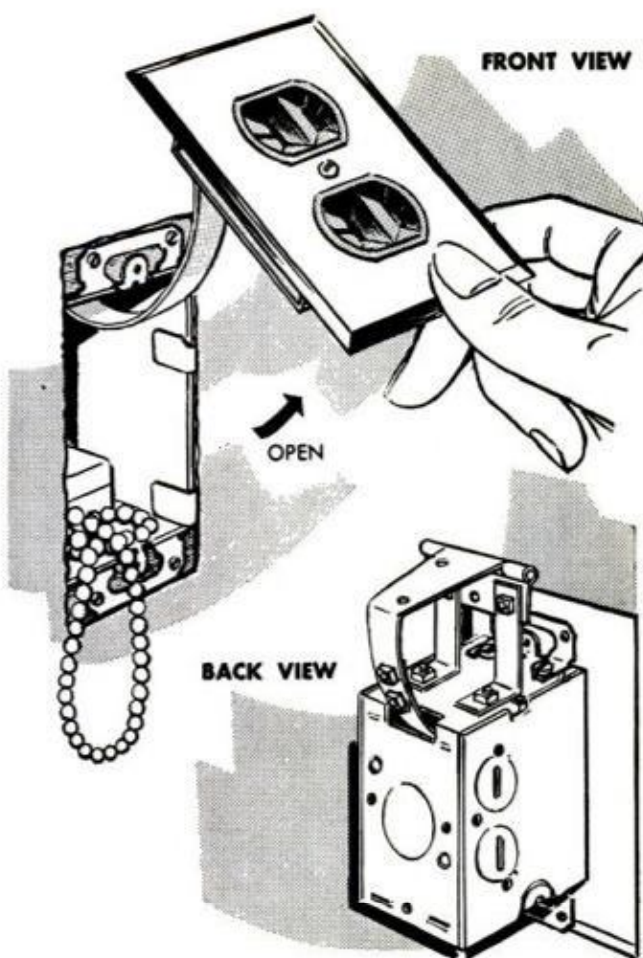
Handy Swing-Out Sorting Tray

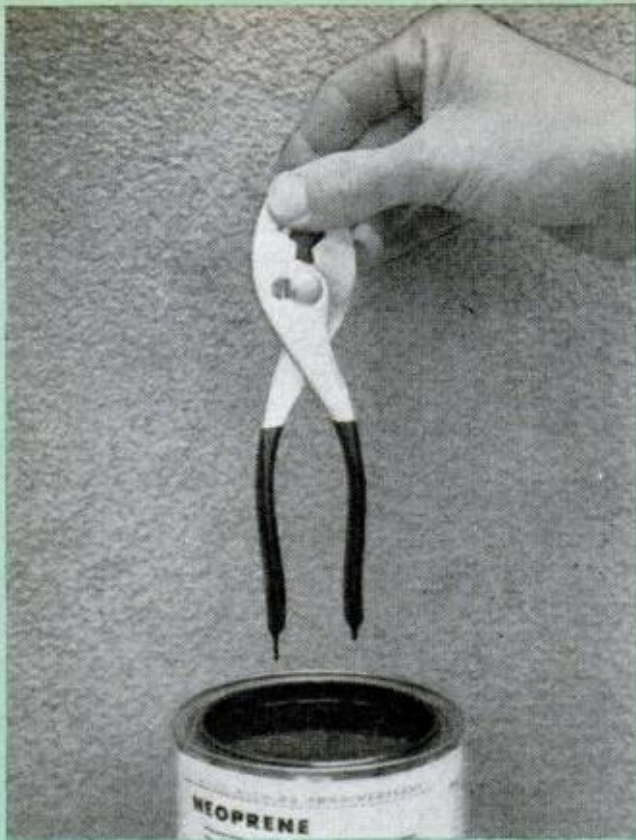
Mounted on the underside of your workbench, this cake-pan tray for holding small odds and ends is completely out of the way when not in use. It's attached with a bolt running through a wood spacer block slightly higher than the sides of the pan, so that the tray swings in and out without rubbing on the underside of the bench. To make it easier to use, you might mount a drawer pull on the bottom.

OUTLET-BOX WALL SAFE

WHO would think of looking inside an outlet box for your valuables? Perhaps only a burglar who has read this article. Outwardly it looks like a regular electrical outlet in which you would plug a lamp. But lift up the wall plate and you have a novel "lockbox" innocently posing as a wall receptable. Providing 12 cubic inches of space, it's big enough for such things as jewelry, petty cash, etc.

The duplex receptacle is not attached to the outlet box as normally done. Instead, the mounting ears are cut off and the receptacle is attached to a curved bracket (D) which in turn is bolted to a bent strap hinge, both of which pass through a slot filed in the back of the box. The hinge is held to the top of the box with L-brackets (C). Since the wall opening must be made 4 in. high, which is more than normal, to provide added clearance for inserting the assembly, the gaps at top and bottom of the box are filled with wood blocks.—D. E. Grant



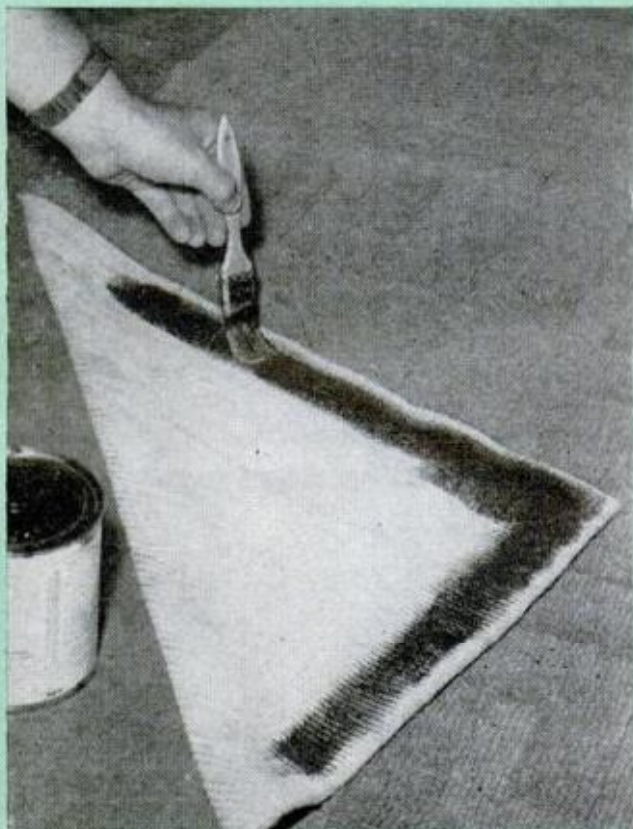


DIP TOOL HANDLES in liquid neoprene to give them a protective rustproof coating. The long-wearing neoprene will air-dry in a matter of minutes, forming a smooth, easy-to-clean surface on the handle

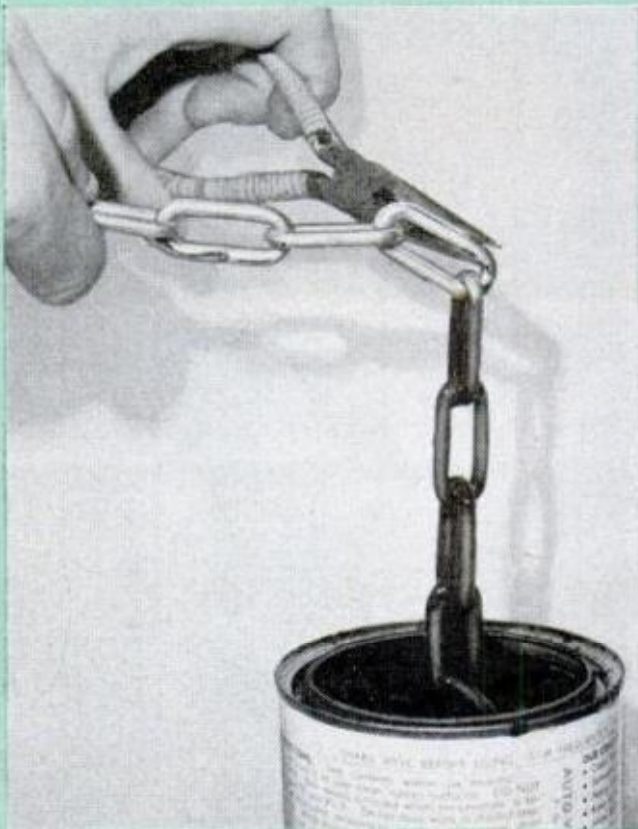
COAT IT WITH NEOPRENE

By V. Lee Oertle

SKID-PROOF those slippery throw rugs by brushing a thin coating of neoprene on the underside. Totally inert once it has dried, the neoprene will grip the floor, eliminating the danger of painful falls



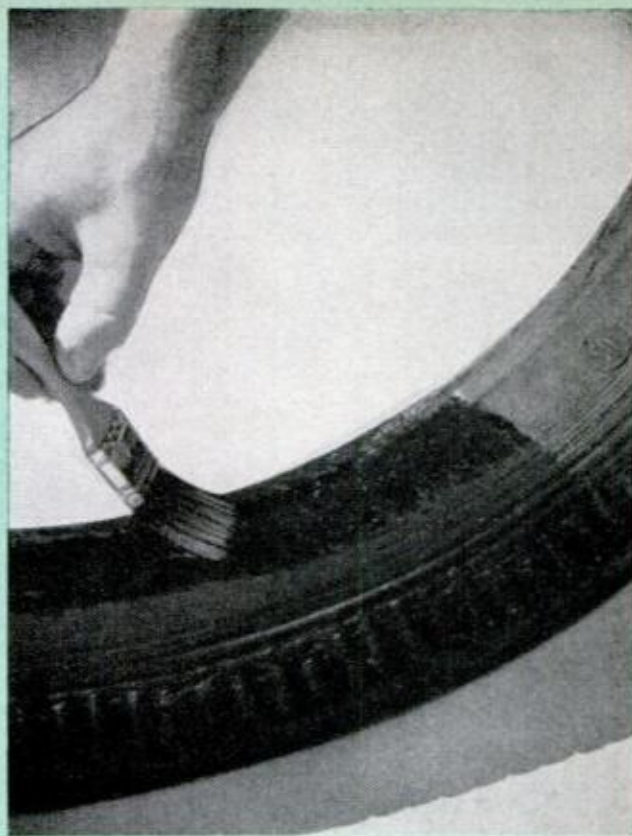
NO SCRATCHED DECKS if you dip your anchor chain in neoprene, and you can use the same treatment for safety or tie-down chains on your boat trailer. Dip and dry several times to coat all surfaces well



DEVELOPED originally to protect stored tires against cracking and smog damage, a new synthetic rubber filler-preservative called Neoprene Tire Shield also offers endless possibilities for general use as a protective coating in the home or shop. Sold in liquid form, it can be applied with a brush, or if the object to be coated is small enough, you may simply dunk it in the neoprene.

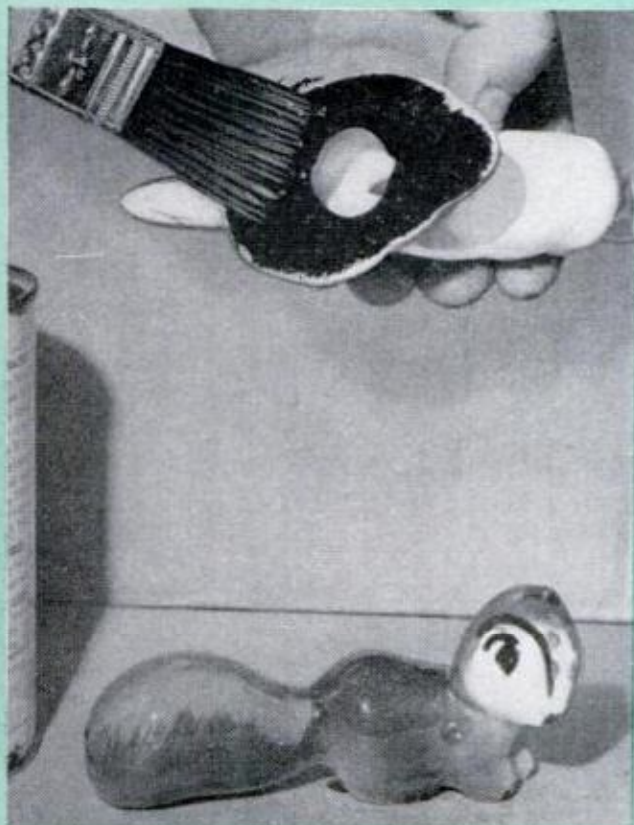
While the manufacturer doesn't recommend that this product be applied to tires in continuous use, the coating will lengthen the life of tires on stored or seldom-used vehicles—mobile homes, camping trailers, boat trailers, etc. Hoses, moldings and other rubber parts of stored automobiles can be protected from deterioration by giving them a coat of neoprene.

Since it adheres equally well to metal, wood, rubber or fabric, this smooth, rustproof coating is extremely versatile, a few of its many uses being pictured in the accompanying photos. A quart of liquid neoprene sells for \$3.95 f.o.b. Neoprene Shield, Box 276, San Dimas, California.

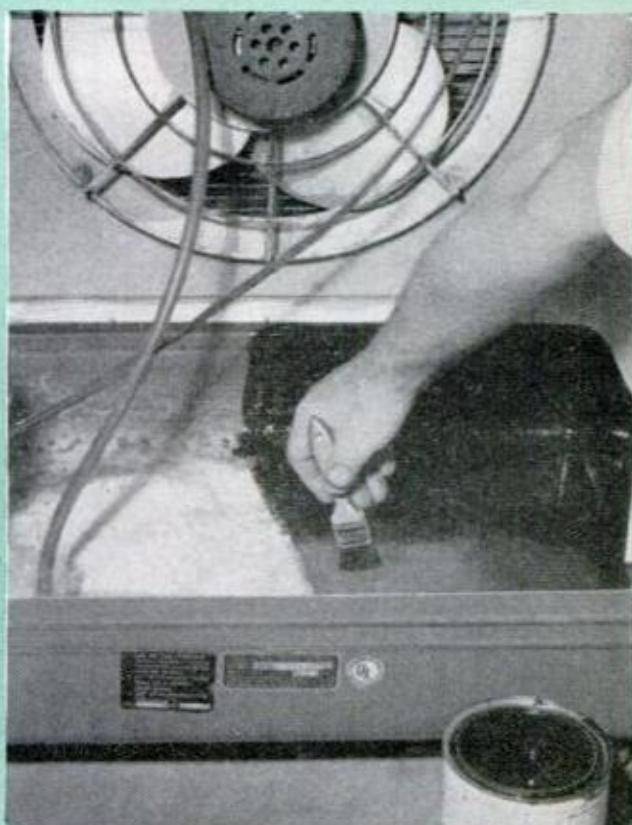


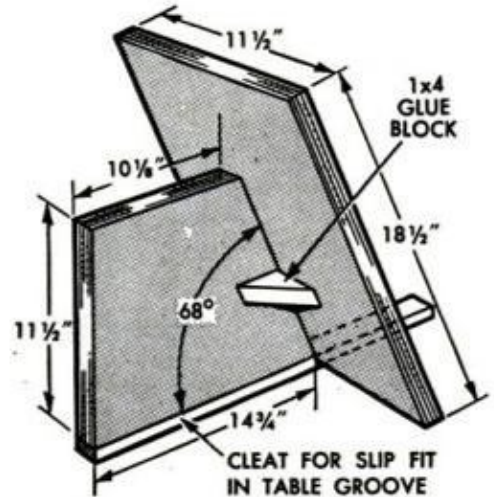
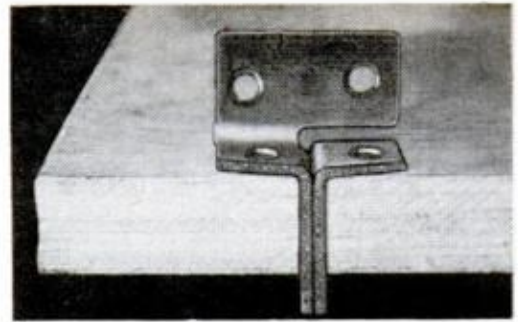
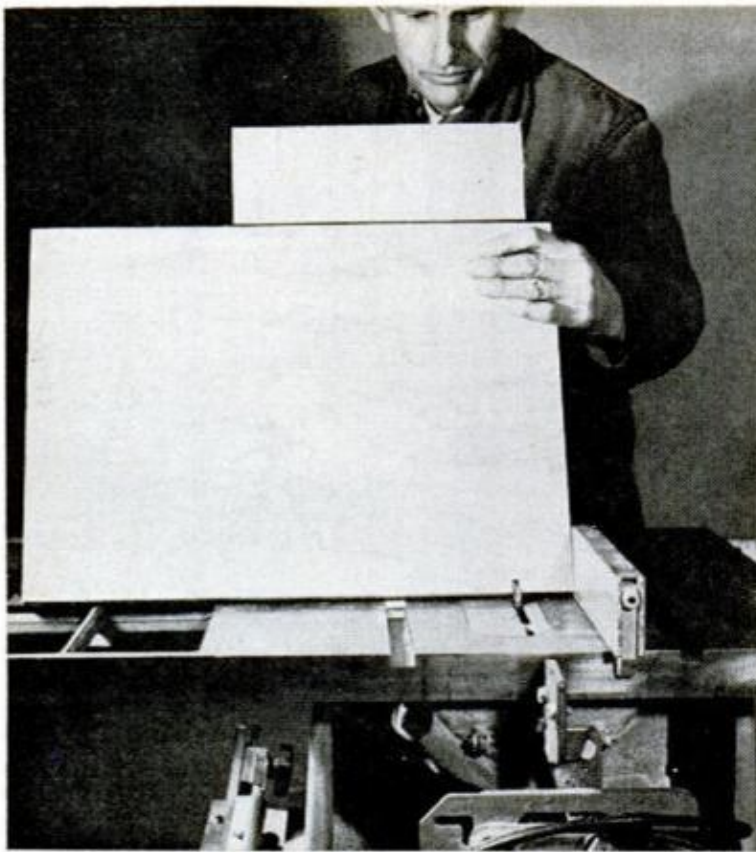
RESISTANCE TO WEATHERING, ozone smog and dry checking make liquid neoprene an ideal coating for protecting tires on all types of stored or seldom-used vehicles. Coat the entire tire, from rim to rim

PROTECT FINISH on shelves and table tops by brushing a no-scratch pad of liquid neoprene on the bottom of figurines, ashtrays, table lighters or other small items. Unlike felt, the neoprene won't slide



EXCELLENT ADHESION to steel makes liquid neoprene a good coating for the inside of tanks on water coolers, dehumidifiers, etc. Since the metal is shielded from contact with the water, it won't rust





Lean-Back Jig Makes It Easy to Cut Kerf Hinge Gains

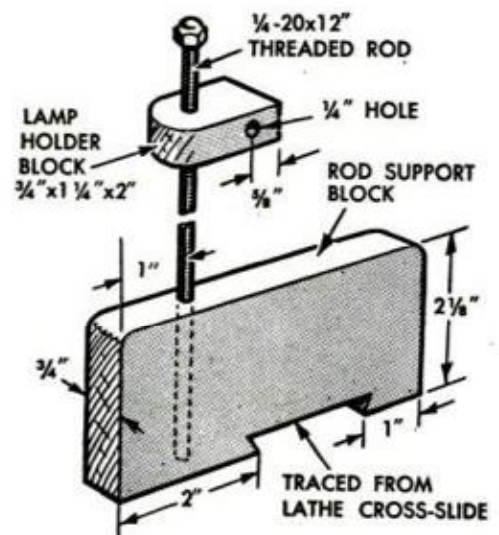
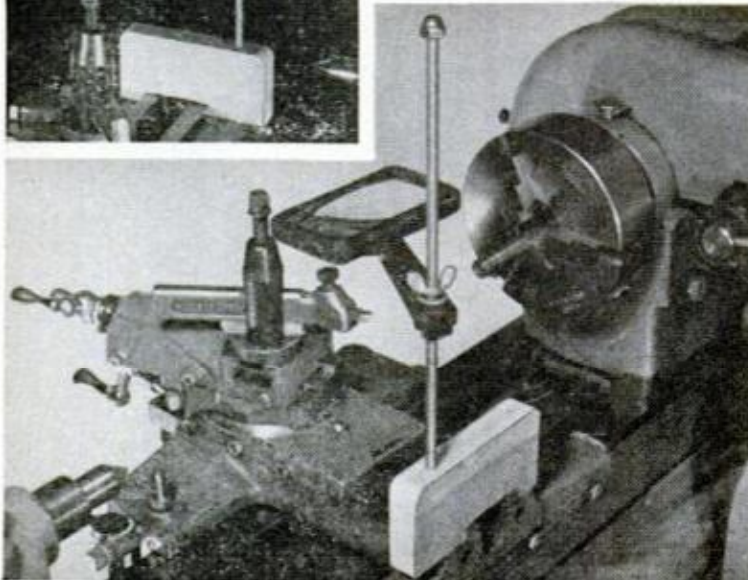
The job of supporting cupboard doors at the proper angle when cutting kerf gains for concealed pin hinges was no job at all for me with this inclined jig which I made to ride in the saw table grooves like a

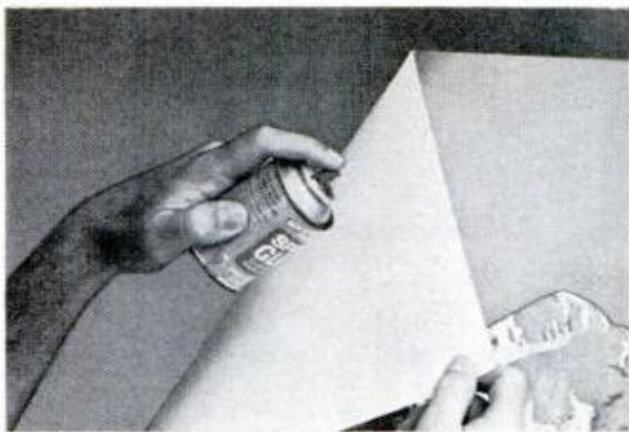
miter gauge. The jig holds the door at the required 68-degree angle as it is passed over the dado, and by using the saw fence as a stop, I was able to position the kerfs the same in several doors.—*Joseph Barker*



Holder for Lathe Lamp or Magnifier

This attachment which fits the lathe cross slide provides a support for a combination magnifying glass and chip shield. It also serves as a holder for a lamp that travels with the tool bit. A bed reading lamp is ideal and may easily be bolted to the holder block. A hole is drilled through the magnifier handle to fit the rod.—*H. Hanscom*

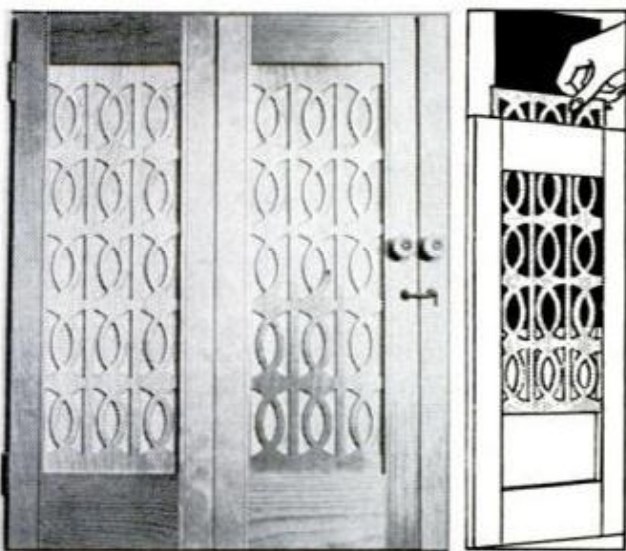
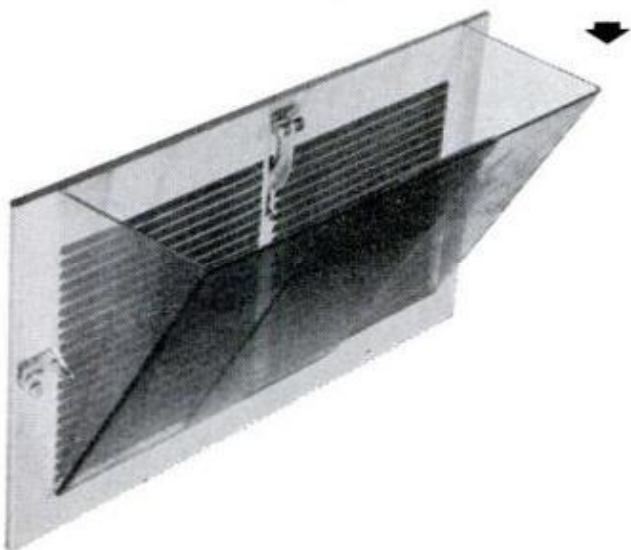




ENERGINE GLUE is claimed to be a multi-purpose permanent spray adhesive. It's a rubber-base compound which gets stronger the longer it sets. The manufacturer recommends it for repairing composition-tile floors, re-gluing wallpaper, hanging posters. Costs 98¢. d-Con Co., 1450 Broadway, New York 18, N.Y.

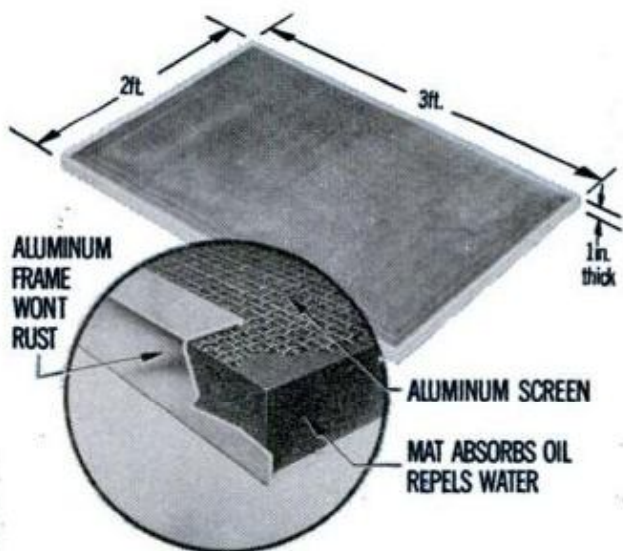
AIR FLECTOR, when attached to a sidewall or gravity cold-air register, deflects the flow upward, thus helping to achieve even distribution. Fits almost all registers. Installed by inserting two screws. In winter, can deflect warm air downward to floor. Lists at \$1.90. The Skuttle Manufacturing Co., Milford, Mich.

