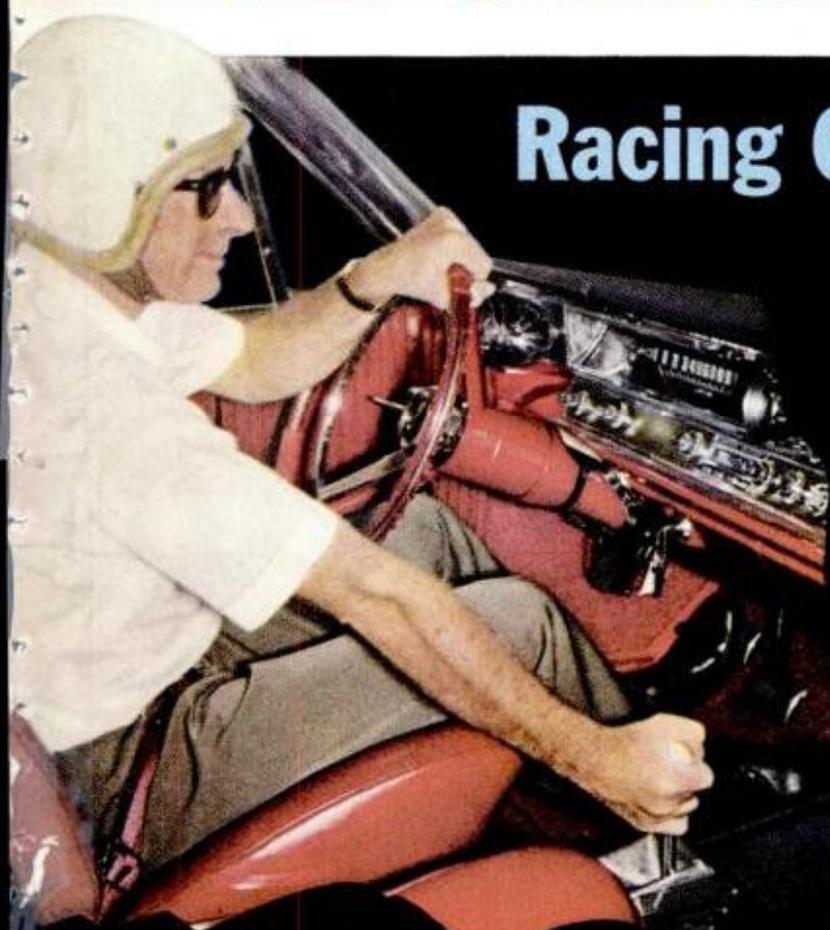


Quick Winter Starts: 20 Sure Ways

POPULAR MECHANICS

**JAN. 1964
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Indy Champ Sam Hanks

**Racing Champ Track Tests
the Hot "400s":
FORD, PONTIAC,
CHEVY, DODGE**

**(While PM Compares Six
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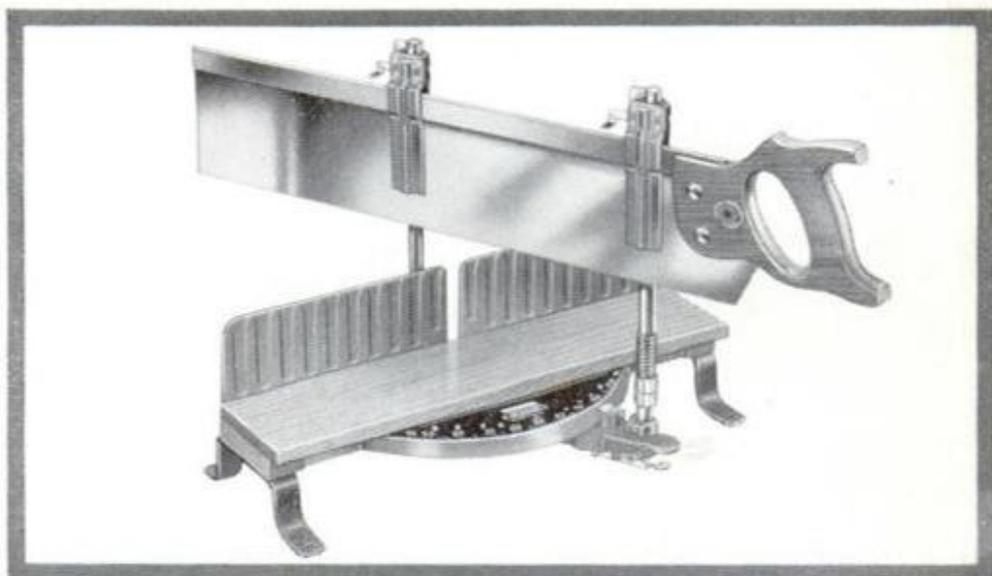
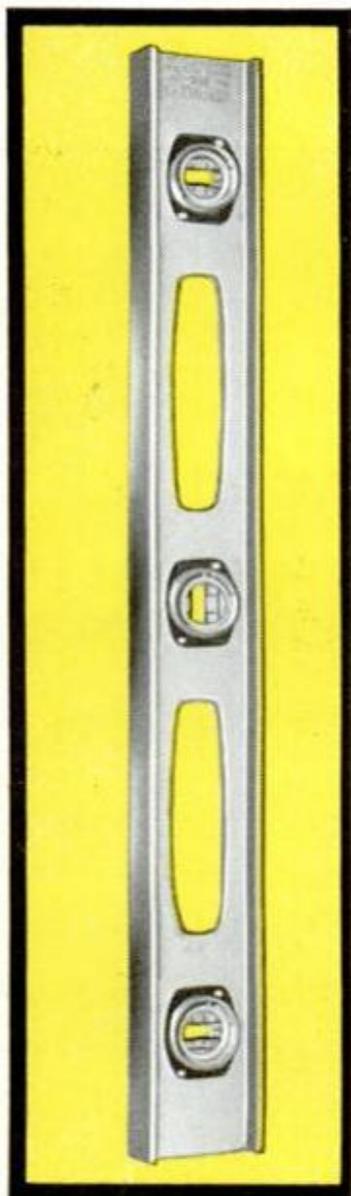
**Arc Welding Basics
Learned in Six Hours**

Three Rollaway Workshops

**Even Smaller 2x4s: How Much
Will They Weaken Your House?**

FOUR FINE STANLEY TOOLS

that deserve space on your workbench



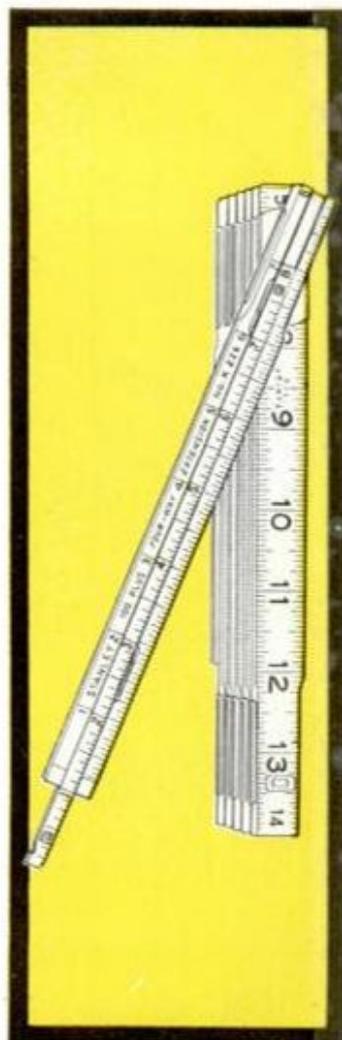
MITRE BOX with SAW — Cuts every angle from 45° to 90°. Accurate enough for the most demanding joining and cabinet work. 24" x 4" back saw. No. 60MB.

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See these and other Stanley Tools at better stores everywhere, or write for complete tool catalog to:





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. . . so lightweight it powered
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New Engine Powers Jetstar 88s, F-85s

Available in Jetstar 88 and F-85 models (with up to 290 h.p.), the new Jetfire Rocket V-8 promises you the smooth, heads-up performance you expect from an Olds! See your Dealer today for a test-flight in a '64 Oldsmobile!

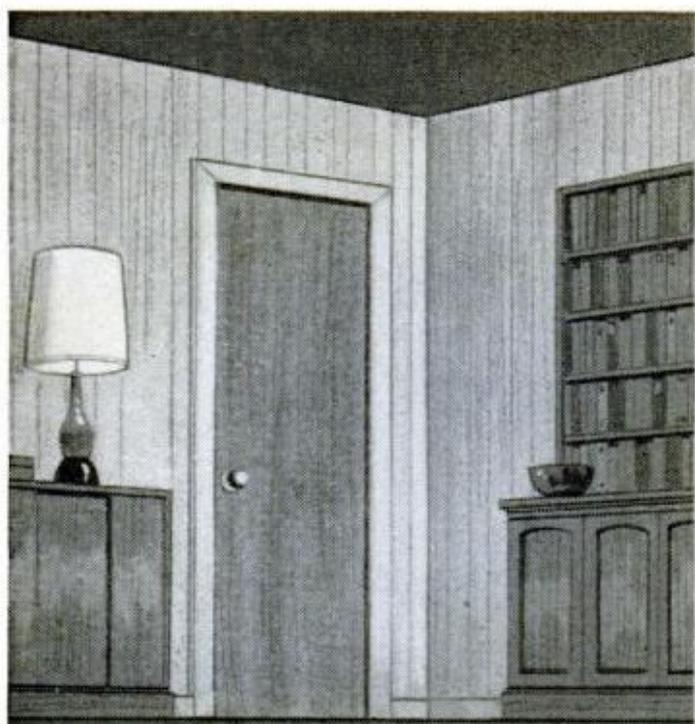
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YXFW-BOY-1FBJ



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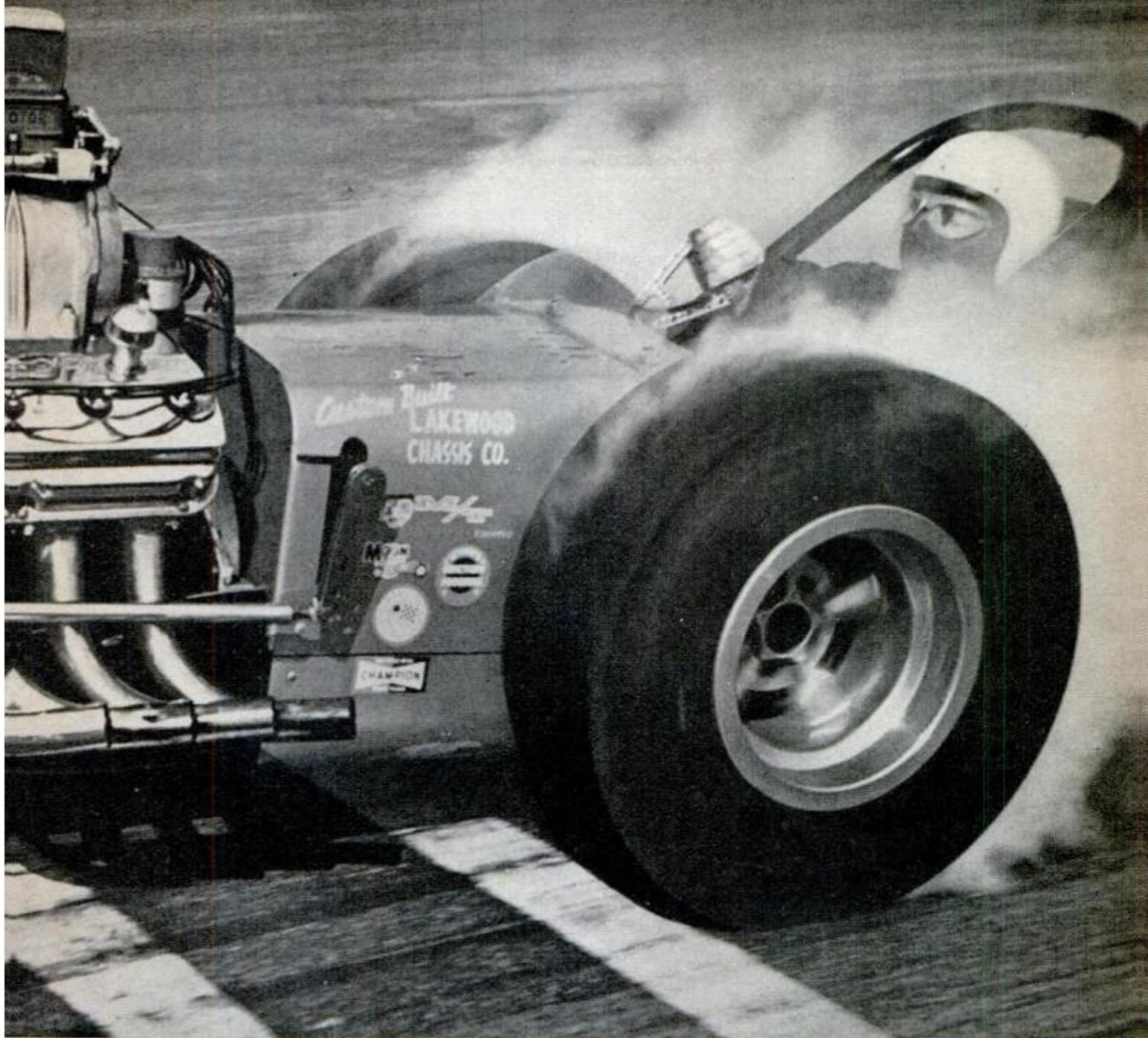
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POPULAR MECHANICS®

JANUARY 1964

VOL. 121

NO. 1

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

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NEXT MONTH—PM brings you a sneak preview of 1964's greatest show, in a behind-the-scenes tour of World's Fair exhibits and how they work. There's an owners' report on Chevelle. You'll learn how a "dwarf" will guide Apollo spacecraft; how to drive on ice; and also how to buy a good used piano

BACKSTAGE at PM . . .

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When you learn a new word, isn't it amazing how often it pops up within the following few weeks?

We find a somewhat parallel "echo" from subjects of features we publish. Having a heightened awareness of the topics, we compulsively spot later developments (and even, on occasion, rashly boast that we were smart to print such newsworthy topics in the first place).

In July, for instance, we printed *Did the Romans Discover America?* and mentioned that Vikings, among those who were here before Columbus, had visited the North American coast. Now a Viking community has been definitely identified in Newfoundland (see *Science Worldwide*, page 21). And—in an echo from the Midwest—the physician for the Northwestern University football team has measured the bashes and smashes of Big 10 football by means of a radio system we described in September, 1962 (see *Science Worldwide* for that, too).

To cite another: 104,000 of the AR-15 rifles, subject of *The Gun That Broke the Red-Tape Barrier* in September, have been ordered this year; 85,000 for the Army and 19,000 for the Air Force.

And, speaking of echoes and military procurement, the minister of defense for India recently ordered plastic tent pegs that he had read about in *Items from All Outdoors* in February. He decided he wanted to test them for the Indian army.

What happens when an editor gets sick and he has a story due to the printer? Well, we found out. He writes it in bed.

It all happened when Jim Whipple, auto editor, was putting together a report on five compacts. At about deadline time, he had several massive doses of penicillin to combat an ear infection—and wound up in bed puffed up like a sausage from a reaction. Jim had tested those cars himself, so there was no way around it: He had to tell the story.

It was completed one weekend at Jim's home with the help of Ed Nelson, who supplied his own automotive knowledge plus nimble fingers for the typewriter. (Jim's were the size of large carrots.

Oh, yes—they made it (see page 104).



With an Apache you just move the fun inside.

Let's face it. Rain happens once in a while, vacation or no vacation. We wouldn't wish it on anyone. But if there's one thing that'll show you how come a lightweight aluminum Apache is the world's largest-selling camping trailer, it's rain. ☺ The reason is room. Lots of it. In a Silver Eagle like this, room is a large pair of built-in double beds to sprawl on. And 35 sq. ft. of vinyl-covered floor space between the beds for a small-fry playroom. And cavernous storage space. And best of all, the whole rig is off the ground. ☺ Those two screened windows look like a nice target for a driving rain. Unless they had zippered storm flaps, that is. They do. (We think of everything.) ☺ There are Apaches for people who like off-the-ground or on-the-ground camping—from the \$495 Raven to the \$795 Golden Eagle. For the name of your nearest Apache Camping Center, look in the Yellow Pages—or write Vesely Manufacturing Company, Dept. G164, Lapeer, Michigan, and we'll also send you our free 1964 Apache brochure at the same time.



Apache Silver Eagle, \$645 F.O.B. Lapeer, Mich.
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Made of rugged chromed steel, racks are easily mounted *and removed* by the use of rubber-based clamps. Can be permanently mounted on station wagons. Lockable ski rack holds 5 pairs of skis. Luggage rack holds a vacation-sized load.

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Owners of convertibles, compacts and foreign cars take note! There's a trunk lid luggage or ski rack for you! Detachable or permanent installation. Ski rack holds 4 pairs of skis. See your Ford Dealer for these top-quality roof or trunk lid racks.

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JANUARY 1964

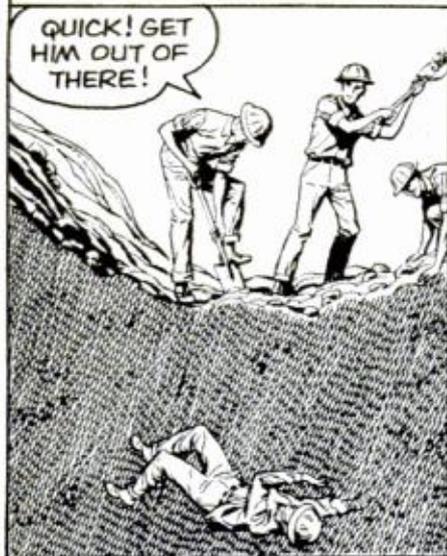
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BURIED ALIVE!



SIX YEARS ON THE SAME JOB WITH NEVER AN ACCIDENT...
AND THEN ONE MORNING...

2 A CAVE-IN PUT ME SIX FEET UNDER FOR SIX LONG MINUTES



3 IN THE HOSPITAL, I HAD PLENTY OF TIME TO THINK



4 I'D PASSED OVER DOZENS OF I.C.S. ADS IN POPULAR MECHANICS. BUT I SAW THIS ONE IN A NEW LIGHT



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FAST! I'M INTO HYDRAULICS ALREADY. AND I THOUGHT I WAS TOO OLD TO LEARN

SIGNING UP FOR THAT I.C.S. COURSE WAS THE SMARTEST THING I EVER DID

ONE MONTH LATER...

GOOD TO SEE YOU BACK ON YOUR FEET, JIM. IT'LL BE AWHILE BEFORE YOU'RE BACK IN THE FIELD. SO WE'LL FIX A TEMPORARY DESK FOR YOU IN THE OFFICE WHEN YOU'RE READY

I'M READY NOW, MR. WALSH

THEY GAVE ME SOME SIMPLE ASSIGNMENTS... AND I SURE SURPRISED THEM!

SAY, WHERE DID YOU LEARN ABOUT PUMPS?

SAME PLACE YOU DID, JOE... I.C.S.

THEN A FEW DAYS LATER, MR. WALSH CALLED ME IN...

JIM, I'M KEEPING YOU HERE AND PUTTING YOU ON SALARY. YOU'LL BE GETTING ABOUT \$20 MORE A WEEK. AND AT THE RATE YOU'RE GOING, I EXPECT I'LL HAVE TO RAISE THAT IN SIX MONTHS

THAT EVENING, JANE AND I WENT HOUSE HUNTING

OH, JIM! IT'S A DREAM HOUSE!

AND THANKS TO I.C.S. IT'S A "DREAM" THAT CAN COME TRUE!

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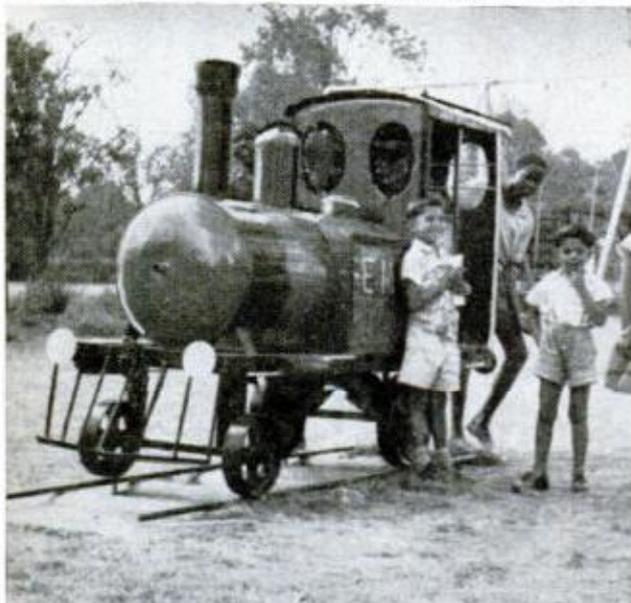
Special low rates to members of U. S. Armed Forces!

Over the Editor's Desk

Train of Thought

I have been an ardent reader of your magazine for many years and have always enjoyed the ideas you've passed along in your articles and pictures.

Being a bit of an "idea man" myself (and also being in charge of the parks of Eldoret), I constructed a playground for



the children of the town. In addition to the usual swings and seesaws, I built a locomotive for them to play on. It's made entirely from scrap parts, including a hot-water boiler and wheels from two old cement mixers and flattened oil drums.

ROBIN B. D. CAMPBELL
Eldoret, Kenya, East Africa

We'll bet the kids of Eldoret are pleased to have a park supervisor who has ideas like this one.

Yen for GM?

After reading your October issue, I am left with the feeling that your automotive editor is closely associated with GM. How about giving another writer proportionate time for the other three manufacturers.

Elmhurst, Ill. T. B. HOLLIDAY

GM got the most space simply because it made the biggest news, counters Auto Editor Jim Whipple. The firm introduced a completely new car (Chevelle) plus several new transmissions, a totally new chassis and body shell, a totally new engine and two vastly changed engines. In contrast, continues Whipple, Ford, Studebaker and Chrysler did primarily "face-

lifting" jobs this year (except for the new body on the Imperial), and American Motors produced a new body shell for the American. These changes were, of course, reported in our stories.

Diplomatic Us

You publish the greatest little ambassador that America ever had. Millions outside the fabulous U.S.A. judge the country by its export literature. Hugh Hefner's ideologies give the impression that "S" in U.S.A. stands for sex. Vance Packard and motivational researchers show us a nation on the verge of mental and moral breakdown, a veritable boggyland.

But the America we see through the pages of *Popular Mechanics* is a place we should all like to belong to. A place with people who are wholesomely human, of sound mind and well blessed with their natural heritage.

Thank you for an absorbing and utilitarian magazine, a most estimable publication.

J. C. PAYTON COTTRELL
Batu Gajah, Perak, Malaya

And thank you, Reader Cottrell, for your letter. We're delighted to be an unofficial part of the diplomatic corps. You'll excuse us, though, if we pass up the striped pants and all that; we have a full-time job continuing to keep up with the expectations of our readers.

More Dirty Realism

How come you show a man in a white shirt with clean hands freeing a sticking heat valve in *The Valve Nobody Knows* (page 178, Oct. PM). You make it look so simple and clean—just hit the valve with a hammer and apply a little graphite.

C'mon now. In reality, those damn valves are often stuck away not only where you can't see them but where there's absolutely no room to tap them with a hammer.

Magazines always make it look so easy.
Chicago, Ill. KEN GREENBERG

Comments the author, Morton Schultz: "If you think it's tough to get your hands down on that valve, you ought to try to get a camera in there. It's impossible. For that reason, we selected a car with a valve that's easy to see—a Chevrolet six-cylinder. And to show the work on the valve most clearly, we photographed the operations on a bench with the unit removed from the car.

"As for the valves being 'stuck away,' I'll have to disagree. We checked every model car with a manifold valve back to

[\(Please turn to page 12\)](#)

Need a better job? Want to own a business? LOOK INTO AIR CONDITIONING AND REFRIGERATION FIRST!

Skilled men are in big demand in the air conditioning and refrigeration field. Industry leaders say that 20,000 mechanics must be trained each year. Here's why: During a 12-year period, production quadrupled. Only one other industry grew so fast. Last year, over 3 million air conditioning units and 5 million refrigerators and freezers were produced. Over 150 million units are in use. It takes skilled men to install, service and repair such equipment. They are well paid. They work steady. Why don't you qualify for one of the better-pay jobs? CTI trains you at home in spare time. For complete information, send coupon. No obligation.



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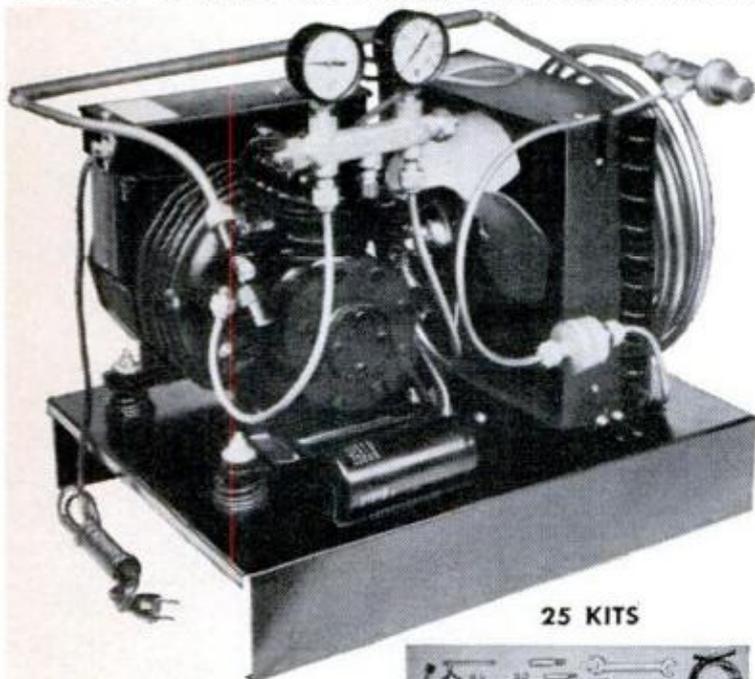
Many earn money while learning

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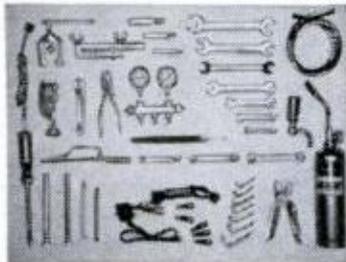
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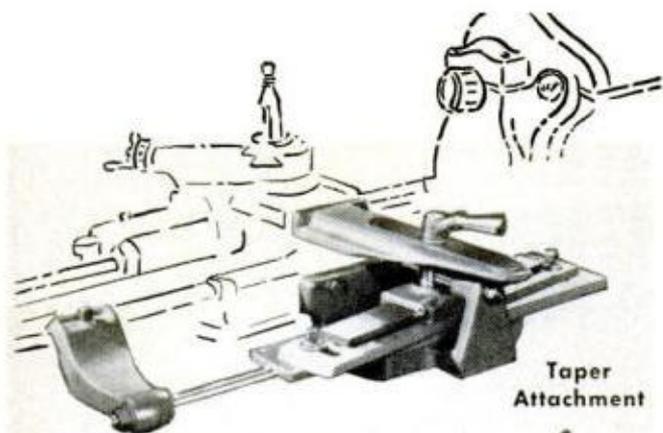
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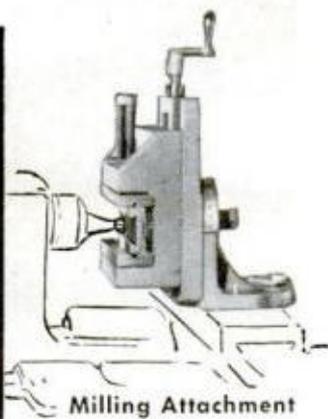
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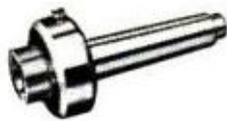
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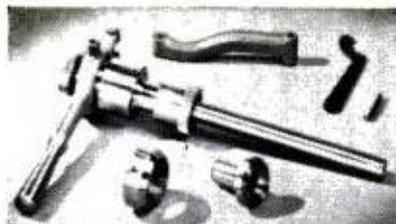
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"Just take a look at some of PM's other automotive articles and chances are you'll find the mechanic winding up with hands grimy enough to make any realist grin."

It's a Good Guide

I was particularly interested in the Shopping Guide titled *Storm and Screen Combinations* (page 134, Oct. PM).

Having spent 15 years in the industry and being associated with the leading manufacturer of aluminum storm windows and doors, I can say without fear of contradiction that this is the finest article on this subject I have ever read. Your article was informative, well written and without prejudice to any one window.

Philadelphia, Pa. LARRY SCHWARTZ

Love on First Flight?

Please permit me to correct the caption under the photo of the Wren landing (*Takeoff at 30*, page 94, Sept. PM) on page 96. Pictured is the final approach for runway 18, Love Field, Dallas—not Meacham Field in Fort Worth.

Hearne, Tex. DON COCHRAN

Aviation Editor Kevin Brown says he doesn't recall taking any pictures at Love Field. "I still think it's Meacham," he reports (somewhat hopefully). So. . .

Heated Exchange

Your Auto Clinic editor was kind enough to offer suggestions on how to improve the heater operation on my 1957 Studebaker Hawk. I was about to put another heater in the car until I received his letter.

It turns out that some genius who owned the car before me had replaced the blower motor with another of the *wrong rotation!* And a centrifugal blower just doesn't put out much when it's rotating backwards. I reversed the brush leads inside the motor and—hallelujah!—it works. Bethesda, Md. MARVIN SCHULDENFREI

Too Many Volts

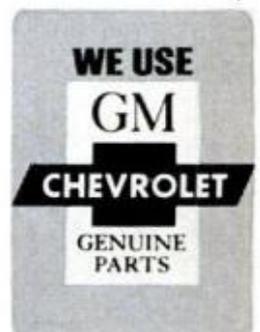
Don't run out and buy a 12-volt auto generator for the *Sidewalk Classic* (page 146, Nov. PM). What it really needs is a six-volt generator; the builder accidentally supplied the wrong specification for the handsome little car. Incidentally, it'll run with a 12-volt generator, but only half as fast as it will with a six.

The Editor

POPULAR MECHANICS

WORN SHOCKS?

Don't send your Chevy to parts unknown! When shock absorbers are worn, your car often tells you. It may nose-dive on sudden stops. Keep bouncing after bumps. Or show uneven tire wear. When it's time to replace, ask for the same kind of parts that gave your Chevy that smooth ride when it was new. Genuine Chevrolet Parts. They're built to your car's specifications, so they'll fit and work right for a long time. They're easy to get, because the people who install them have access to more than 75,000 of them for cars and trucks back to 1938. Ask for Genuine Chevrolet Parts by name at your local Chevrolet dealer's or at leading independent garages and service stations. . . . Chevrolet Division of General Motors, Detroit, Michigan. Remember . . . **It pays to keep your Chevy the Chevy-est.**



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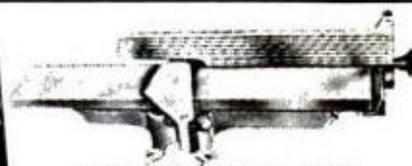
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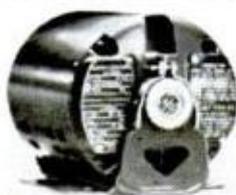


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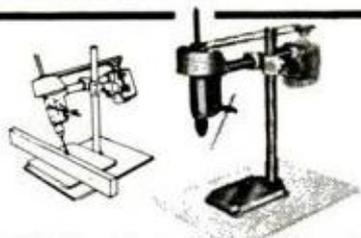
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Sidelights from the SERVICES

By William R. Kreh

Electronic muscles. Space travelers and submarine crews may soon have a new way to keep physically fit. A group of Marines recently finished experiments with a device called the Isotron, invented by a civilian neurosurgeon. The machine causes the muscles to contract by applying an electrical current through electrodes placed on 14 spots on the body that have been found to control groups of muscles. It's painless, and it's said that the Isotron will give a more complete workout in 140 seconds than an hour or two with weights.

Springy building. Workmen are installing huge steel springs as mountings for buildings in the North American Air Defense Command's underground combat operations center. Nearly 1000 of the springs, each made from three-inch steel, will be used for the bomb-proof facility inside Cheyenne Mountain at Colorado Springs, Colo. Weighing 1500 pounds and costing \$400 apiece, the springs will protect electronic equipment from damage by earth-shaking nuclear blasts.

Automated dough. The Navy is testing a new system for making baking dough aboard ship. Called Amflow, the compact machinery produces from 100 to 300 pounds of dough for buns and bread each hour of operation. The future Navy baker will put the raw ingredients into the machine and the dough will come out mixed and ready for baking. The equipment is designed to replace cumbersome baking machinery now used aboard Navy ships.

Fire finder. Infrared scanners developed by the Army are being tested by the U.S. Forest Service for use in detecting and mapping forest fires. The airborne scanners can accurately map fires night or day and through dense smoke.

Shark surgeon. A Cornell University scientist, working under an Office of Naval Research contract, has developed a remote "stethoscope" for sharks and used it to obtain the first heartbeat recordings ever made from a free-swimming sea creature. Operating on a 40-inch lemon shark, the scientist put a tiny electrode next to the creature's heart and then ran a cable from the electrode to a recorder and took read-

ings as the shark swam freely in a large pen. The study may help the Navy learn more about how a shark reacts to different types of repellents.

Ersatz baubles. An Army chemist is making artificial rubies and sapphires said to be identical with the same precious gems found in nature. The scientist uses a plasma furnace which produces temperatures up to about 28,000 degrees. He pours certain chemicals into the flame. They vaporize, then condense and fall into an asbestos cup, forming an upside-down gem icicle.

Steam launch. The Navy is experimenting with using steam instead of compressed air for launching Polaris missiles from submarines. The steam system eliminates a lot of complex valves, piping and the need for large steel air-storage tanks.

Can't escape it. Not even astronauts nor submariners are safe from smog. The Office of Naval Research has found that the amount of aerosols, "trace particles" and carbon dioxide and carbon monoxide aboard a submarine is twice as much as that in the Los Angeles atmosphere, and there is eight times as much organic substance containing a lot of strongly acid materials. The same will be true of spacecraft, scientists say, and the problem must be solved before man can make any extended space flights.

Scientific dogcatchers. MPs at Fort Leonard Wood are catching stray animals on the post by using a rifle that shoots a drug-laden dart. The drug immobilizes the animal without harm and after-effects.

Cramped cockpits. A Navy doctor has found that Navy pilots average more than an inch taller than Air Force fliers and says they may be too big for safety in the cockpit. Air Force measures are used to determine the cockpit sizes of all military planes, and a study showed a definite connection between Navy pilots more than six feet tall and the number of air accidents in high-performance jet aircraft.

New hobby. Servicemen who have picked up the habit of collecting beer coasters during their tours are organizing. The Society of American Coaster Collectors is being set up for those who have been picking up the circular souvenirs in German beer gardens, French cafes, English pubs and Japanese tea rooms. In case you're wondering, the "scientific" name for the hobby is said to be tegestology.

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Not yet completed—workmen were still on scaffolds when we were there recently—it still has more than enough to satisfy anyone, young or old, who has only a passing interest in military aviation. If your interest is more than passing, be forewarned. It could bring tears to your eyes. All the old birds are there.

Some of the early experiments with balloons and gliders are depicted, but the real stars of the show are the actual aircraft, starting with the Wright brothers' *Flyer*, purchased by the Army Signal Corps in 1909, and ending with some of our latest missiles. The museum is still adding to its collection.

Some of special interest include one of the Douglas *World Cruisers* that made the first around-the-world flight in 1924 (perhaps the largest open-cockpit, single-engine plane you'll ever see); a P-26 (the first low-wing, all-metal plane used by the Army); and a P-59 (America's first jet).

All the World War II planes are there, bless them—the P-38, P-63 (no P-39), P-40, P-47 and P-51, and the B-17, B-24, B-25 and B-29. Also, a Japanese *Zero* and a few German bombers. The Korean jets are well represented (including a Russian *MiG*), but the planes we found most interesting were those that didn't make it.

The XF-91, with wings that look like paddles, is there, also the X-3 and X-5 rocket ships, both follow-ons to the original X-1, the first plane to break the sound barrier (it's there, too), and one of the weirdest looking fighters we've ever seen, the F-107 with an air scoop above and behind the cockpit.

Perhaps the oddest sight of all, however, is the stubby, rudder-studded XF-85 *Goblin*, only 15 feet long with no landing gear, alongside the gargantuan, 10-engine B-36, some 162 feet long. The *Goblin* was carried aloft and dropped by a mother ship and was to fly back to it again and hook on for the return home. The B-36 looks like a large motel with wings.

Sorry, no Navy or Marine planes. It is, after all, an Air Force museum.

Kevin V. Brown
Aviation Editor

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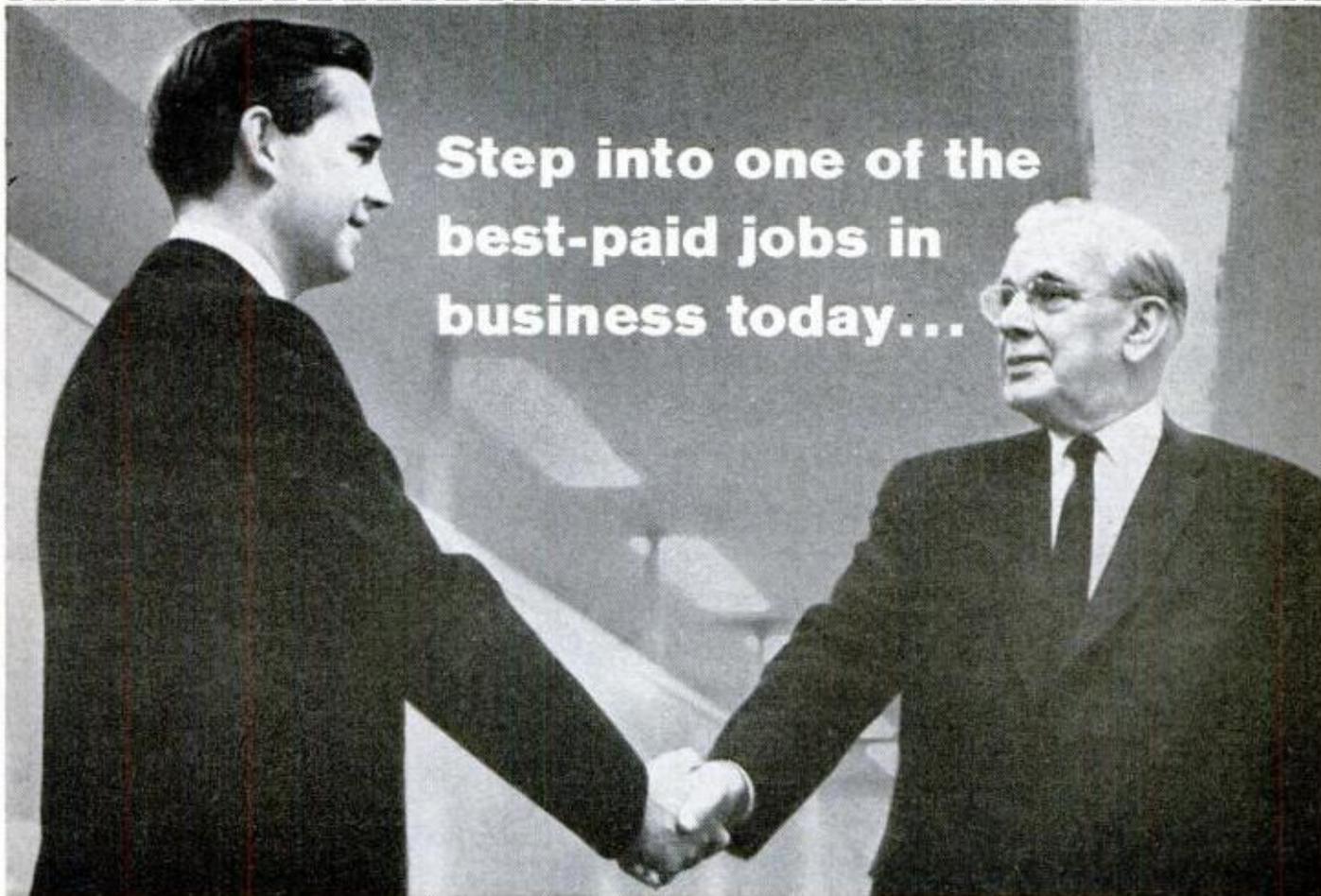
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Viking ruins found recently in Newfoundland go far toward proving that Europeans were in the Americas before Columbus, the subject of *PM's* article *Did the Romans Discover America?* (page 70, July, 1963). A Norwegian expedition has found the remains of a settlement near the fishing village of L'Anse aux Meadows which is almost certainly Viking. Radiocarbon tests date the ruins to about 1000 A.D. One large house may have been the home of Leif Ericsson.

Photographs inside the eye can now be taken through a tiny telescope designed by two Australian eye specialists. The telescope, which is attached to an outside camera, is inserted in the eye through an incision.

St. Paul actually wrote only five of the 14 epistles attributed to him—or so a computer analysis of the biblical works indicates. A Scotch Presbyterian minister, Rev. Andrew Q. Morton, fed the original Greek versions of the epistles into the computer to tabulate the writing style. It analyzed the use, proportion and spacing of certain common words, which give scholars definite clues to an author's individual style. The computer concluded that St. Paul actually wrote only *Romans*, *First and Second Corinthians*, *Galatians* and probably *Philemon*.

Special traffic lights for the blind have been installed in Gedera, Israel, which is near Malben Village for the Blind. Some 150 blind persons were given keys to a special box attached to traffic lights. The keys turn a switch in the box, causing the light to turn red and ring a bell to tell the blind pedestrian he can safely cross the street.

Backfield men in a line plunge often take blows on the helmet equal to 5000 times the force of gravity, according to tests conducted by Dr. Stephen Reid, Northwestern University's team physician. As reported in *PM's* article *Should Your Son*

Play Football (page 94, Sept. 1962), Dr. Reid tests impact forces by planting tiny FM recorders in players' helmets; transmitters in the shoulder pads send impact signals to a special recording machine on the sidelines.

By contrast, the astronauts experienced only about seven or eight Gs during the blast-off of Mercury space boosters. The spacemen, however, experience G forces over the entire body for several minutes, whereas football players receive the impact over a very small area for only a fraction of a second.

Dr. Reid, who reported test results recently to the National Safety Congress, hopes to come up with minimum requirements for a safe football helmet.

Birds whistle for their mates in a code-like song, two German scientists say. They find that when a bird warbles a tune that only its partner has sung before, she understands his message and returns to him almost immediately.

The big noise around Cape Kennedy these days is being made by the most powerful siren in the world. It's used to study the sound effects of a Saturn V rocket launcher. The big noisemaker can shatter sheet metal and scramble electronic components.

A leaky submarine was plugged by British dentists recently. In Singapore, the submarine *Amphion* sprang a leak in her radar mast, and nobody could find a replacement part. The dentists fashioned a plate out of material used to make false teeth. It fitted snugly over the leak and *Amphion* was seaworthy once more.