FILIGREED INSERTS of the Slide-A-Grille shutters can be removed for easy cleaning and finishing, or to change patterns. The clear pine shutters come in 48 sizes from 6x18 to 12x39 in., to fit nearly every size of window. Prices start at about \$2.00. From Artply Co., Inc., 907 Shepherd Ave., Brooklyn 8, N.Y.



SOAKUP GARAGE FLOOR MAT is made of expanded volcanic rock. Manufacturer says under normal conditions it will absorb oil drippings from an average car for 3 to 5 years. Won't become temporarily waterlogged. Price: \$8.95, 2 for \$16.25, prepaid. Compositions, Inc., 646 Chestnut N.W., Grand Rapids, Mich.

BELT DRESSING IN A TUBE, called Stop-Slip, is said to stop squeaks and boost power on all rubber and leather belts, both flat and V-shaped. Softens gummed dirt and removes surface glaze. For use on auto fans and generators, belt-driven power tools, attic fans, appliances. Costs 98¢. Devcon, Danvers, Mass.



there's in desert-dry air

Winter heating can turn indoor air twice as dry as a Sahara wind. This harms both health and home—unless you put that moisture back

By Steven J. Howard

MEDICAL SCIENCE now considers the very air in your home a major threat to health—the everyday air you and your family must inhale to exist.

The danger, which is kept in a dormant state through the summer months, is transformed into reality each year when you perform the simple act of turning on your furnace.

Immediately, the air circulating through the house dries out—often to the point of becoming much drier than the air in a desert. This condition continues to make life miserable (and unhealthy) for you

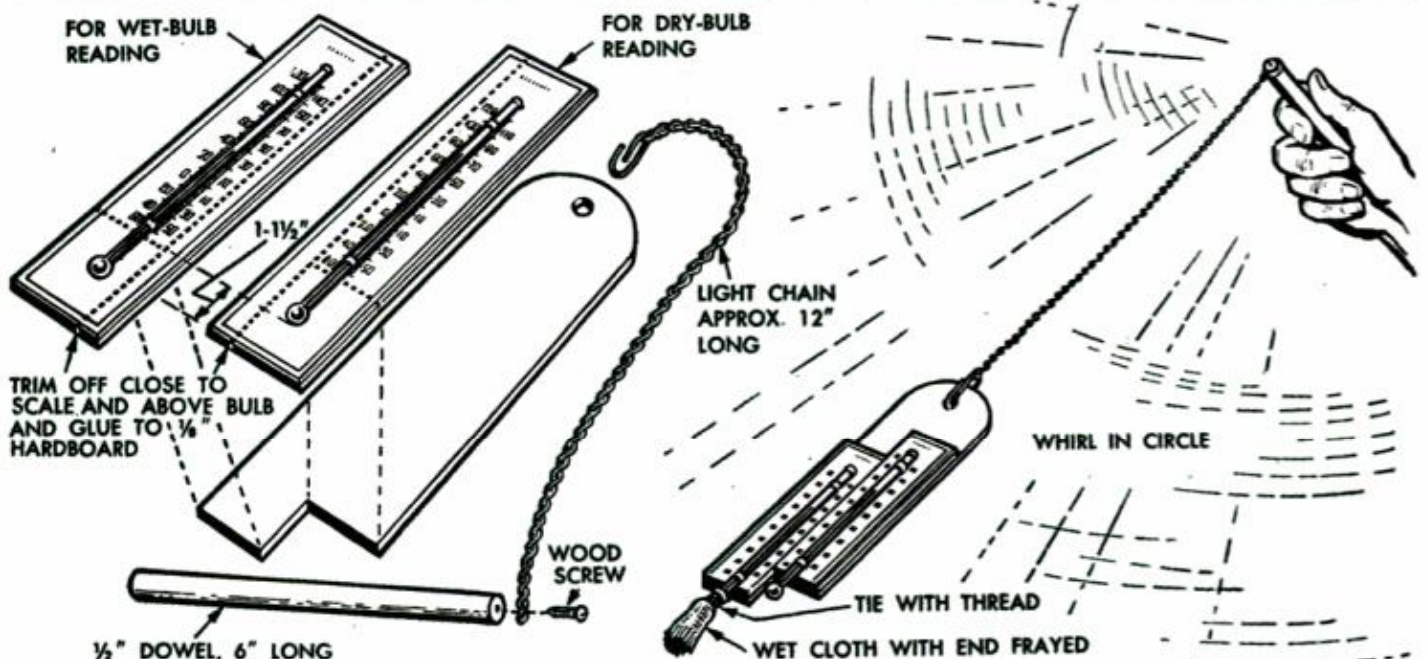
and your family for the entire length of the heating season.

According to this medical research, dry air is a major cause of respiratory ailments, excessive colds, sore throats, itchy skin, and the feeling of being chilly most of the time.

In a recent article in the New York State Journal of Medicine, for example, Dr. Joseph Lubart of New York City, a specialist in ear, nose and throat medicine, said the following about "The Common Cold and Humidity Imbalance:"

(Text continued on page 161)

TWO WALL THERMOMETERS MAKE A PSYCHROMETER



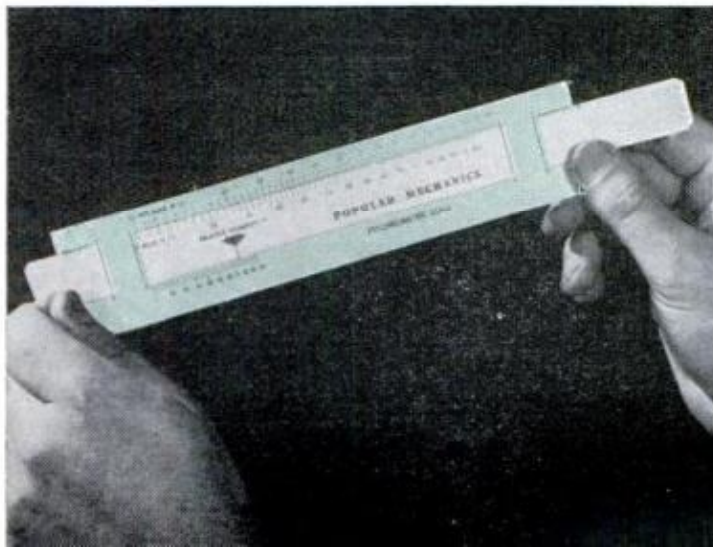
YOU CAN'T PLAN AN R_x TILL YOU FIND THE RH

TO CALCULATE relative humidity, you will need a sling psychrometer. It consists of identical Fahrenheit thermometers—one of which has its bulb wrapped in moistened cloth. You can buy a psychrometer for around \$15, but it's not hard to make your own, as shown on the facing page. Buy a pair of thermometers with one-degree calibrations.

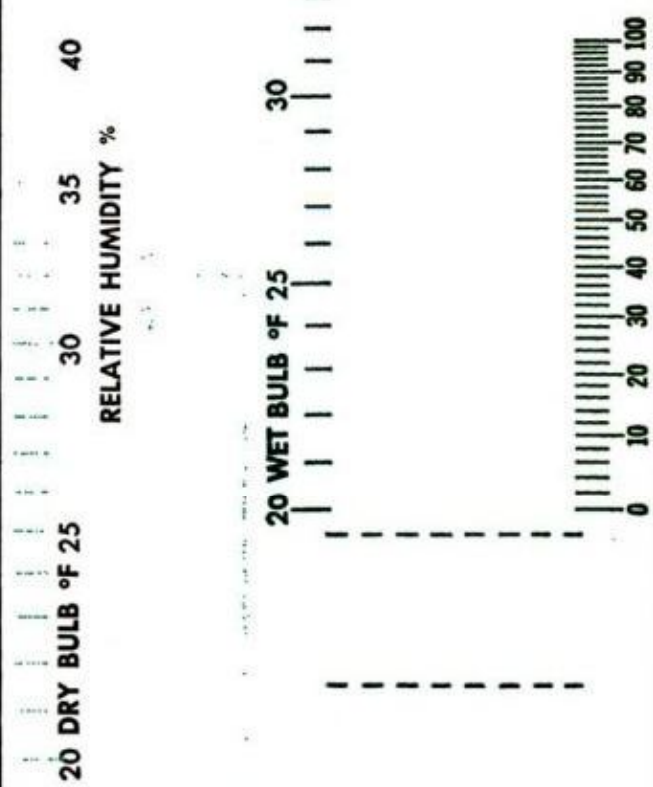
Relative humidity (RH) is the percentage of saturation of the air at a given temperature; 100 percent represents the maximum amount of moisture that a given volume of air will hold at a given temperature. Since this is inversely proportional to the rate of evaporation, you can measure RH by comparing the readings of wet-bulb and dry-bulb thermometers after forcing evaporation by whirling them through the air. Evaporation, of course, lowers the temperature of the wet-bulb thermometer while the dry one continues to register the normal room temperature. (It's to avoid the influence of the cooling evaporation that the dry bulb is offset at least an inch.)

Whirl the thermometers until the wick is dry and the wet-bulb scale has hit its lowest reading. To convert the thermometer readings to RH, set the center scale of your assembled slide rule so that the dry-bulb reading lines up with the wet-bulb reading. The arrow now points to the relative humidity in your home. For example, a dry reading of 74 and a wet one of 59 give an RH of 40.

SNIP OFF THE RIGHT HALF of this page and center it on a strip of thin cardboard two inches longer. Cut the two scales apart and thread them together as shown below so you can slide one along the other

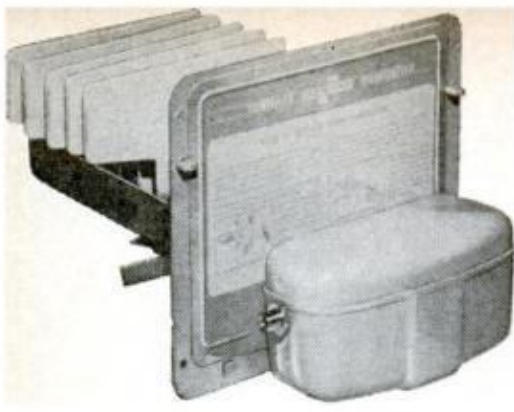


MOUNT ON THIN CARDBOARD AND CUT ON TWO HEAVY LINES. ADD 1" TO EACH END OF DRY-BULB SLIDE

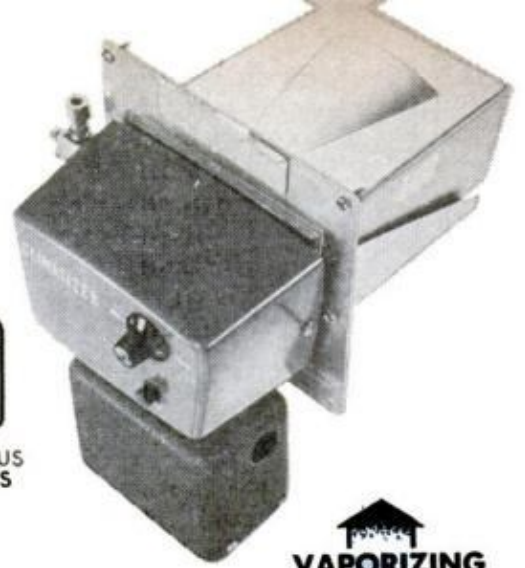
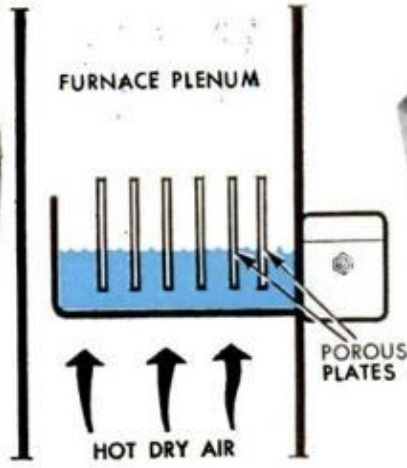
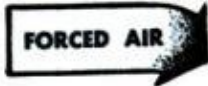


POPULAR MECHANICS

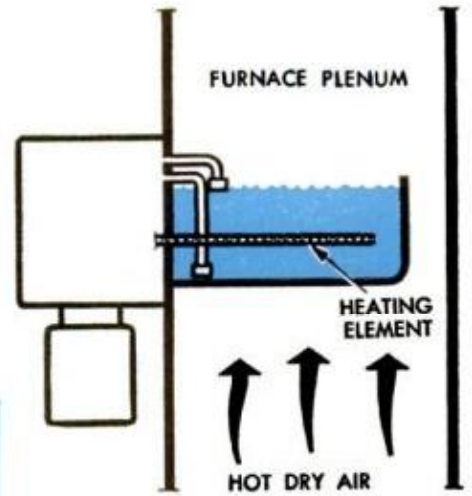
PSYCHROMETRIC SCALE



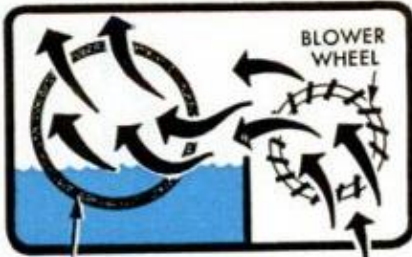
EVAPORATIVE



VAPORIZING



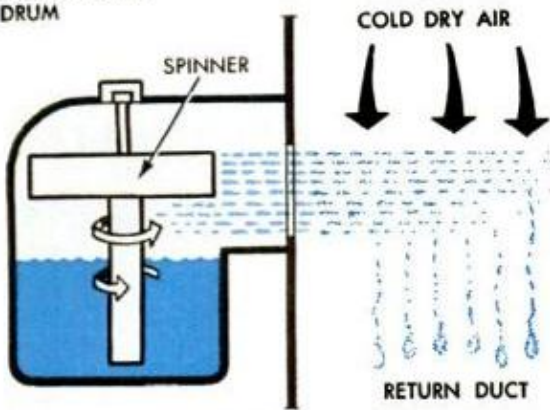
FURNACE PLENUM



ROTATING PLASTIC-FOAM DRUM

HOT DRY AIR

FIVE MAJOR TYPES OF HUMIDIFIERS

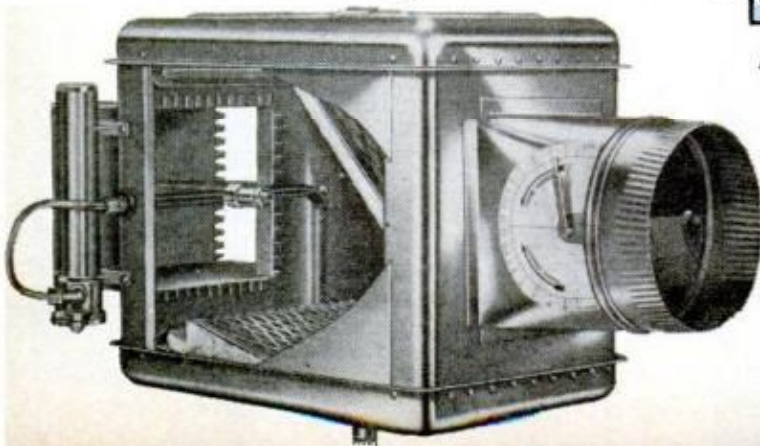


COLD DRY AIR

RETURN DUCT

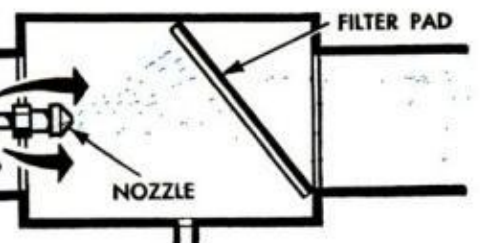


ATOMIZING



HOT DRY AIR

NOZZLE



FILTER PAD



"The regulation of the humidity in the living quarters (of a home) will go a long way toward creating an indoor climate much less favorable for the activity of cold-inciting agents. It is significant that coincidental with the institution of heating in the fall, patients complain of smarting and burning in the pharynx and the usual seasonal infections begin to make their appearance.

"These are popularly attributed to the inclement weather, *but the actual cause of the coughs and colds is a dry nose and throat caused by artificial heating.*

"In spite of the remarkable progress made in medicine in conquering most diseases," Dr. Lubart concludes, "there is as yet no cure for the common cold . . . Prevention at present is our nearest approach to a cure and the *most important* preventive measure would appear to be the proper regulation of the humidity during the heating season."

Industrial research, too, has uncovered dangers in the air that circulate around us during the winter. According to its findings, dry air can wreak havoc upon our homes and furnishings.

Cracked walls, creaking floors, rattling doors, checkered and cracked paint, loose furniture joints, peeling veneer, excessive rug wear—these and a whole list of other household ailments result from your innocent act of turning on the furnace.

There's another aspect to this dry air problem that's often overlooked. It concerns your money—money that literally goes up in smoke along with fuel that shouldn't be burned in the first place. According to government figures, a home's comfort level is increased 1 degree for every 8 percent of humidity that's in the air. And for every degree of heat over 70 degrees you use, your heating cost rises about 3 percent.

How can ordinary air cause such discomfort, damage and expense?

Well, air is like a sponge that absorbs water. Cold air acts like a small sponge that's capable of holding only a little water. But when you heat that air, it swells into a huge sponge with a giant thirst that pulls moisture from everything it contacts. It never seems to reach a saturation point.

Take a look at the charts on page 164. They show why parched air leaves you chilly, even at what *should* be a cozy temperature. But how does all this affect your health?

Well, nature has provided the human body with a protective "cleaning" system in the form of a layer of mucus in the nasal passages. Germs, bacteria and foreign matter that enter the body when we

inhale are trapped by this sticky substance.

In turn, the mucus layer moves continually from the nose to the throat, where the inhaled germs, bacteria and foreign matter are deposited to travel harmlessly out of the body.

Everything works fine under normal conditions. But when the mechanism is subjected to the desert-like environment in the average winter-heated home, it breaks down.

The dry air steals the protective layer of moisture from the "cleaning" system, and bacteria and germs are left in the nasal passages to incubate into the many persistent infections prevalent in winter.

"Wait a minute," you may say at this point. "Your arguments sound valid, but if humidity is so all-fired important, how come doctors recommend that patients suffering from respiratory diseases, such as asthma, escape to a drier climate, such as that found in Arizona?"

The key to the answer to this question lies in the word *relative*. It isn't humidity as such that makes people comfortable or uncomfortable—it's the relative humidity, which is the amount of water vapor in the air as compared to the amount the air could contain at a given temperature. In other words, people are most comfortable when the heat-moisture ratio is at a certain point.

In the desert, you feel comfortable because the temperature is high while the humidity is low. If we dropped the temperature to a point experienced in the northern part of the country during the winter, while keeping the humidity at desert level, you would feel uncomfortable and leave yourself wide open to sickness.

The relative humidity in the Sahara Desert averages about 25 percent; the relative humidity in Death Valley averages about 23 percent. *The average relative humidity in nine out of ten American homes during the heating season is only 13 percent*—and this at a temperature considerably lower than that found in the desert.

The ideal relative humidity for maximum comfort and protection of health and home is 30 to 40 percent with the temperature at 70 degrees.

OK—so the humidity level in most homes during the winter is too low. What can we do to increase it?

Simple enough! Industry has provided us with a device called a humidifier, which pumps moisture back into the air.

Humidifiers, which come in all sizes, shapes and forms, are normally thought of as devices for use in homes heated by forced air. At present, there is a controversy raging among heating experts as to whether the device is needed in those



ATOMIZING HUMIDIFIER has three basic parts—from left to right: cover, float pan, and motor. Before installation, see float assembly is properly adjusted



MAINTENANCE involves removal of the perforated screen for cleaning. Screen serves as filter to protect unit from foreign matter present in water

homes heated by hot water. We'll discuss the pros and cons of this argument at the end of this article.

There are three general categories of humidifiers on the market today, although there are several variations of each as shown on page 160.

● The most common—but also the one that's the most outdated—is the evaporative-plate type. Building contractors have installed these in many new homes that have forced-air heating systems. They are the least expensive, costing from \$15 to \$25.

The three main drawbacks to the evaporative-plate humidifier are these: (1) their output is not usually sufficient for average-sized home; (2) this output can't be regulated; (3) the units require almost

constant maintenance, especially in hard-water areas.

The humidifier is mounted in the furnace plenum. Plates absorb water from the humidifier pan by capillary action, and moisture is picked up off the plates by the movement of air through the furnace. In forced-draft versions of this humidifier, the plates are usually replaced by a drum that rotates through a water bath.

● The second basic type of humidifier is the vaporizer. It sells for from \$2.00 to about \$80, depending on whether it's a portable unit or one that's installed in the furnace, and also upon its rated output. It is similar in operation to the portable vaporizer you use in junior's room when he's at home with a cold.

START MAINTENANCE of a plate-type evaporative humidifier by shutting off the valve on the water line that feeds the humidifier pan; then disconnect the line



DETACH THE UNIT from the duct by removing a bolt on each side. You can now slip the unit free, except for types where plates must first be removed



there are several things you should consider in your selection of a unit. (Usually, you can get a furnace-equipment dealer to come to your home and estimate your requirements for you with his specialized instruments. This service is often done free of charge by the dealer in the hope that he can sell you a unit.)

The amount of water you should add to the air for proper humidification depends basically upon two factors:

1. The cubic footage of the area to be humidified.
2. The difference in temperature between outside air and inside air.

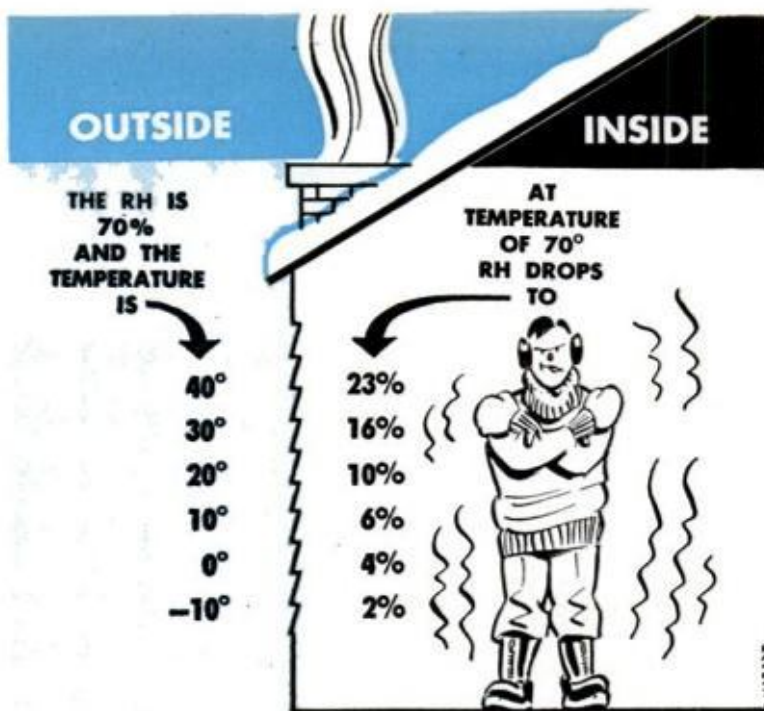
Other factors to be considered, although to a lesser degree, are the average relative humidity of the outside air; the amount of natural evaporation in the home because of family activities such as washing clothes, cooking, perspiring and even breathing; and the tightness of the home's construction—that is, the degree to which air and moisture seep through walls.

Since there are so many variables, some of which change from minute to minute, it's almost impossible to compute exact moisture needs, although an expert with his equipment can come close. However, a general rule-of-thumb you can use to estimate your needs has been developed and is suitable in most cases.

It is this: *add one gallon of water per room per day* for effective winter-time humidification. Thus, if you have a five-room home, you should consider purchasing a unit that can put out five gallons of water per day.

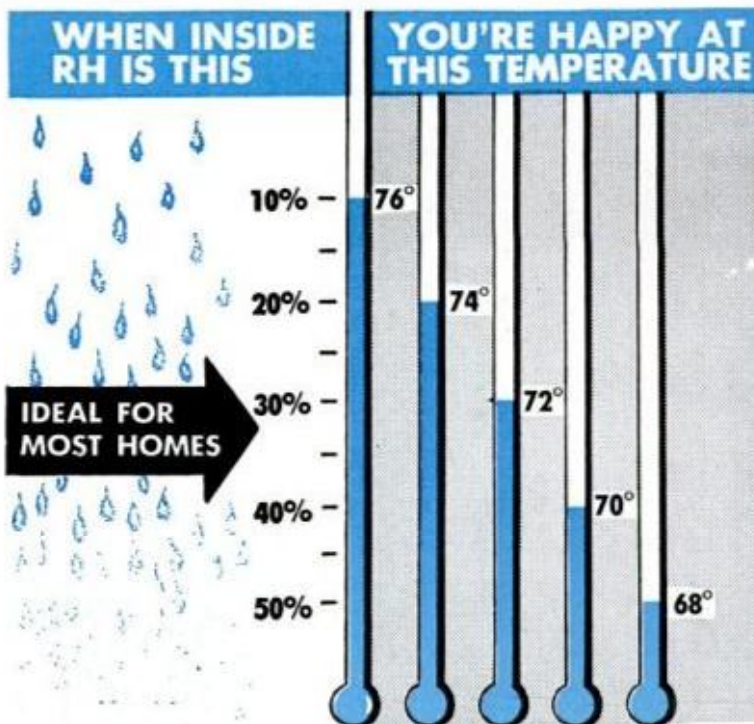
Adding such a great amount of moisture to the air at first may seem ridiculous. Most people believe that a home is a solid-walled container. Thus, if you heat air in a home to 70 degrees and saturate it once, why must you keep saturating it—especially with such a great amount of water!