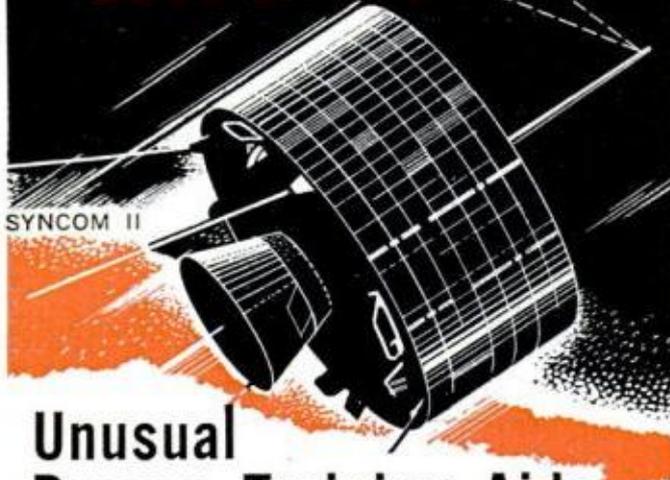
Moon explorers only five miles apart on the lunar surface may have to communicate with each other by bouncing radio signals off the earth. Reason is that there's no ionosphere on the moon to reflect signals. Radio impulses would take two seconds to make the half-million-mile round trip to earth.

An electronic nose that's more than 100 times as sensitive as human nostrils is being tested at City College of New York. The super-sniffer conducts an electric current through a liquid which acts like the mucus in the lining of the human nose. When an odor is whiffed, odor molecules dissolve on the liquid surface, changing the electric current in a significant way.

Tipsy farm animals might be a common sight any day now. Tests show that cattle

(Please turn to page 22)

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Science Worldwide

(Continued from page 21)

and sheep add weight faster when alcohol is added to their diet. The ideal tippie for steers over a five-month period was found to be about three gallons of whisky.

An ancient meteor made two hits on the earth, one in the U.S. and one in Australia, according to a British scientist. He came to this conclusion after studying two meteorites, one 500-pound one from Bear Creek, Ore., and a 71-pounder from Naraburra, Australia. He found that the two are not only chemically identical but also have the same microstructure.

Botulina, the toxin responsible for the botulism disease which killed two women in Michigan recently, is the most powerful poison known to man. Cobra venom, curare and arsenic are mild in comparison to it. Victims usually get the disease by eating improperly canned foods and death is swift. Experiments at the University of Michigan show that one one-hundred billionth of a gram is a lethal dose.

Radio-carrying sheep tell Australian farmers exactly where their flocks have strayed. A tiny radio transmitter strapped to the back of the lead sheep in the flock sends a periodic signal to the farmer's direction-finder receiver. Since sheep always follow a leader, the farmer knows where all his sheep are at a given time.

An oral contraceptive, Ortho-Novum 2 mg., was reported as 100 percent effective in recent tests in the U.S., Mexico, Puerto Rico and Canada. Now available for doctors' prescriptions, it has markedly reduced the side effects noticed in other oral contraceptives, according to Dr. Alan F. Guttmacher, president of the Planned Parenthood Federation.

A lot of mud is going to college. Nearly a ton of sediment scraped from the bottom of the Antarctic Ocean is being shipped each month to Florida State University for study. Gathered by the research ship *Eltanin*, the scrapings may reveal much of the climatic history of the polar region. Fossil deposits, age and mineral content will also be determined.

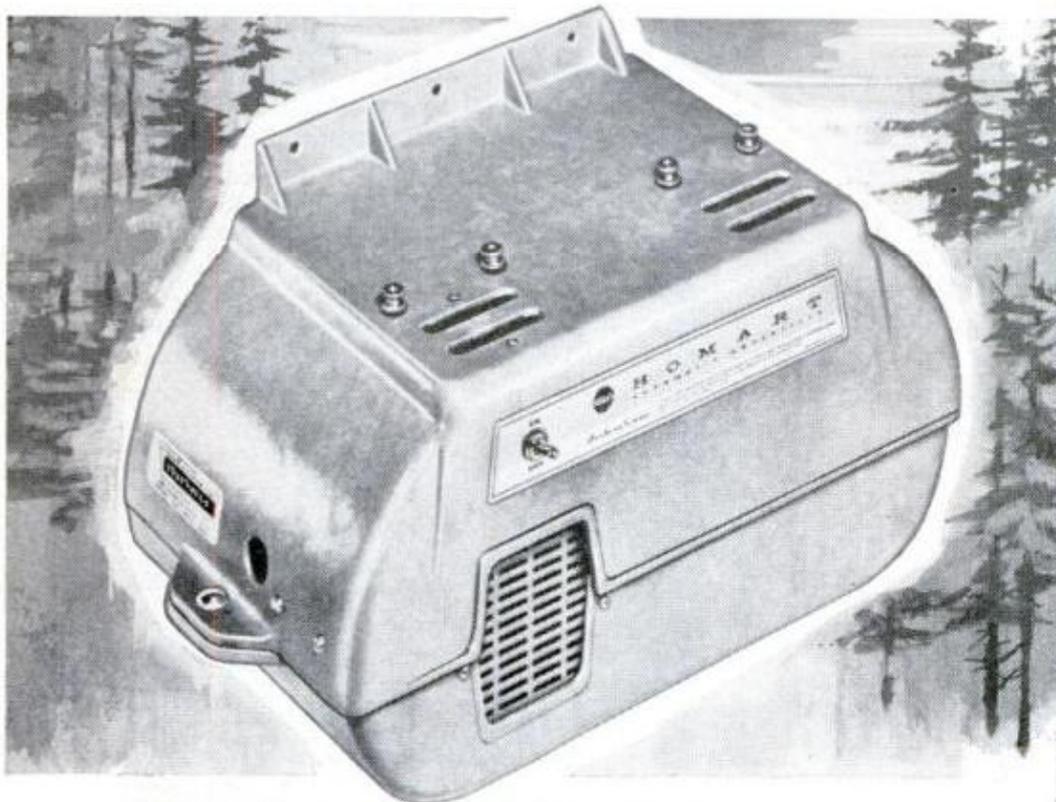
False-teeth wearers chew their food more on the right side of their mouths than their left. A British dentist put two miniature radio transmitters on the dentures of a group of patients to test their chewing habits. Signals indicating tooth

(Please turn to page 24)



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Science Worldwide

contact were picked up by aeri-als and fed into an oscilloscope; the transmitters operated at different frequencies.

Aircraft crashing into Canadian lakes will be easier to locate, thanks to a new underwater ultrasonic transmitter developed in Ottawa. It begins transmitting as soon as a disabled plane hits the water; tests show it has a range of nearly a mile from depths of 360 feet.

Boat decks can be given a permanent waterproof covering with a liquid plastic developed in England. Applied cold by brush or spray gun, it dries in a few hours and leaves no joints. The nonslip, flexible plastic can go on most deck surfaces.

SOS for small craft. Because small boats are difficult to detect on radar screens of searching ships and aircraft, an English firm has come up with a radar reflective signal for use on life rafts and lifeboats. A small gun shoots a rocket to a height of 1350 feet where 280,000 tiny pieces of metal chaff are released along with a seven-second flare. Echoes of the chaff

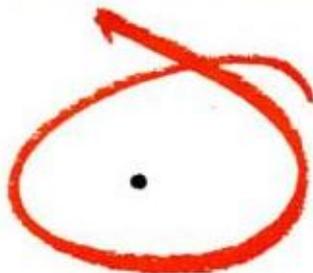
are "visible" on radar scopes 30 miles away for an average of 15 minutes.

An atom smasher more than a mile across will be built soon in the U.S. Framing the 200-billion-electron-volt (Bev) machine, now under study at Lawrence Radiation Laboratory in Berkeley, Calif., will be a giant steel ring of 600 to 700 magnets a mile in diameter.

Heart of the ring will be a three-by-six-inch vacuum tube providing a flight path for speeding protons, the nuclei of hydrogen atoms. So enormous is the new smasher that a "baby" version (five Bev) of the same machine may be necessary to fire the atomic particles. Purpose of the unit is to help "clarify present puzzles about the ultimate structure of matter," says the laboratory's Dr. Lloyd Smith.

Hunting cries probably led to the development of human speech, says Ashley Montagu, an anthropologist at Princeton University. Early huntsmen, he says, may have communicated during a chase by means of cries or yells. With repetition and imitation, these sounds gradually became established as words.

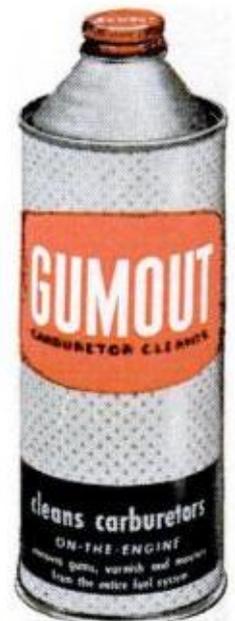
John P. McNeel
Science Editor



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Grant Mauk

In the past, many men started businesses of their own—and failed. Some entered businesses that were already on the decline. They were as foredoomed to failure as a buggy-whip salesman. Some had no talent for the businesses they entered. Others had no experience in business management.

Today, all that has been changed by reputable Franchising firms. Our Franchise business is one that has been tried, and tested, and proved by the parent company. It is one that has been shown to have an enormous and a growing market. It is a business that has been brought to a high level of success by many other men. The kinks have been eliminated. The methods and plans that lead to success have been clearly charted. When an ambitious man is given the equipment and training he needs, and follows the plans laid out for him by the parent company, success is the logical result.

There are many kinds of Franchise businesses. Many require investments as high as \$50,000. The profits they pay depend on how well the owner follows instructions.

We have a Franchise business that does not require a large investment. In our business you can get started for a few hundred dollars. We finance the rest of the investment for you and let you pay it in monthly payments so small that the profits on less than one day's service covers your payment. The overall investment is small—yet the potential is \$250 a week net profit. That's for a one man operation. If you have two or three or more men working for you, the potential increases accordingly.

A small dealer just starting and doing his own service should gross \$180 profit from 20 hours service in a week. If he uses 30% for advertising, etc., he nets a clear \$125. If he services 40 hours, net profit is \$250.

With only two men working for him a 35 hour week brings the owner \$420 gross profit. Allowing 20% for advertising, etc., (since he has time to sell) he clears \$336.

What is this business? It's one of the fastest growing businesses in America today. It includes six different services that you perform for the housewife right in her home. No office or shop is needed. No investment in real estate. No problems of finding a good location. In fact, if you have a telephone at home and a car with space in the trunk—you have everything you need except the things we furnish. Your business comes to you on the telephone and in personal calls following up leads generated by National Advertising and by your own local Direct Mail Plan which we furnish. You quote your prices to the housewife, do the job, or have one of your

men do it and collect the money on the spot.

What are these services? The first and most important is the cleaning of carpets, rugs, and upholstered furniture by a revolutionary modern process known as the "Absorption Method." The work is done right in the customer's home. No scrubbing with harsh motor-driven rotary brushes. No soaking with gallons of water. An Aerated Foam loosens the greasy, atmospheric dirt and holds it in suspension until it is removed. A test conducted by an impartial laboratory showed that the new absorption method in the home removed more than twice as much dirt as was removed by the old fashioned machine scrubbing Absorption Method.

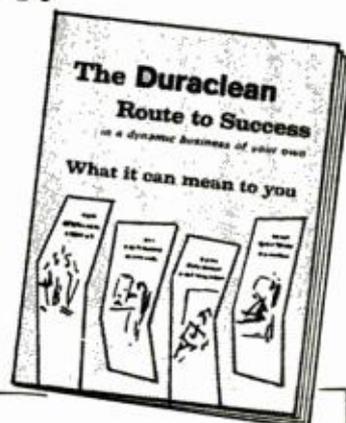
Five other services add to your income. With portable power equipment you spray furniture and carpets with a product that retards soiling. You remove stubborn spots like magic. You spray another liquid to make fabrics flame resistant. You mend small damages such as cigarette burns and moth holes, often saving the owner the price of new furnishings. And finally, you deep spray fabrics with a moth killing liquid on which you can give a company guarantee for six full years.

As owner of a business, you have the opportunity to make more money than you could hope to make working for someone else. Also, should you wish to sell, you are building a business with a cash value. When an arm injury made it necessary for Al Svitek to sell after operating his dealership only 17 months, he sold to a prospect supplied by Duraclean at a price 50% above his original investment. G. F. Monroe sold his Texas Dealership after 12 months for ten times his cost. Leo Lubel, after 30 months, sold for \$7,116 over cost. When our Franchise owners want to sell, we help them find buyers.

It's all explained in this free book. Pictures and descriptions show you how the work is done; how to start without giving up your present job; how to build to full time operation through plans worked out for you.

If you are tired of working for others, tired of jumping from one proposition to another; if you have good health, energy, and ambition; if you have a real yearning for independence in a business you own, send for this book. If you have thought that starting your own business would be difficult or expensive, or risky, this book will open your eyes. With our plan it is easier than ever for you to become master of your own destiny in a business you own.

There is no obligation, no charge. No salesmen to high pressure you. Send for this book now. Read it. Then decide if you want to take the next step toward independence.



OPPORTUNITIES TO FIT YOUR OWN AMBITIONS

The Duraclean Franchise is so flexible that it can be fitted to your own ambitions. As a one man business and based on the rates in our National Price Guide you can make a net profit of \$6.00 an hour—\$250 for 40 hours of servicing.

Ward Whitebeck wrote "I have made as much as \$225 in one day." L. Lawson says: "In September, working alone, jobs totaled \$1,476." L. Canaday wrote: "\$1,571 in a single month."

If you wish, you can operate as the head of a multi-crew business with others doing the work.

This increases the profit opportunity as the owner of a business can make as much as \$6.00 an hour gross profit on every hour each employee works. Even after paying him a good hourly wage, the owner can clear \$336 a week for himself with only two men on his staff.

Ed Kramsky wrote, "In my second year I now have two assistants, a nice home, and real security for my family." And, E. Davis reported "Gross income increased \$17,660 this year."

So, no matter at what level you have set your sights, here is a Franchise that is worth careful investigation. Send your name now for the Free Book that tells all angles of the business.

Send name for FREE BOOK

Grant Mauk, President
4-161 Duraclean Building, Deerfield, Illinois

Dear Mr. Mauk: Please mail a copy of your Free Book telling how I can get a Duraclean Franchise started in spare time without giving up my present income, and how I can build a highly profitable one man business or a multi-crew operation. No charge. No obligation. And, no salesman is to call on me. After reading your book I will let you know my decision.

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Items from All Outdoors

Family campers will be able to visit the 1964 World's Fair in New York, and camp just 35 minutes' drive from the Fair Grounds. An 800-unit camp site to accommodate tents and camper trailers is being built on Long Island adjacent to the Veteran's Highway near Jones Beach. Planned expressly for Fair visitors, the camp ground will be equipped with electricity and hot showers. There will be a laundromat and grocery store, plus daily milk and bread delivery. There will also be 24-hour police protection and a complete baby-sitting service. Jack Connell, who manufactures the Right Camper Trailer, is building the site, and for information regarding reservations you can write to him at: Right Products, Inc., 213 Dunn St., Cincinnati, Ohio.



This "sporting" life . . . A friendly fisherman on a lake in the Midwest called to a man by himself in a small skiff: "Do you want some fish? I've caught way over the limit." It was a game warden in the second boat, and he got a summons for his generosity. . . . In Jonesboro, Ark., last deer season, a 16-year-old hunter took a snap shot at what looked like a huge buck, and shot the horse from under a game warden. . . . Our man on the West Coast encountered a traffic jam on a twisting road in the High Sierras. He stopped in the long line of cars and asked the driver ahead of him where everyone was going. "I don't know," the driver answered, "we're just following that Fish and Game tank truck."



Backpackers can save space and weight by eliminating the coffee pot and the tent from their gear. Replace the coffee pot with a tea strainer. Boiling water poured through a spoonful of coffee in the strainer makes delicious coffee. Instead of a tent carry a polyethylene tube that becomes a perfect rain shelter when supported on a piece of heavy cord tied between two trees. Called the Poly Tent, it is over nine feet long and has a nine-foot circumference. It weighs only one pound and costs \$2 from Kelty Mfg. Co., Box 3453, Glendale, Calif.

STUART JAMES

Outdoors Editor

POPULAR MECHANICS

Profits That Lie Hidden in America's Mountain of Broken Electrical Appliances

By J. M. Smith President, National Radio Institute



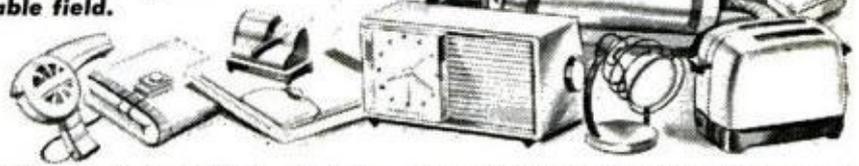
And I mean profits for you — no matter who you are, where you live, or what you are doing now. Do you realize that there are over 400 million electrical appliances in the homes of America today? So it's no wonder that men who know how to service them properly are making \$3 to \$5 an hour — in spare time or full time! I'd like to send you a Free Book telling how you can quickly and easily get into this profitable field.

THE COMING OF THE AUTO created a multi-million dollar service industry, the auto repair business. Now the same thing is happening in the electrical appliance field. But with this important difference: anybody with a few simple tools can get started in appliance repair work. No big investment or expensive equipment is needed.

The appliance repair business is booming — because the sale of appliances is booming. One thing naturally follows the other. In addition to the 400,000,000 appliances already sold, this year alone will see sales of 76 million new appliances. For example, 4,750,000 new coffee makers, almost 2,000,000 new room air conditioners, 1,425,000 new clothes dryers. A nice steady income awaits the man who can service appliances like these. And I want to tell you why that man can be you — even if you don't know a volt from an ampere now.

A Few Examples of What I Mean

Now here's a report from Earl Reid, of Thompson, Ohio: "In one month I took in approximately \$648 of which \$510 was clear. I work only part time." And, to take a big jump out to California, here's one from



J. G. Stinson, of Long Beach: "I have opened up a small repair shop. At present I am operating the shop on a spare time basis — but the way business is growing it will be a very short time before I will devote my full time to it."

Don't worry about how little you may now know about repair work. What John D. Pettis, of Bradley, Illinois wrote to me is this: "I had practically no knowledge of any kind of repair work. Now I am busy almost all my spare time and my day off — and have more and more repair work coming in all along. I have my shop in my basement."

We Tell You Everything You Need to Know

If you'd like to get started in this fascinating, profitable, rapidly growing field — let us give you the home training you need. Here's an excellent opportunity to build up "a business of your own" without big investment — open up an appliance repair shop, become independent. Or you may prefer to keep your present job, turn your spare time into extra money.

You can handle this work anywhere — in a corner of your basement or garage, even

on your kitchen table. No technical experience, or higher education is necessary. We'll train you at home, in your spare time, using methods proven successful for over 45 years. We start from scratch — tell you in plain English, and show you in clear pictures — everything you need to know. And, you will be glad to know, your training will cost you less than 20¢ a day.

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INVENTORS' CORNER

By Joseph H. Kraus

Mr. Kraus has been helping inventors solve their problems since 1919. Readers may send queries on ideas, inventions and patents to him, care of *Popular Mechanics*. Questions of general interest will be answered in this column. Please include all information necessary to understand the proposed idea or invention, plus your return address.

PORTABLE RADIO, about size of pack of cigarettes, powered by penlight cell; 12-inch speaker; has operated continuously for more than 1500 hours. Robert W. Johnson of Poulsbo, Wash., wants to know how to market the device—which he says would be useful in major disasters, such as fires, earthquakes, floods.

Forget about glorifying your idea with possible use during major disasters. You should have a patent search made and start procedures toward protection if you have something seemingly patentable. If your statements hold up under test and depending on selectivity and tone, you might have a valuable product which should sell on its merits.

POWER FROM OCEAN WAVES: Charles L. Turner of Alamogordo, N.M., sends diagrams and description of device to harness ocean waves for producing power. No patent applied for. Is there any individual or corporation which might be interested in it?

None to my knowledge. And even if you found a backer, it would be advisable to search the Patent Office records. Substantially this same invention was patented prior to 1931. As this patent protection has expired, anyone can use the information. Very little power is potentially possible. You would be lucky to get a pressure of three pounds per square inch from waves 10 feet high.

ORNAMENTAL LAMPS: Mr. and Mrs. Henry P. Moore, Jr., of Pawleys Island, S.C., design and manufacture decorative lamps, some of which they'd like to patent. Is this advisable and how should they go about it?

Normally, I recommend a patent attorney. However, you may be able to get design patents yourself, with the claim, "Design for a lamp substantially as shown." I

recommend that you do this for some of your most novel designs. Write to the Patent Office, Department of Commerce, Washington 25, D.C., and ask for Patents and Inventions, an information aid for inventors, and General Information Concerning Patents.

CHECK PROTECTOR, submitted by H. L. Hager of Paradise, Calif. Patent applied for. Is there a market for it?

Rather dubious considering the previous history of such devices. Check altering seems to be on the wane. Also some bank checks leave telltale marks when attempts are made to change them. Large companies have inexpensive check-writing machines. And protectors similar to yours have been marketed. You may find it difficult to locate a manufacturer; you should plan to produce and market the item yourself.

BREATH TESTER, a bowl-shaped device with an opening for the nostrils and a tube leading to the user's mouth. Otto M. Dyer Jr., of Detroit, Mich., who holds patent 2,780,220 on the device, believes that a user can test his own breath. What do I think of his invention and how and where can he sell it?

You would not have the slightest difficulty in selling this invention if it works as you describe. But you fail to recognize that a person can't smell his own breath except in very rare instances. Chew on a clove of garlic or eat some strong cheese and try to detect either with your tester.

MARKUPS: George W. Jackson of Orelan, Pa., is surprised that the selling price of an item should be figured at five times production cost. How is this figured?

On small items, a five-time markup is modest. A dollar toy, for example, is sold to the dealer at about 55 cents. After the jobber gets his percentage, the manufacturer receives 44 cents. This must cover cost of production, overhead, packing, shipping, advertising, billing, losses, and other expenses. Move an automobile out of the salesroom and its price drops \$300 to \$600 before you have traveled a foot. The markup on cosmetics is terrific. Often you pay more for the bottle than for its contents.

SMALL-CRAFT MOTOR: Robert B. Lewin of Fremont Calif., sends diagrams and description of a mechanical motor to be attached to small craft. More than 40 manufacturers contacted, but none showed any interest. A search indicates it is patentable. Is it worthwhile?

(Please turn to page 30)



We helped break America's smoking habit

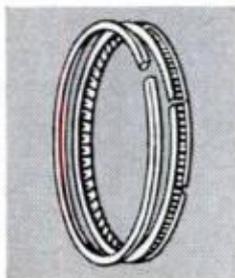
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INVENTORS' CORNER

(Continued from page 28)

The first outboard motor was a direct development of a device such as you designed. I imagine it would sell. But you will find it difficult to find a manufacturer willing to risk production. The motor would have more appeal if it could be folded. Success will depend on your ability to produce and sell this item yourself. Also, you will risk competition from imitators; they can base their plans on expired similar patents.

NEW PATENTS

Cylindrical tanks and geodesic domes can be erected from the top down by building them on top of large pneumatic bags, which are gradually inflated in the desired shape of the building.

The bags, which support dome weights of 39,000 pounds, lift the structure as each section of the work is completed—all at ground level. Made of fabric, the bags are withdrawn when the dome is completed. Patent 3,106,772 went to Gordon B. Holcombe of Millbrae, Calif.

A portable greenhouse for home or office use is described in patent 3,106,801. Invented by Gerard H. Risacher of Mansfield, Ohio, the base of the automatic electric device is made of a molded-foam heat-insulating material. A thermostat maintains the desired temperature.

Bird fanciers can disinfect their pets with an artificial bird companion and fumigant dispenser invented by Peter J. Scray and Cary Crews of Jacksonville, Fla. The hollowed-out figure, which contains a disinfectant, is attached to one side of the live bird's swinging perch; when necessary a bird can be sprayed with disinfectant any time it sits on its perch. The device received patent 3,105,464.

Used typewriter ribbons can be rejuvenated by dipping them in a chemical solution described in patent 3,105,769 granted to Erwin H. Ellerin of South Euclid, Ohio. The solution is a combination of hexane, trichlorethane and methylene chloride.

Gas leaks from buried pipelines could be detected with a truck-mounted analyzer described in patent 3,107,517. Instead of drilling holes to find leaks, the cruising analyzer's probe sucks in atmospheric samples for testing. Inventors are James F. Rollins, Edward R. Loyd and Martin C. Kelsey, all of Dallas, Tex.

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LAND ROVER

It has muscles to admire—but could a suburban housewife find happiness driving the world's greatest safari vehicle to the nearby grocery?

By Ed Nelson

IF, AS YOU MOVE ALONG the expressway, you'd like to dream you're pounding across the Sahara or through Central American jungle, try driving a Land Rover.

After all, it's the standard safari vehicle of the world. Its British manufacturer says it's also used by 26 different armies and operates in 157 countries. He calls the Land Rover the best 4-wheel-drive vehicle in the world and, from our experience, you'd be hard put to prove him wrong. He also calls it the world's most versatile vehicle; that claim may be a bit stickier.

Connecticut "mountains" aren't high, but they're packed close together, include lots of ups-and-downs, and provided a good rough proving ground for PM's Land Rover. We had the long-wheelbase (109-in.) version with station wagon body and took it along a "trail" of boulders and ditches. The frame and box didn't groan once at the extreme torsion. To us, it was as though, from the frame up, the vehicle hardly knew the torture that was taking place. Only some healthy compensating by

the stiff springs made steady contact with the ground possible.

Some of the grades were extreme and no running start was possible. But even with a creeping start, we could almost make them in two-wheel drive with the transfer case in high range. Grinding along with the main box in Low or Second (over-all ratios of 16:1 and 11:1), there's such a sense of power that you can forget even more might be called for. When you remember, you find it's on tap.

Stylists Ignored

No concessions are made to style in this muscle-car; frills are few. Nobody tried to prettify the Rover. For example, there's not a significant speck of chrome on or in it. Belt-line molding and bumper are heavily galvanized instead. Even the grille is heavy wire mesh—galvanized.

The ride, of course, is somewhat truck-like with a shorter-wheelbase jounce. But the sense of commanding power, both from the ride and the driving position, is most

[\(Please turn to page 34\)](#)



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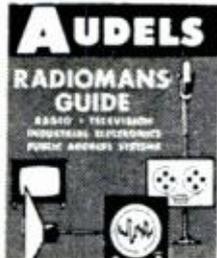
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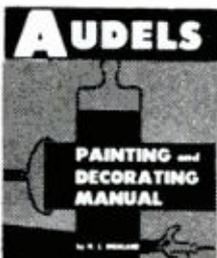
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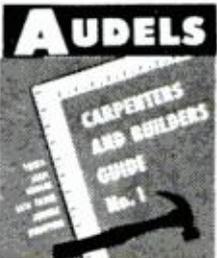
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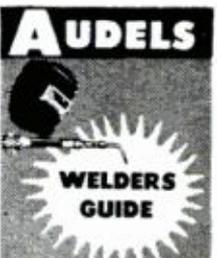
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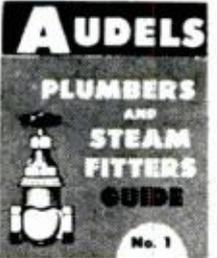
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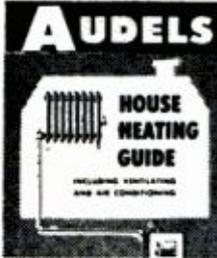
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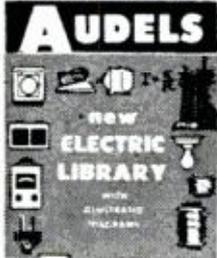
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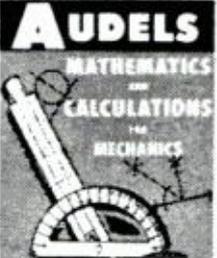
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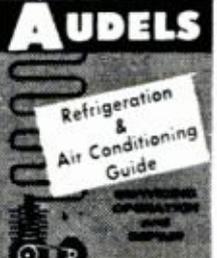
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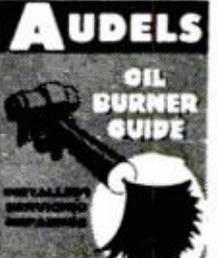
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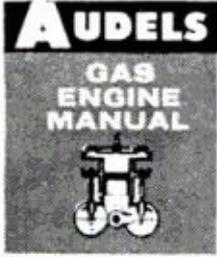
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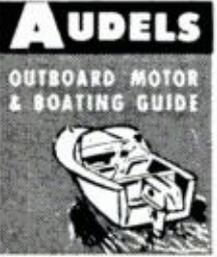
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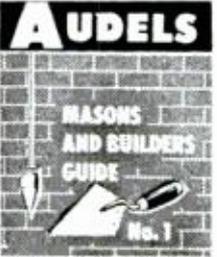
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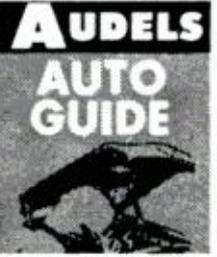
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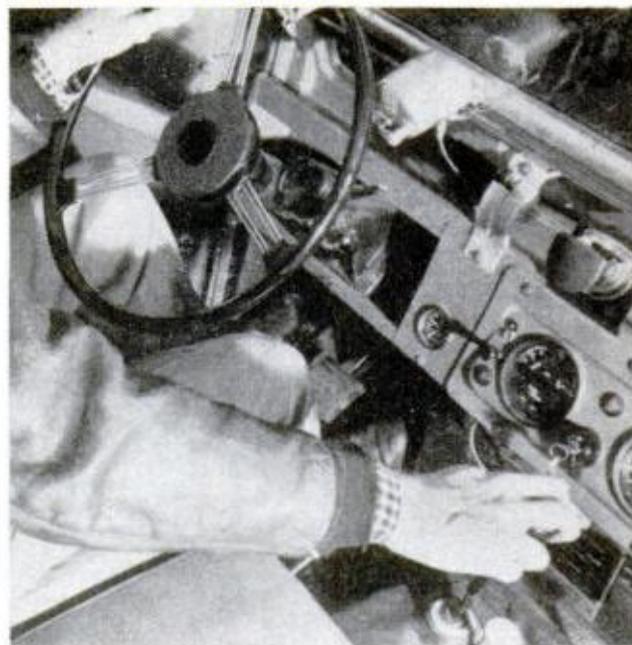
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Spotlight on the Land Rover

(Continued from page 32)



INSTRUMENT CLUSTER IS CENTERED in right- or left-hand-drive versions of the Rover. Driver here can't see calibrations marking 30 m.p.h. Note shift reach

exhilarating. Even hung up in a mid-New York traffic jam, you feel king of all you survey. And those rugged looking fenders discourage lane jumpers who'd like to edge you over.

The seat is surprisingly comfortable. Backs are rather low and cushion springs aren't particularly deep. Yet those springs co-operate with the hard suspension so you rarely bottom or bounce high off the seat. Belts, however, would have been welcome.

Driving position is comfortable, though hardly sporty. The wheel angle is similar to those of passenger cars you're used to, and its position is convenient. The interior seems designed, however, for very wide "great white hunters." The bench seat itself offers, as claimed, room for three. But controls are scattered around so the driver needs two of the three places and a center passenger would have to be either nimble or legless. Pedals are crowded against the left wall and the stick is squarely in the center of the floor area; in Third or High it can even crowd a passenger on the right. The engine is located well back, so the fire wall surrounding it bulges almost to the edge of the dash. And tucked down on a hidden part of the fire-wall—far to the right—is the starter button. Fine for right-hand-drive versions; not so great for the States.

The combination choke and throttle, called the cold start control, is tied to a

(Please turn to page 37)

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Spotlight on the Land Rover

(Continued from page 34)



THE DEEPEST, MUDDIEST RUTS present no obstacle. The grille and headlights are recessed between square fenders, well protected from any heavy underbrush

heat sensor in the head. When coolant and engine reach operating temperature an amber warning winks from the dash to say the choke is no longer needed.

Filled With Space

How about the shell? The body is purely functional. Side windows slide fore-and-aft to allow thinner doors and walls. Door handles, both inside and out, are recessed into the door so they don't protrude. All available space is packed into the over-all dimensions—175 in. long, 64 wide and 81 high. Steps outside the doors fold up out of the way, but they're priced up at \$48 and you can clamber in and out without their help.

The power from the four-cylinder, 139.5-cu.in. engine (rated at 77 hp. at 4250 r.p.m.) comes through a set of gear ratios that would do justice to a tractor. But, of course, they raise hob with fuel economy. The long (four-door) station wagon we had gave a shade under 13 m.p.g. in more than 900 miles of driving, including nearly a full day in the rough and several days in New York City traffic.

Those same ratios—from a 2.996:1 Low to a direct High through a 1.148:1 transfer-case High and a 4.7 rear axle—give a highway gear whine that might become irksome. Nevertheless, the Land Rover cruises at an indicated 70 m.p.h. without strain.

The basic design offers superb vision,

(Please turn to page 33)

JANUARY 1964

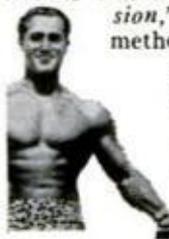
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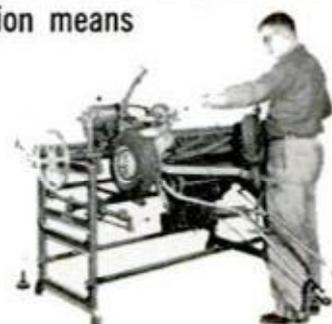
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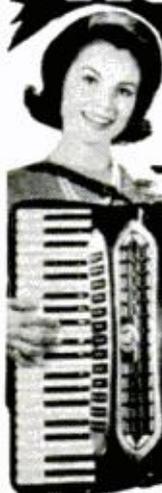
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Spotlight on the Land Rover

(Continued from page 37)

especially forward. But the hood-top spare tire mount for which many owners pay an extra \$6 spoils right-front vision. The tire is better left on the rear door.

The horn's mild bleat seems intended to avoid frightening faint-hearted jungle animals; certainly it does little to cow New York cab drivers. But the shape of the car itself, fairly screaming *Strength-Without-Foolishness*, gets plenty of attention from neon-jungle inhabitants.

For The Family

With all these rough-country virtues, how would the versatile Land Rover do as a family vehicle? Certainly it will get you back and forth to market. Particularly as a long wagon, there's room for a flock of kids being hauled to and from school and even the most exuberant can't damage the interior. There's room for two adults and a child in front, three snug adults amidsthips, and two big adults or four youngsters in back. This peaceable tank is comfortable enough, too, for such short trips. It would be a delight on the beach.

But Mary Housewife may not enjoy reaching over to wrestle the long stick. Until she learns how to hook the choke (assuming she understands one), she can easily skin a knuckle. Standard front-wheel-drive equipment makes the turning circle wide and the variable-rate steering (15:6:1 straight ahead, 23.8:1 at full lock, manual only) is heavy.

Sure, there are women who could handle the package. But to want to learn how, they'd need full appreciation of the Land Rover's other virtues. At \$3925 (East coast POE), it'd be more at home on a construction job or in a logging camp or oil field than in an Elm Street driveway.

Unless, that is, yours is a family of stalwart individualists. ★ ★ ★

Magnets Ripen Tomatoes

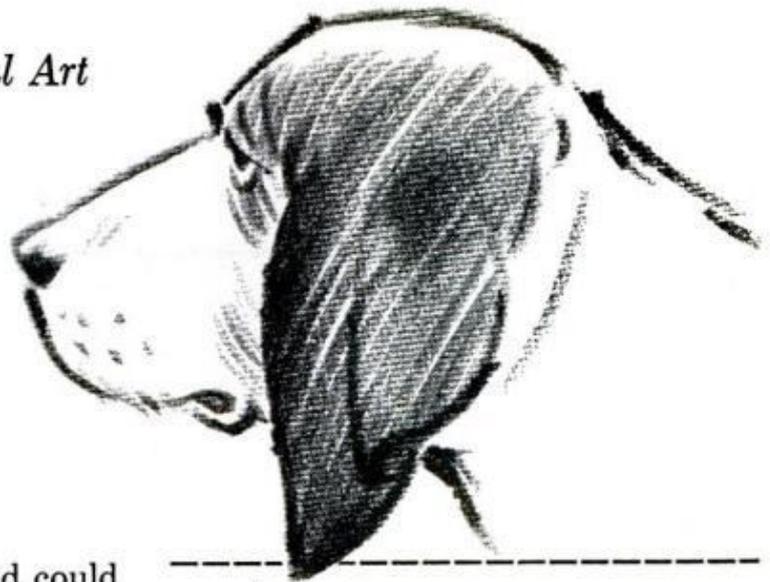
For quick ripening of green tomatoes, a large magnet may some day be a common kitchen "appliance."

Tests at Utah State University have proven that green tomatoes put under a magnet, especially near its south pole, will ripen much faster than those a few feet away.

Horticulturists, Drs. A. A. Boe and D. K. Salunkhe, suggest the effect is due to a loss or gain of protons or other reactive groups in magnetized compounds. They theorized that a magnet activates or quickens an enzyme system and thus speeds up respiration.

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Your drawing of this sad-looking hound could win you a scholarship from America's largest home study art school! You'd get the same training as many of America's top artists. Just draw the dog any size (except one that would look like tracing). Use pencil. Everyone who enters the contest gets a free professional estimate of his talent. Entries for February 1964 contest due by February 29. None returned. Amateurs only. Our students not eligible. Winner will be notified, so start sketching now, *it may be you!*

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Please enter my drawing in your Draw the Basset contest. (PLEASE PRINT)

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AGILE CAT leaping for a blob of milk? No, just a cat having a snack on the top of a sheet of glass



WELL, here's milk in your eye! Ignoring the camera, the kitten enjoys his lunch—down to the last drop

LOOKING like smoke signals, even the cat's milky footprints provide an amusing subject for the photographer



New Outlook on Spilt Milk

SOME CATS would get up in the air over a spot of milk—at least that's the way it looks.

Pouring some milk on a sheet of glass suspended between two chairs and adding one cat, a photographer gives a new wrinkle to the stock shot of a cat drinking milk. Shooting from beneath the glass, he pictures the cat seemingly suspended in mid-air.

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CROUCHED under the glass, which is suspended on the backs of two chairs, the photographer shoots upward at the kitten and milk



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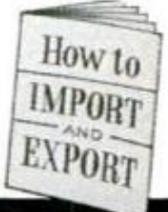
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CLINIC FOR HOMEOWNERS

Q A year ago I built a cupola for my garage and had a copper roof made for it. I varnished the roof as I was told to keep the metal from tarnishing. But now a year later the metal is discolored and the varnish is flaking off. Is there any permanent tarnish-proof finish?—L.A., Wis.

A The varnish, rather than tarnishing, is mainly the cause of the apparent discoloration. Ordinary varnish will not adhere permanently to smooth metal. Remove the cupola roof if possible, then take off the varnish with a remover and clean and polish the metal, using steel wool and a polish made for use on copper. Remove all residue—and this is important—of the polish with a solvent and then coat with a metal lacquer. This is a clear lacquer made especially for the purpose and it should be applied according to the instructions on the container. After cleaning with a solvent and before applying the lacquer avoid touching the surface of the metal with the fingertips or palms. Even a metal finish applied in this manner cannot be considered permanent. It will have to be renewed after a few years.

Q Only lately our oak parquet floor, laid over a concrete slab, began to break up. I discovered that several of the squares were practically disintegrated under the finish. I also discovered a number of tiny insects which an exterminator says are termites. These, he says, have worked up through a crack in the slab under the wooden floor. Also, he says he can exterminate the termites by drilling through the concrete and forcing in an insecticide solution. Is he right?—M.M., La.

A Quite likely. If we can judge correctly from your description of the damage and the insects, the latter, which are no doubt termites, have established a colony somewhere nearby, possibly under the concrete slab. This is probably a comparatively new colony and very likely it has caused a minimum of damage to your home. However, we think it wise to conduct a thorough examination at the edges of the slab for the telltale tunnels which termites build from the grade level to the sills and other parts of the structure. In the meantime we think you should have your exterminator proceed as he suggests. While we doubt if he would guarantee results, it is quite likely he will succeed in eradicating the colony as he proposes.

Q This coming summer my house is going to need repainting. Already I have bids on both brush and spray application and the latter bid is so much lower that I'm wondering—is this manner of application as good as brush painting? Do they use less paint, a cheaper paint, or what?—K.L., W. Va.

A No doubt your spray-painting contractor is figuring less time on the job as spray application is much, much faster than brush application. The manner of applying the paint, whether by brushing or spraying, is far less important than is a thoroughgoing knowledge of the proper techniques of handling either a spray gun or a brush. If spray painting is done in accordance with approved practice, there's no reason why the job should not prove to be as durable and attractive as the brush-applied job. The best exterior spray painting practice requires that windows, doors and all other areas not to be painted be effectively masked and that the paint be reduced to the proper spraying consistency with approved solvents.

Q Does heat really pass through glass? One often hears the statement "due to loss of heat through the glass" and I'm wondering what it means.—E.N., Me.

A We assume you are referring to a window pane. Tests have shown that most of the resistance to passage of heat is not in the glass itself, but rather in the static films of air that normally lie close to the surface on both sides of the pane. Space is lacking for a complete discussion, but in general one such test has shown that with a temperature of 70 degrees F. on one side of a pane of glass and -30 degrees on the opposite side there was a difference of less than 3 degrees in the temperatures measured at the two surfaces. Of course, these figures are for a test made in still air. With forced air circulation on, say, the cold side of the pane, these values would, no doubt, vary considerably as the protective air film would be more or less continually displaced.

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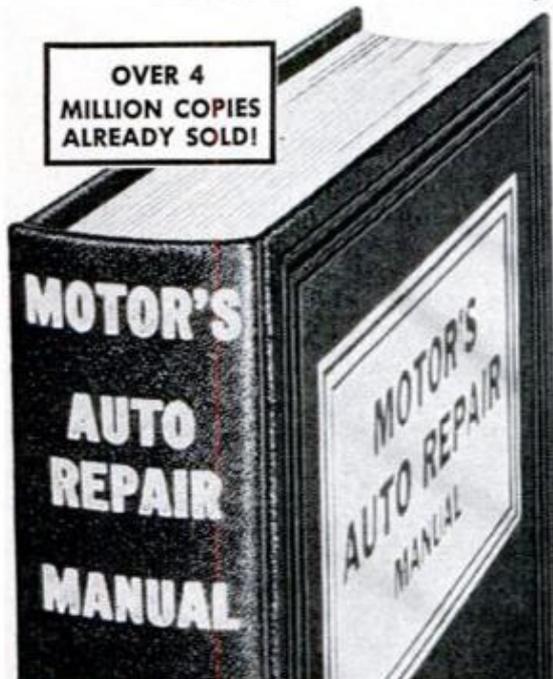
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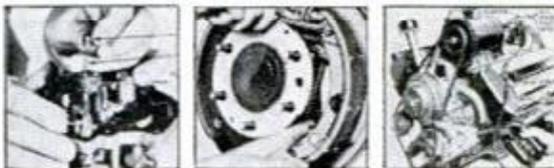
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By Jim Whipple



Ford's Got a New Baby for Old 'Bird Lovers! Now, V8 Fun for All as Dart and Valiant Join Up

After what seems ages of setting off rockets in the shape of one-of-a-kind "idea cars," dream show styling cars called **Cougar, Mustang, Allegro, Cougar II** and **Mustang II**, Ford Motor Company is finally hatching a new 'Bird.

Best of the educated guesses as we go to press, is that the new car will be called **Thunderbolt**.

It will be a unique blend of sports and personal car, low-slung and with superior handling characteristics. However, Ford will hedge the bet somewhat by having "two-plus-two" seating. This means a pair of front buckets and "bucket-shaped" bench just behind.

With this four-passenger capacity, Ford's **Thunderbolt** won't be exactly petite; it has a 108-inch wheelbase and is approximately 185 inches long—slightly larger than a **Corvair Monza**.

The **Thunderbolt**, however, will have its engine and transmission up front and the drive will be through a conventional shaft and live axle at the rear. **Thunderbolt**, like the original **T-Bird**, will be a convertible with optional detachable hardtop.