Actually, air in a home is constantly seeping out through the walls, and outside air is constantly seeping in. It has been proved by research laboratories, such as Walton Institute of Humidification in Irvington, N. J., that the entire air in a room is replaced



WITHOUT HUMIDIFICATION, cold air entering a house expands as it is heated—but its actual moisture content remains the same. This means its relative humidity (the percentage of moisture it presently holds compared to the amount it could hold) zooms far below level required for comfort or health. For example, say it's 20 degrees outside, and the RH is a moist 70 percent. When that air seeps inside (as it does constantly) and gets heated to 70 degrees, the RH drops to a low 10 percent that leaves you shivering despite high temperatures

CHART BELOW SHOWS WHY you shiver at 70 degrees if relative humidity is only 10 percent. You'd need a temperature of 76 degrees to feel warm with air that dry. How come? Well, that dehydrated air is greedy for moisture. It sucks it up from everything it contacts—including your body. Rapid evaporation from your skin makes you cold (as you know if you've ever stepped from a shower into the path of a fan). Air with proper humidity (30 to 40 percent RH) isn't thirsty, so you can be comfortable with the thermostat set as low as 70 degrees



by outside air at least once an hour.

In the same way you must keep your furnace going to maintain a comfortable heat level, so must you keep adding water to the air to maintain a comfortable and healthful humidity level.

In using a humidifier, however, you must make sure that it isn't putting too much water into the atmosphere. If moisture is excessive, your home could suffer water damage.

A tip-off to excessive moisture in the air is condensation on windows. When this happens, you should immediately decrease the moisture output of the humidifier.

Some humidifiers are equipped with a control, called a humidistat, that adjusts moisture output much as a thermostat adjusts heat output. If your installation includes a humidistat, lower its setting until window condensation disappears. If you don't have a humidistat, turn off the humidifier at its installation point until window condensation vanishes. Then, turn it on again. Of course, plate-evaporative units aren't equipped with any sort of control (except a shut-off valve on the water line) but their output is rarely sufficient to cause condensation.

The most effective way to humidify a home heated by forced air is to insert the humidifier right into the furnace plenum or cold air return, whichever is recommended by the manufacturer. Installation itself is seldom difficult, but there are certain things you must watch carefully or the unit won't function properly.

For example, you must make sure where the humidifier is to be placed—whether in

the return duct or supply duct; you must pinpoint the exact location on the duct; you might have to hook up both a water line and an electric feed line so the humidifier works in conjunction with the furnace blower motor, turning on when the blower operates, shutting off when it does.

Most dealers include installation cost in the price of the humidifier. Some will not sell and guarantee a unit unless they are permitted to hook it up.

If you are sure you can do the installation yourself (humidifier kits contain detailed instructions), you might be able to buy a unit for less than the cost originally quoted by the dealer. But be sure! It's often worth the extra few dollars to have an expert do the job.

Once the unit is installed and is operating, several things could happen to impede its output. One sure way to insure that the unit is putting out the amount of moisture to properly humidify the air is with the psychrometer and psychrometric scale shown on pages 158 and 159.

No matter what type of humidifier you have, maintenance is a continual and important function. Most humidifiers should be cleaned out at least three times during the heating season to guard against the clogging effects of calcium deposits. This maintenance is easily done and takes only a few minutes.

The procedures for two different types are shown on pages 162-3. In all cases, the unit must be removed from the furnace plenum or return duct. The first job on most units is to clean the water pan

[\(Please turn to page 188\)](#)

NEXT MONTH IN SHOP AND CRAFTS

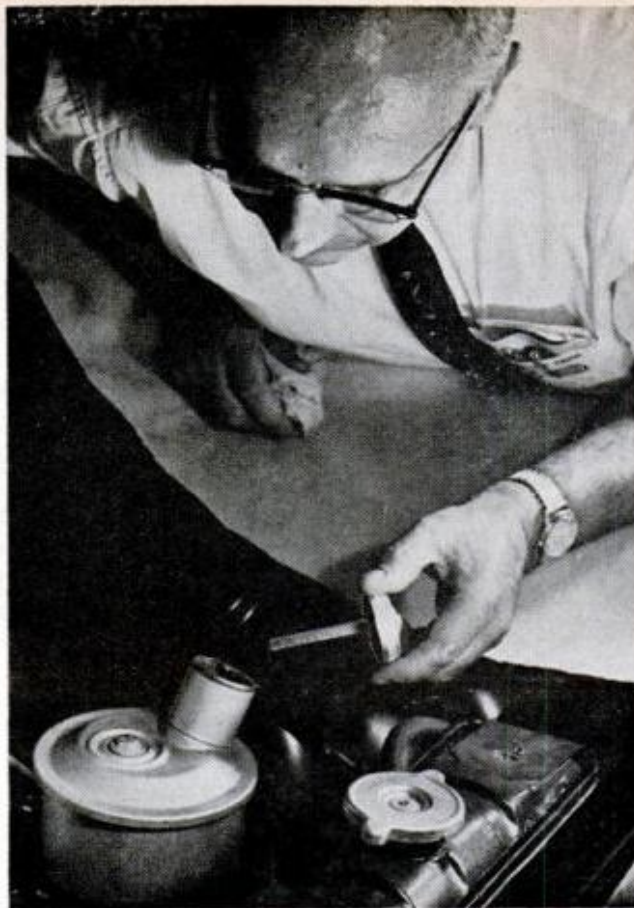
6-HOUR COURSE IN ARC-WELDING BASICS. If you're one of the many people who think that arc welding is too difficult for the average home craftsman, be sure to pick up a copy of the January issue. You'll find Part I of a two-part article which shows how easy it is to become proficient at common "downhand" welding with only six hours of practice. Easy-to-understand diagrams and photos are included to answer your questions

SHARPEN SKATES ON YOUR SAW. A simple jig for use with an abrasive wheel on your circular saw makes it possible to put a perfect hollow-ground edge on ice skates in minutes. You'll find complete plans for this jig in next month's *PM*, so whether you want to sharpen just one pair of skates or set up a seasonal business, be sure to get the January issue

MOTORIZED YOUR TURNING CHISEL. Teamed up with your wood lathe, a portable electric router makes turning chisels obsolete. Supported by a shop-built jig which clamps to and rides the lathe bed, the router puts chisels to shame in making duplicate cuts, and its high speed produces glass-smooth turnings

MODELMAKER'S BELT-DISK SANDER. It's a bench-top affair which is driven by your electric drill. Features a three-wheel band sander fitted with a 3/4-in. belt. Uncoupled and swung 90 deg., the drill drives a small sanding disk. Ideal for shaping small parts in both metal and wood, it can also be used to sharpen your chisels

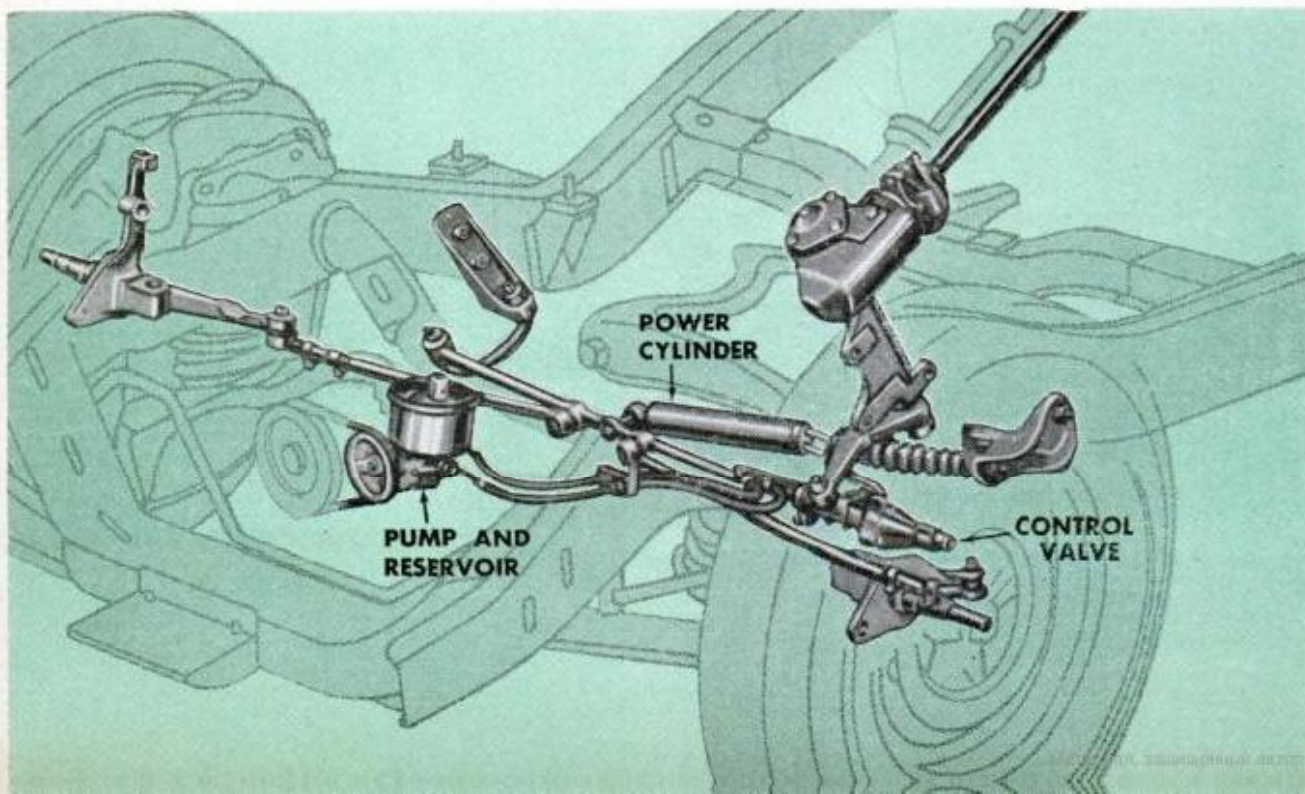
keep the power in **POWER** **STEERING**



By Morton J. Schultz

Here are the facts about your system—facts that dispel persistent myths that could cost you a pile of cash . . . like the one that claims you should replace (not repair) components . . . or the one about heat in the system breaking down hydraulic fluid

X-RAY VIEW of front wheels shows linkage of typical power steering system. Note how three main parts, connected by tubes for pressured flow and return of fluid, relate to operational schematics on next page



WHEN DETROIT developed power steering, it gave us the most sophisticated control system automotive engineers have yet devised. It's unlikely any future steering-system developments will top it—though that's always a dangerous prediction in the automotive field.

Power steering is one of the most trouble-free units you'll find in a car. It requires practically no maintenance, it seldom breaks down and it's constantly on the job, reacting immediately to the very quiver of your hands as you turn the wheel. Furthermore, when something does pop up that resembles steering troubles, chances are better than even that the cause is not in the steering, but in a related area.

Does this mean there's no need for you to understand power steering . . . to know how to maintain it . . . how to troubleshoot it and make adjustments?

By no means! Although power steering doesn't require much maintenance, it does need some. As for troubleshooting, why pay a steep "repair" bill when many times you can trace and correct power steering shortcomings yourself?

Power-steering systems vary with different make cars. All systems, however, do the same job—they proportionally assist the driver in steering. In other words, the more pressure you apply to the steering wheel, the greater will be the flow of hydraulic fluid through the power-steering system and the greater will be the assist provided to you in steering.

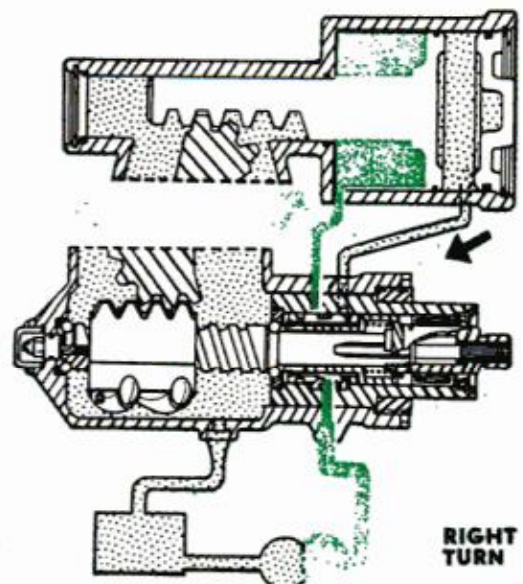
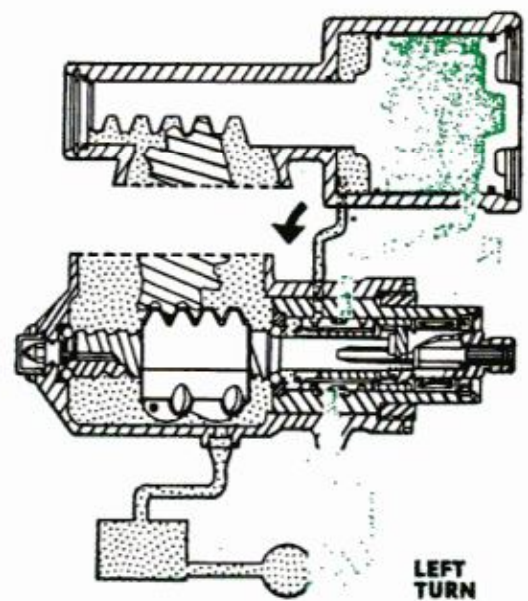
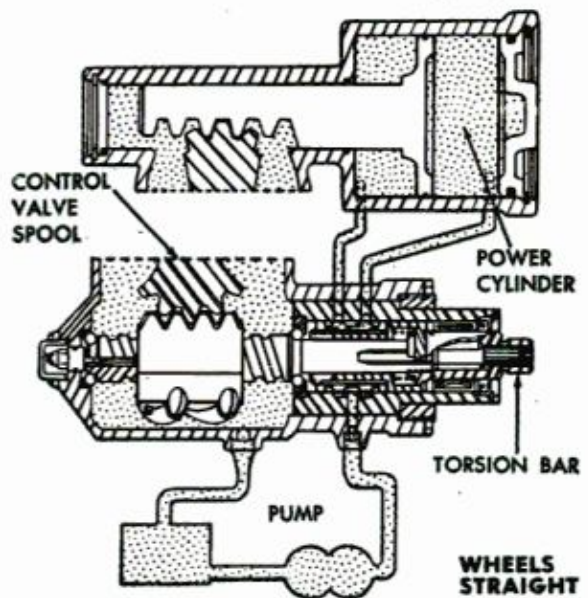
No matter what type of power-steering setup you may have in your car, it is made up of three major units, connected in the manner shown, below left. One is a pump that supplies hydraulic fluid under pressure. Another is a control valve that regulates the flow of fluid being delivered to the third major unit. This is a cylinder and piston assembly (called the power cylinder) that receives the fluid and does the actual work of turning the wheels.

Although systems differ in operation, the one described here (for late model Fords, which use a torsion-bar principle) will help in understanding power steering.

When the car's wheels are straight ahead, the control valve spool is in a neutral position—that is, it's neither to one side nor the other. A strong centering spring keeps it in this position.

Fluid being sent from the pump through the valve and to the power cylinder is equalized throughout the entire system. The fluid just makes a round trip, going to the cylinder and returning to the pump reservoir through the control valve, as in the top sketch on this page.

When the steering wheel is turned to the left, the torsion bar begins to twist. The pressure on the control valve spool



TROUBLESHOOTING A POWER STEERING SYSTEM

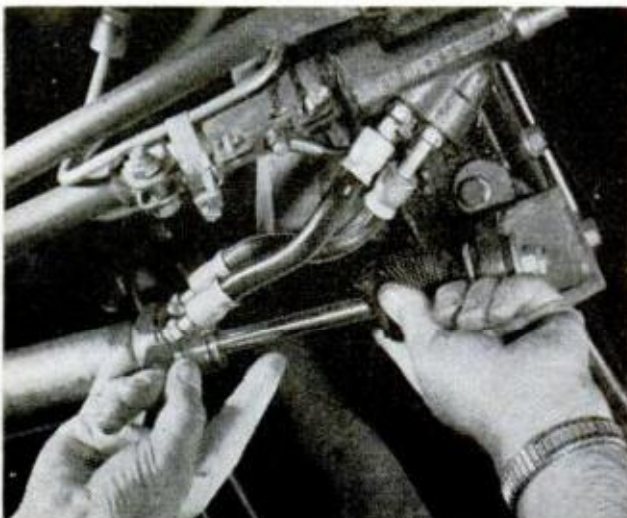


CHECK FITTINGS for tightness. In most systems, there are only four—two for the pressure line, two for the return. If space between fitting and frame is too tight for open end wrench, use flat tube type

DRAIN RESERVOIR prior to checking for leak or replacing defective line. Just disconnect one of the lines. Add $\frac{1}{2}$ teaspoon dye per pint of fluid and replace it in reservoir to help you detect leaks



CHECK PISTON ROD for scoring by skinning back protective rubber boot. Rod should have high polish without score marks or nicks. Also inspect boot itself. If cracked or damaged, it must be replaced



by the torsion bar overcomes the force of the centering spring, and the valve spool moves to the right. This means that the fluid coming from the pump under pressure can now flow through the line feeding the right side of the power cylinder, as in the center sketch.

At the same time, fluid on the left side of the cylinder is forced back through a return line to the pump reservoir. This unequal pressure on the sides of the power piston provides the steering assist. The power piston is shoved to the left since there's nothing on this side to stop its movement.

The same thing happens when the steering wheel is turned to the right, except the process is reversed (third sketch). Here, fluid is pumped to the left side of the cylinder, moving it to the right.

At the first sign of steering troubles, you should check four areas of your car before taking it to a power steering specialist. These are the steering system's fluid level, tire pressure, fan belt adjustment and wheel alignment.

If the fluid level in the system is not up to capacity, the power piston doesn't receive the force it needs to move in either direction. This results in hard steering.

It's a good idea to check the fluid level at least once every 1000 miles. To do so idle the engine until it reaches normal operating temperature. Before removing the reservoir cover, clean the area around it to prevent dirt from dropping into and contaminating the fluid.

Check to see that the fluid level is at its maximum in the reservoir, as shown in the photo on page 167. Usually, there's a line stamped into the side of the reservoir about one inch below the top—or a dipstick extending from the cap. If the fluid is low, add enough to bring it up to the indicated level. If it's *very* low, there's probably a leak in the system.

Once you add fluid, it's a good idea to bleed the system to eliminate any air pockets that may have formed in the empty space left by the low fluid level. These air pockets can cause dead spots in steering.

Run the engine at idle and turn the steering wheel quickly all the way to one side and then to the other. After doing this a few times, check the fluid level again. You might find that you have to add more fluid to bring it up to full capacity.

Maybe you've been told that you should change the fluid in your power steering at periodic intervals (such as every 25,000 miles) because the fluid breaks down under heat generated by the system. This is nonsense. There isn't enough heat given off by the system to break down an ice cube, let alone hydraulic fluid. Fluid

changes can add up to an expensive proposition over the life span of a car since each one costs about \$4.00.

If in checking the fluid level you find it to be very low—or if you ever see blotches of fluid on your garage floor near the front end of the vehicle—you had better check the system for leaks. Once leaks begin, it will mean a constant outlay of money for fluid refills if you wish to avoid hard steering.

To check for leaks, get beneath the car and clean off the pump, control valve, power cylinder, and all lines and connections. Tighten the latter, as shown in the top photo on the opposite page.

In order to detect a leak more readily, drain the fluid from the pump reservoir into a clean container (second photo) and add some pre-mixed red oil-soluble aniline dye to it. This dye is used especially for tracing leaks and can be purchased in an auto supply store.

Pour the fluid back into the reservoir and start the engine, turning the steering wheel all the way from side to side several times. This circulates the dyed fluid through the system.

While an assistant turns the wheel from side to side, holding it at each side stop for about 20 seconds, inspect the systems for leaks. If a fitting or hose is leaking, you can replace either with a new one. But if the pump, control valve or power cylinder is leaking, it will have to be ripped down for repair, and this requires the knowledge and tools of a power steering mechanic.

A leaky pump usually indicates a ruptured seal or gasket. Cost of repairing this damage varies from car to car, but generally runs about \$20.

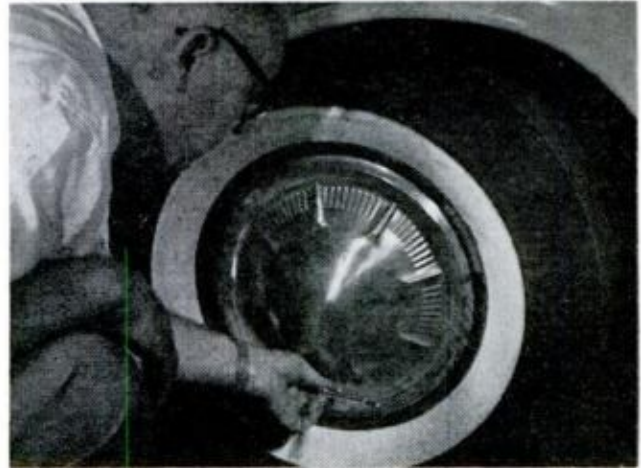
A leaky power cylinder also indicates damaged seals, which cost about \$8.50 to repair. When inspecting the power cylinder, check to see if the piston rod is scored, as in the bottom photo at left. If it is, the entire cylinder should be replaced. This costs about \$40.

A leaky control valve often means that the valve itself is damaged or badly worn. Repairs cost about \$20.

There's one point to keep in mind when you take your car to a mechanic—it could save you money: Never is it necessary to replace the complete power steering system. Don't let yourself be talked into this. In fact, it's seldom necessary to replace even one component. Most times, if a component, such as the pump, power cylinder or control valve, is damaged, it can be repaired with one of the many power steering rebuild kits available to a mechanic.

Now, let's say you've checked the fluid level, and have satisfied yourself that the

YOUR PROBLEM MAY LIE OUTSIDE THE SYSTEM



CHECK TIRE PRESSURE. Mechanics say more steering-trouble complaints are caused by low pressure than by mechanical malfunction. Keeping tires firm not only insures full-power steering but increases tire life

CHECK PUMP BELT with dial gauge that fits over belt. Pump is driven directly by fan belt, or by separate belt also driven by fan. Unless adjusted right, belt can't drive pump at r.p.m. needed to move fluid



LUBRICATE LINKAGE of steering gear, in cars where fluid doesn't double as lubricant. Just remove filler plug, add gear oil. Caution: Overfilling or use of pressure gun might force oil up into steering column



system isn't leaking. But the steering is still acting up. It's time to look *outside* the system for the cause. Run through the procedures demonstrated in the photos on the preceding page:

- Low or high pressure can lead to hard steering, pulling to one side, side-to-side wander and wheel shimmy.

- If the pump's belt is broken, glazed or worn, replace it. Adjust tension to the specifications called for in your car's manual (it's usually about ½ inch of free play). Fan belts on cars equipped with power steering must be tighter than belts on cars without power steering. If you're not sure of getting a good fit by tightening the belt yourself, it's worth the few cents to have a mechanic do the job.

Front wheels out of alignment can cause loose and jerky steering, pulling to one side, and shimmy. The tip-off to faulty alignment is irregular wear of the front tires. Be certain also that front wheel bearings are lubricated as called for in

your car's manual, since this too can affect steering performance.

- The steering gear linkage and front suspension should be kept well lubricated—if lubrication is called for. In some cars (late model Chryslers for example) it *isn't* called for, since the fluid of the power steering unit doubles as a lubricant in the steering gear box. Check your car's lubrication chart to determine whether the steering mechanism needs periodic lubing. If so, do it each time the car is greased by removing the filler plug from the steering gear box and sticking your little finger in. If the oil is below the filler plug hole, add oil till it just reaches the hole's bottom.

If by now you've failed to find the cause of poor steering, the car should be taken to a shop. Here, the mechanic will perform a fluid pressure test to isolate the trouble in either the pump or the control valve. He might also run the test shown below. Neither of these tests is within the scope of the average Saturday Mechanic. ★ ★ ★

HERE'S ONE REMEDY YOU SHOULDN'T TRY



OFF-CENTER VALVE SPOOL can cause hard steering by cutting down on fluid allowed into cylinder on a turn. If wheel turns harder in one direction than in other, there's an external adjuster on the control valve (inset) to restore proper pressure balance. But it's a job for a pro, requiring special wrenches, and should be done in conjunction with a valve-spool centering test (below). Here, precision gauge attaches to steering column to measure amount of force needed for turns, permitting exact adjustment



AUTO CLINIC

The automatic transmission of my 1962 Ford Fairlane 500 keeps slipping out of gear when I take a sharp curve at about 10 to 15 miles per hour. As soon as the car straightens out, the transmission shifts back into DRIVE. This happens in the transmission, and not with the shift lever. What's up?—D.E.A., Minnesota.

Early issues of this model had a faulty vacuum shift which caused the transmission to slip from gear at low speed. The manufacturer later replaced the original vacuum shift with another one. Remove the original part from the car (it should have a black band around it) and replace it with the new part (No. C1AP-7A377B). This one has a yellow band.

Strange noises are coming from beneath the hood of my new Chevy II. The other day on the freeway, when I was cruising at 65 to 75 m.p.h., a low-pitch siren sound developed under the hood. I dropped my speed down and a few seconds later the noise stopped. To check this out, later, my mechanic hit 90 without a peep. But when I drove the car immediately after, the noise started again. Now, it keeps occurring intermittently. Is it mechanical?—F.W.G., California.