The engine is Ford's ubiquitous **Fairlane V8** of 289 cubic inches coupled to a four-speed synchromesh transmission.

As far as its sports car potential is concerned, we'd expect **Thunderbolt** to be more at home on a rally than in a race, with its handling and roadability pegged as noticeably better than a **Corvair Monza's** and a bit below a race-prepared **Corvette Sting Ray**.

In performance, its "full house" version (271 horsepower) should be able to challenge the **Sting Ray** on any drag strip in the land. Getting the **Thunderbolt** into production isn't too great a problem for Ford because brakes, steering, rear axle and much of the suspension hardware is already in the bin and being used on **Falcons, Fairlanes** and **Comets**.

A real happy bit of intelligence regarding the price comes from a reliable source—"under \$3000 for the basic version." At that price Ford's biggest problem will be building enough of 'em.

The swing to performance automobiles is turning into a stampede with every car maker putting "four on the floor" and "eight up front." With two more cars, **Valiant** and **Dart**, adding V8s as their "64½" models, Rambler's **American** and the **Checker** become the last six-cylinder-only cars, while **Cadillac, Imperial, Lincoln Continental** and **Thunderbird** are the only makes who do not provide some sort of transmission control mounted in the center of the front compartment.

The new **Dart-Valiant V8** is a variation of the 318-cubic inch V8 used as the basic engine on full-sized **Plymouths** and **Dodges**. These engines share a common cylinder block, crankshaft and connecting rods. Both have a stroke of 3.312 in., but the new engine has a smaller bore (3.62 vs. 3.9 in.), resulting in a cubic inch displacement of 273.

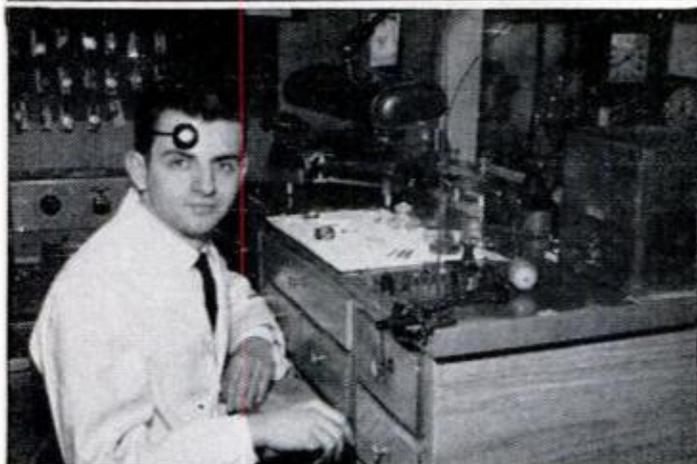
Cylinder heads and manifolds of the smaller engine are newly designed and are responsible for a weight reduction of 70 pounds from the 318-cubic inch engine. The **Valiant-Dart V8** will develop 180 horsepower at 4200 r.p.m. and has a torque rating of 260 at 1600 r.p.m. Compression ratio of 8.8. to 1 will permit use of regular grade fuel. Carburetor is two barrel.

Everybody's getting into the act. Ford's **Fairlane V8** has been shoehorned into a wide variety of vehicles ranging from the '64 **Ford Galaxie** to (in aluminum version) Colin Chapman's **Lotus Grand Prix** cars.

Latest vehicle to give engine room to Ford's baby bundle of torque is the **Sunbeam Alpine** sports coupe. Normally this small, but highly competitive British bomb is propelled by a four-cylinder, 97-cubic-inch engine of 87 horsepower. By virtue of a hands-across-the-sea deal between Ford and **Sunbeam's** parent, the Rootes Group (**Hillman, Humber**, etc.), 300 to 400 **Alpines** each month will be powered by 260 cubic inch, 164 bhp. **Fairlane V8s**.

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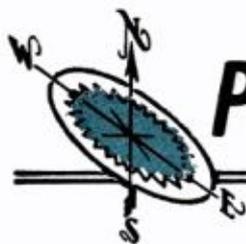
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Fish thermometers, ant farms, fiber optics and crystal growing kits are only a few of hundreds of items listed in Edmund Catalog 641. Its 148 pages present the latest buys on science, math and optical items. Of particular interest for the home craftsman is the Unimat, a complete miniature machine shop for forming shaping and milling metal and plastic. Another unusual item—the Spilhaus Space Clock—gives sidereal time, sunrise, moon phases, time

when constellations appear in the northern sky, time around the world. The catalog is free upon request from Edmund Scientific Co., 101 E. Gloucester Pike, Barrington, N.J.

Films on boats, fishing in outboards, waterway vacations (over 60 in all) are listed and briefed in the "Directory of Boating Films," offered at no cost by the Outboard Boating Club of America, 307 N. Michigan Ave., Chicago 1, Ill. Most of these 16-mm. films are in color and sound; all may be borrowed without charge. The pamphlet tells how and where to get them.

"Surplus Bargain Directory" lists addresses of Government Surplus Retail depots where you may buy a wide variety of items at low prices. Over 100 outlets are listed, along with store hours, types of items available, identification required to enter, and where sales are held. The 48-page directory is available from Aviation Surplus, Department SSS, Box 789, York, Pa., for one dollar.

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(Please turn to page 50)

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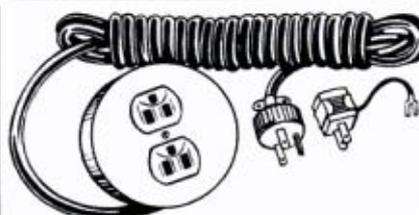


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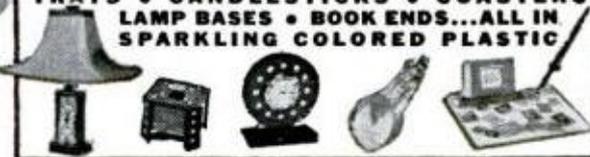
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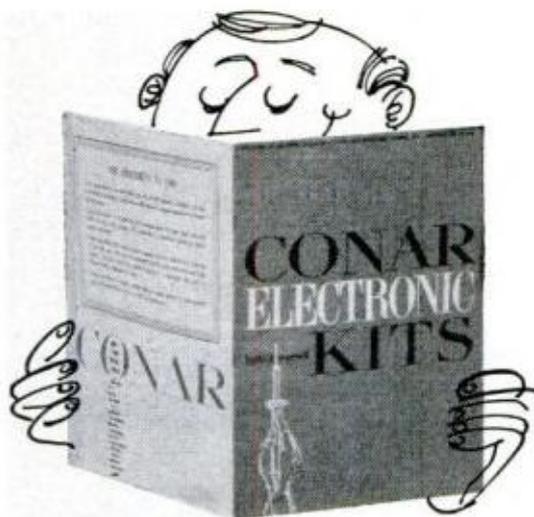
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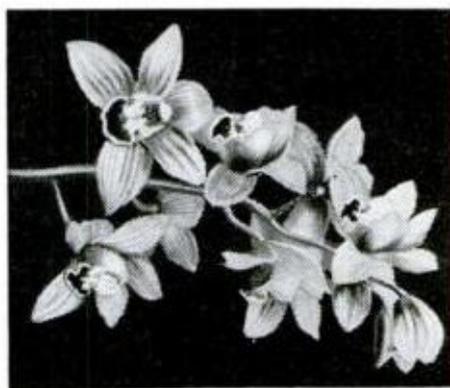
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(Continued from page 48)

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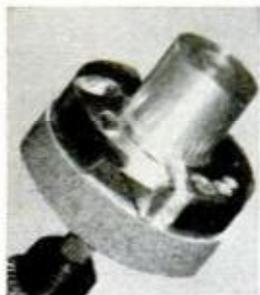
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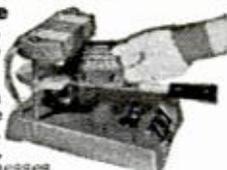
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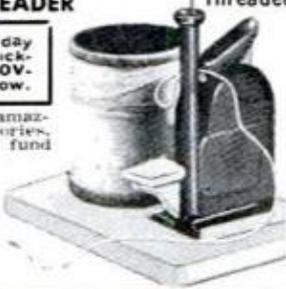
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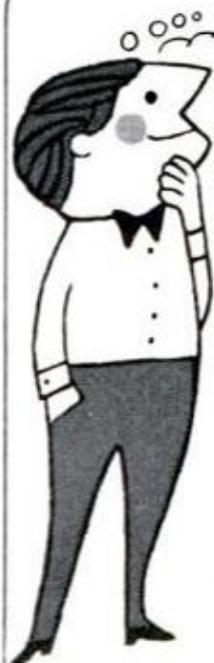
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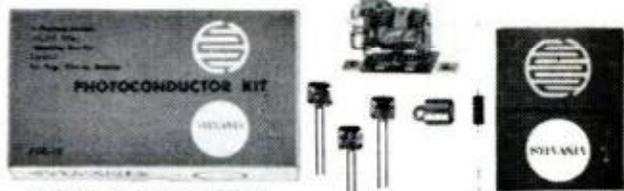
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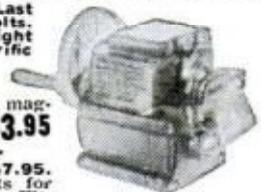
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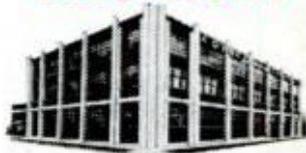
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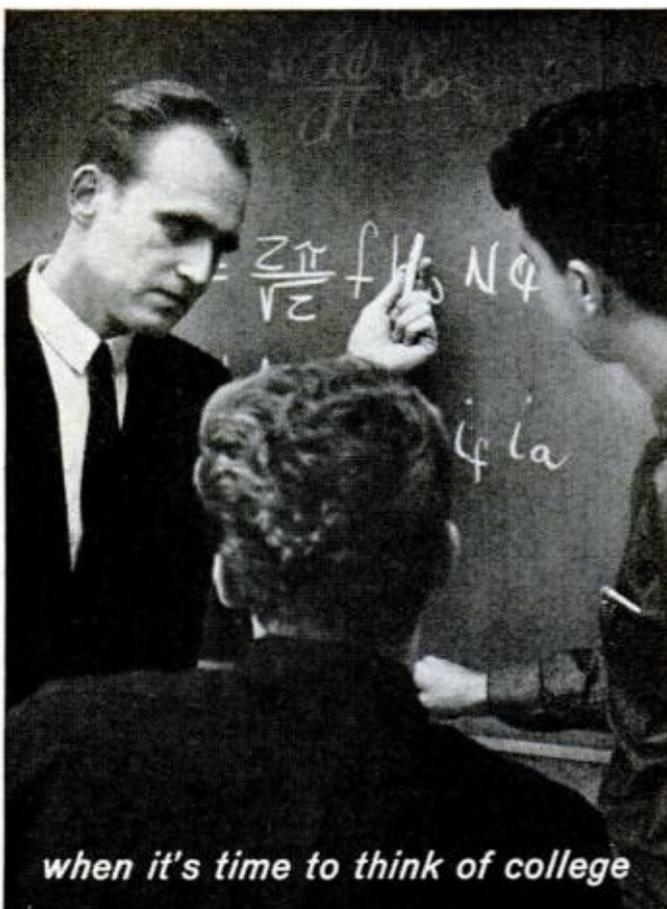
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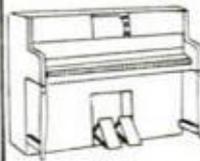


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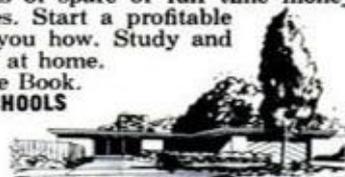
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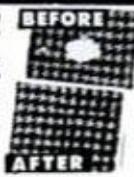
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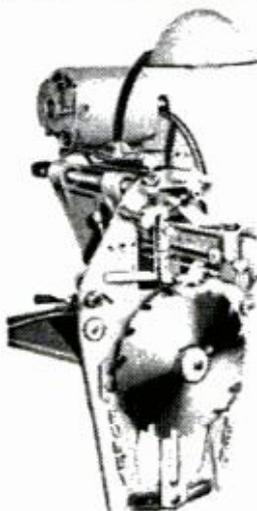
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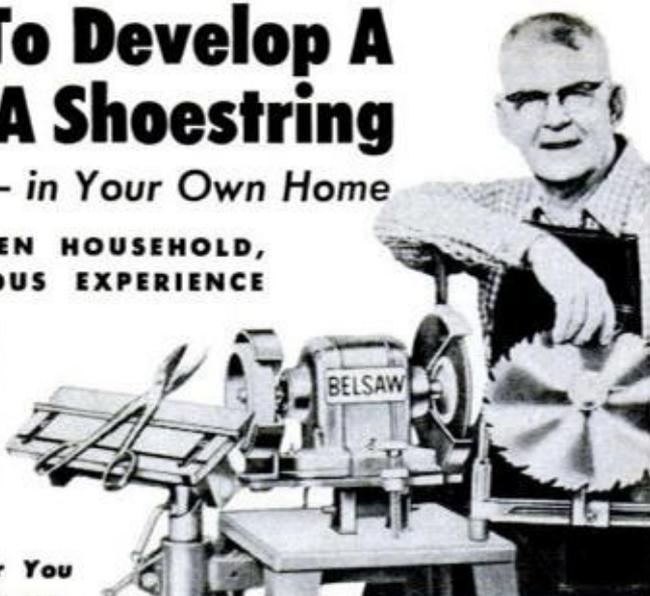
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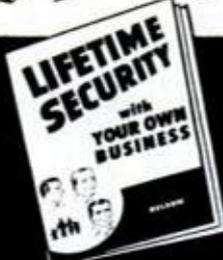
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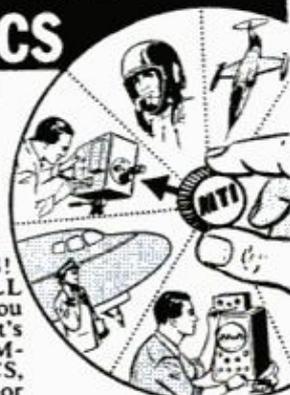
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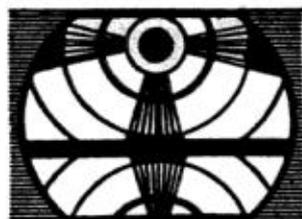
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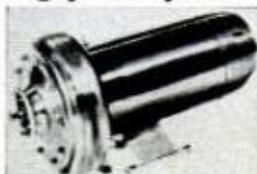
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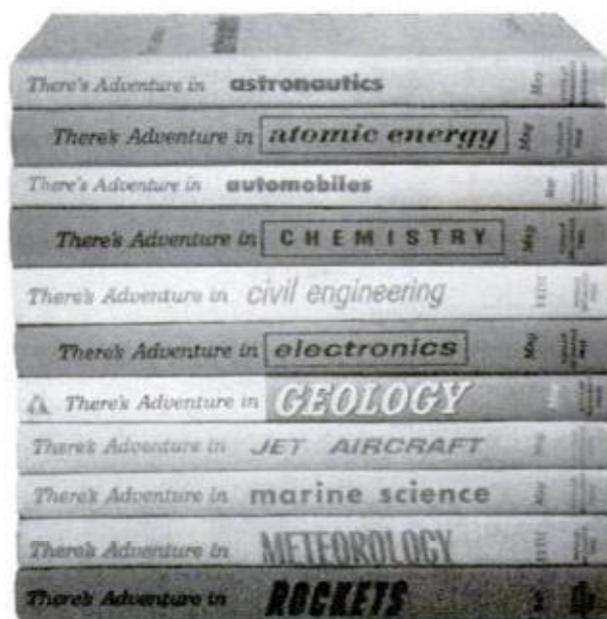
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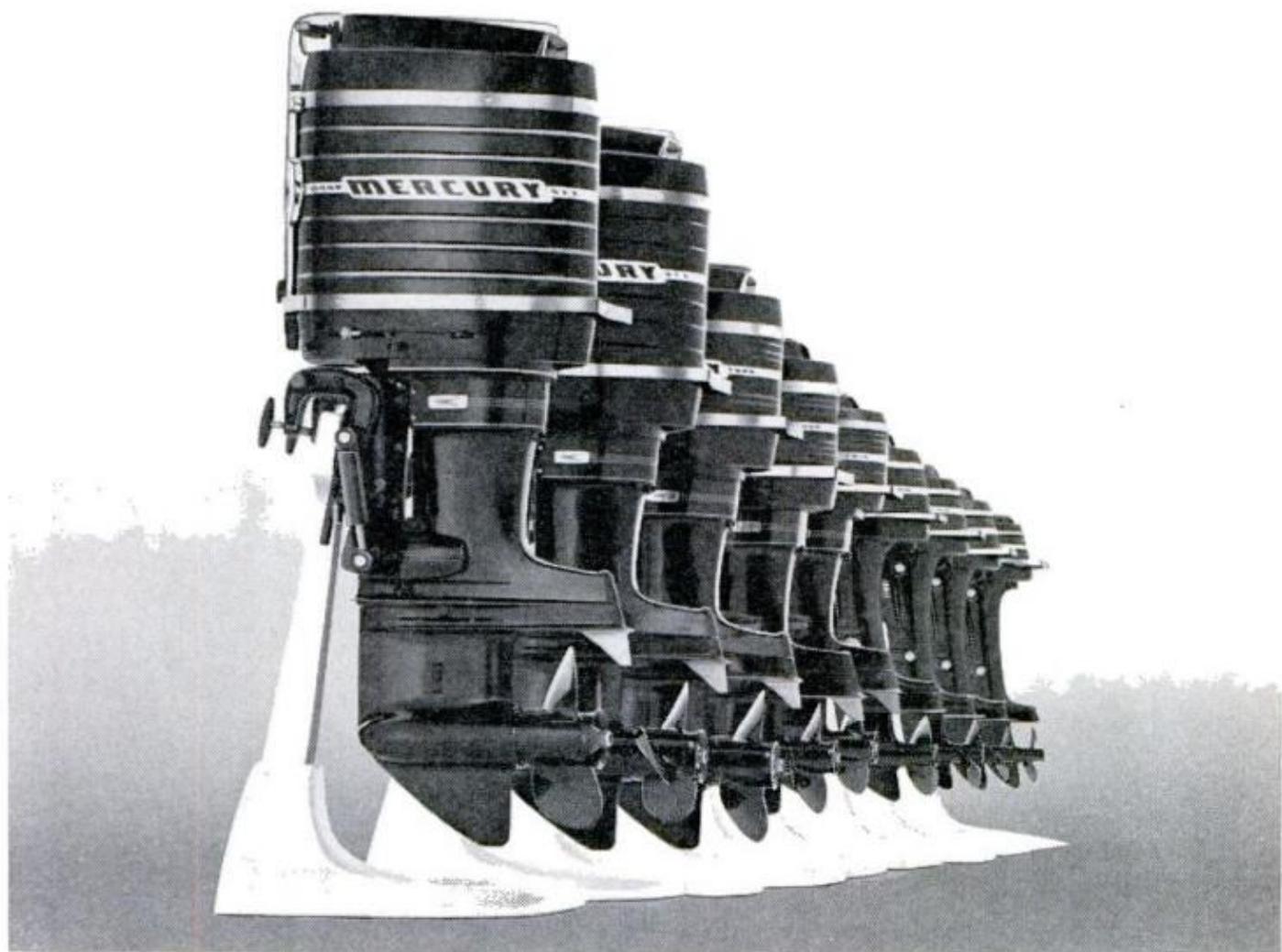
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Fixed-jet carburetors with special fuel-economy linkages give the correct mixture at all speeds... to give you the most miles per gallon. All have Mercury's exclusive Jet-Prop exhaust to bury sound and fumes deep underwater. There are no shear or "drive" pins on *any* Merc. The propellers are splined on and protected by a live-rubber safety clutch that yields momentarily on impact. Only Mercury has 6-cylinder outboards. All Mercurys have full gearshift, and *single-lever* remote control is available for all models... even the smallest.

This is the Silver Anniversary Fleet... engineered to give you the *most* RUN for your money with Mercury... 100, 85, 65, 50, 35, 20, 9.8, 6 and 3.9 horsepower outboards... and MerCruiser Stern Drive Power Packages... 110 to 310 horsepower.

MERCURY



SILVER
ANNIVERSARY FLEET



LOW... FLAT... FLOOR!

only 22 inches to lift slide loads right through easiest, fastest loading ever!

Look—no rear engine hump! You load Ford's Econoline Van at low knee level. And just look at all the other reasons why Econoline outsells any truck in its class by 2 to 1. More space

for your load. Wide-open access. Easier maneuvering. Solid savings on price—and on gas and upkeep, mile after mile. Get all the good news at your Ford Dealer's today!

'64 FORD Econoline Van

PRODUCTS OF  MOTOR COMPANY

BIG 204-CU. FT. LOADSPACE—up to 56% bigger inside than old-style panels! Yet Econoline is 2½ ft. shorter outside . . . turns sharper . . . parks in less space!

UP TO 8 BIG DOORS—4-ft. door openings all around (left side doors optional) put every part of your load within easy reach. You save time at every stop!

NEW 1-TON PAYLOAD—new heavy-duty option increases payload from 1,650 lbs. to 2,000 lbs. Opens the way to new uses for versatile Econolines!

COSTS LESS—to buy and to run! Already famous for gas economy, '64 Ford Econolines offer you new self-adjusting brakes . . . new service savings!





Sam Hanks

**Racing Champ Track Tests
the Hot-Engined...**

Ford "Fastest on straightaway but wheel slippage isn't helping on turns..."

Chevy "Right there at 40 to 60 but automatic shift slows it between 60 to 80 mph."

Dodge "Gets a good bite on the track although engine is flat on the curves..."

Pontiac "Lays in real well along sweeping curve but she feels heavy..."

Plymouth "Fastest one-lap time though I was losing oil pressure..."