No. If it were mechanical, the noise would be occurring constantly and not just on occasion. The cause of the noise is probably excess pressure being forced from the radiator—pressure that is being built up because of excess speed on a new engine. Your Chevy II radiator is built to accept a pressure of 13 pounds. When it exceeds this pressure, as it will when the car is driven for a time at high speed, the radiator relieves itself through the radiator pressure cap. The siren-like sound you hear is this pressure being forced from the radiator through the cap.

Hard starting when the engine is hot is a problem with my 1961 Oldsmobile Dynamic 88. It seems to cause more trouble when the car has been run for a time and then stopped for 10 to 30 minutes. I've checked points, plugs, carburetor and manifold heat control valve—all to no avail. What's next?—C.W.S., Ohio

The cause is in one of two places. You could be experiencing percolation if the engine is running hotter than normal. This causes a blockage in the fuel

system which prevents gas from flowing normally, resulting in hard starting. One way to combat this is by inserting a pressure regulator in the gas line to keep pressure from building up. Another way is to install an insulating block, which is just a gasket, beneath the carburetor. If this doesn't prevent the trouble, check the carburetor's float level for proper adjustment. One that's out of whack can cause hard starting.

The transmission on my 1956 Buick has been rebuilt, a new ball joint assembly put in, all vents cleaned and new rear seals added. Yet, I keep losing fluid through the torque tube. Why?—C.F.M., Calif.

The problem is no doubt external. Chances are you have a burr on the end of the drive shaft that's tearing into the seal, damaging it, and causing the leakage problem.

Service Tips

★ You can literally burn up electrical components in your car, especially the transistor radio, if you have them turned on while the battery is being quick-charged. The peak electrical current being put into the battery during a fast charge can surge into these items and cause internal damage. Before fast charging a battery, make sure the radio and all other electrical components are turned off. To be doubly sure that damage doesn't occur, disconnect the battery ground cable during the quick-charge period.

★ If your 1963 6-cylinder Ford with a manual choke is having cold engine starting problems, blame it on an over-long choke cable. The extra length interferes with the pull-down rod or control shaft lever when the choke control knob is pulled all the way out. The obstruction prevents full closing of the choke plate, resulting in too lean a fuel mixture in the carburetor when the cold engine is started. Cutting off the excessive length of choke wire solves the problem. The end of the choke-control housing should extend only 1/4 to 1/2 inch beyond the clamp.

As a service to the readers of Popular Mechanics in solving problems relating to their cars or to driving in general, you are invited to submit your questions for answering either through this column or by mail. Address Auto Clinic, Popular Mechanics Magazine, 575 Lexington Avenue, New York 22, New York.

\$35

Electric

Tired of hopping out of the car in rain or sleet to tug up that garage door? Here are plans for a low-cost motorized rig that you assemble and install yourself

YOU TURN INTO YOUR DRIVE and glide to a stop beside something that looks like a plumber's periscope rising unobtrusively from shrubs on the left. You dart your hand through the car window, insert a key, and the garage door at the far end of the drive rolls back to let you pass.

The set-up isn't new, of course. But many people have regarded automatic garage door openers as a luxury. The one shown here certainly isn't. You can make it yourself at a fraction of what a commercial unit costs.

Up till now, economy-minded homeowners have often been discouraged from building their own systems because con-

CLICK! A key switch mounted on a post at the head of the drive triggers the mechanism inside the garage. Door won't raise without key signal



Door Opener

By Frank L. Greenwald

struction called for a "bomb-bay door opener" or "wing flap actuator" to serve as the reduction unit. This opener neatly sidesteps the need for *any* reduction unit. Using only standard hardware items, plus a few parts from an electronics supply house, you can make it for less than \$20, if you already have a $\frac{1}{4}$ or $\frac{1}{3}$ hp. motor on hand (See sample costs, page 178.)

One valuable feature not usually found on home-built openers is the safety trip located along the lower edge of the door. Should the door encounter any obstacle while it's closing, the trip wire automatically shuts off the mechanism. (Perhaps a child has wandered into its path, or you've neglected to drive the car into the garage far enough to clear.) And it won't start again until it's reactivated by the key switch or an interior push button.

First construction step is to weld up a 9-ft. threaded rod from three 3-ft. sections of Redibolt, as shown in photos on page 176. When you turn two sections into a

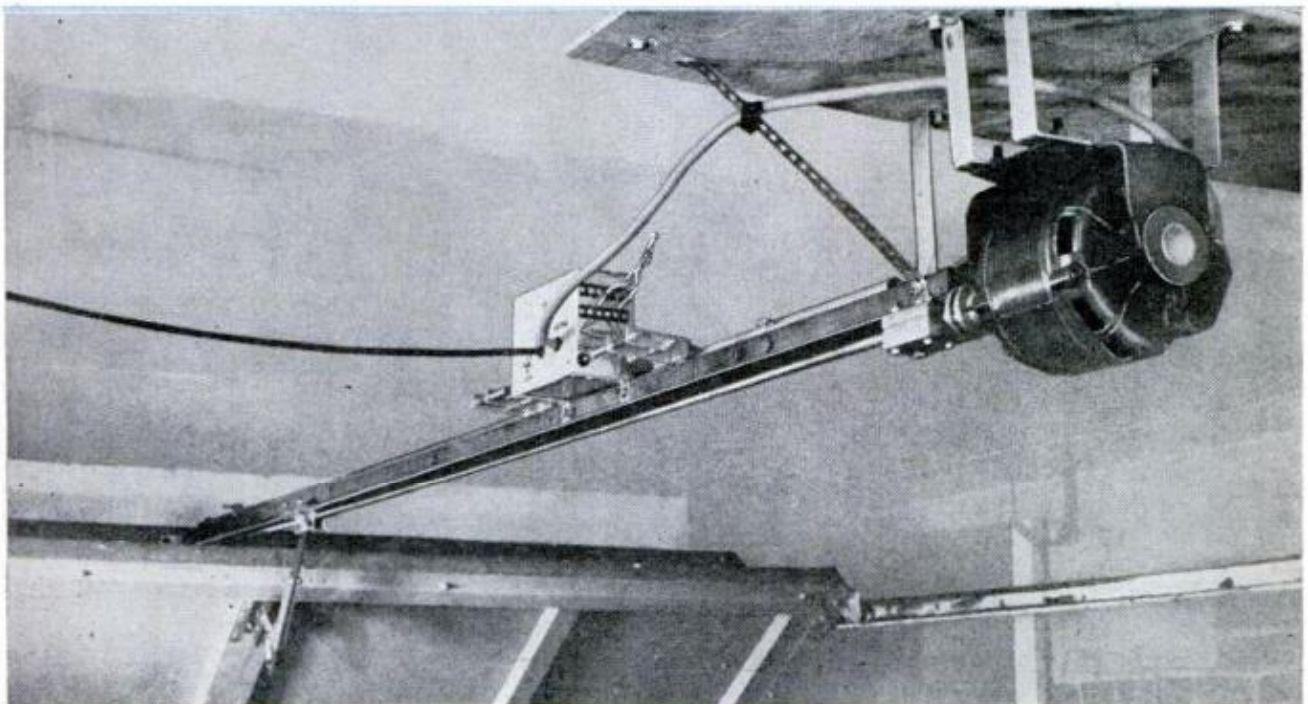
nut for thread-alignment, leave $\frac{1}{16}$ -in. gap between the ends for weld penetration.

The task of running a $\frac{1}{2}$ -in. die over three feet of thread to reach the welds (from each end) can be speeded up by locking two nuts on one end and using a socket and speeder wrench.

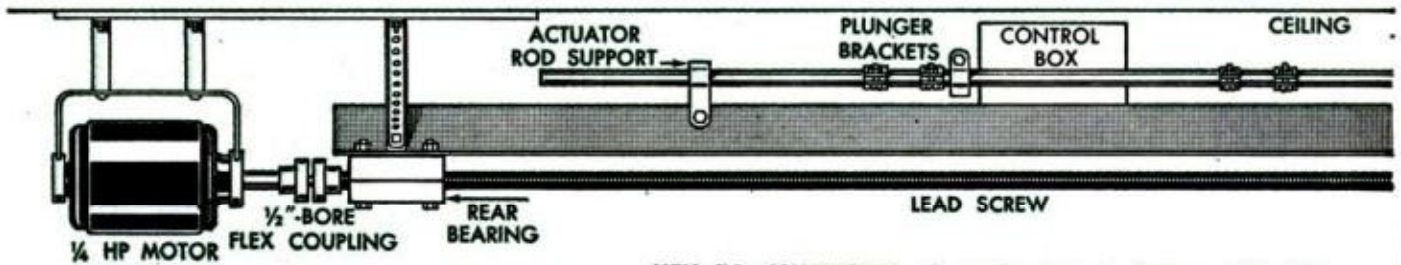
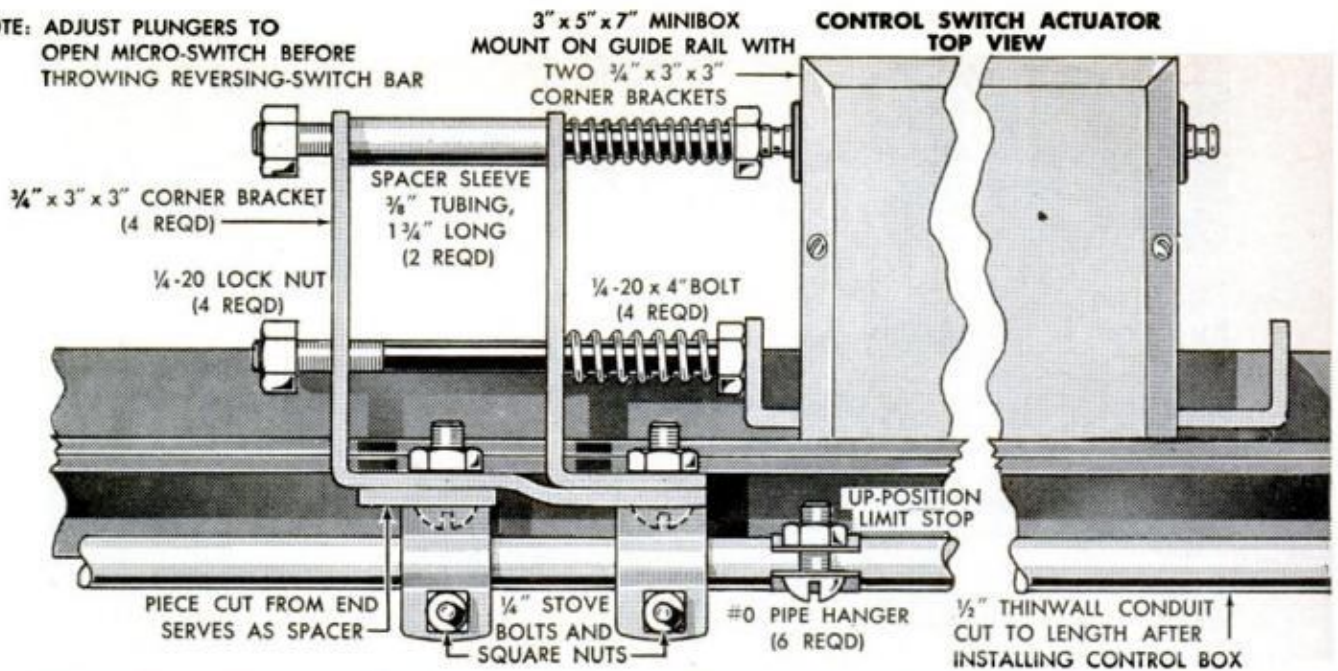
Next, make up the track by bolting two 96-in. lengths of angle iron back-to-back to form an inverted T. I found $\frac{1}{8}$ x $\frac{7}{8}$ x $1\frac{3}{8}$ -in. angle available at a local iron shop, but more-standard $\frac{1}{8}$ x 1 x 1-in. angle works as well without altering any of the other measurements. If continuous lengths aren't available, you can make up a track from six 3-ft. lengths of 1x1, available at most hardware stores. One length should be cut in half, with one of the halves bolted to a full length at the start. The resulting track, with staggered joints, will function satisfactorily if you carefully align the joints in the horizontal flanges.

The easiest way to bore the bearing blocks on the split line is to groove the

INSIDE GARAGE, the mechanism can be operated by several push buttons located at convenient points. Note how traveler (linked to door at left) is drawn toward control box (center) where it will break a contact, shutting off motor that spins lead screw (underslung from angle-iron track). Door is then up

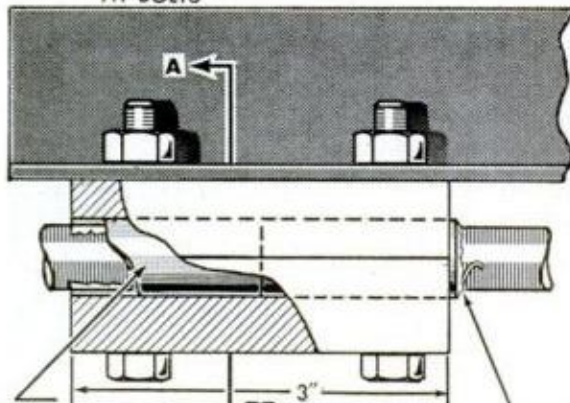


NOTE: ADJUST PLUNGERS TO OPEN MICRO-SWITCH BEFORE THROWING REVERSING-SWITCH BAR



KEY TO SIMPLICITY of mechanism is fact a 1/2-in.-13 threaded rod, turning at 1725 r.p.m., will advance a nut about 2 in. per second—just right for opening or closing garage doors. Length of upper portion of spring-loaded bar of door link (far right) must be sufficient to fully seat door before reaching vertical position shown

1/8" x 3/8" x 1 3/8"
ANGLE IRON FASTENED
EVERY 18" WITH 1/4" x 1/2"
FH BOLTS



BUSHINGS
MUST TURN FREE

LEAD SCREW

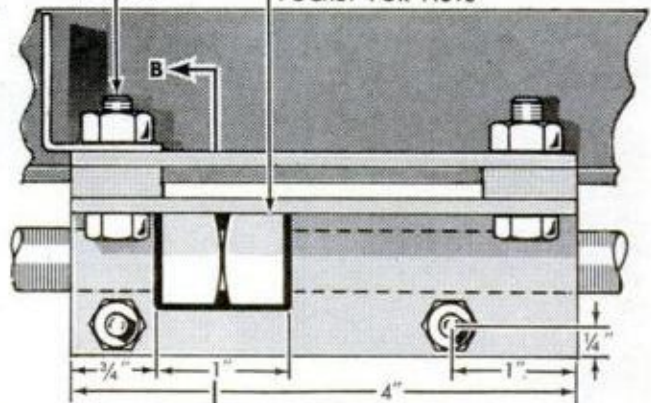
WRAP THREADS WITH #18
IRON OR COPPER WIRE,
FORCE BUSHINGS ON AND
SOLDER AT ENDS

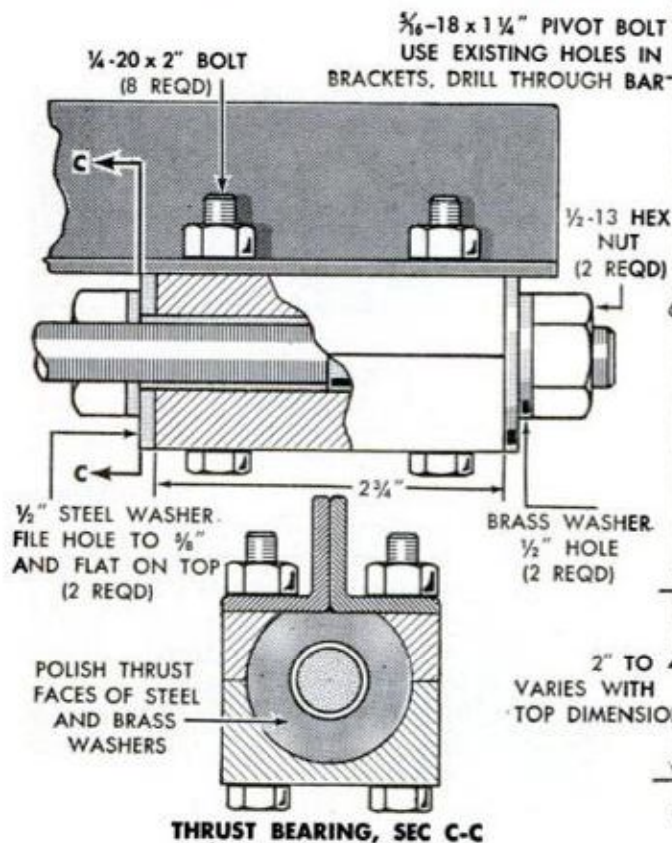
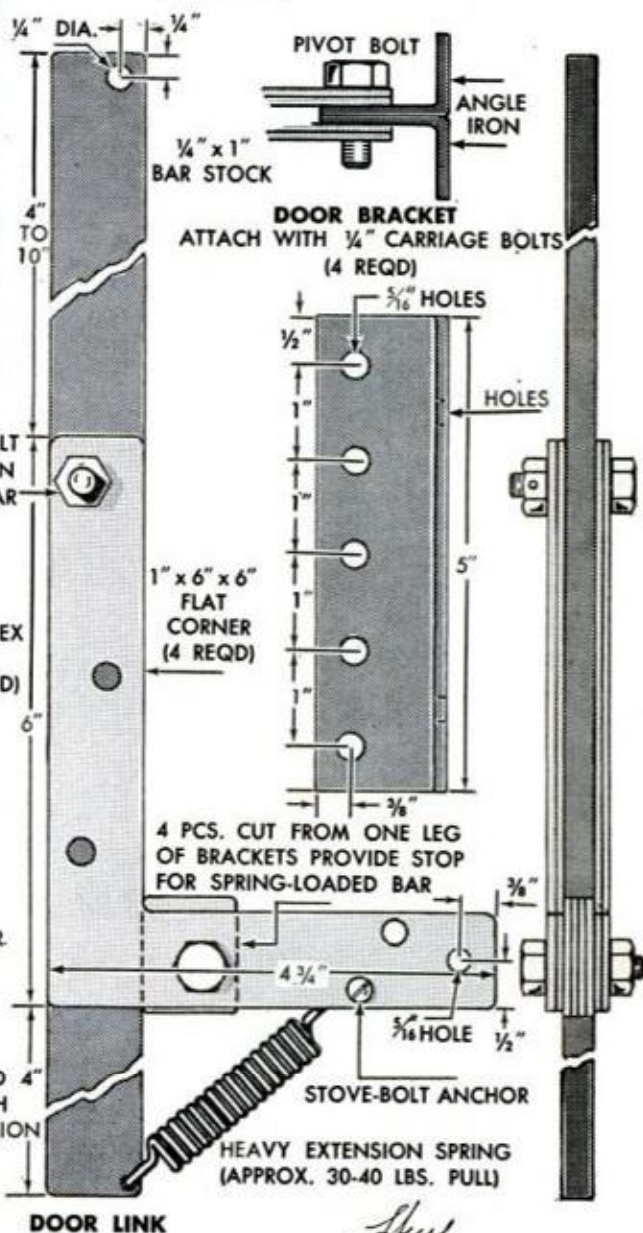
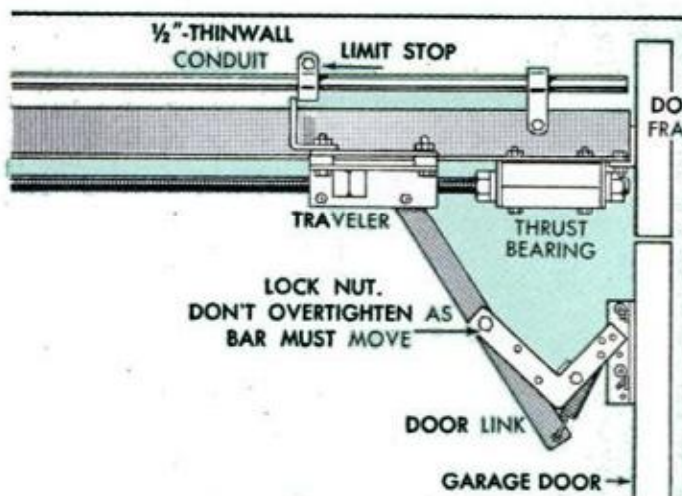
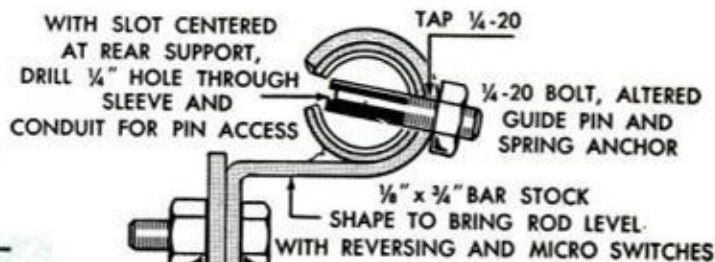
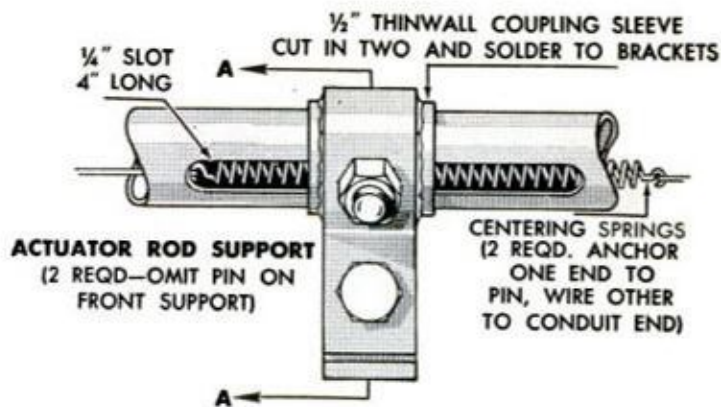
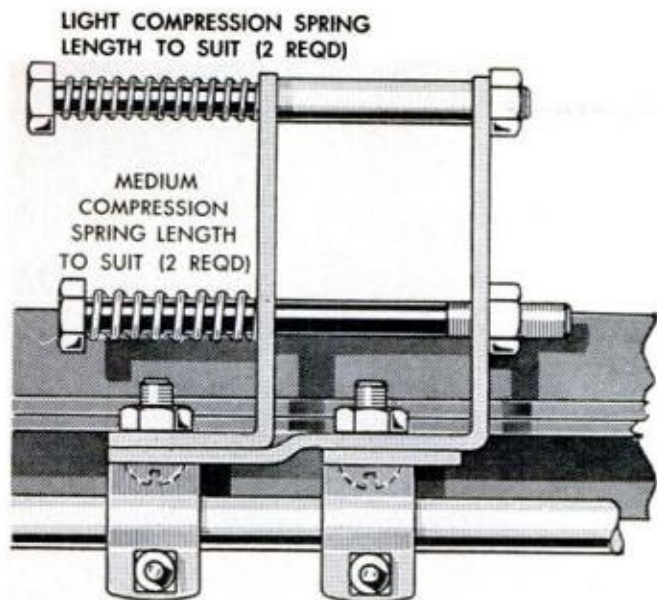
STEEL SPACER FOR
CLEARANCE

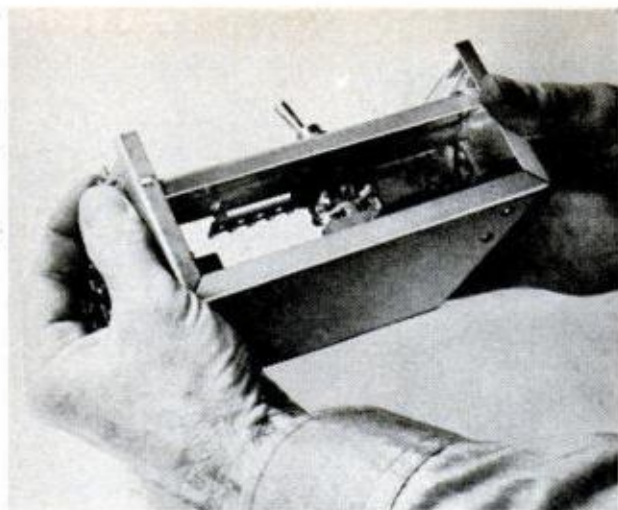
MAPLE BEARING BLOCKS
WITH 5/8" HOLE BORED
ON SPLIT LINE

REAR BEARING, SEC. A-A

1/4-20 x 1" BOLT
(4 REQD)



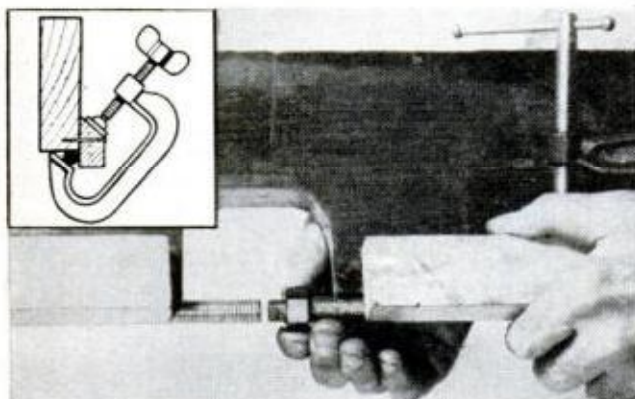




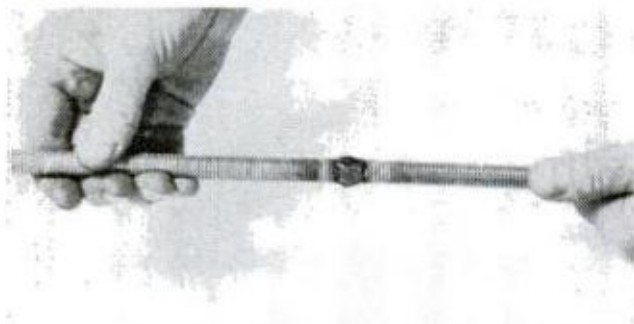
CONTROL BOX is modified Minibox. Ordinary toggle switch reverses motor connections, is flicked by sliding bar with hole to take bat handle. Switch is mounted on ledge as shown at left and in alteration sketch, next page



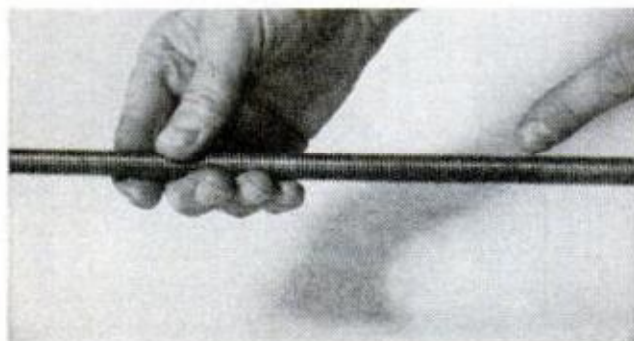
POSITIONING JIG is long plank with cleats nailed along one edge to create shoulder for clamping rods (inset). Turn rods into nut for thread alignment



BACK NUT OFF after clamping, and weld the joint. Joint will have bulge of excess metal (below) which must be filed or ground down to diameter of $\frac{1}{2}$ in.



JOINT DISAPPEARS when $\frac{1}{2}$ -in.-13 die is run through weld to produce continuous thread. You must weld three 3-ft. lengths for required 9-ft. lead screw



mating faces down the center before clamping them together. The aligned grooves provide a pilot hole for the drill—which should be a full-size-body (carpenter's) bit. Before assembly, soak the maple blocks thoroughly in light engine oil, then shim the split line as needed for running clearance for the bushings.

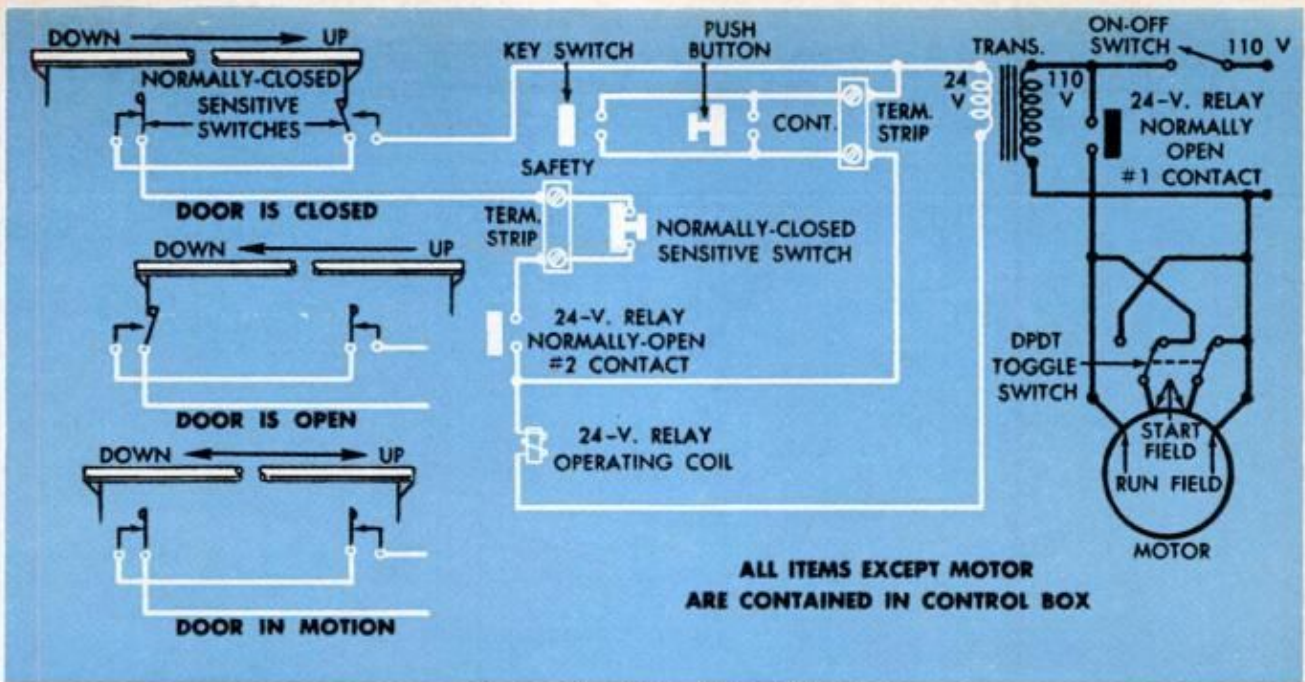
The two bushings for the rear bearing are forced onto the shaft over wire wound in the threads. A fillet of solder is placed at both ends to secure the wire and bushings to the shaft. This is not necessary with the front bushings.

The traveler—which rides both track and lead screw—is made of two pieces of angle iron with a window cut in each to house two $\frac{1}{2}$ -in.-square nuts. Run these nuts on the lead screw before you hang it in the bearings. Assemble the traveler around the nuts, inserting steel spacers (or square nuts) between the angle and the 4-in.-long steel flange pieces, to provide running clearance on the track.

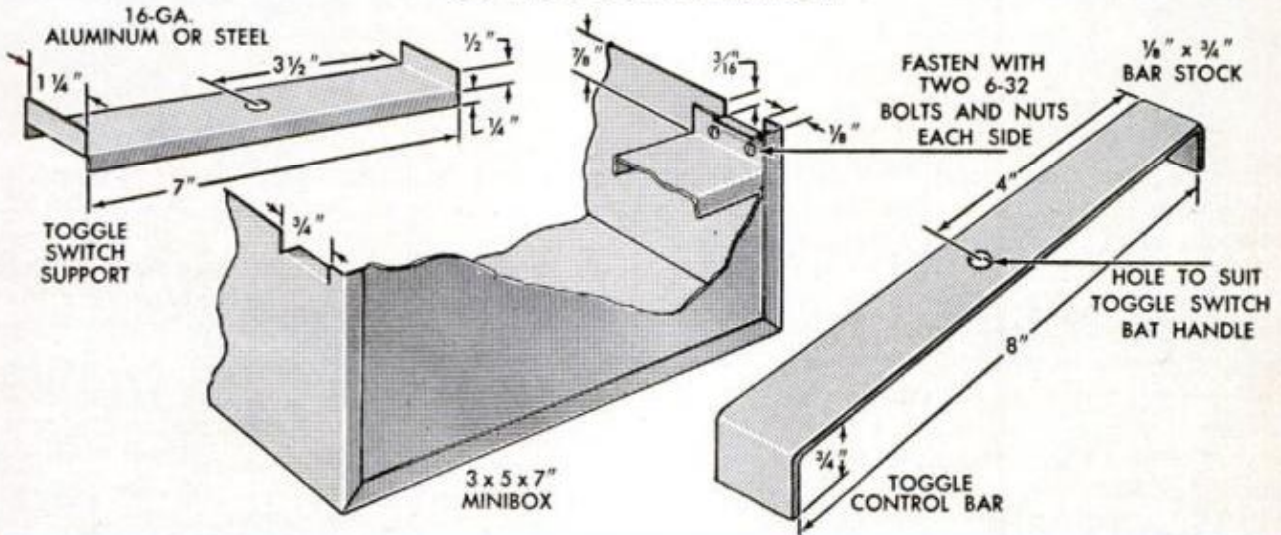
Hang the track at the lowest position that will permit the upswinging door to clear. The door end of the track rests on an angle-iron bracket fastened to the door header with $\frac{3}{8}$ x $1\frac{1}{2}$ -in. lag screws. The rear end is supported by $\frac{1}{8}$ x 1-in. flat steel and braced by perforated hanger strap. To simplify the hanging from an unfinished garage ceiling, I spanned three joists with a 4-ft.-long panel of $\frac{1}{2}$ -in. plywood, to create a mounting platform.

The electrical circuit is designed for reliable operation without use of fancy components. A 24-volt filament transformer and double-pole-double-throw relay provide a safe, low-voltage control circuit.

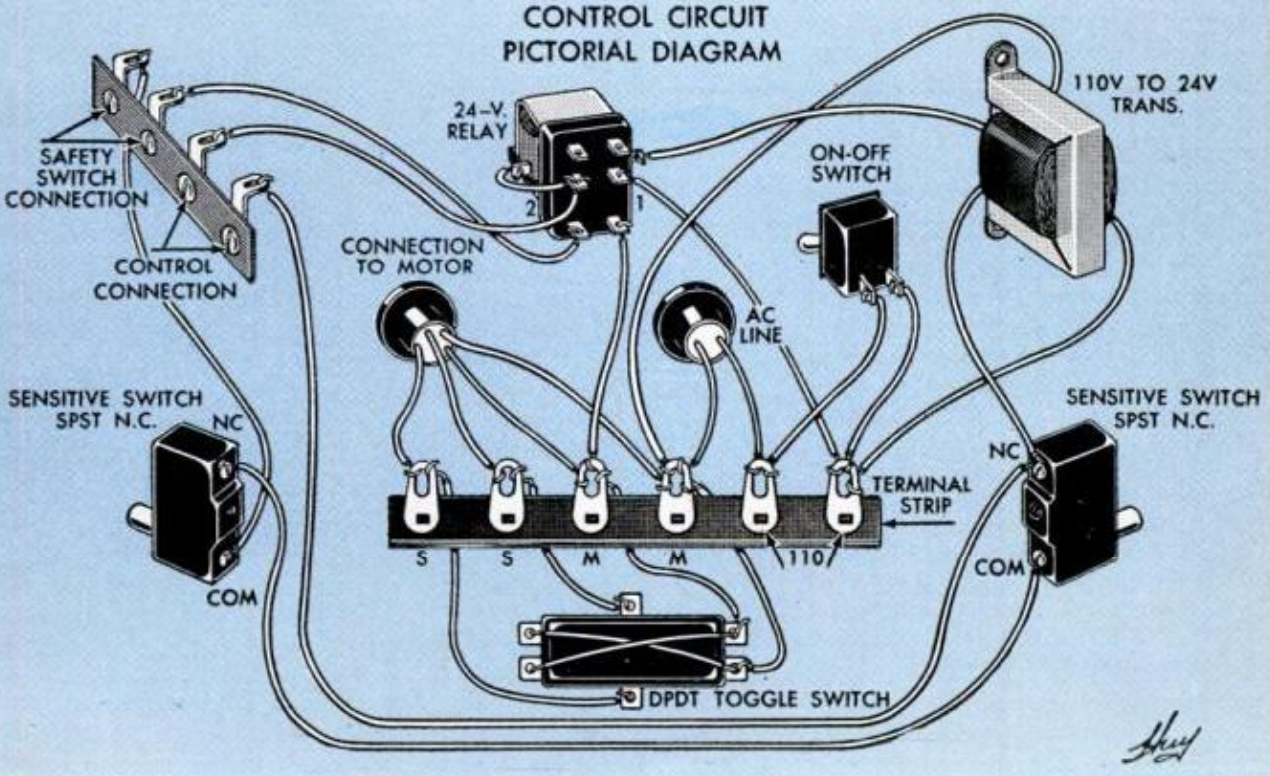
Any momentary connection across the control terminals completes the circuit to the relay operating coil. When the relay closes, the #1 contact closes and starts the motor. A holding circuit is completed

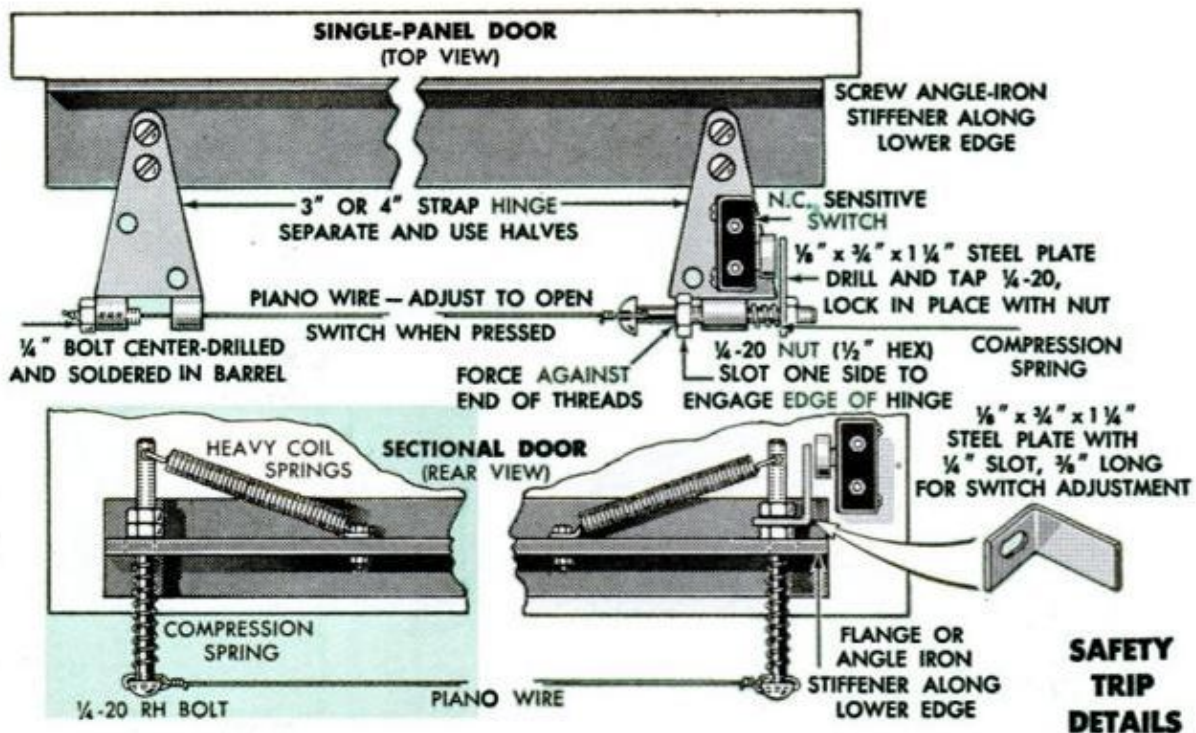


CONTROL BOX ALTERATION



CONTROL CIRCUIT PICTORIAL DIAGRAM





through the "up" and "down" sensitive switches, the normally-closed safety switch, and the #2 relay contact. The motor continues to operate until the "down" switch is opened at the end of the travel. The #1 relay contact opens, stopping the motor, and the #2 contact opens in the maintaining circuit to the relay. After the motor circuit has been opened but before the travel-action stops, the spring-loaded plunger throws the toggle switch, reversing the starting field leads.

After wiring, check out the circuit as follows: Separate the starting and running field leads, connect the power cord to

a 110-volt supply and flick on the on-off switch. Connect the safety switch terminals, then make momentary contact across the control terminals. The relay should pick up and stay in. Actuation of either sensitive switch should drop out the relay.

Mount the control box on top the rail with corner brackets, as shown on page 173. Form the two actuator rod supports so that the conduit moves on a level with the toggle control bar and sensitive-switch buttons. Attach the plunger assemblies to the conduit so that the pair on one side has about 2-in. clearance when the other pair is making contact. The actuator rod is moved back-and-forth by means of a right-angle bracket extending above the traveler to contact the two limit stops.

To install these stops, first position the traveler several inches from the front bearing, attach the "down" stop (as shown in the color-panel sketch, page 175) and connect the door link. Note that with the door fully-closed, the link should have a slight amount of spring load. Now, set the reversing switch to open the door, start the motor and let the door draw back to full-open position. Stop the action by pressing either sensitive switch. Attach the "up" stop so that it is in contact with the traveler bracket. Now, close the door, making sure the "down" stop halts the door for smooth seating.

For my key switch, I drilled a $\frac{1}{16}$ -in. aluminum disk and wedged this assembly tight in the threads of a $1\frac{1}{4}$ -in. pipe elbow. Plastic bell wire is run down inside the pipe and trenched back to the garage. ★ ★ ★

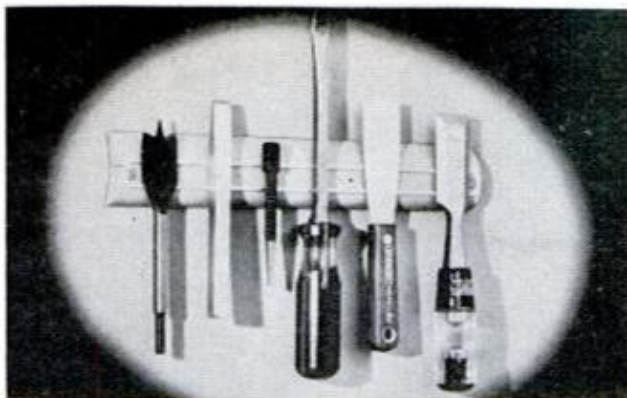
MATERIALS LIST

ELECTRICAL

| | | |
|---|--|-------------|
| 1 | DPDT 24-V. Relay (Guardian 1200-G24) | 3.60 |
| 1 | DPDT Toggle Switch (Cutler-Hammer) 7564-K6 | 1.16 |
| 3 | SPST Normally-Closed Sensitive Switch | .60 |
| 1 | 24-V. Filament Transformer | 1.49 |
| 1 | 3x5x7-in. (Bud Minibox CP-3008-A) | 1.32 |
| 1 | Key Switch (Arrow-Hart 817.15-L) | 1.63 |
| | | <u>9.80</u> |

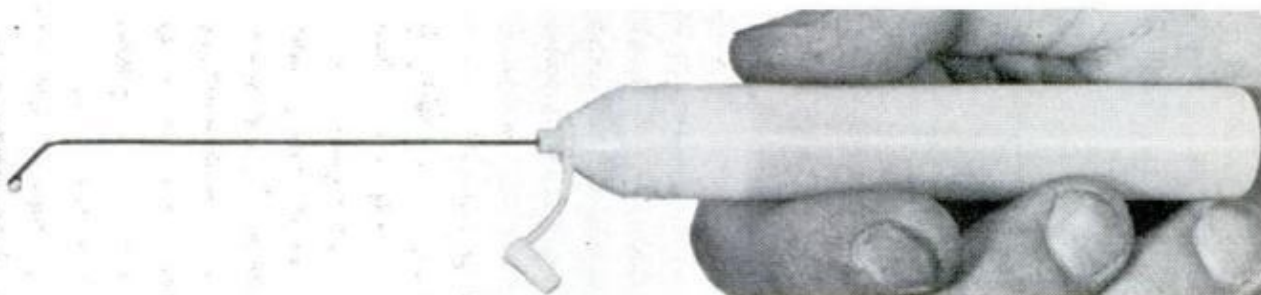
MECHANICAL

| | | |
|--------|--|----------------|
| 3 | $\frac{1}{2}$ -in.-13 Threaded Rod (3-ft. lengths) | 1.89 |
| 16 ft. | $\frac{1}{8}$ x $\frac{7}{8}$ x $1\frac{3}{8}$ -in. angle iron | 3.20 |
| 10 ft. | $\frac{1}{2}$ -in. Thinwall Conduit | .69 |
| 4 | 1x6x6-in. Flat Corner | .68 |
| 6 | $\frac{3}{4}$ x3x3-in. Corner Bracket | .74 |
| 6 | Pipe Support Clamp, Size 0 | .48 |
| 12 | $\frac{1}{4}$ -in.-20 Nylon-Pellet Lock Nuts | .44 |
| 4 | $\frac{1}{2}$ I.D. x $\frac{5}{8}$ O.D. x $1\frac{1}{2}$ -in. Bronze Bushing | 1.16 |
| 1 | $\frac{1}{2}$ -in. Bore Flex Coupling | .89 |
| | | <u>10.17</u> |
| 1 | $\frac{1}{4}$ -HP. Motor, $\frac{1}{2}$ -in. Shaft (Sears) | 12.99 |
| | Total, minus taxes, postage | <u>\$32.96</u> |



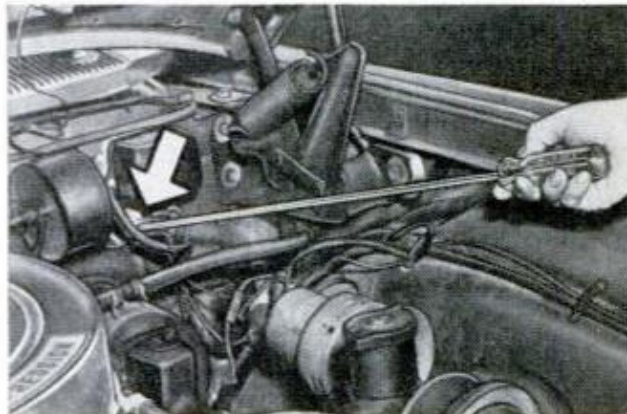
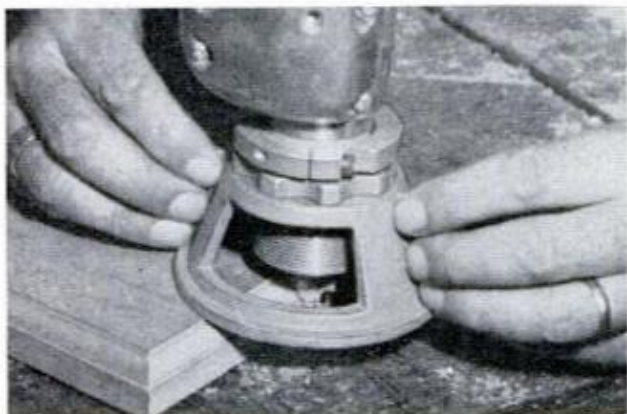
MAGNETIC TOOL RACK holds scissors, knives, chisels, etc. Designed to angle tool points inward for greater safety. Unit is 12 in. long and has interlocking ends for adding other units. Costs about \$2.89 at dealers. The Stanley Works, Hardware Div., New Britain, Conn.

PRECISION OILER makes an easy job of lubricating clocks, tiny motors, appliances and other small mechanisms. A squeeze of the plastic body delivers any desired amount—even a fraction of a drop—of high-grade, gumless instrument oil. Stainless steel spout retracts, permitting oiler to be carried like a fountain pen. Over-all length, extended, is 9½ in. Retail for \$1.00. Armité, 1845 Randolph Street, Los Angeles 1, Calif.

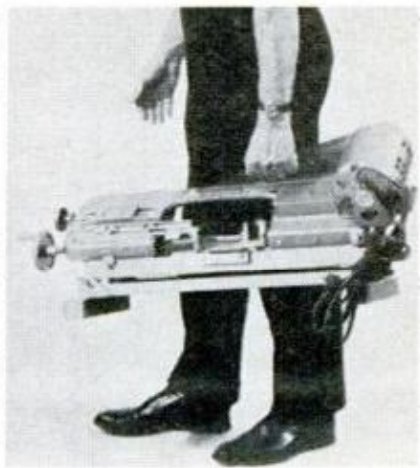
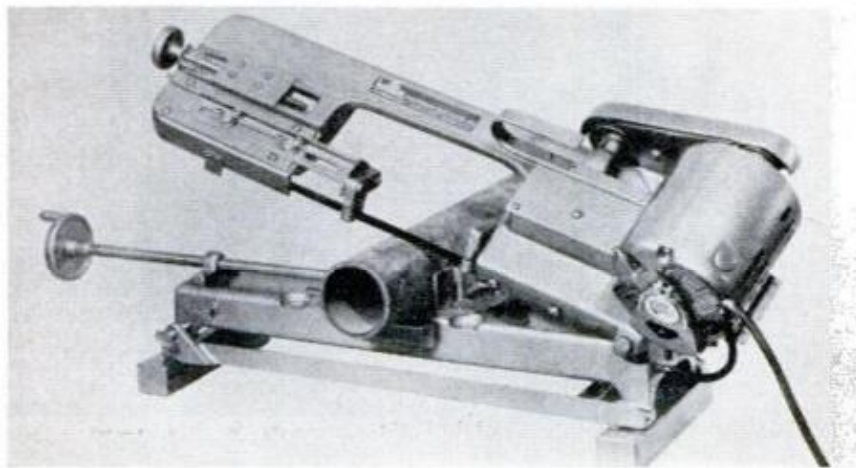


CONVERSION KIT lets you use your ¼-in. electric drill as a router. Performed well in PM tests, despite drill's relatively low spindle speed. Priced at \$9.95. B&L Products, 7480 Potter Road, Davison, Mich.

LONG SCREWDRIVER has a 20-in. No. 2 Phillips blade that reaches into many places almost inaccessible with normal-length tools. Costs \$2.44 at dealers. Vaco Products, 317 E. Ontario St., Chicago 11, Ill.



HORIZONTAL BANDSAW is reported to cut metal and plastics faster than reciprocal power hacksaws. It's made of cast aluminum, and weighs only 52 lbs. with ¼-hp. motor. Capacities are 3½ x 6 in. square, 3½ in. round and 3½ x 3 in. at 45 deg. Manufacturer claims this saw cuts square within .005 in. on a 3-in. cut. The unit sells for \$199.50. Willis Machinery and Tools Company, 4848 Monroe Street, Toledo 13, Ohio



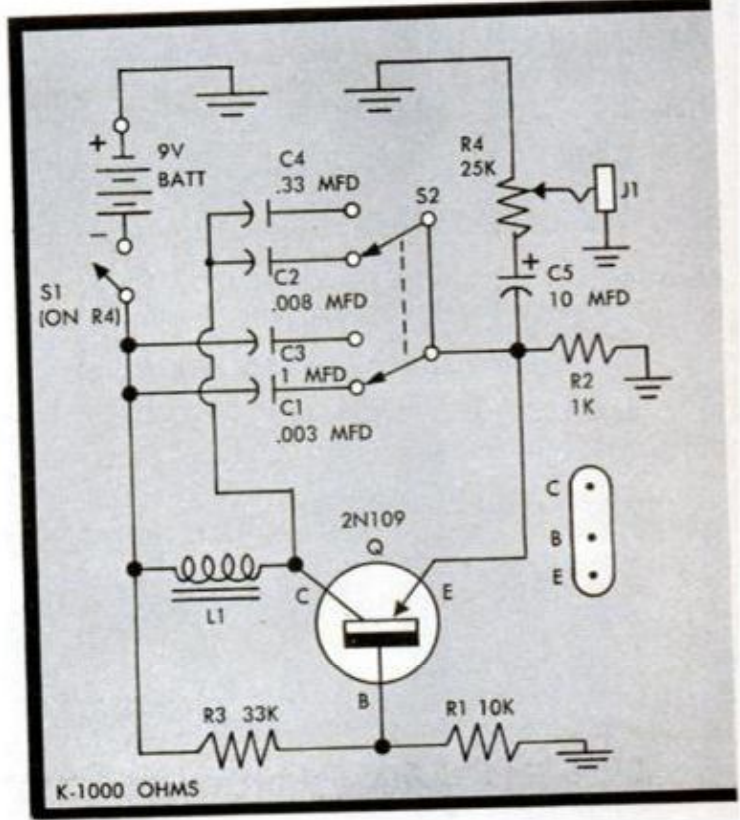


ONE LEAD connects the tester to your recorder. Just plug it into the input jack. Record for two minutes at each switch setting, playback, and you'll know what shape recorder tape heads are in

Check Your Tape Heads

By Tracy Diers

Build-it-yourself tester gives a rapid go-no-go test that tells you when tape-recorder heads are worn and require replacement. The one-transistor circuit is economical, and insures getting the most from your recorder



ARE YOUR TAPE-RECORDER heads worn? Chances are the answer is yes, and you don't even know it.