STARTER WAVES Pontiac off on quarter-mile drag. Superb shift action helped offset bad engine lug at start. Note timer below car

By Thomas E.
Stimson

HOW ABOUT these extra performance '64s, the new assembly line hardtops with the big displacement engines and the "four-on-the-floor" stick shifts?

They are as docile as Walter Mitty's compact in traffic — until you mash the throttle. Then there's a WHOOOOM of induction air and you are leaving tracks on the pavement.

Are these street dragsters from Detroit as hot as they



HANKS IN THE 427-cubic inch Ford, straightening out the corners on Turn 3 at Willow Springs. Manual steering made this car "run out of steering wheel" on the tight turns and Hanks reported a feeling of front end push

seem? To find out, *Popular Mechanics* asked Sam Hanks to wring out a few of them.

Hanks is an old pro on the test track. He is director of racing at Indianapolis Motor Speedway. He has been national big car champion, national champion in the midgets. Hanks won the Indianapolis 500 in 1957 and has placed high in stock car point standings time after time. He has an extra sense that lets him push a car right up to the limit of its safe performance.

The cars: Ford Galaxie with a 427-cubic-inch engine, Plymouth Sport Fury with a 426-cu.-in. engine, Pontiac Grand Prix with a 421 cubic incher under the hood, Chevrolet Impala Sport Coupe with 409 cubic inches, and the Dodge Polara 500 (426 cu. in.). Usually these cars are powered with smaller engines; the big "extra performance" powerhouses are optional.

All the cars were tested "as is." None was specially tuned. All had stock mufflers, all wore standard production tires. The only change we made was to inflate the tires to 40 lbs. pressure to increase the safety factor in high speed cornering.

The place: Willow Springs Raceway at Rosamond, Calif., on the desert 99 miles north of Los Angeles. This sports course is about two and a half miles long and had just been repaved. It includes a 5/8-mile straightaway (with Chrondek electronic timing for quarter mile drags), a long sweeping right turn and some tight climbing turns that carry the track 176 feet above the start, then a hard downhill left corner and a back stretch all in view

of the spectator area. Willow Springs does nicely, in fact, for "moment of truth" testing of the wilder ones.

This was to be an evaluation of each car, not a full-fledged competition, for the simple reason that the cars we were able to obtain when these tests were run (late October) were not fully competitive either in speed or running condition. The Ford had a full competition engine and manual brakes and steering, with extra stiff suspension. The others had "street" engines, power steering and brakes, standard shocks. Chevrolet had an automatic transmission, the others had four-speed floor stick shifts. The luxury Pontiac weighed 700 lbs. more than the Plymouth. With all these variations, it's interesting to note [how close the results were \(see chart, page 88\)](#).

We wanted to know how well each car performed, how it handled and what bugs it had, if any. We asked Hanks to run each car through the quarter-mile drag for its top speed through the trap. (The straightaway wasn't long enough to measure ultimate top speed).

We wanted to know how fast (and how well) each car could be driven around the entire course, how fast each accelerated from a standing start, how each handled in an emergency panic stop from 60 miles per hour. We wanted to know its passing acceleration from 40 to 60 and from 60 to 80.

These production line automobiles performed amazingly well.

A fast sports car, with racing rubber, can turn the Willow Springs course in one minute and 40 seconds at best. The pro-



PANIC STOP from 60 in Chevy, which had the best stopping time and showed the least amount of wheel fight. Note smoke coming from all four wheels of car



HOW TO PUT FLAT SPOTS on tires. Here the Dodge panic stops from 60 with all four wheels burning rubber and only a slight amount of yaw evident

duction cars didn't have the wide tires used in stock car racing and were 20 to 26 seconds slower.

To test a car, Hanks first made a practice run and then ran it twice against the clock. The two times were compared and the best time was recorded. Then, while his impressions were still fresh, Hanks evaluated the car on a tape recorder. Here are his comments on a test-by-test basis.

Quarter-Mile Drag

"The Ford with its competition engine was outstanding here. It turned 93.07 m.p.h. in the trap and had an elapsed time of 16.32 seconds. Gear shifting in the Ford was fantastically good. There were no flat spots in the engine.

"The Plymouth performed well with no flat spots and went through the trap at 91.55 m.p.h. But I did have trouble selecting third gear. I had to slow the shift a bit to get from second to third.

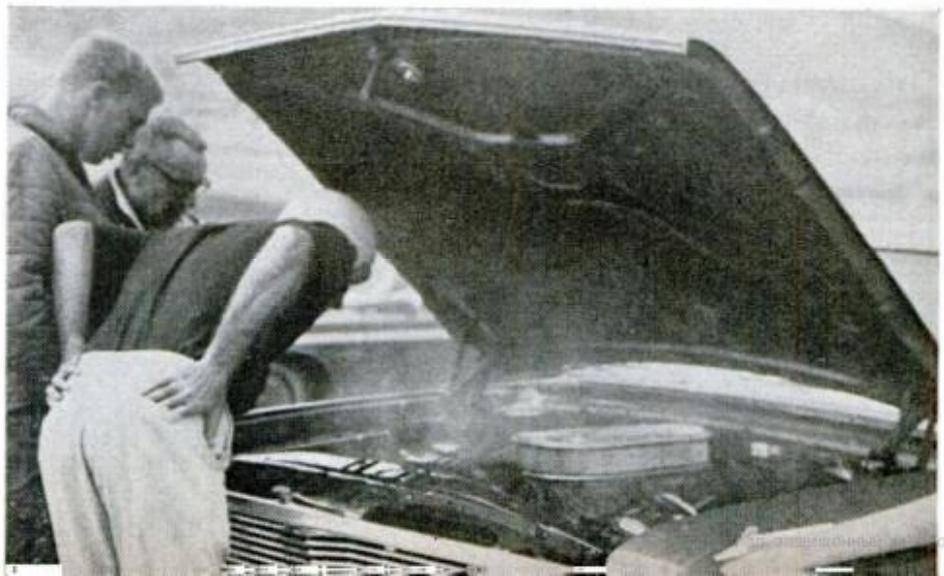
"The Dodge, I would say, had too high a gear. I pulled third gear all the way

down the course and through the timing lights. Again, I had trouble shifting. In fact, in the first two runs I missed second gear completely and had to go back and re-run. I think I could have shifted quicker if it could have taken it. Engine performance was good, however, and there were no flat spots.

"For the Pontiac, as soon as the tires got hold of the track after the wheel spin at the start, I noticed a bad lug in the engine, on both runs. This suggests the car was too heavy for the gear it was carrying, or it may have been carburetor adjustment. Gear shifting in the Pontiac was as good as the Ford if not better. I think this is why I picked up a little of what I lost by engine lug, getting off the line.

"The Chevrolet Impala had a Powerglide transmission and of course was defeated by the stick cars it was running against. Performance was good, though I had to lift my foot to get it to shift. It seemed to want to stay in the low range for too long a time."

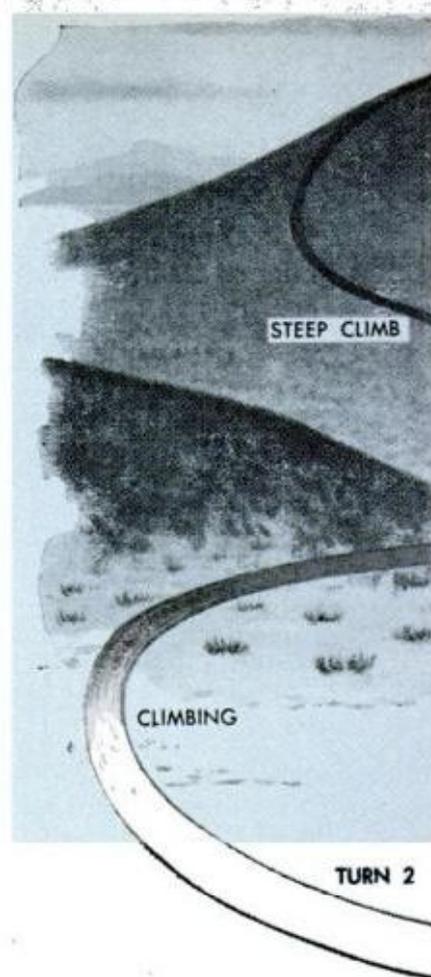
COOLING OFF a hot one. Ford's filler cap twisted loose on one run around the course and gave its engine compartment an unplanned steam cleaning. This hot Ford ran the fastest straightaway



HOW THEY RATE

	CHEVROLET IMPALA SPORT COUPE	DODGE POLARA 500	FORD GALAXIE 500	PLYMOUTH SPORT FURY	PONTIAC GRAND PRIX
Engine Size (cu.in.)	409	426	427	426	421
Rated Brake Hp.	340 @ 5000 r.p.m.	365 @ 4800 r.p.m.	425 @ 6000 r.p.m.	365 @ 4800 r.p.m.	350 @ 4600 r.p.m.
Torque (ft.lbs.)	420 @ 3200 r.p.m.	470 @ 3200 r.p.m.	480 @ 3700 r.p.m.	470 @ 3200 r.p.m.	454 @ 3200 r.p.m.
Bore and Stroke	4.31 x 3.50	4.25 x 3.75	4.23 x 3.78	4.25 x 3.75	4.09 x 4.00
Compression Ratio	10:1	10.3:1	11.5:1	10.3:1	10.75:1
Carburetion	1-4 bbl	1-4 bbl	3-2 bbl	1-4 bbl	3-2 bbl
Valve Lifters	Hydraulic	Hydraulic	Mechanical	Hydraulic	Hydraulic
Axle Ratio	3.36:1	3.23:1	3.54:1	3.91:1	3.42:1
Suspension	Standard	Standard	Heavy Duty	Standard	Standard
Power Steering, Brakes	Yes	Yes	No	Yes	Yes
Transmission	(1) Automatic	4-Stick	4-Stick	4-Stick	4-Stick
Wheelbase	119"	119"	119"	116"	120"
Weight	(Curb) 3605 lbs.	(Curb) 3725 lbs.	(Curb) 3735 lbs.	(Shipping) 3420 lbs.	(Curb) 4125 lbs.
Price FOB Detroit	\$2775	\$3994	Not Announced	\$2713	\$4751
Power Pack Available?	(2)	(3)	(4)	(5)	No

- (1) 4-speed stick and tachometer available: \$37.65.
 (2) Carburetion, special cam, mechanical lifters to produce 425 hp.
 (3) Several options at 11:1 CR, 12.5:1 CR, and lightweight front-end kit.
 (4) Lightweight package including fiberglass fenders, aluminum bumpers.
 (5) Same as (3).



AS THE ABOVE FIGURES show, these hot-engine cars were not perfect competitive matches. But they were the hottest models of each available at test time

DESPITE A SUBSTANTIAL variation in engine size and condition many of the actual performance results were surprisingly close, as the chart below indicates

HOW THEY RAN

	CHEVROLET	DODGE	FORD*	PLYMOUTH	PONTIAC
Engine, Cubic Inches	409	426	427	426	421
Transmission	Automatic	4-Speed Stick	4-Speed Stick	4-Speed Stick	4-Speed Stick
¼-Mile Drag—Speed M.P.H.	83.33	88.06	93.07	91.55	90.45
¼-Mile Drag—E.T. Seconds	17.02	16.67	16.32	16.43	16.93
Lap Time—2½-Mile Course	2 Min. 6.69 Secs.	2 Min. 5.12 Secs.	2 Min. 6.65 Secs.	2 Min. 1.00 Secs.	2 Min. 3.26 Secs.
Top Speed—½ Mile	97.19 M.P.H.	101.23 M.P.H.	103.21 M.P.H.	102.62 M.P.H.	101.46 M.P.H.
Acceleration 0-60****	8.49 Secs.	8.00 Secs.	8.15 Secs.	9.02 Secs.**	8.73 Secs.
Panic Stop 60-0	3.27 Secs.	3.47 Secs.	4.00 Secs.	4.02 Secs.	3.88 Secs.
Running Acceleration 40-60	4.10 Secs.	3.59 Secs.	4.17 Secs.	4.74 Secs.	4.33 Secs.
Running Acceleration 60-80	6.26 Secs.***	4.02 Secs.	4.75 Secs.	4.95 Secs.	4.40 Secs.

Note: Each figure is best of two runs. Drag and straightaway speeds Chrondek-electronically timed.

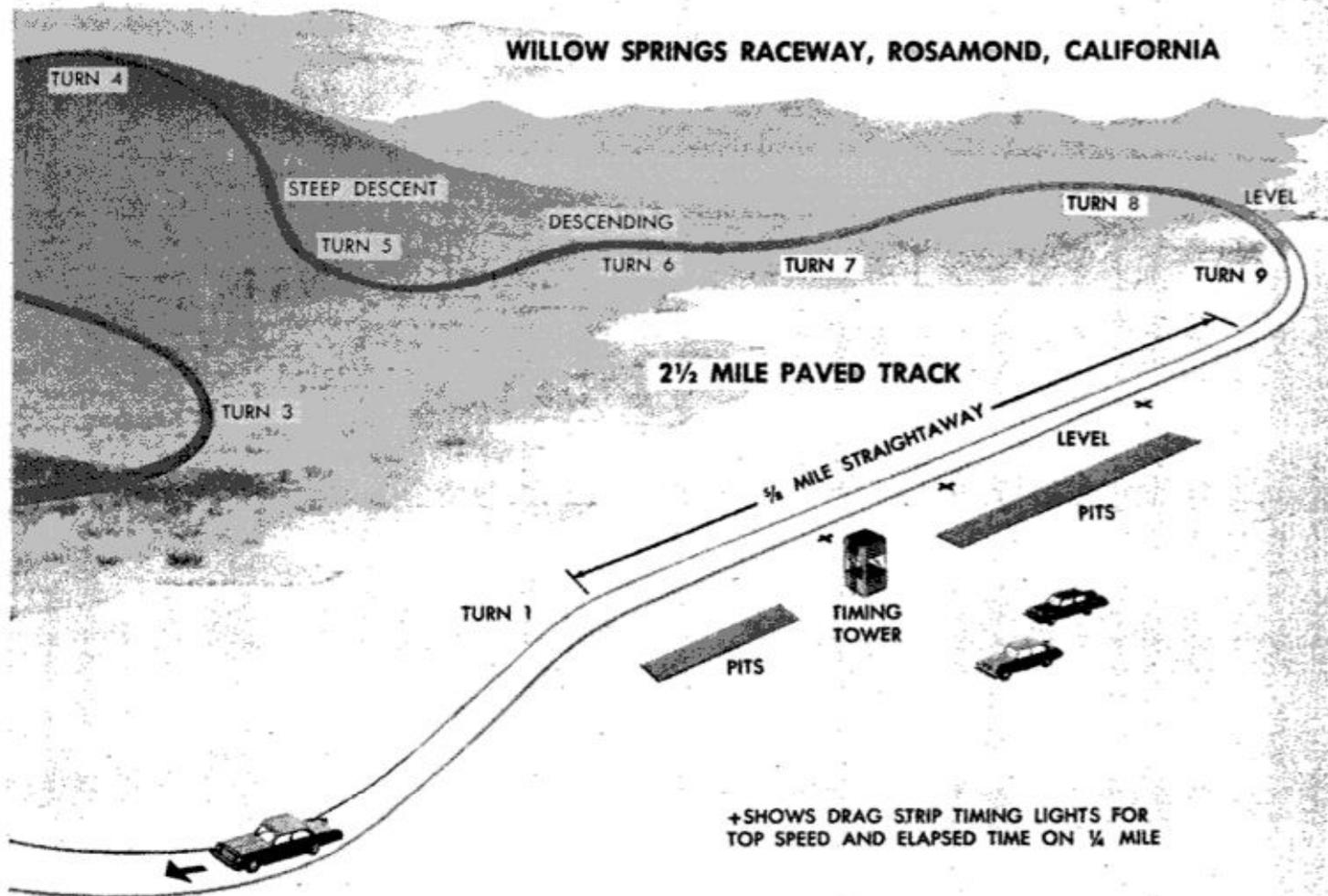
*Manual brakes and steering. All others power equipped.

**Excessive wheel spin at start.

***Shifted automatically from passing gear at 75 M.P.H.

****Speedometers not calibrated.

WILLOW SPRINGS RACEWAY, ROSAMOND, CALIFORNIA



LAYOUT OF WILLOW SPRINGS Raceway at Rosamond, Calif., where Sam Hanks conducted our tests. The two-and-a-half mile sports course includes a 1/4ths-mile straightaway with electronic timers for the quarter-mile drag runs

Sports Car Track

"The Ford was the fastest on the 1/4th of a mile straightaway which we took with a running start after circling the course. It went through the trap at 103.21 m.p.h., but it was next to the slowest getting around the whole track. I think the manual steering is one thing that slowed me down. I was running out of steering wheel on the tight turns and had to let go and grab again. And I had a lot of inside rear wheel slippage that I don't think was helping me at all. The Ford has tremendous engine performance but its suspension is stiff, maybe too stiff for this track. Probably that's why I'm just buzzing the inside wheel every time I touch the throttle on these tight turns. And it definitely had a push on the front end. I'd turn left or right real hard and the car wanted to go straight ahead.

"The Pontiac has power steering and so has a faster steering ratio than the Ford.

I didn't run out of steering wheel with it or any of the other power-assist cars. The Pontiac felt heavy—I used second gear around almost half the course, which indicates it had a fairly high axle ratio. I had very little rear wheel spin with it. Both it and the Ford laid in real well on that long sweeping turn.

"The Dodge was running out of fuel badly on Turn Two, the long sweep to the right. It seemed to be getting a good bite on the track, but in all the turns the engine was pretty flat. I think the fuel was floating away from the main jets, as often happens in stock car racing. Handling of both the Dodge and Pontiac was very nice and I had complete control in all the drifts I'd set them in, nice four-wheel drifts. Neither wanted to push its front end.

"It's amazing how well the Chevrolet gets around here with its little old automatic transmission. It ran only .04 second behind the Ford. It's easier to drive—you don't have to worry about shifting.



HOT PLYMOUTH driven by Sam Hanks shown in a controlled slide through the tight Turn 5 at the Willow Springs Raceway. The 426-cubic inch engine Plymouth scored the fastest course lap but was plagued by oil problems

I just dropped it into low range through the turns. And it steered beautifully. But on the long stretch where I'm getting about 110 indicated I noticed a very bad vibration in the drive line, and I had the same thing in the Pontiac, too, a severe vibration. In each case this could be an out-of-balance wheel and tire, or an unbalanced drive line.

"I ran the Plymouth only one lap around the course because I was losing oil pressure. The warning light was on through about a third of the course and I figured if I ran the engine another lap it might scuff the bearings. I think the oil was climbing up the crankcase wall and starving the pump. Probably a different baffling design would keep the oil down where it belongs. But that one lap in the Plymouth was the fastest lap in any of the cars, one second over two minutes.

"The cars were all laying into the turns very well. I'm quite surprised how well these street jobs can get around this course. We are leaving a lot of rubber on every turn. Turn Five, that downhill left turn, is the tightest turn here and if you go into it too hard or brake too hard the car'll go sideways and you have a handful of real trouble. The smoother you make that turn the faster you can run all through the course."

Acceleration-Braking Test

"The problem was to accelerate to 60 from a standing start, then immediately make a panic stop from that speed. Time was taken on stop watches by a trained observer who rode as passenger. None of the speedometers had been calibrated and so we can't make an exact comparison as far as time is concerned, though the times were actually pretty close together. But

this test is a good indication of how each of these test cars would perform on the highway in an emergency. All the cars burned rubber from the instant I mashed the brake until we were completely stopped.

"The Chevrolet had the best stopping time and the least amount of wheel fight. Ford was the worst for wheel fight; I don't think the front wheels were locking up like the other cars. It had a real hard pedal, naturally, with no power assist. The Pontiac had a little out-of-line stoppage but it was the heaviest car of the group and so wasn't bad. All the other cars had a little yaw from a straight line. I would say they were all pretty fair."

Running Accelerations

"On the 40-to-60 and the 60-to-80 accelerations we ran against uncalibrated speedometers again, so any of these figures might be off by a few hundredths of a second. We flared out at 40 and held it a little bit in third gear, and then with the throttle in mashed position we started one watch. The instant we hit 60 we stopped that watch and started the other and didn't back off the throttle. This was actually a continuous run from 40 to 80 with power applied all the way.

"The Pontiac was a little lazy getting off the 40 mark; it had been all day. Perhaps the carburetor wasn't correct. The Dodge felt awfully strong all the way through, a nice power application and the figures show it.

"The Chevrolet's transmission was in driving range with the throttle shoved down into passing gear. The car was right in there with the others at 40 to 60, but it was slow between 60 and 80 because it

(Please turn to page 214)

A Grease-Rack Review of the 1964 Cars: Are They

Service-Free or Service-Prone?