The result is poor high-frequency response that is detracting from the sound quality of the tapes you have been listening to. But don't wait until you actually have trouble. Build this tester, and keep a running check on the condition of your recorder's record and playback heads.

Assemble the tester following the schematic. Build it onto a piece of perforated phenolic board, and package it in a small metal case. The unit is actually a compact 1-transistor audio amplifier that produces both 1-kc. and 10-kc. (kilocycle) signals.

Check the completed tester with a pair of headphones connected to the output jack. You should hear pure 1-kc. and 10-kc. signals fully controlled by the level control. Once you're sure the tester is operating try it out on your tape recorder.

Plug the tester into the "radio-phon" jack of the recorder. Start with the 10-kc. signal and turn up the tester's output gain to almost maximum. Then adjust the recorder's volume control until the indicator shows the normal level input. Record for about two minutes.

Now switch the tester to its 1-kc. range and adjust the output to match the strength of the 10-kc. signal (use your *v.t.v.m.* here). Do not touch the tape recorder volume control. Then record for another

two-minute stretch. What you have done is feed in two signals separated by a 10-to-1 ratio at the same input level.

Now play the tape back with your *v.t.v.m.* connected to the tape-recorder output. If the tape heads are in good shape, you will get a higher reading on the 10-kc. signal than on the 1-kc. signal.

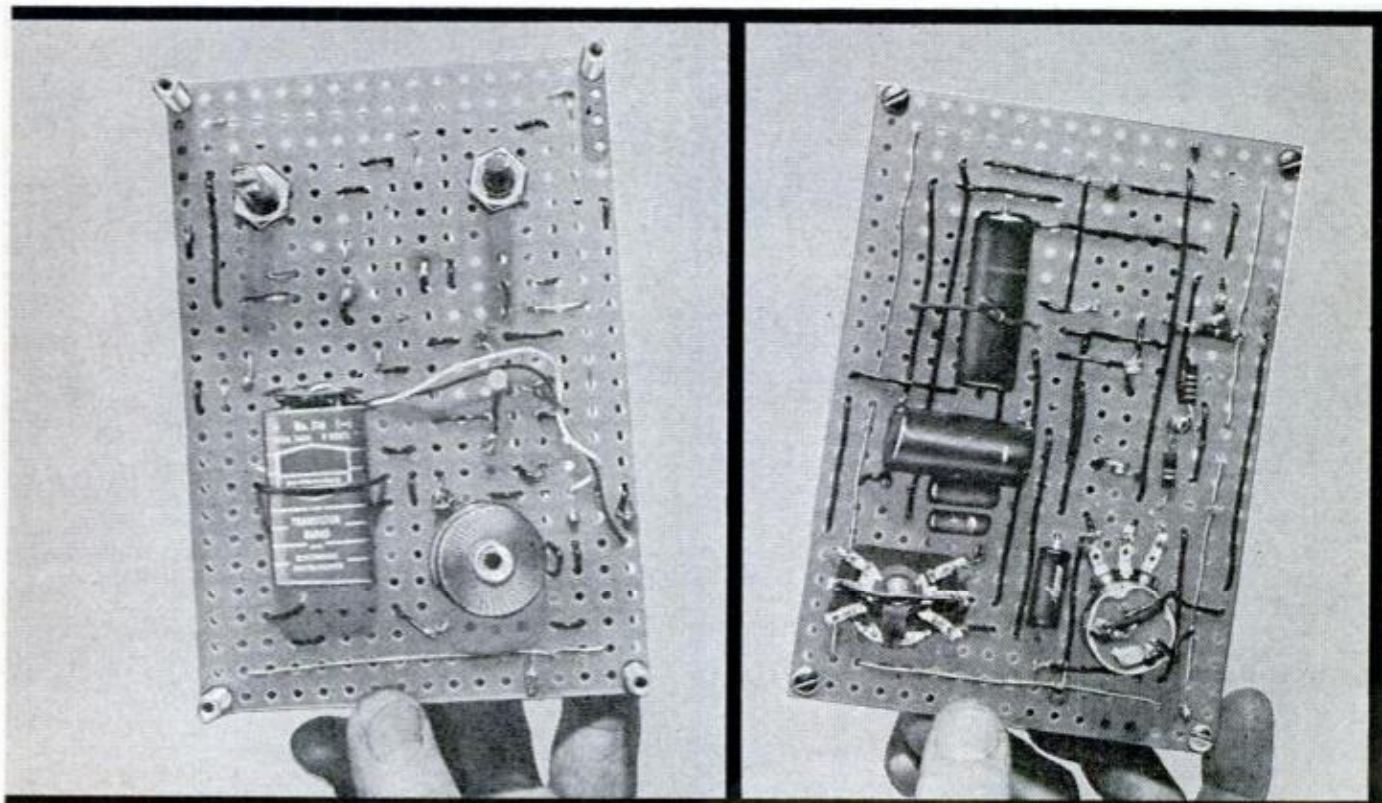
If the head is worn, the 10-kc. signal will be weaker than the 1-kc. signal. This happens because head wear widens the gap in the head which in turn cuts down on reproduction of high-frequency signals.

Check your heads in this manner after every 10 hours of use and you'll pick up worn heads before they start detracting from your listening pleasure. ★★★

PARTS LIST

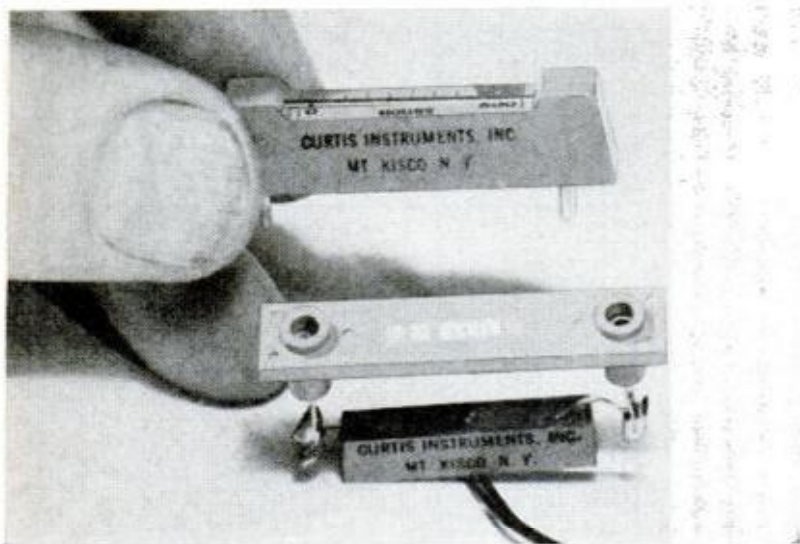
- R1—10,000 ohms, ½-watt carbon resistor
- R2—1000 ohms, ½-watt carbon resistor
- R3—33,000 ohms, ½-watt carbon resistor
- R4—potentiometer, 25,000 ohms, linear, with s.p.s.t. switch S1
- C1—.003 MFD, 25 volts or higher
- C2—.008 MFD, 25 volts or higher
- C3—1 MFD, 25 volts or higher
- C4—0.33 MFD, 25 volts or higher
- C5—10 MFD, 25 volts, electrolytic
- Q—2N109 RCA transistor
- L1—100 mh iron-core choke (Miller 960)
- J1—phone jack
- S1—switch on R4
- S2—2-pole 2-position shorting (Centralab 1462)
- Case, 7 x 5 x 3 inches (Premier PMC 1008)
- Dial plate (Mallory 484)

ALL COMPONENTS are mounted on a perforated phenolic board. This eases construction and makes for a neat arrangement of parts and wiring. The finished board is mounted into a metal case with four tubular spacers. Power for the tester is a built-in 9-volt battery which makes the unit portable

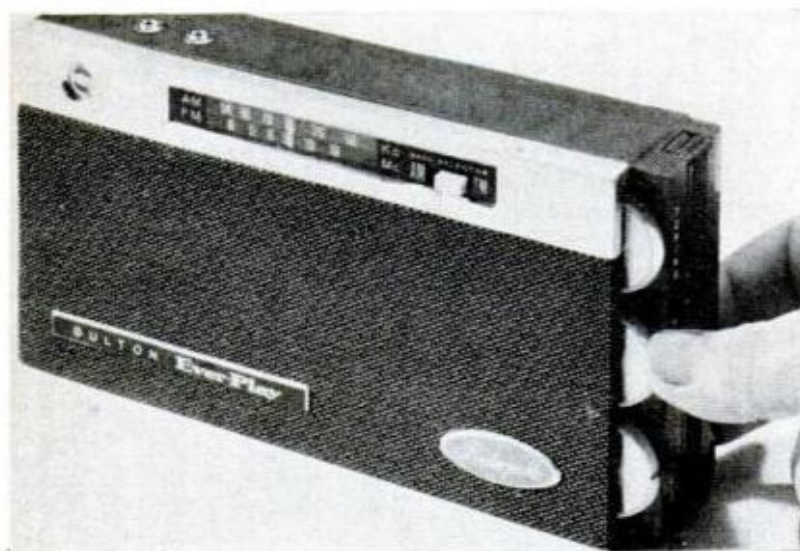


What's New in Electronics

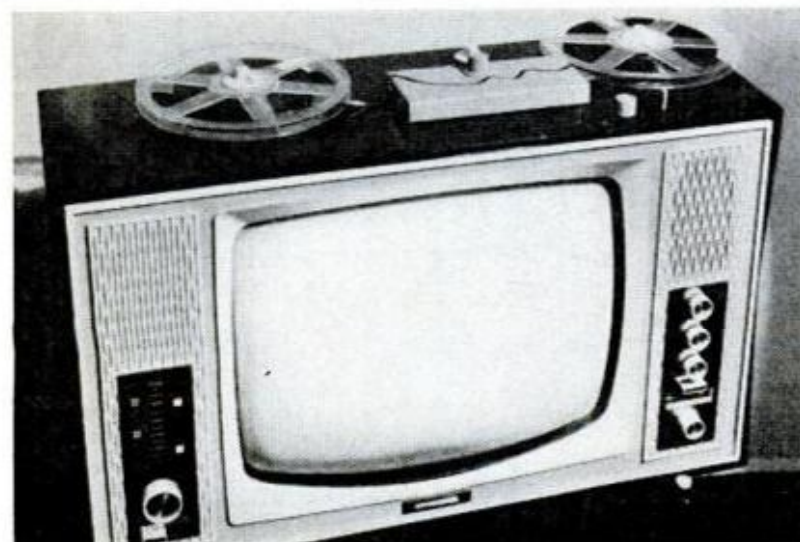
TRIPLE-LENGTH RECORDING TAPE, Scotch Brand 290, comes in 3600-foot lengths on 7-inch reels. The new tape gives 33 percent more recording time than previously available—90 minutes of uninterrupted recording time at a speed of $7\frac{1}{2}$ inches per second. The extra playing time is made possible by a half-mil polyester tensilized backing and a 0.18 mil coating of iron oxide. There's even a built-in silicon lubricant. The price is \$11.95 for a 7-inch reel, \$2.95 for a $3\frac{1}{4}$ -inch reel. The tape is made by 3M Mfg. Co.



← **MINIATURE ELECTRONIC TIMER** is ideal for keeping a check on phonograph stylus use. Mount a thousand-hour unit on the turntable and wire it in parallel with the turntable motor. It will keep an accurate record of stylus use. After a thousand hours, replace the stylus and timer. Curtis Instruments Inc., 351 Lexington Ave., Mt. Kisco, N.Y.



← **EVER-PLAY AM-FM RADIO** is powered by rechargeable nickel cadmium batteries which never need replacement. The set will play continuously for 24 hours on one overnight charge. It has a built-in afc circuit to prevent FM drift. Tuning indicator shows both proper tuning and battery condition. Price is \$79.95 from Gulton Industries Inc.



← **\$200 TV TAPE RECORDER** has been developed in England. It uses a $\frac{1}{4}$ -inch tape that runs at 120 or 60 inches per second. An 11-inch reel of tape gives 20 minutes of recording on each side, will cost about \$25. Set will be made and sold in U.S. by Cinerama-Telecan. Also coming from England is 33-r.p.m. record that plays back a TV picture



\$2.98 Clock Radio

Convert your alarm clock into a radio alarm

ARE YOU ONE of the millions of sleepy people who have to wake up each morning to an alarm clock? Do you hate that clanging? Then you'll be interested in this idea. With a simple adaptation of your clock you can wake up to your choice of music or an early-morning news broadcast.

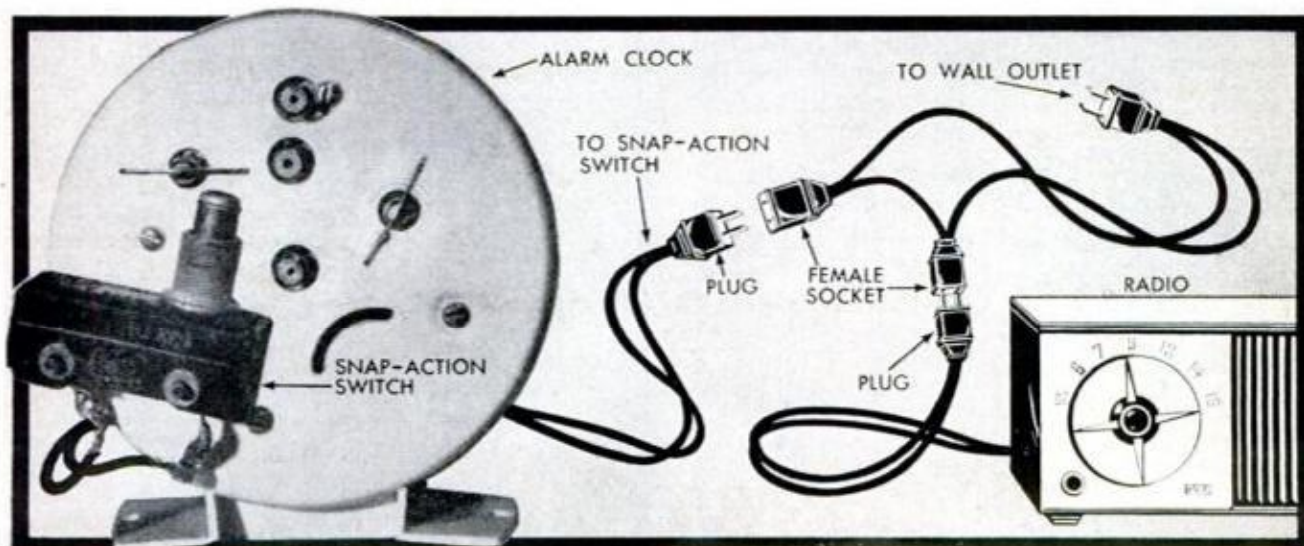
You don't need any electronic experience to convert easily most ordinary alarm clocks to radio alarms. First step is to remove the back from the clock and silence the alarm by wrapping a couple of strips of rubber tape around the clapper.

Next get a normally open snap-action switch from a local electronics supply house and mount it on the rear of the

clock. Set it up as shown below so when the alarm goes off, the winding knob trips the switch turning on the radio.

Wiring is simple. Connect the switch into the radio's line cord as shown in the schematic below, and insulate all joints with electrical tape. When the alarm goes off, the switch will close and the radio will be turned on. It will continue to play until you turn it off or rewind the clock alarm to release the pressure on the switch. Now your sweet dreams can be interrupted by music each morning if you remember to set the alarm for about five minutes past the hour to avoid catching the station break commercials.—*By John W. Spencer*

THE SNAP-ACTION SWITCH is mounted on the rear of the clock and arranged so it is tripped when the alarm rings. It is wired into the radio line-cord as shown and turns the radio on when it closes. Solder all wiring connections





Hottest new ideas in photography—

The new quick-loading



New KODAK DUEX 8 Cassette uses regular 8mm roll film. No in-camera threading!



Cassette snaps into camera. Flip it over after first 25 ft.—you're set to go again!

New KODAK Electric 8 Zoom Camera

Always keeps you ready for action

There's nothing to slow you down when you're out to shoot action with this movie camera! The new KODAK DUEX 8 Cassette provides quick drop-in loading using standard 8mm roll film. Preload several cassettes, and you're ready for continuous filming.

Battery-powered motor drives 10 to 24 rolls of film through the camera with never a slowdown, never time out for winding.

Zoom lens lets you close in on ac-

tion—fast and smooth. And you see the zoom in the coupled viewfinder!

No worry about exposure. Sensitive electric eye sets the super-fast $f/1.6$ lens automatically—even signals when light gets too dim.

See the new KODAK Electric 8 Zoom Camera at your Kodak dealer's in time to capture your holiday fun in movies. With built-in filter, hand strap, neck strap, one cassette and pistol grip—all less than \$150! Batteries extra.

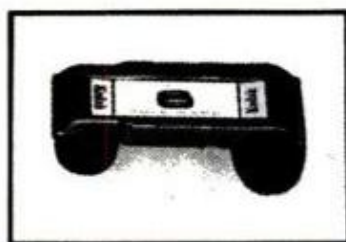
The more you know about photography... the more you will count on Kodak

EASTMAN KODAK COMPANY

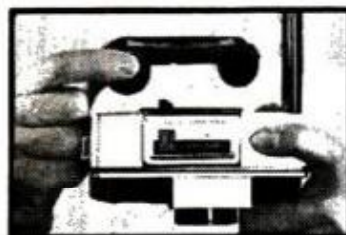
POPULAR MECHANICS



cameras from KODAK!



KODAPAK Cartridges are factory-loaded with Kodak color or black-and-white film.



Drop in a Kodapak Cartridge—camera's loaded! Load, unload—even in bright sun.

New KODAK INSTAMATIC 700 Camera

Easiest-to-use camera ever designed for fine pictures

Why will you take better pictures with this new camera? Because all you have to think about is the picture. The KODAK INSTAMATIC 700 Camera takes care of the other details with amazing ease.

Drop in a KODAPAK Cartridge, and the camera's loaded instantly, the film speed's set into the electric eye. And, in turn, the electric eye not only sets the $f/2.8$ lens, it also adjusts the shutter speed if necessary, to insure correct exposure under a broad range of outdoor and indoor "available light" conditions.

Flash is this easy. A touch pops up the built-in flash holder, sets the shutter at $1/30$. Focus—and the lens is automatically set for a perfect flash picture.

See how much more rewarding it is to take pictures with the KODAK INSTAMATIC 700 Camera. Less than \$110. Three other new KODAK INSTAMATIC Outfits from less than \$18. All are great for Christmas giving or getting. See your Kodak dealer.

Prices subject to change without notice. Because of demand, there may be a delay on some KODAK INSTAMATIC models; if so, ask your dealer for the special INSTAMATIC Camera Gift Certificate.

Kodak
TRADE MARK

Rochester 4, N.Y.

DECEMBER 1963

185

Silent War in Liquid Space

(Continued from page 127)

smoothly to cover the vacated spaces in the screen, like halfbacks shifting position to cover a hole in the line. All these moves show up on the Iconorama screen, CIC's new-fangled situation chart.

As the minutes wore on, the contact wavered, disappeared, was picked up by another helo, and finally dribbled out altogether. "They've probably picked up a school of dolphin," said Lt. (jg) Dick LaRoche, looking up from his sonar repeater, "or it could have been a knuckle."

"A knuckle can sure fool you," he went on. "It happens when a submarine makes a sharp change of course underwater. At the apex of the turn, it leaves a dense bunch of bubbles which can hang suspended in the water indefinitely. Sonar signals 'see' it as a possible sub."

After sweating through several more abortive contacts during the night, pay-off came for the waiting sub hunters at 0331 hours. Powerful radar beams from a Grumman Tracer unerringly picked up the exposed periscope of the quarry, which had surfaced just before dawn for air. A waiting helo made the "kill."

New Weapons Join Fleet

New ASW weapons and detection tools are constantly being devised. One, a new kind of helicopter, just now coming into the fleet, is designed for destroyer duty. Known as DASH (drone anti-submarine helicopter), it is sent out under remote control to attack contacts.

Killer subs for tracking down undersea raiders are also becoming increasingly effective. (The ill-fated *Thresher* was the first of an advanced class of nuclear killer subs; it won't be the last. Dozens more are slated to join the fleet.) Better sonar detection gear will permit the killers to pursue enemy subs into deep undersea valleys and thermal layers.

Nuclear-armed rockets, torpedoes and depth charges have tremendously enlarged the lethal range of ASW weapons. An atomic torpedo can miss its target by a wide margin and still score a kill.

All this armament sounds impressive, but ASW men are far from satisfied. "The nuclear submarine was a tremendous breakthrough in attack capability," one officer told me. "What we need in ASW is a breakthrough in detection equipment."

Efficient long-range detection equipment provides, or will provide, the real answer. So, in addition to sonar, radar and other devices, the Navy is working on still other detection methods. According to a number of published reports in the *Wall Street*

Journal, *Christian Science Monitor* and *Data*, a semi-official armed forces magazine, these include:

- **Infrared heat-sensing** equipment to zero-in on a sub's warm-water wake.

- **Magnetic devices**, operating from high-flying planes or earth satellites, that will trace a sub's movements.

- **The Screamer**, a magnetic radio device which will be strewn in narrow channels to lock onto a sub's hull; a transmitter broadcasts a continuous signal to pinpoint the sub's movements.

- **The Sniffer**, an airborne electronic instrument, detects submarines by sensing atomic changes in the air due to the exhaust from submarine engines. It can also detect the train of radioactive water behind nuclear subs.

- **Project Caesar** utilizes underwater sonar hydrophones. It is being set up as a network around the North American continent and has been reported to have an accurate range of 500 miles.

Such a sensory system might provide one of the breakthroughs ASW men need. The North Atlantic, at least, could easily be "sterilized" once the difficult problem of sound identification was solved.

Meanwhile, the aging World War II HUK groups are holding the line.

These include the battle-scarred *Essex*, commissioned in 1942, which launched 14,000 sorties against the Communists during the Korean War. Last September, after six months in the Brooklyn Navy Yard, the *Essex* emerged as the most formidable ASW carrier in the fleet.

The *Essex* was at Guantanamo Bay when last year's Cuban crisis broke, and she spent 28 days continuous duty during the "quarantine" before being relieved. How many Russian submarines did the *Essex* sight? "Sorry, can't tell you that" is the invariable reply.

"But I'll tell you one thing," a pilot said. "Every time one came up for air we had a destroyer on the spot. The ship's band always gave them a rendition of 'Dixie.'"

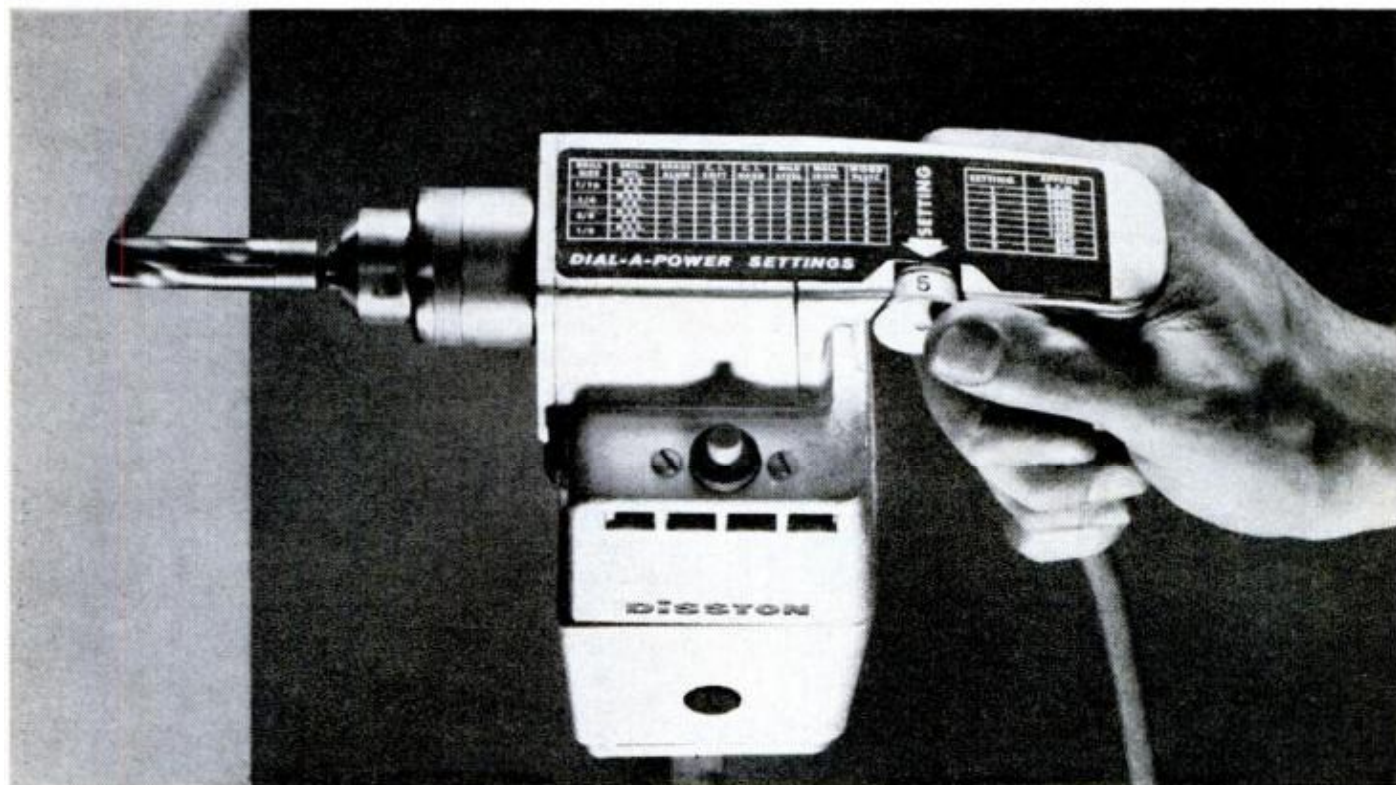
Hitler put a mighty crimp in the Allied war effort with an initial fleet of only 57 submarines. Russia is now thought to have more than 500 subs, of which perhaps 20 or more are nuclear-powered and several dozen capable of firing nuclear missiles.

The ASW men are not sitting around waiting for any technological aspirin that will neutralize the nukes.

But sometimes, during the numbing monotony of a sub patrol, they wish their countrymen would come alive to the undersea menace. They realize only too well that their particular enemy, the submarine, may—for the moment—have an edge over them. ★ ★ ★

For Christmas 1963
DISSTON
D-38 DIAL-A-POWER

gives constant power over a full range of speeds



STEEL— $\frac{1}{2}$ " bit, 700 rpm



MASONRY— $\frac{3}{8}$ " bit, 1,000 rpm



WOOD— $\frac{1}{4}$ " bit, 1,200 rpm

speeds from 600 to 2000 rpm by turning a dial

Disston's D-38 Dial-A-Power, world's first variable speed drill, lets you choose the exact rpm you need—whether boring wood, metal, masonry or plastic. You can even adjust speed to suit the size bit you are using. You get faster, more efficient drilling, save wear and tear on bits. And at every speed, a revolutionary electronic circuit delivers full, constant power at the chuck. The Dial-A-Power eliminates the need for several drills; its powerful 4.1 amp motor drives bits up to $\frac{1}{2}$ ". Built-in overheat thermostat automatically protects motor from burnout. U.L. approved and industrially rated for rugged use. Retail at \$69.95. Hardware and Industrial Products Division, H. K. Porter Company, Inc., Porter Building, Pittsburgh, Pa. 15219.

See the many other Disston Christmas specials at your dealers, now!

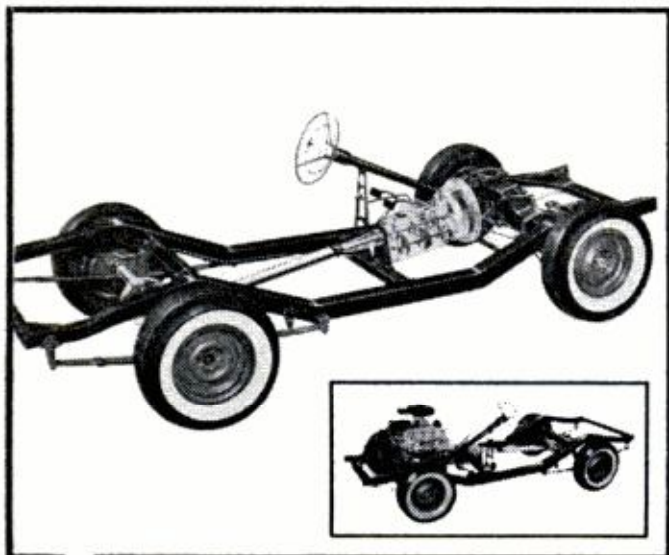
PORTER

**HARDWARE AND INDUSTRIAL
 PRODUCTS DIVISION**

H. K. PORTER COMPANY, INC.

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The Danger in Dry Air

(Continued from page 165)

thoroughly with detergent. Scrape away hardened calcium deposits with steel wool or a stiff bristle brush.

Atomizing unit motors are equipped with bearings that must be lubricated. Consult the instruction guide for your unit to determine the location of lubrication points. Use either a special atomizing motor oil or any good grade engine oil (SAE 20 is usually recommended). Only a few drops for each bearing are needed.

The grill that surrounds the base of most atomizing unit motors can be cleaned with an old toothbrush.

The evaporator plate humidifier is also easy to maintain, although it usually needs more frequent maintenance than other types. Run a piece of wire through the water nozzle to clear any calcium that may have formed.

Next, inspect the plates. If they are relatively clean and intact, use them again (plates are generally good for a period of three years, although this time is reduced in proportion to the hardness of the water). If the plates are covered with calcium, or are broken, replace them with new ones. In areas with a severe hard-water problem, even the valves eventually lime up. One solution is to hook the unit into a soft-water line, but this often means a long tubing run.

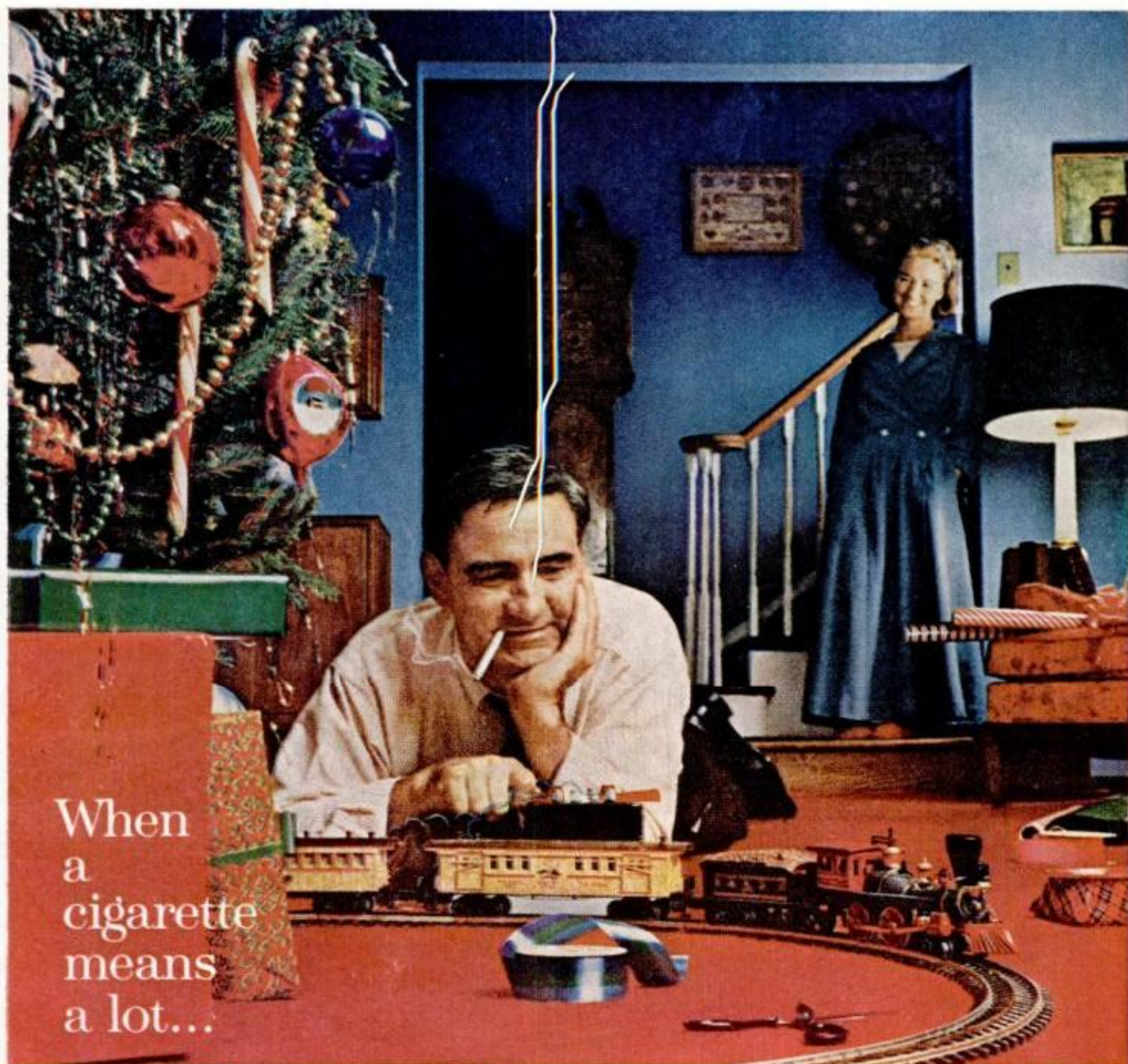
Vaporizing units are also easy to maintain. All that's involved is cleaning the pan and making sure the water nozzle that feeds the pan is unclogged.

Is humidification necessary with hot water heat? As mentioned before, this is a controversial question among heating experts. Some contend that since steam heat is wet heat, little moisture is removed from the air in a tight modern home.

Others contend that dryness can still be a problem with a hydronic (hot water) heating system, since air from the outside, which may be low in humidity to begin with, is introduced into the home by infiltration and open doors and windows.

The only way to be sure is to test the air in your home with a measuring device, such as a psychrometer. If a unit is needed, you can use portable humidifiers, placed in one or two key areas around the home.

Another type of humidifier you can use in a home equipped with a hydronic heating system employs heated water and a blower that distributes humidified air through a duct and small register to a central location in the home. It usually has a humidistat. Water is heated by an electric coil—or by steam or hot water through a pipe from the boiler. ★★★



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PRODUCTS OF

MOTOR COMPANY



Monorails

(Continued from page 74)

There's a considerable saving in the cost of constructing a monorail versus a conventional system, they claim. A good share of the advantage can be laid to speed of construction.

Goodell plans to build its 17-mile Los Angeles line at the rate of a mile a week and a cost of \$2,600,000 per mile. Alweg says it can do the 43-mile "backbone" line in Los Angeles at a rate of a mile every 20 days and a little under \$2,500,000 per mile for the overhead system. Goodell, in a bid on the same 43 miles, figured \$2,290,000 per mile for that job.

In contrast, Toronto has an eight-mile section of subway under construction that will take five years to build. It's part of a 10-mile project that will cost \$206,000,000—or \$20,600,000 per mile. (Purchase of right of way is included and amounts to about 10 percent of the cost.)

And the first section (13 miles) of the Cleveland Rapid Transit system, completed in 1955, was built at a rate of a mile each 3¼ months at a cost of a little over \$3,692,000 per mile. (This average cost figure is computed from the \$30,000,000 spent in the 1950s plus some \$18,000,000 in preliminary work done by farsighted planners 40 years ago.)

"A monorail system goes together almost like an erector set," said an Alweg official. "Foundations are drilled, T-columns are bolted in place, beams are placed on top, and soon trains are in operation.

"It is this ease of construction that accounts to a great degree for low installation costs—making possible fare-box financing of a basic rapid-transit network."

(The Seattle monorail was paid for in five months. However, according to a study by the Metropolitan Transit Authority in Los Angeles, the 50-cent monorail fare was supplemented by a 25-cent surcharge on every ticket sold to the World's Fair.)

Alweg erected its 1.2-mile Seattle system in a matter of 10 months at a cost of almost \$4,200,000. The firm estimates that it could build the 43-mile Los Angeles monorail system (on which it has made a proposal) in 30 months. The first third of that system, says Alweg, could be in service in 12 months. Cost of the 43 miles is set at \$105,275,000.

The 2½-mile Disneyland-Alweg Monorail System cost \$3,300,000 to build. The three trains, though, are smaller than equipment built for city transportation.

The concrete posts and beams of the Alweg system require that holes be excavated for the concrete foundation under each supporting column. The foundation,

of poured concrete, is 25 feet deep and five feet in diameter. Each supporting column is then precast at the site and tilted into place on the foundation. Then the horizontal concrete beams are lifted into place on the supporting columns.

Goodell describes construction of its system as a matter of driving 40-foot steel pilings into the ground—each going into place in a matter of five minutes.

The work from then on can be performed mainly from overhead. A work train riding on both rails would pick up with its own boom 80-foot lengths of steel beam from a car at its rear and lower the beams into place on the steel columns.

Another pertinent construction estimate was made in Los Angeles by the Metropolitan Transit Authority. A combined subway-surface system, the MTA said, would cost \$10,000,000 per mile. However, a similar estimate for Atlanta was cut down to slightly over \$4,000,000 per mile by using railroad right of way.

Comparative construction costs and estimates, then, would seem to give a clear advantage to monorail—providing no effort is made to run the monorail underground where subway openings must generally be larger to accommodate the bulk of the beams plus coaches.

How to Switch Monorails

Switching is still a problem with monorails, contend its critics.

This has probably been the largest single headache for monorail—and it continues to be. In any mass rapid-transit system, switches are unavoidable. With monorail, it becomes an especially sticky problem because the entire supporting structure must be moved whenever the switch is thrown.

Monorail switching is usually accomplished by directing the entire train onto a tangent track by means of a section of curved track moved into proper position.

Alweg has two types of switches: straight beam and flexible. The straight beam is 140 feet long and three feet wide—and rests on four supports. One of the supports is pivoted and the other three are on movable carriages traveling with the beam. When the beam reaches the proper location for switching the train, it locks into place. This type of switch is for low-speed areas, and—according to Alweg—takes 9 to 12 seconds to operate.

For high-speed installations, a flexible switch using an aluminum beam has been developed recently that, Alweg claims, cuts switching time to seven seconds.

The switches of the Goodell suspended system can be operated in four seconds.

(Please turn to page 192)



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Monorails

(Continued from page 191)

In horizontal switching, one end of an 80-foot section of Goodell's track is moved aside eight feet and at the same time one end of a curved 80-foot section moves into the position vacated by the main track. In vertical switching, a 150-foot section of track is raised 10 feet at one end and locked into place with another track at this second level (which may be either higher or lower).

The time that it takes to operate the switches of the monorails (Alweg: seven seconds; Goodell: four seconds) is slightly greater than the three seconds that it takes to switch New York subways.

What about safety?

The safety record of the oldest operating monorail, the Wuppertal line in Germany, is amazingly good. In all those years, only two passengers have been injured—and one of those was a baby elephant put aboard by a circus promoter. (The elephant bolted through the car doors and landed in the Wupper River 23 feet below the train.)

Alweg reports that only one of the eight million World's Fair riders had an injury claim against the railroad.

Despite the excellent precedents, builders are taking no chances.

To avoid collisions, Alweg divides its proposed Los Angeles system into a series of electronic zones. If a train attempts to proceed into a zone occupied by another train, power is cut off automatically.

Goodell proposes to automate its system and control it electronically. No operating personnel will be aboard the coaches. Door areas and passengers in the coaches will be observed by television receivers in a central monitoring station; passengers will also have two-way voice communications with the station.

In case a train stalls between stations, Alweg plans to transfer passengers via a gangway to a parallel train or lower them to the street. Goodell has an emergency escape system that enables exit doors to open if the train stalls so passengers may be removed.

The question of safety was dramatically posed in September when an overhead monorail ride at the Los Angeles County Fair snapped a bolt in its support system, allowing one end of the single coach car to drop down at a 30-degree angle. Monorail proponents, however, are quick to say that the small 24-passenger coach, suspended on the bottom flange of an I-beam, is strictly a "fair ride" and is not a prototype of a high-speed transit train.

So the comparisons and arguments go.

Other items on the debit side for monorails include: Lack of compatibility with existing transit system (monorail trains run only on their own tracks and not on the conventional tracks that a city may already have); the need for some claims of monorail proponents to be taken on faith to a great extent rather than on proven performance; and the lack of support from professionals in the transit industry.

On the credit side for monorails is the possibility of their being built over congested areas without disrupting traffic below. Proponents feel, too, that the novelty of monorail would attract new riders to city transit systems.

Despite the fact that the city acceptance of monorail has been going along at a snail's pace, there are several companies in addition to Goodell and Alweg that are in the single-rail business.

American Machine and Foundry Co. will build a 4000-foot suspended-type monorail at the upcoming New York World's Fair (see illustrations). The system will include two parallel kidney-shaped loops, each carrying three two-car trains suspended on a single rail.

AMF's train system at the World's Fair will be an improvement of a design by American Crane and Hoist Co. Above each car will be a pair of rubber-tired "bogies" running along the lower edge of an I-beam track. Top speed is 10 m.p.h.

AMF has also been licensed recently to market the French Safege-Transport high-speed monorail system in the U.S. This also is a suspended-type monorail with its bogies running *inside* of box beam (hollow) rails. Snow and ice cannot affect the traction of the wheels, which are protected within the beam, says the firm. A French prototype has been operating on a test track for two years, traveling at speeds as high as 90 m.p.h.

The beams, which are now steel, may possibly be constructed of prestressed concrete, says AMF, with wood rails inside for the rubber tires to run on. AMF adds that it has a high-speed switch that needs only 3½ seconds to operate.

Despite the awakening of interest in the U.S., it appears that Tokyo may be the first city to test monorails under mass-transit conditions. Several lines, including Lockheed, Safege and Alweg are being built there.

City planners are predicting that by 1970 there'll be 30 million more Americans and that 85 percent of the total population will be living in urban centers.

The climate is right for a breakthrough in urban transportation—and those monorail builders are just itching to show what they can do. ★ ★ ★

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Skyway Crash Preventers

(Continued from page 110)

radial is accurate, the others should be.

"The last panel," he said, as we moved on, "records our position at any given moment by taking fixes from two ground stations, with the airplane as the third point in the triangle."

By using the precise position of the aircraft as a reference point, the signals received from the stations at any instant can be checked just as precisely.

Fowler patted another instrument alongside one of the technicians. Graphlike paper with needle tracings on it was slowly moving from it. "This is one of our recorders," he said. "It can record as many as 36 different pieces of information at one time, including signal accuracy, signal strength, percentage of modulation and so on."

Fowler explained some of the discrepancies that the tracings show up.

"Basically," he said, "most problems are caused either by the equipment itself or, more often, by outside interference." Fowler described some of the more common discrepancies caused by interference: Roughness, scalloping, bending, alignment (see diagrams).

There are definite tolerances beyond which action must be taken, and the most stringent is alignment. If a radial is displaced by more than one degree, the station automatically switches to a standby transmitter. If this doesn't work, the station shuts down altogether. No signal is better than a faulty one, because pilots can easily tune into another station.

During the flight we went up front and sat behind the pilots as they flew the route at 41,000 feet, and watched as the cockpit instruments ticked off the information from the VOR, TACAN and VORTAC stations down below. Between San Antonio and Fort Stockton, Texas, we witnessed one apparent displaced alignment. The 281-degree radial from the San Antonio station and the 96-degree radial from Fort Stockton should have met in the middle to form one long straight line. Half way past San Antonio, they switched to the Fort Stockton station but were six degrees off course, although they had been dead center on the San Antonio radial. Obviously, San Antonio or Fort Stockton or both, were out of alignment. Later, at Seattle, they found the VORTAC station had shifted clockwise. All 36 radials were displaced.

(Please turn to page 196)

These are piston rings.



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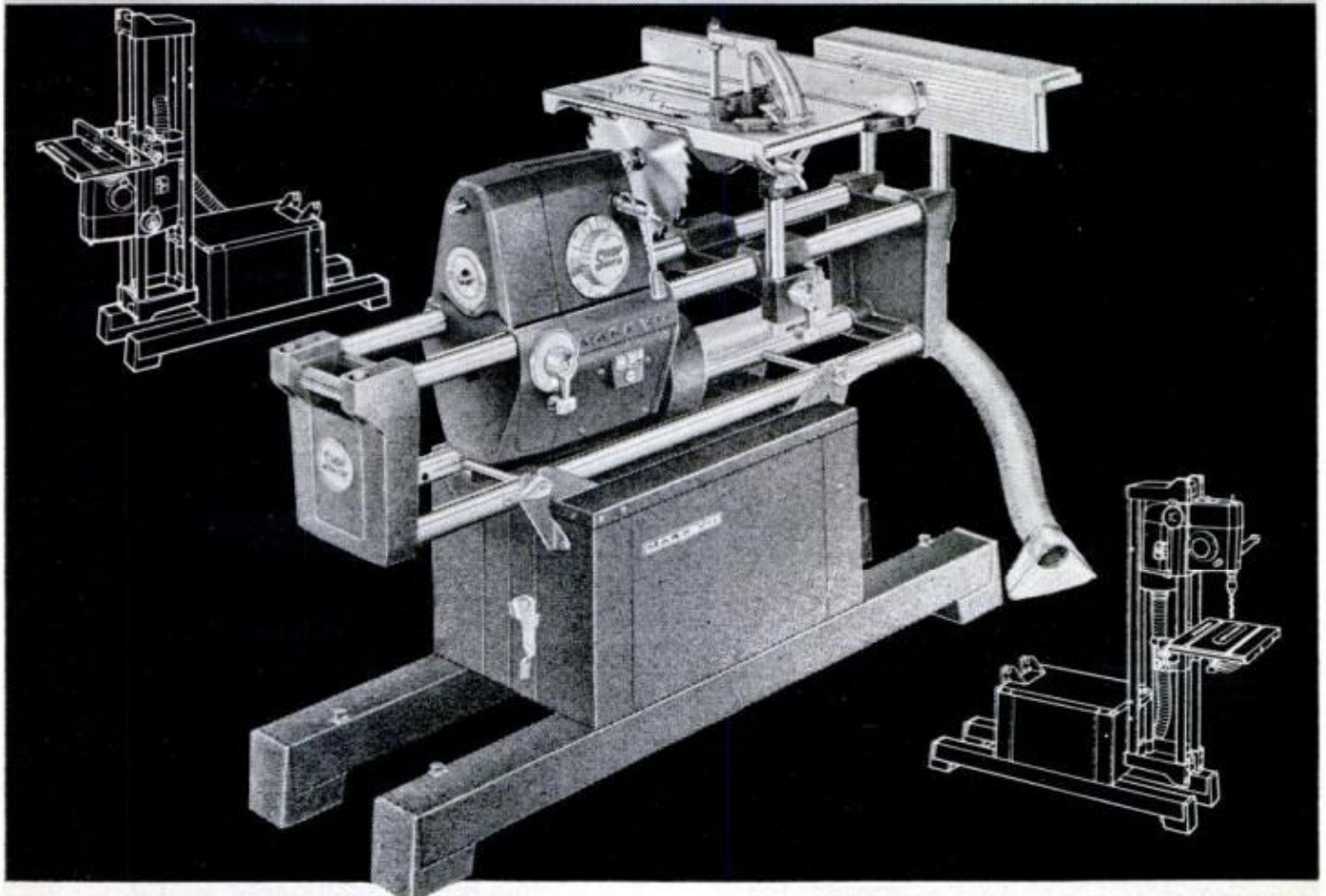
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Skyway Crash Preventers

(Continued from page 194)

These obvious errors are rare. Most are more subtle, and it's the job of recordings and the computers to spot small trends in signal output that forewarn of trouble.

When we returned to New York, we visited the FIDO office on Long Island, completing our coast-to-coast survey, and spoke to some of the men who do the low-level inspection.

Technicians are stationed at the site to be checked—a VOR station or an ILS system—equipped with a two-way radio to the plane and a theodolite, a surveyor's instrument with a telescopic eyepiece, calibrated for precise angles in both elevation and azimuth. At a VOR site it is aimed outward along a predetermined radial and the plane flies over the station and out along this radial. The ground observer centers the plane in the theodolite's cross-hairs and guides it with voice commands, and it is a matter of pride to the flight-inspection crew that just having the plane in sight is not enough. Only the middle of the fuselage is acceptable. By using the theodolite, and matching it against the recordings being made at the same instant in the plane, the technicians

can check the accuracy of any VOR radial within $\frac{1}{1000}$ th of a degree.

The Instrument Landing System is checked in much the same way. The ILS consists, basically, of a *localizer* which tells the pilot which way to steer his airplane toward the runway, a *glide slope* which tells the pilot what angle of descent to use, and two *markers*, the first of which tells the pilot when he is about five miles from the end of the runway and the second when he is about 3500 feet.

To check the ILS, the most critical of all NAVAIDS, the plane with its recorder working and the theodolite following it, flies across the beam sent out by the localizer to see that it is no wider than it should be—within a half-degree tolerance.

To check the glide slope, the plane flies the incoming course but maintains a precise altitude. As it passes the outer marker, the instant is recorded and a triangle is computed. The distance from the runway to the outer marker is known, the altitude above the marker is known, so the angle from the plane to the runway can be measured. It should match the beam sent out by the glide slope.