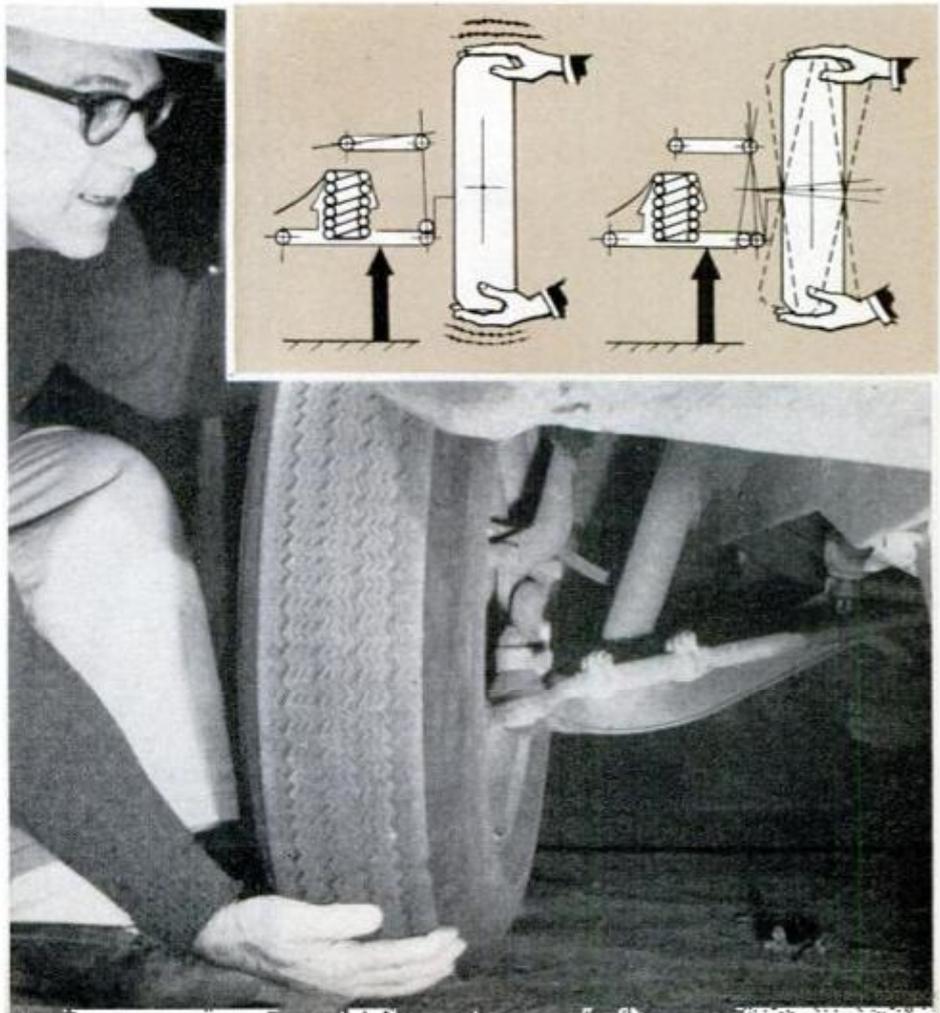
THE SERVICE-FREE AUTOMOBILE is still a happy dream, of course, but there's nothing dream-like about the struggle to achieve it.

One reason for the struggle is the introduction of new materials such as aluminum, whose light weight contributes to better performance and fuel mileage. At the same time, problems of cavitation erosion and crevice corrosion have cropped up in such parts as new aluminum water pumps and these increase the service load until they can be corrected in design.

Perhaps the most compelling reason for designing a car to be as service-free as possible is the serious shortage of competent mechanics—of men who love and understand fine machinery, and can handle the increasing numbers and complexity of today's cars. Because of this shortage, auto manufacturers are trying to design cars which are as mechanic-proof as possible.

That's why several of the 1964 GM makes have grease

BALL JOINTS have become an unnecessary service headache due to lack of knowledge on the part of some mechanics who do not realize that "play" in lower ball joint is normal when cars with coil springs or torsion bars acting on the lower arms are jacked up. Allowable "play" runs up to .20 inch in vertical plane, up to .25 inch in horizontal plane (as in the diagram at right)



fittings protected by newly developed seals with one-way relief valves. If a service station attendant gets overly enthusiastic with the grease gun, the excess grease escapes through the valve instead of rupturing the seal.

Other important 1964 innovations have the same target in mind—that of reducing the car owner's repair bills by avoiding or eliminating problems which can be made more so by the untrained mechanic. Outstanding among these improvements are fool-proof automatic chokes, double-guarded hydraulic systems for brakes and front end bearings that never need grease.

Chrysler boasts the new automatic choke with a simple diaphragm outside the choke housing, where it won't be fouled by carbon or gum like the vacuum-activated piston that preceded it. General Motors' 1964 cars have sealed reservoirs for brake master cylinders, lessening the chance of contaminating the fluid. The way this trick was achieved is as simple as it is effective. Any hydraulic reservoir must be vented to allow air to enter or

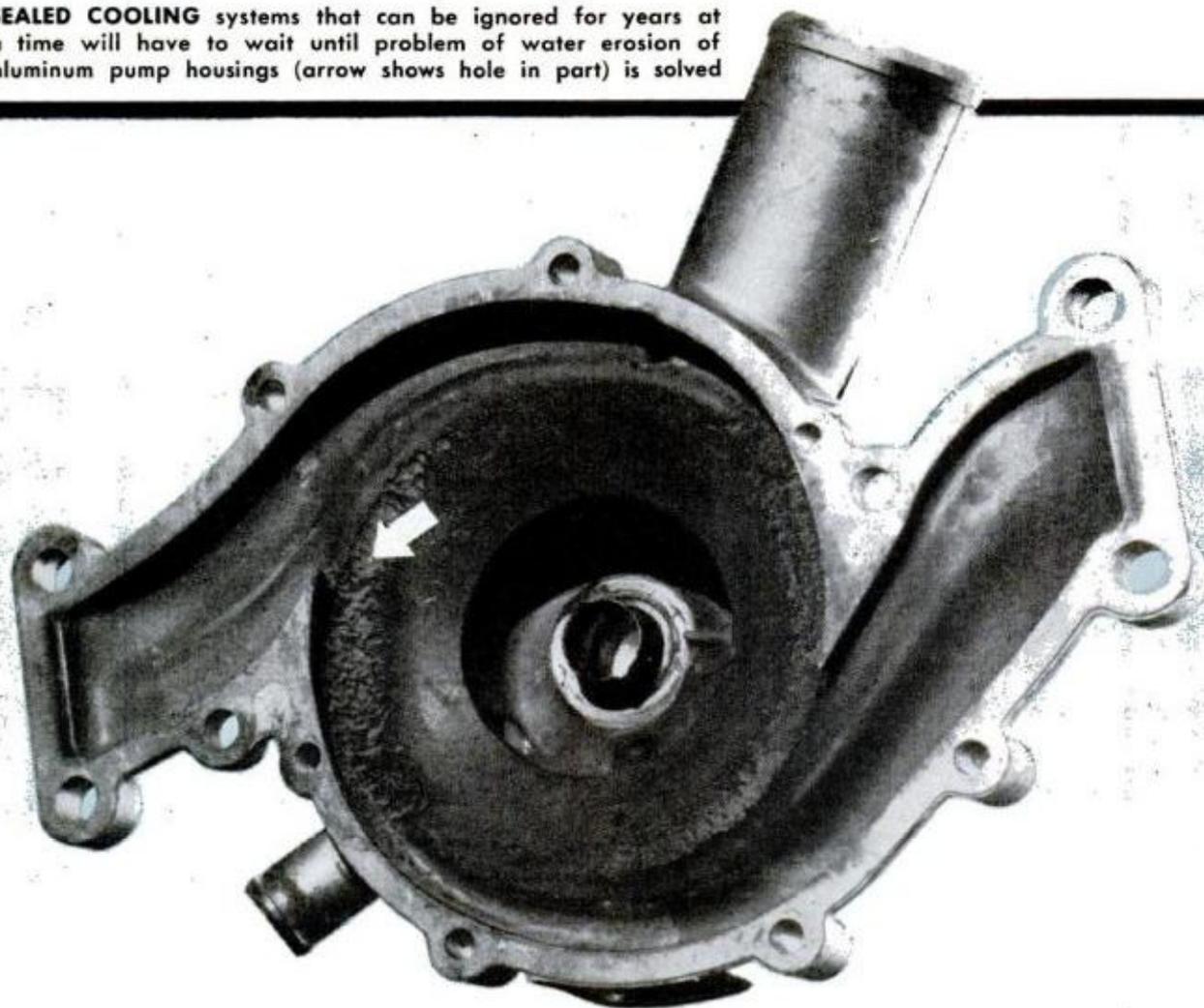
escape as fluid level changes. Ordinarily, this opening lets moisture and dirt slip in with the air. In GM's design, a rubber diaphragm covers the fluid and acts as a barrier against outside air. As fluid rises and falls, the diaphragm flexes, maintaining atmospheric pressure in the sealed portion of the reservoir, while air enters or leaves the vented section.

Goodbye, Prop Rod

Owners of the 1964 Ford Falcons who like to do their own mechanical work, or merely take an occasional look inside the engine compartment, will be happy to know that the hood is now counterbalanced. It's no longer necessary to grope for the prop rod, while supporting the hood with one hand.

Rambler American's new front suspension has made it possible to extend chassis lubrication to the same 33,000-mile intervals recommended for larger Ramblers. Lower ball joints need repacking at this mileage, while the upper trunnion metal bushings have been replaced by rubber

SEALED COOLING systems that can be ignored for years at a time will have to wait until problem of water erosion of aluminum pump housings (arrow shows hole in part) is solved



bushings that never need grease. Studebaker has also joined the club, increasing lubrication intervals for steering linkage and front suspension to 6000 miles.

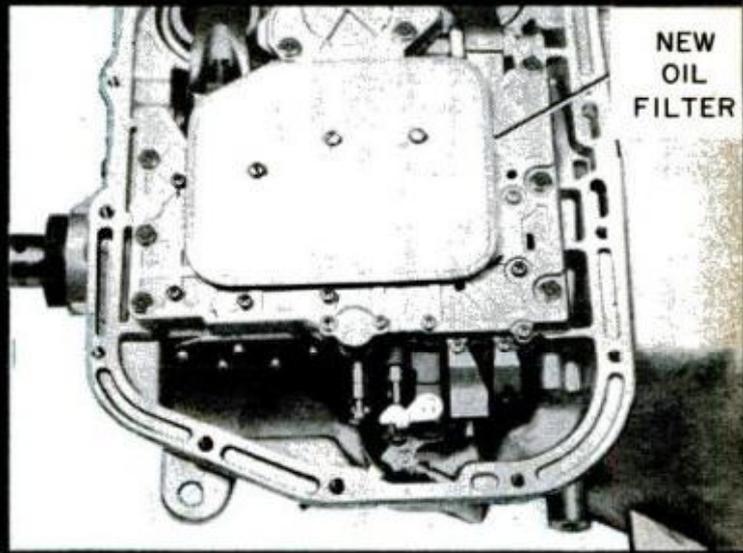
A new valve for the positive ventilation system in Chrysler Corp. cars is designed to keep itself clean. A spring-loaded plunger, sensitive to manifold vacuum, flutters constantly inside the valve's orifice to prevent the formation of deposits that cause clogging or sticking. Other Chrysler changes include additional splash pans on some models to keep the ignition system dry, more durable stainless steel synchronizer springs in the three-speed manual transmission and an internal full-flow oil filter on the TorqueFlite automatic. Moving the filter inside the case eliminates potential leakage points.

Ford has adopted headlamps with heavier filaments, said to last nearly twice as long as the usual type. In some Fords, rocker panels are equipped with one-way drain valves, allowing water to escape but preventing road splash from entering.

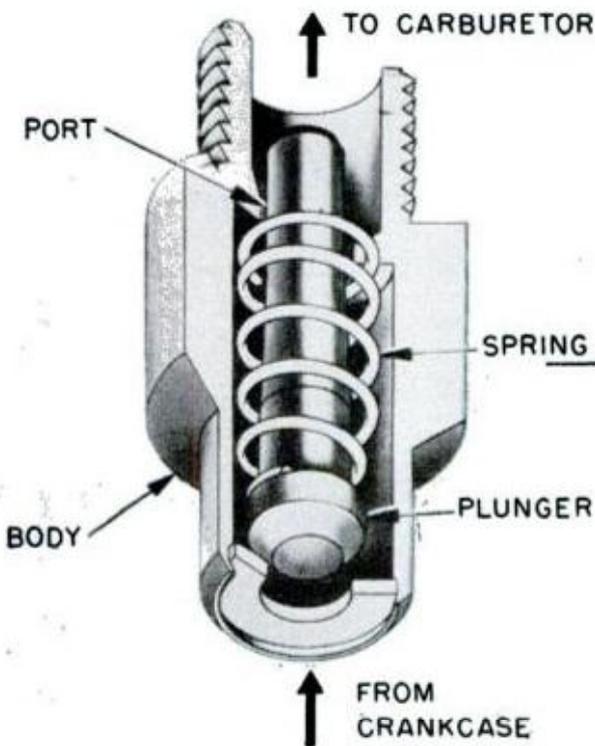
Every year there's at least one big tech-



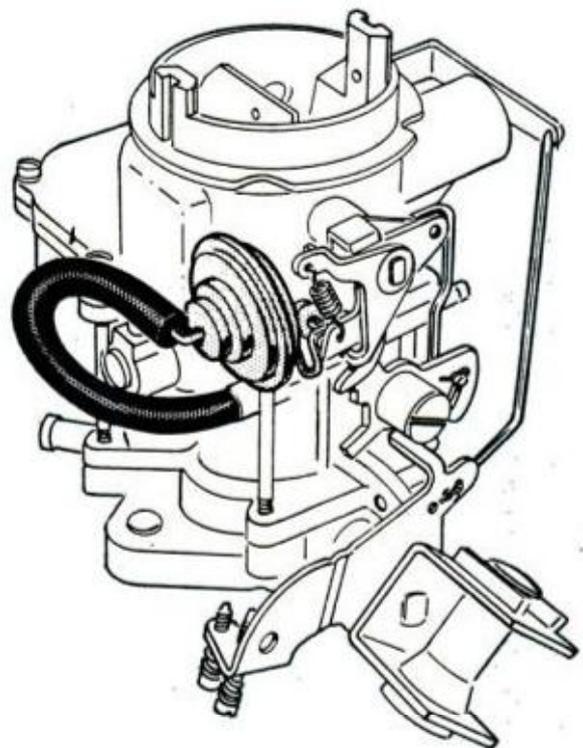
SPLASHBACK of water into '64 Ford rocker panels is prevented by plastic flapper valves which will permit water to drain out and thus reduce rust



TRANSMISSION OIL FILTER, right, on all Chrysler-built cars is dacron felt, replaces former cartridge in oil lines, lengthens change interval to 32,000 miles



CHRYSLER CORPORATION engineers fight problem of crankcase ventilation valve by designing one that wiggles as it works, keeping itself from sticking



VACUUM DIAPHRAGM mounted externally replaces the internal piston modulator which used to gum up and fail on pre-'64 Chrysler products

POPULAR MECHANICS' 1964

MAKE	OIL CHANGE	FILTER CHANGE	FRONT SUSP. LUBE	STRG. LINK LUBE	UNIV. JOINT LUBE
American Motors Rambler, All Models	4000	4000	33000-3 Yr.	NR	NR
Chrysler Corporation All Models	4000-3 Mo.	8000-6 Mo.	32000	32000	NR
Ford Motor Company Ford, Fairlane, Falcon Thunderbird Mercury, Comet Lincoln Continental	6000-6 Mo. 6000-6 Mo. 6000-6 Mo. 6000-6 Mo.	6000-6 Mo. 6000-6 Mo. 6000-6 Mo. 6000-6 Mo.	36000 100,000-3 Yr. 36000 36000	36000 100,000-3 Yr. 36000 36000	36000 100,000-3 Yr. 36000 36000
General Motors Corporation Buick Special Buick, All Other Models Cadillac Chevrolet, All Models Oldsmobile F-85 Oldsmobile, Other Models Pontiac Tempest Pontiac, Other Models	6000-2 Mo. 6000-2 Mo. 6000-2 Mo. 6000-2 Mo. 6000-2 Mo. 6000-2 Mo. 6000-2 Mo. 6000-2 Mo.	6000-6 Mo. 6000-6 Mo. 6000-6 Mo. 6000-6 Mo. 6000-6 Mo. 6000-6 Mo. 6000-6 Mo. 6000-6 Mo.	6000-6 Mo. 6000-6 Mo. 6000-6 Mo. NR 6000-6 Mo. 6000-6 Mo. 30000 12000-1 Yr. 30000	6000-6 Mo. 6000-6 Mo. NR NR 6000-6 Mo. 6000-6 Mo. 6000-6 Mo. 12000-1 Yr. 30000	NR 6000-6 Mo. NR NR NR NR NR NR NR
Studebaker Corporation All Models	6000-2 Mo.	6000-6 Mo.	6000	6000	NR

* Riviera only

† Bowl-type only

• Cars placed in service after Jan. 1, 1964 will not require coolant change until fall, 1965

nical advance that isn't quite ready in time for new model announcement. This year it was Ford's sealed cooling system. Ford engineers worked feverishly to develop a system that could be filled at the factory with ethylene glycol and water, then forgotten for the life of the car. It had to be turned down because neither Ford nor any other manufacturer has yet developed a completely leak-proof cooling system. As soldered joints work loose, hose clamps lose their tension and gaskets deteriorate; then the coolant seeps out.

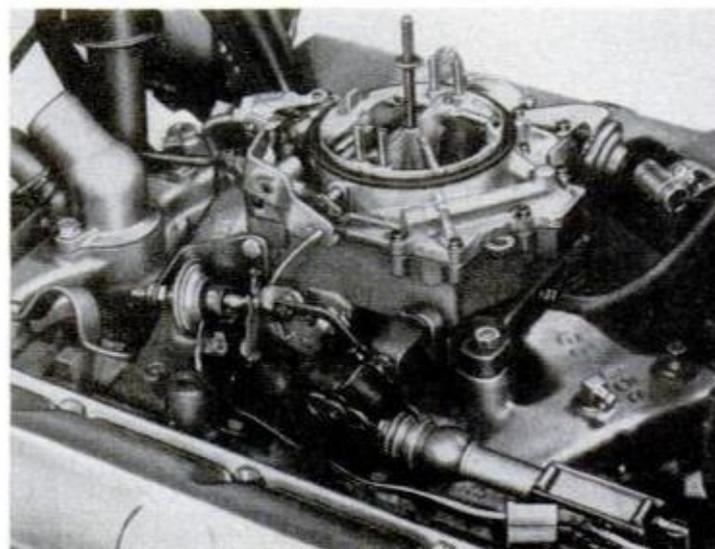
Even with a tight system, an uninformed service station attendant can spoil things by opening the radiator cap when the engine is warm. Modern cooling systems operate at 12-15 pounds above atmospheric pressure. Every time this pressure is released by opening the cap, some coolant escapes. When there's a noticeable drop in coolant level, the helpful attendant adds a little water. With a few repeats, the solution becomes so diluted that protection against freezing and corrosion is reduced.

To find out what happens to long-life coolants in actual services, a leading supplier of antifreeze conducted a survey of

Ford and American Motors cars that had been filled at the factory with two-year coolant. All cars checked had covered over 1000 miles, but none had been in service for more than one year. Owners were asked if water or other liquids had been added to the system.

A surprising 21 percent replied that

ELECTRICAL SWITCH on '64 Oldsmobiles carburetor coordinates transmission downshift with throttle position, eliminates problems of loose control rods



SERVICE CHECK LIST

AUTO TRANS. DRAIN	MAN. TRANS. DRAIN	WHEEL BRG. PACK	CLEAN AIR CLEANER	REPLACE AIR CLEANER	SERVICE PCV SWOG VALVE	FUEL FILTER	COOLANT
NR	NR	25000	4000	25000	8000	12000	2 Yr.
NR	NR	NR	6 Mo.	2 Yr.	6 Mo.	16000-1 Yr.	1 Yr. ●
NR	NR	24000	6000-6 Mo.	36000	6000-6 Mo.	36000	36000-2 Yr.
NR	—	24000	6000-6 Mo.	36000	6000-6 Mo.	36000	36000-2 Yr.
NR	NR	24000	6000-6 Mo.	36000	6000-6 Mo.	36000	36000-2 Yr.
NR	—	30000	6000-6 Mo.	36000	6000-6 Mo.	12000	36000-2 Yr.
24000	NR	NR	12000-1 Yr.	—	6000-6 Mo.	12000-1 Yr.	1 Yr.
24000	NR	NR	12000-1 Yr.	12000*	6000-6 Mo.	24000	6 Mo.
30000	—	30000	—	30000	6000-2 Mo.	6 Mo.	2 Yr.
NR	NR	36000	12000	—	6000-2 Mo.	12000†	2 Yr.
24000-2 Yr.	NR	NR	12000◆	18000	6000-6 Mo.	NS	2 Yr.
24000-2 Yr.	NR	NR	—	18000	6000-6 Mo.	NS	2 Yr.
24000-2 Yr.	NR	NR	6000-6 Mo.	—	12000-1 Yr.	1 Yr.	2 Yr.
24000-2 Yr.	NR	NR	6000-6 Mo.	—	12000-1 Yr.	1 Yr.	2 Yr.
NR	NR	24000	6000-6 Mo.	24000	6000	6000	6 Mo.

◆ V6

NR Lubrication not required unless unit is disassembled for repairs

NS Not Specified

plain water had been added, while two percent indicated that a mixture of anti-freeze and water had been poured in to make up for the loss of factory-fill coolant. Among the 73 cars that had traveled over 16,000 miles before they were one year old, 45 percent had required additional amounts of coolant to be added.

Antifreeze Fadeaway

Laboratory tests of antifreeze samples showed that those taken from 11 percent of all cars had lost more than half of their ability to prevent corrosion. In 12 percent of the solutions checked, freezing protection had also dropped to less than half of the original level. In the high-mileage group, 33 percent of the cars had retained less than 50 percent of their protection against freezing and corrosion.

One of the principal reasons for long-life coolants was the growing use of aluminum for engine parts such as water pump housings, intake manifolds and thermostat housings. Car factory engineers know that effective corrosion inhibitors must be kept in such systems at all times. Antifreezes meeting the automobile manufacturers'

specifications contain suitable inhibitors, and the easiest way to protect aluminum parts from corrosive action is to specify year-round use of antifreeze.