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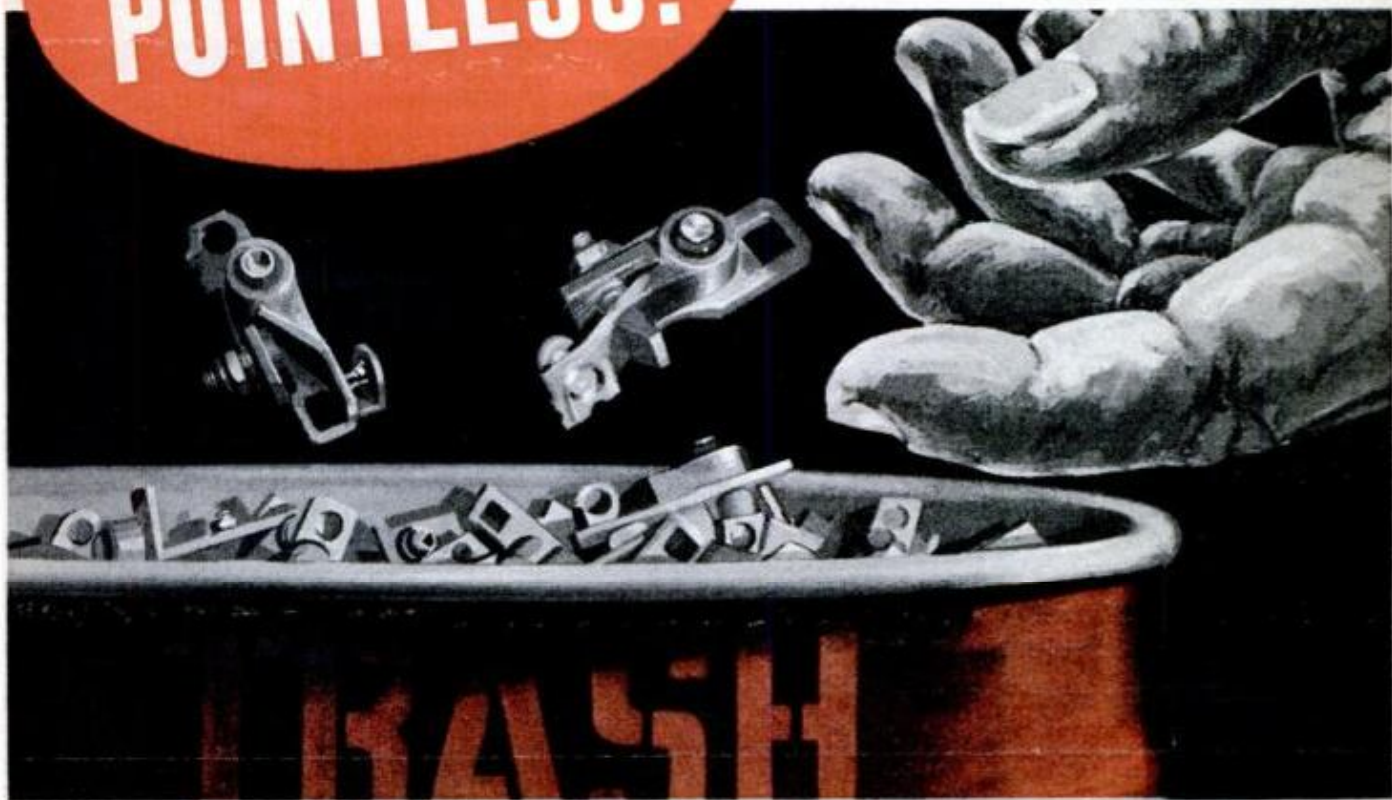
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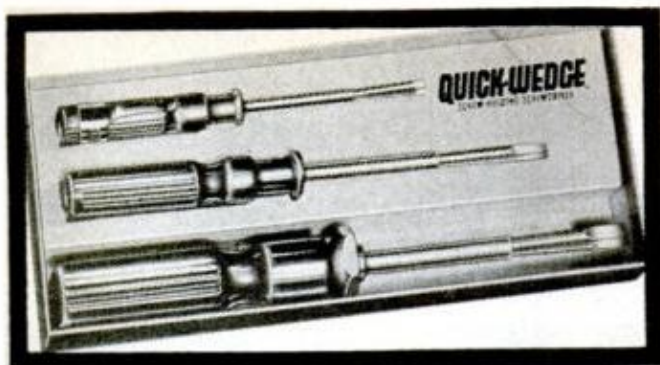
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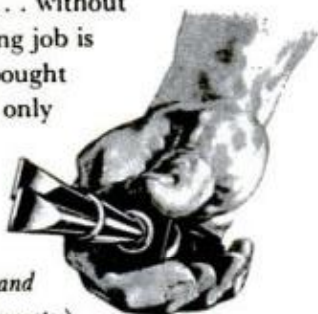
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Separate 48-page catalog with pictures and prices of more than 400 items you can order **DIRECT BY MAIL** is yours free when you send \$1.00 for the surplus catalog. Examples:

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Super Filer No. 11 joints and sharpens hand and circular saws 6" to 10" with all teeth correct in height, depth, pitch, bevel. When file hits steel roller, teeth are finished. Saw runs true with no side pull. Includes 8" file.

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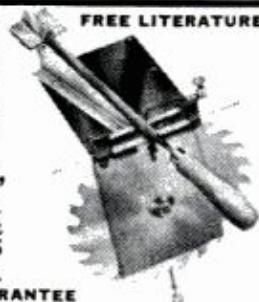
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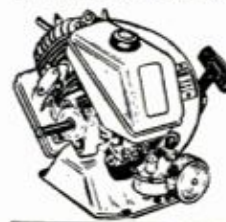


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Never before and perhaps never again—this offer of brand new genuine Clinton and Briggs & Stratton engines including 1 yr. factory warranty at less than cost. Perfect power for go-carts, scooters, tractors, mowers, generators, pumps, sprayers, etc. We bailed out 3 big factories who needed cash and the savings are yours while quantities last. Act fast.



Clinton 2 1/2 hp, MdI. 500—Re-coil starter Std. 3/8 shaft w. keyway—ready to go. Reg. price \$49.50 Special (item 1002):

\$29.95

2 for \$59.50
6 for \$176.50



Briggs & Stratton 2 hp, MdI. 60101 Rope start, std. 3/8 shaft w. keyway. Sturdy 4 cycle power. Regular price \$49.80 Special (item 106a)

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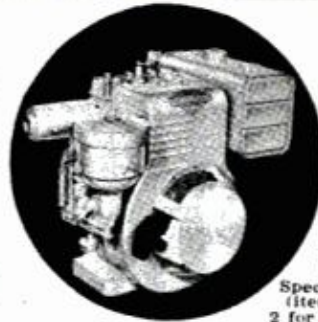
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5 3/4 hp.

Briggs

&

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Briggs & Stratton 5 3/4 hp, MdI. 143302. Re-coil start. Std. 1" shaft w. keyway, aut. choke & throttle control—a rugged big engine ready to tackle any job. Regular price ..\$92.60 Special (item 1059) ... **\$67.50**
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2 3/4 h.p. Clinton—34.95

Model 400, rugged 4 cycle model. Alum. Block, castiron cylinder Rope start—3/8" std. shaft

Item 1107 34.95

2 For 67.50

3 1/2 h.p. Clinton—39.95

A big engine with big power. Model 406, 4 cycle, rope start, 3/4" std. shaft.

Item 406 39.95

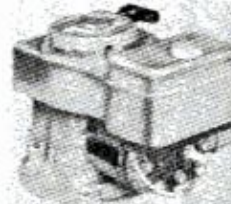
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2 1/2 h.p. Lawn Mower Engine \$29.89

Clinton Model 403, 4 cycle, 2 1/2 h.p. or 3 h.p. rotary mower. Standard 1/2" dia. shaft with female 3/8" thread. EZ recoil starter. Aluminum block with long life steel cylinder sleeve. It's less than the cost of an overhaul.

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The Incredible Gateway Arch

(Continued from page 90)

360-degree motion), a long crane that points like a finger toward the sky, and a platform supported by an adjustable leveling brace. The 43 by 32-foot platform, built like the command post that it is, holds a tool shed, a heated room for ironworkers, sanitary facilities, radio equipment and TV cameras that provide eyes for the boom operator as he maneuvers each new section into position.

There were some tense moments when the derrick lifted the first "piece of cheese" into place, for the cheese weighed 45 tons and the derrick weighed about 80 tons. The crawling rig is so cleverly designed, however, that the 125 tons of weight were transmitted to the tracks, then safely down the side of the leg to the Arch's foundation.

After each section is lifted into place and the concrete poured, the derrick's tracks are extended up the face of the new wedge. Then the derrick creeps upward like some giant spider spinning its web against the sky. So far, progress has been steady, with a new section installed on each leg about once a week. Now that the legs are more than a hundred feet high, workers ride an elevator up one of the

tracks to the derrick platform and stay there until quitting time.

The derrick crawls up the outside face of the Arch; along the other two faces a unique creeping scaffold has been installed. To an outsider it may not look like much, but construction experts admire it literally to the skies. The scaffold was worked out by Mel Calabrisi, a construction engineer barely 21 years old. It also is held away from the gleaming sides, and is positioned along the joint between sections to enable the joint to be welded. The higher the scaffold goes, the more it tips to match the weld joint.

The welding rig itself is an innovation in the construction industry. Big suction cups hold a rail just above the joint. A welding head, towed along the track by a tractor, automatically welds the seam. The weld matches the seams of the prefabricated sections so precisely that it is almost impossible to locate a joint between sections.

In 1964, when the two fingers probe toward each other at the 600-foot level, a huge brace will bridge the gap to position the legs for the keystone section. When the last wedge slips into place, the brace will be removed and the derricks will start crawling back down the legs.

(Please turn to page 202)

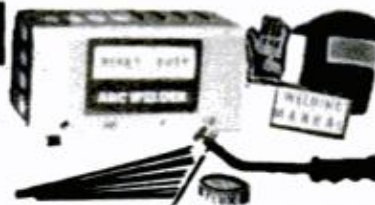
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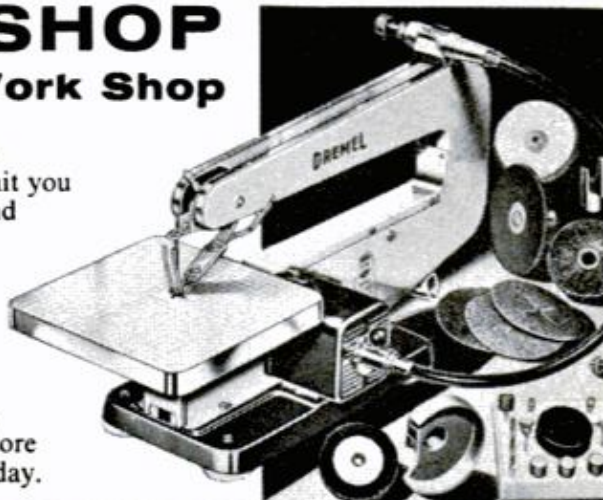


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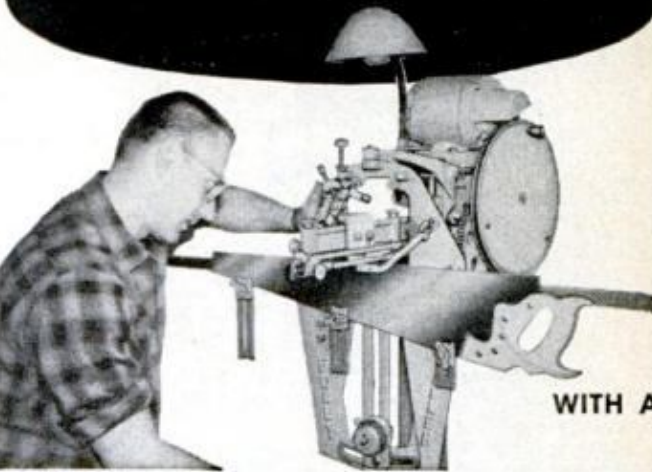
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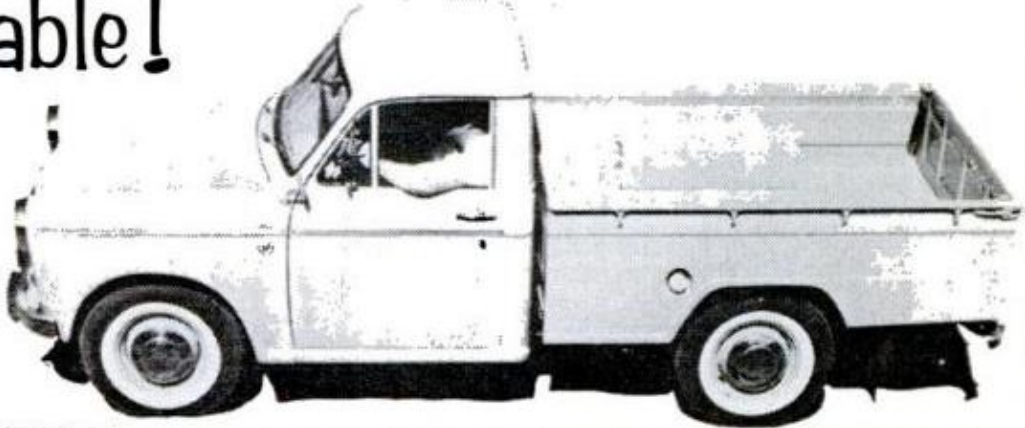
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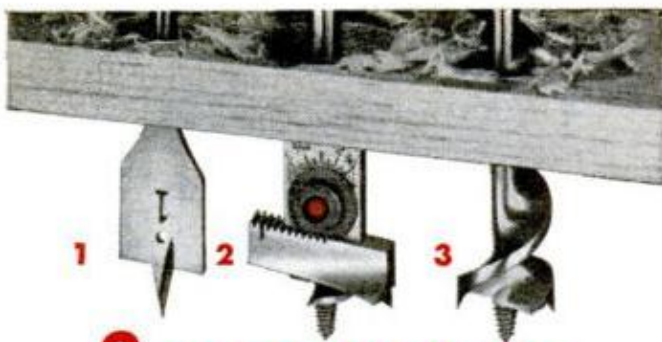
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SEND FOR FREE CATALOG

HYDE TOOLS

SOUTHBRIDGE, MASS., U.S.A.

HYDE TOOLS



The Incredible Gateway Arch

(Continued from page 200)

As they drop, the tracks will be removed above them and the bolt holes filled with stainless steel plugs to make them invisible. The exterior of the Arch will be finished—and two young men will heave a mighty sigh of relief.

Vertigo Syndrome

"We've run into some problems so far," said Kolkmeier recently, "but nothing we didn't really anticipate. A major problem hasn't come up yet, but the possibility keeps nagging at me. That's the problem of vertigo. I don't know; maybe it *never* will come up. All my men are experienced, and are accustomed to working at great heights. However, in working on all other construction jobs, they've had a subconscious frame of reference—horizontal and vertical lines around them. In this job there isn't a straight line anywhere in the Arch. There simply isn't any frame of reference on the job, and the men will be working more than 600 feet in the air. They won't have anything to confirm their inner feeling of what is 'straight up,' or 'sideways.' Who knows what this will do to their sense of balance?"

No one will know the answer to this question for several months.

With the completion of the Arch itself, the transportation system will be fitted into each leg. The most novel part of the system, of course, is the train that will lift visitors up and down the Arch.

Fitting Trains in the Legs

Each train will consist of eight capsules seating five persons to a capsule. At the loading level in the museum, the train is virtually in a horizontal position. After the passengers board, the doors are locked and the train begins its ascent to the observation deck high above.

Consider the problems in designing such a train: It moves along a weird, continually changing curve. In order to handle the anticipated volume of traffic it must travel at a speed of 340 feet per minute; the space is extremely restricted.

The problem of designing such a train obviously was a nightmare and Richard B. Bowser, the design consultant called in for the job, came up with a surprisingly effective plan.

"I had to compute the weight of both loaded and unloaded trains, traveling both up and down, at locations every six feet throughout the 748 feet of travel," he reports.

The eight barrel-shaped capsules are

(Please turn to page 204)

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DEPT. PM-123 BAY CITY, MICHIGAN

The Incredible Gateway Arch

(Continued from page 202)

strung together like beads on a string so they can be hauled upward at any attitude in relation to each other. Each capsule is held on fine bearings inside a big ring. The weight of the passengers causes the capsule to revolve inside the ring, so the seats are always level.

The ring, in turn, has flanged wheels that ride in tracks 30 inches apart, built up through the hollow core of the leg. The train is powered by standard elevator equipment, drastically altered to meet the unique problems of the Arch.

Each train will be able to make a round trip every 7.6 minutes. With both trains operating at peak efficiency, the system will handle a volume of 440 persons per hour, and the supplementary elevators to the 372-foot level will handle 277 passengers per hour. Thus 11,000 persons can make a trip up inside the Arch in 14 hours.

Even now, before the Arch is finished, a visit to the site is a memorable experience. Stop in at Art Pritchard's headquarters and you will be presented with a fancy identification card designating you, by name, as a "Sidewalk Superintendent of the Gateway Arch." Then climb up into the 30-foot observation tower con-

structed to give a spectacular view of the worksite. To your right and left, workmen swarm around the foundations of the two legs. High overhead, the creeping derricks haul more materials into place. The legs now are high enough that your eye can trace a graceful line across the sky that will be the path of the completed Arch. You can pick up one of several phones on the tower and a voice will tell you exactly what is happening.

If you aren't souvenir-minded, you may soon throw away your Sidewalk Superintendent's card.

But you'll never be able to discard the memory of one of the most spectacular and most difficult construction jobs in history. You'll be back, along with the millions of other Americans, to see your newest national monument. ★★★

Think of U. S. automobile production and you probably think of Detroit and Michigan. But 17 other states produced motor vehicles last year, including Missouri, Wisconsin, California, New Jersey, Ohio, Georgia, New York, Delaware, Maryland, Kansas, Texas, Illinois, Minnesota, Indiana, Massachusetts, Kentucky, and Virginia. That's one less state than in 1961 when Pennsylvania built 0.17 percent of all the cars assembled in the U. S.

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Revolutionary REDI-TAPPER eliminates slow hand tapping. You can place tap directly into your standard drill chuck and get perfect tap and hole alignment. Tapping is actually faster than drilling. REDI-TAPPER fits most drill presses. Unit is guaranteed satisfactory or your money back. Mail coupon today. Dealer inquiries invited.

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4114 N. Knox Ave., Chicago 41, Illinois

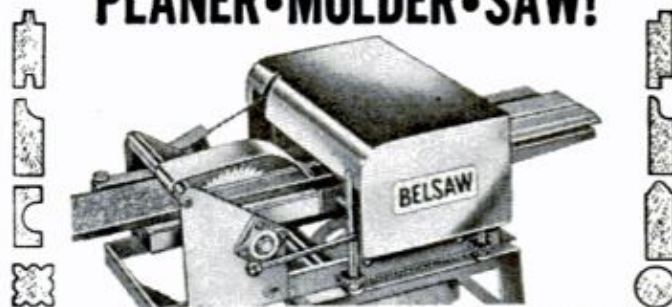
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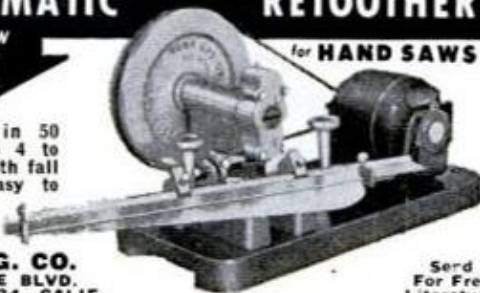
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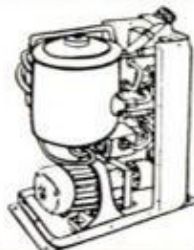
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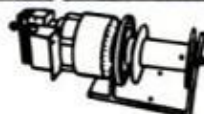


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Pump rated @ 3000 PSI, 1 GPM @ 1500 RPM. Complete unit incl. 1 1/2 gal. reservoir, hydraulic fluid level sight gauge, 1 relief valve, one 5000 PSI pressure gauge, pump unloading valve and hi-pressure filter. Unit driven by 1 1/2 HP electric motor, 200V, 400 cycle, 3 phase. Excellent condition. Approx. GOVT. COST \$3250. Shpg. wt. 90 lbs. **\$49.50**
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Rugged, heavy-duty winch with ball bearing construction thruout motor & gear train. 225-1 gear reduction. Rated cap. 2500 lbs. Has heavy duty enclosed forward, neutral & reverse switch. Rugged 1/4" plate steel mounting base with outrigger support. Dim. 22" L. x 9" W. x 8" H. Handles 250' of 1/4" cable. Built for 12V. battery operation: will also operate on 6V. at reduced cap & speed. A must for scouts, jeeps, trucks, boat loading trailers. Shpg. wt. 80 lbs. Approx GOVT. COST \$490. New. Model E-D **\$75.00** plus new Fed. Excise Tax of \$4.50
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Complete with GE Type CM-77 Generator (30 volts D.C., 400 Amp., 3000 RPM up; ampere rating is for continuous duty, intermittent amperage is 500 to 600 amps.), also 2 rheostats, 1 voltage reg., 1 voltmeter, 1 electrode holder, 1 welder's mask, 1 toggle switch, 10 lb. vacuum packed 1/8 in. welding rods, pair welder's gloves & spline coupling. All units guaranteed pre-tested. Wt. 110 lbs. Approx. GOVT. COST \$700. All items, now only **\$64.50**.



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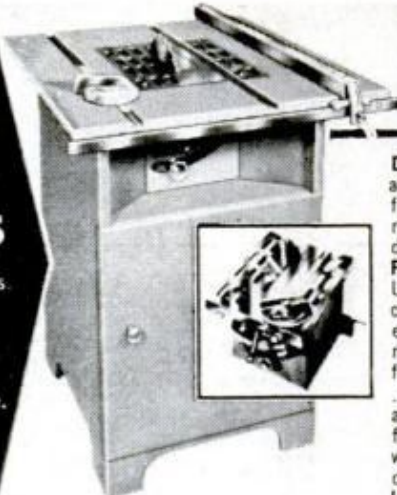
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Includes completely assembled cast iron and steel 8" tilt arbor power saw with ground cast iron table . . . less blade. If desired, RIP FENCE for easier work alignment, \$3.50 additional



REVOLUTIONARY PATENTS DECREASE COSTS, INCREASE EFFICIENCY
Full scale power tools of heavy duty 100% cast iron and steel. Streamlined design reduces weight, cuts material and production costs. Special patents provide added efficiency, accuracy, savings. Parts made, assembled, tested and packed right in our own factories, shipped direct . . . save store profits.

DOES WORK OF \$75 BENCH SAW as is. Converts easily to equal any \$300 floor model cabinet units! Crosscuts, rips, mitres, cuts compound angles, dadoes, makes coves and mouldings. **FREE CABINET BASE PLANS** Use as portable bench saw as received (inset photo) . . . or transform easily and inexpensively into floor model (as shown) guar. to do work of floor models costing \$300. **FREE plans** . . . sheet of 3/4" plywood and 3-4 hours are all you'll need. Use your AMCO saw for cutting. Plans provide 27" x 24" work surface, 33" height, pullout sawdust bin, tool storage compartment. **UNCONDITIONAL 10 YEAR GUARANTEE**

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• Locks securely at any angle to 50° raises, lowers 0"-2 1/4" • Patented tilt mechanism, accurate etched scale • Patented motor mount takes std. 1/4 h.p. or larger motor, keeps belt tight, assures perfect alignment at any angle, transmits full power • Takes std. blade, saw insert removes to take dado heads, cutters, etc. (not incl.) • Accurate mitre gauge assembly • Ground spindle • Enclosed steel base • "Compo" bearings • Accessories available at factory prices • RIP FENCE, if desired for easier work alignment: Std. size (for bench saw) \$3.50; larger fence (for cabinet base, as ill'd.) \$4.50.

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Optional Faceplate for turning bowls, trays, lamp bases, rosettes, etc. \$2.50



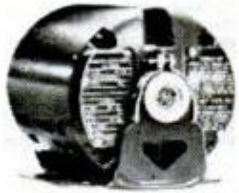
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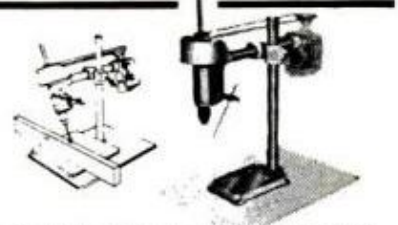
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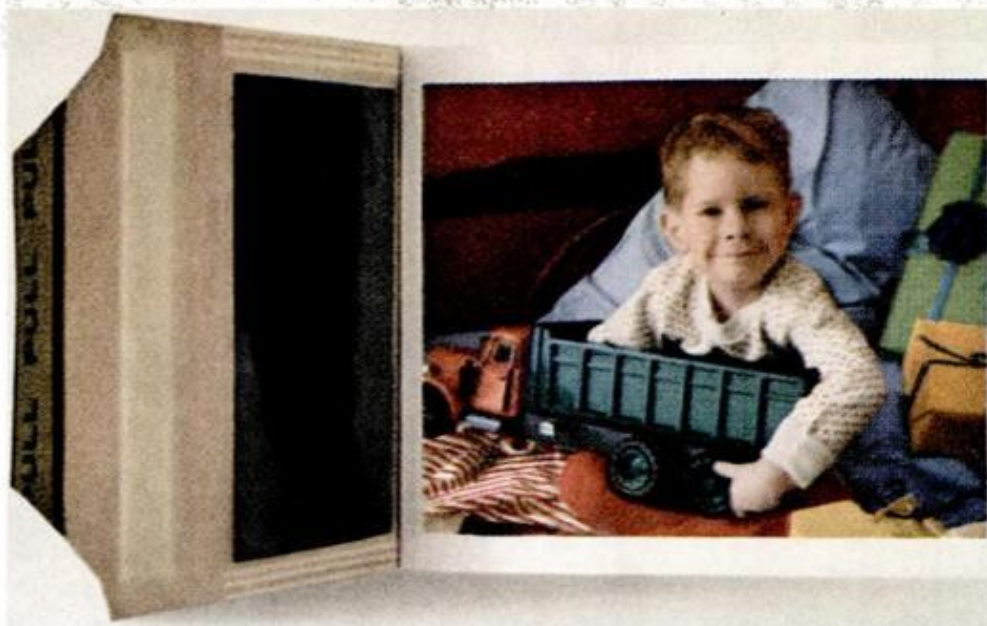
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Although it's the most advanced camera in the world, it's very easy to use. You'll be taking beautiful pictures while they're still handing out presents.

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