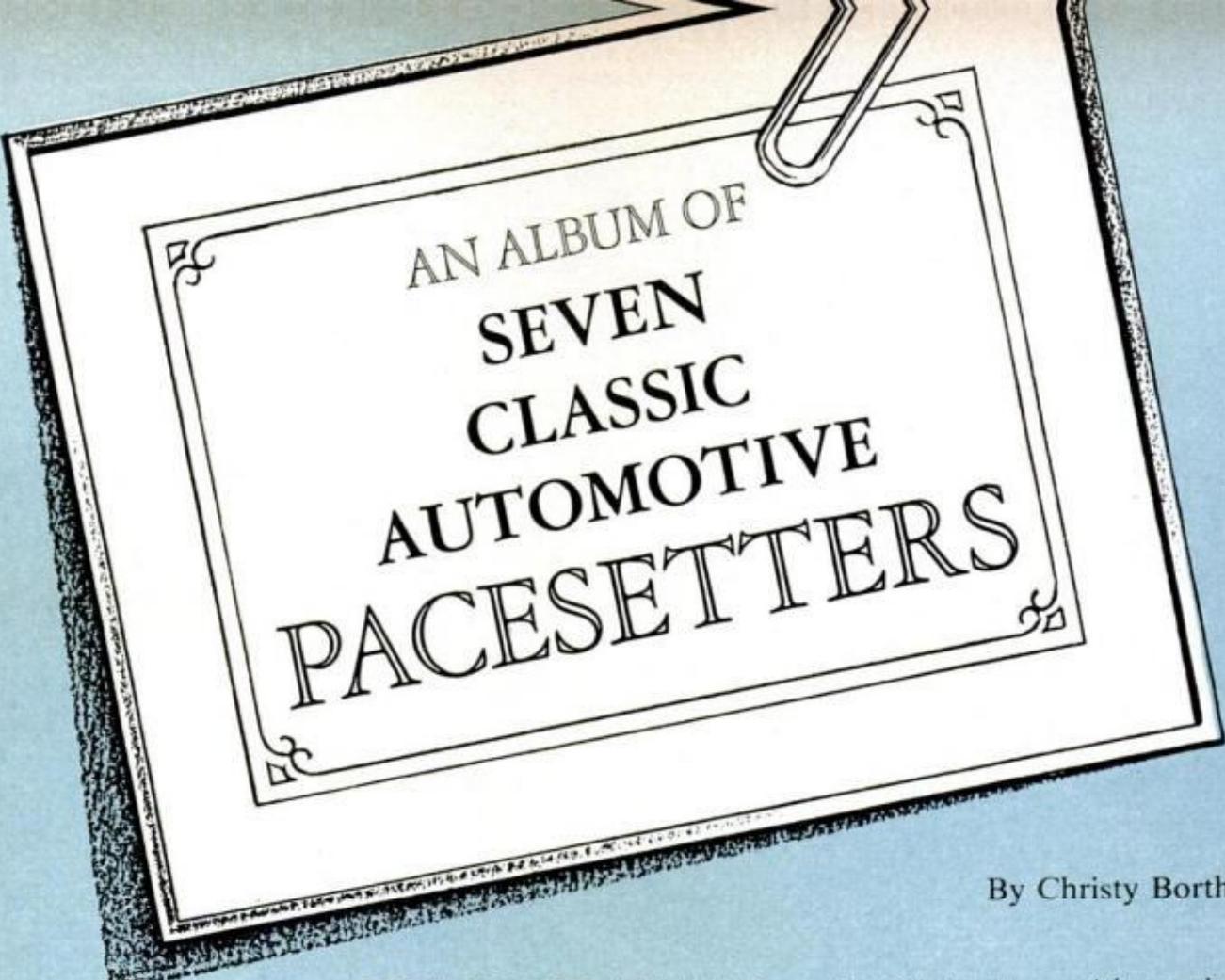
Even when inhibitors are used faithfully, some aluminum parts are running into trouble. Two of the thorniest problems are cavitation erosion and crevice corrosion.

Cavitation erosion occurs when the smooth flow of coolant is disturbed by an abrupt change of direction or an uneven surface. The resulting turbulence causes separated blobs of fluid to strike adjacent surfaces at high velocity, instead of flowing smoothly by. The metal is eaten away until pinholes appear (photo, p. 92) resulting in leakage. Engines that run at high speed for prolonged periods are most prone. Police pursuit cars seem to suffer chronically from this ailment.

Licking Cavitation Erosion

Some water pumps have been redesigned to prevent such damage. Contours inside the pump body have been smoothed to eliminate turbulence. Another approach

(Please turn to page 222)



AN ALBUM OF
SEVEN
CLASSIC
AUTOMOTIVE
PACESETTERS

By Christy Borth

TO RE-CREATE today's automotive scene without the innovations of these seven pacesetters, you'd have to turn the clock back at least 30 years.

Car bodies would be narrow and cramped with space devoted to running boards instead of passengers if Cadillac hadn't showed the way.

Brakes would still be uneven and unreliable without the principle of hydraulic operation introduced by Duesenberg.

Many people would have to learn to drive all over again but for the automatic transmission pioneered by Reo.

Without the shatterproof glass first used on Ford, even a minor collision would be potentially deadly.

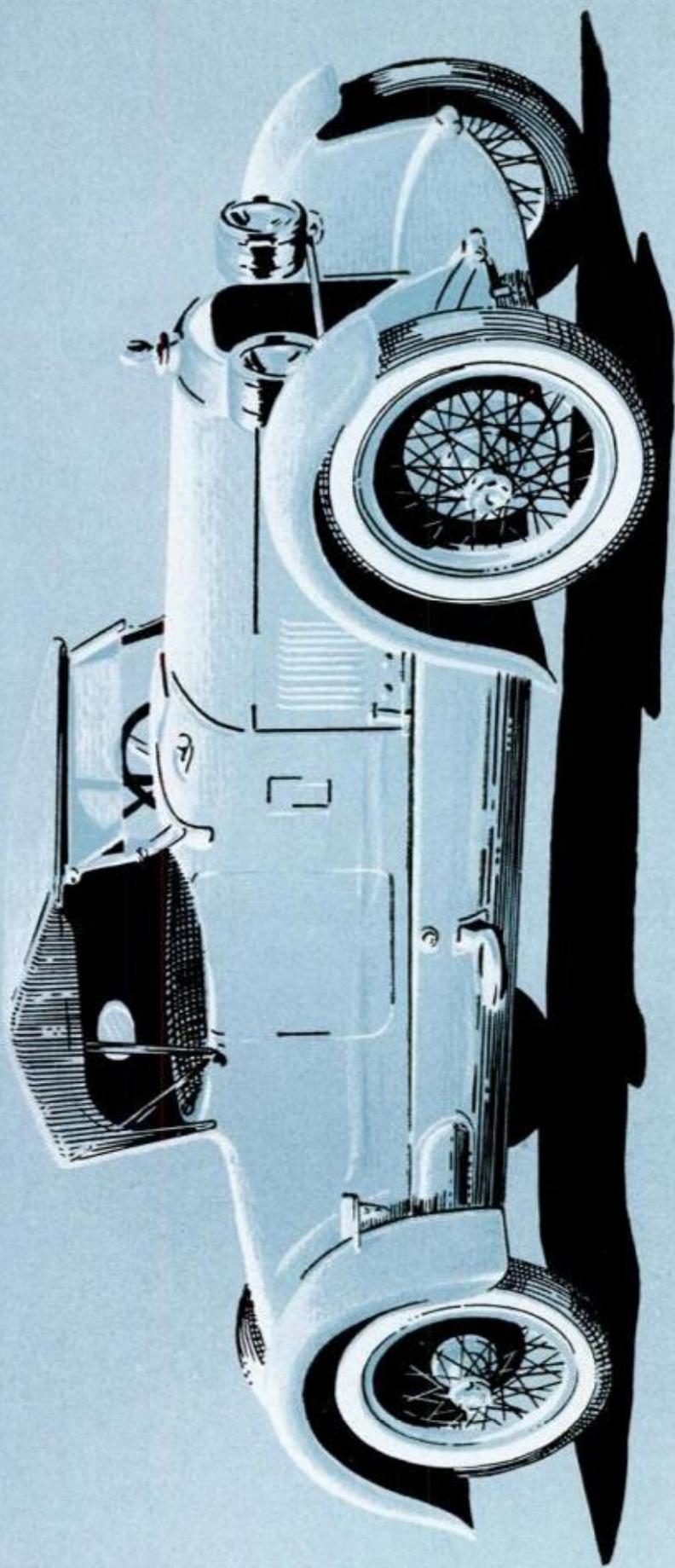
But for Star's example there might be no station wagons.

In winter, cars would still be stuffy and their windows be-fogged without some variation of Nash's Weather Eye heater.

Finally, there would be no smooth, powerful V8 engines if Wills Sainte Clair hadn't proved that it could be done.

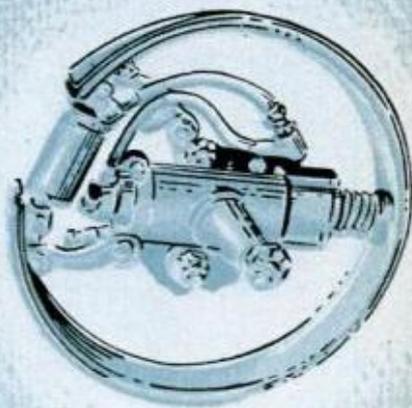
The principles embodied in these seven design breakthroughs did not spring full-blown from the engineering staffs of the cars on which they were introduced. As is true of almost every successful development, there were earlier ideas which pointed the way.

However, these seven designs passed the ultimate test—they went into production and thence to final judgment in the hands of car owners. Today, it's hard to imagine an automotive world without any of these trend-setting innovations.



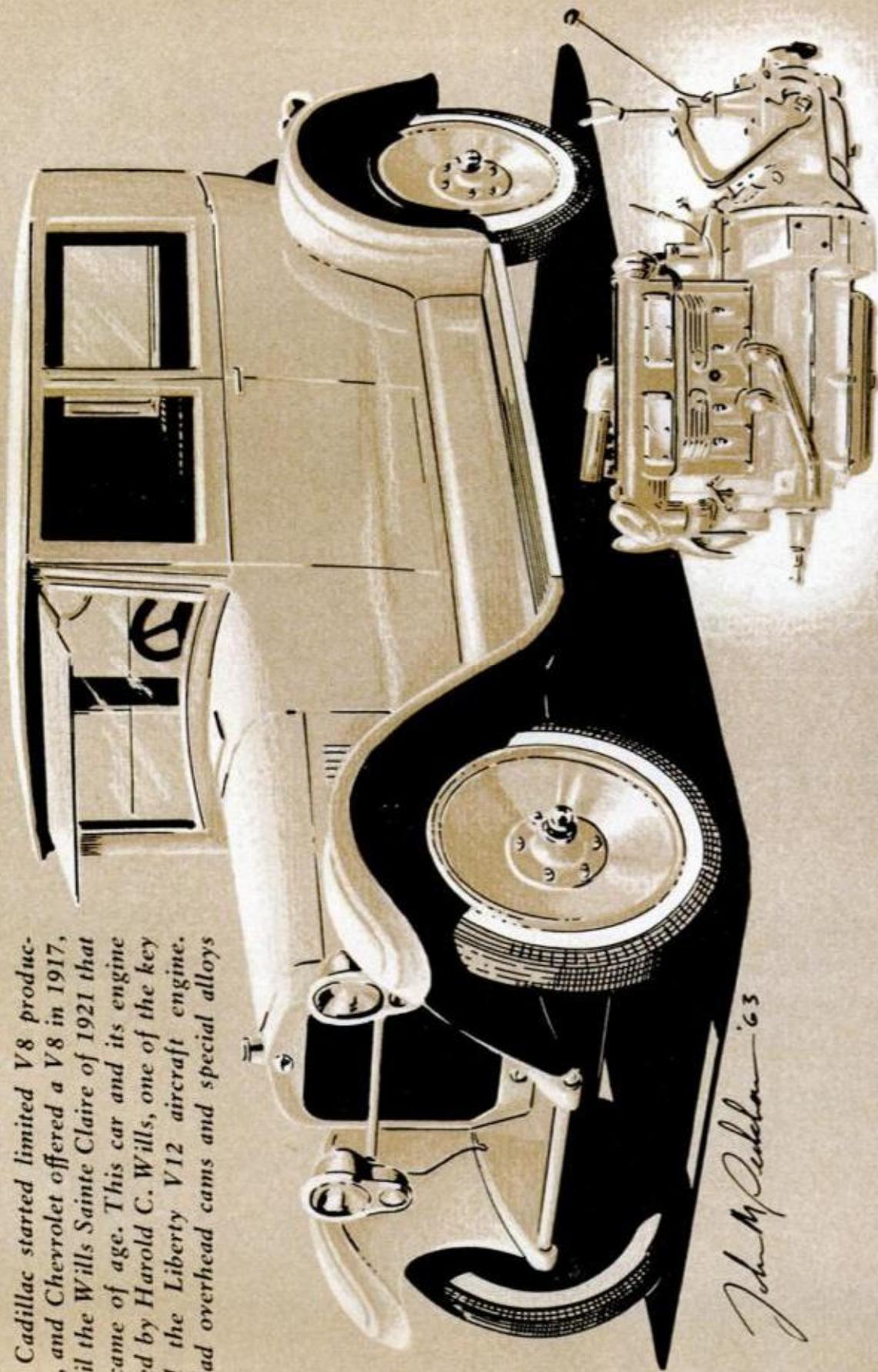
1920 Duesenberg Model A

In an era when four-wheel brakes were the exception, the principle of actuation by fluid under high pressure and in flexible lines was considered to be mechanical heresy by many practical engineers. But the advantages of applying equal pressure at each wheel, and eliminating the need for adjusting of rods or cables, was incentive enough for Fred Duesenberg. He introduced his internal expanding hydraulic brakes to the auto world on his sporty 1920 Model A Duesenberg

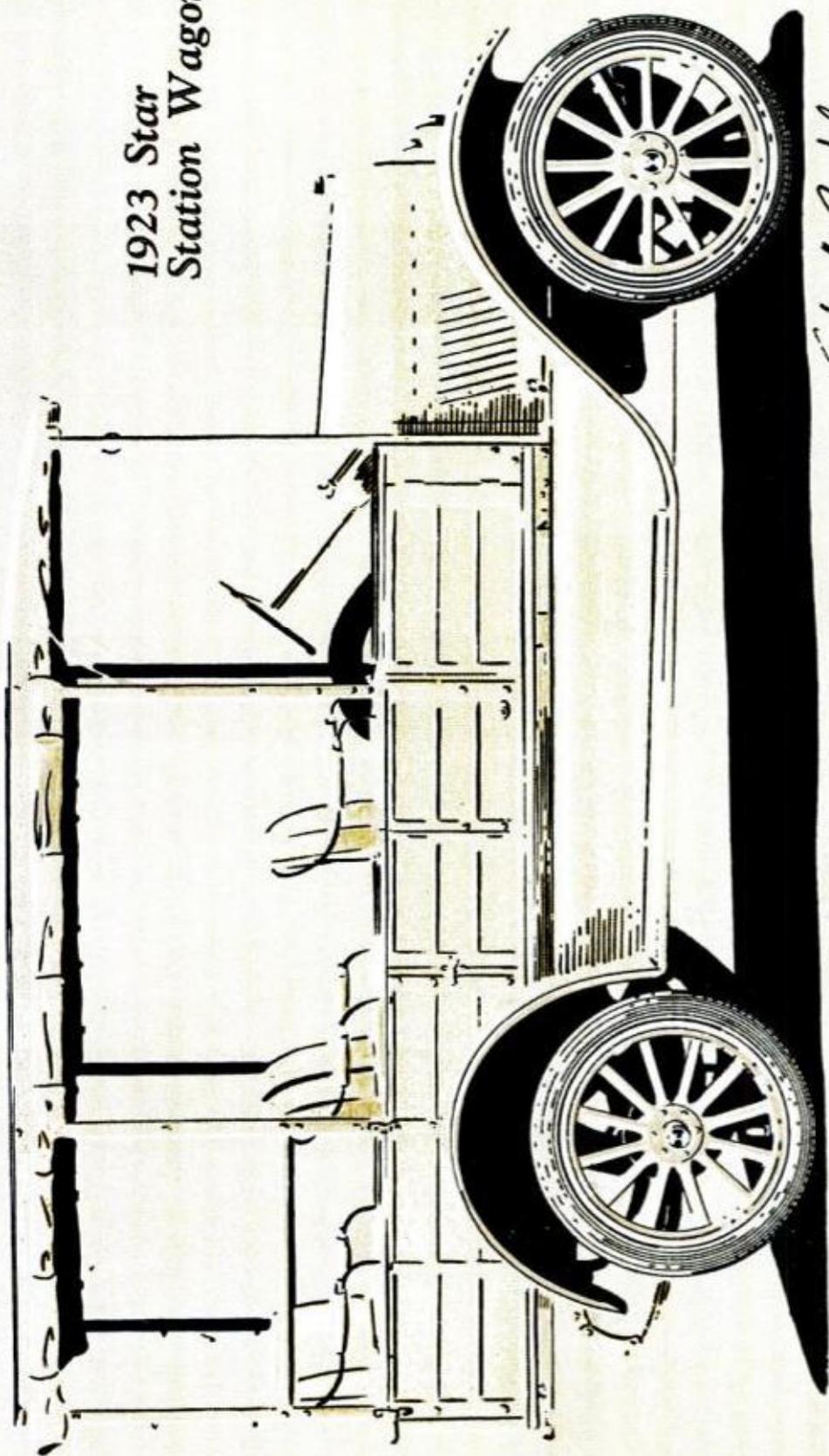


1921 Wills Sainte Claire

Although Cadillac started limited V8 production in 1914, and Chevrolet offered a V8 in 1917, it wasn't until the Wills Sainte Claire of 1921 that the engine came of age. This car and its engine were designed by Harold C. Wills, one of the key men behind the Liberty V12 aircraft engine. Wills' V8 had overhead cams and special alloys



1923 Star Station Wagon

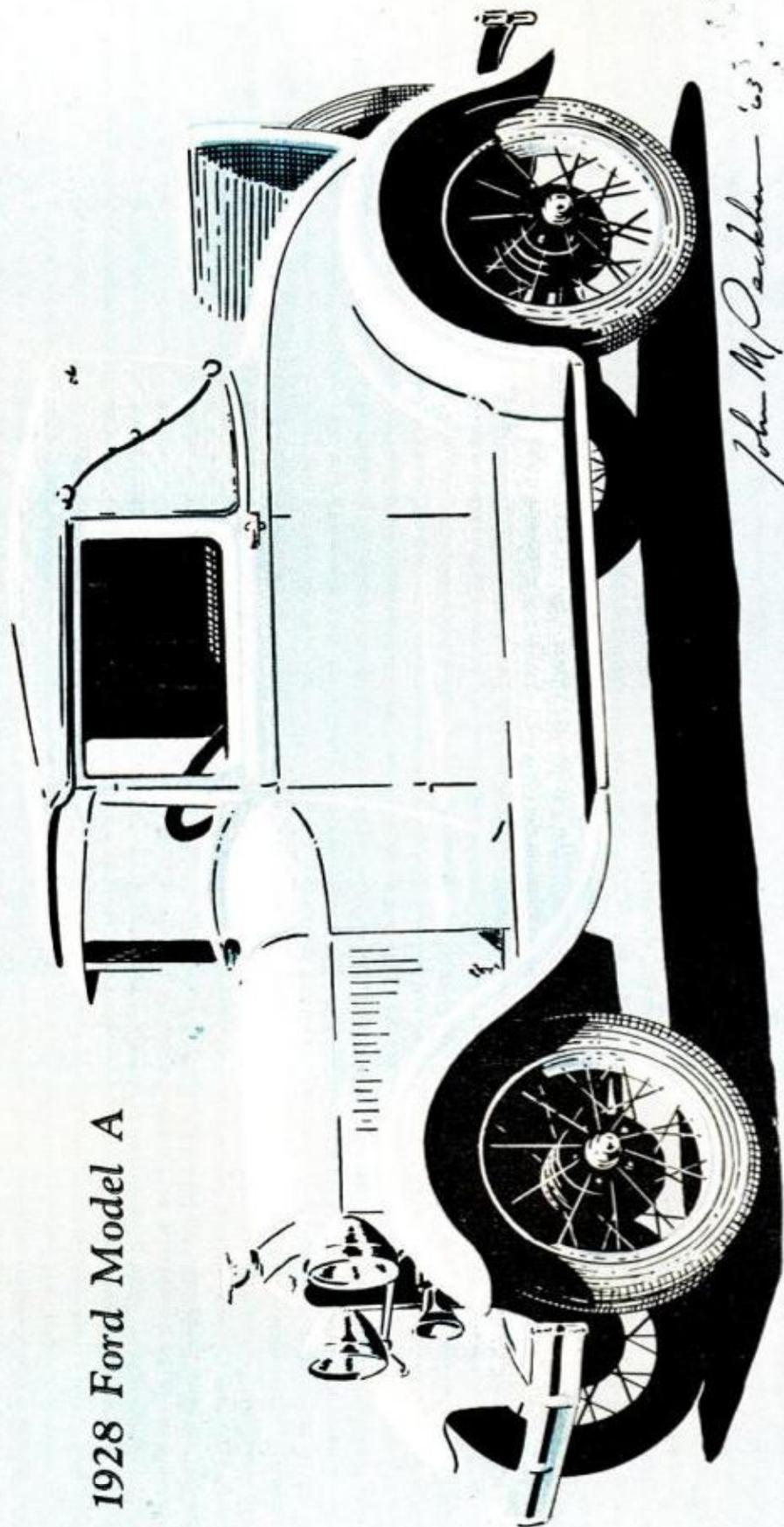


John M. Packham '23

In the beginning, station wagons were just what the term implies, wooden horse-drawn vehicles with multiple seats used to convey passengers from the railroad station to "downtown" areas much as the four-seat

airport limousines do today. As the automobile began to replace the horse, wagon builders made special station wagon bodies for auto and truck chassis. Star, however, was the first to build a production model

1928 Ford Model A



With the 1921 introduction by Essex of the low-priced closed body, year 'round motoring became a reality. However, some motorists grew nervous surrounded by sheets of glass which even a minor collision would transform into a shower of lethal slivers.

Although British and French automakers had experimented with safety glass, pioneer Henry Ford was first to introduce it in mass production. When the Model A bowed in January 1928 it had a windshield made of two thin glass sheets bonded to a plastic core which held the glass upon impact, stopped flying splinters. At first invisible, the plastic core of the A's windshield soon advertised its presence by fogging or turning to various colorful hues—a trouble later corrected



John M. Puckham '33

1933 Reo Royale

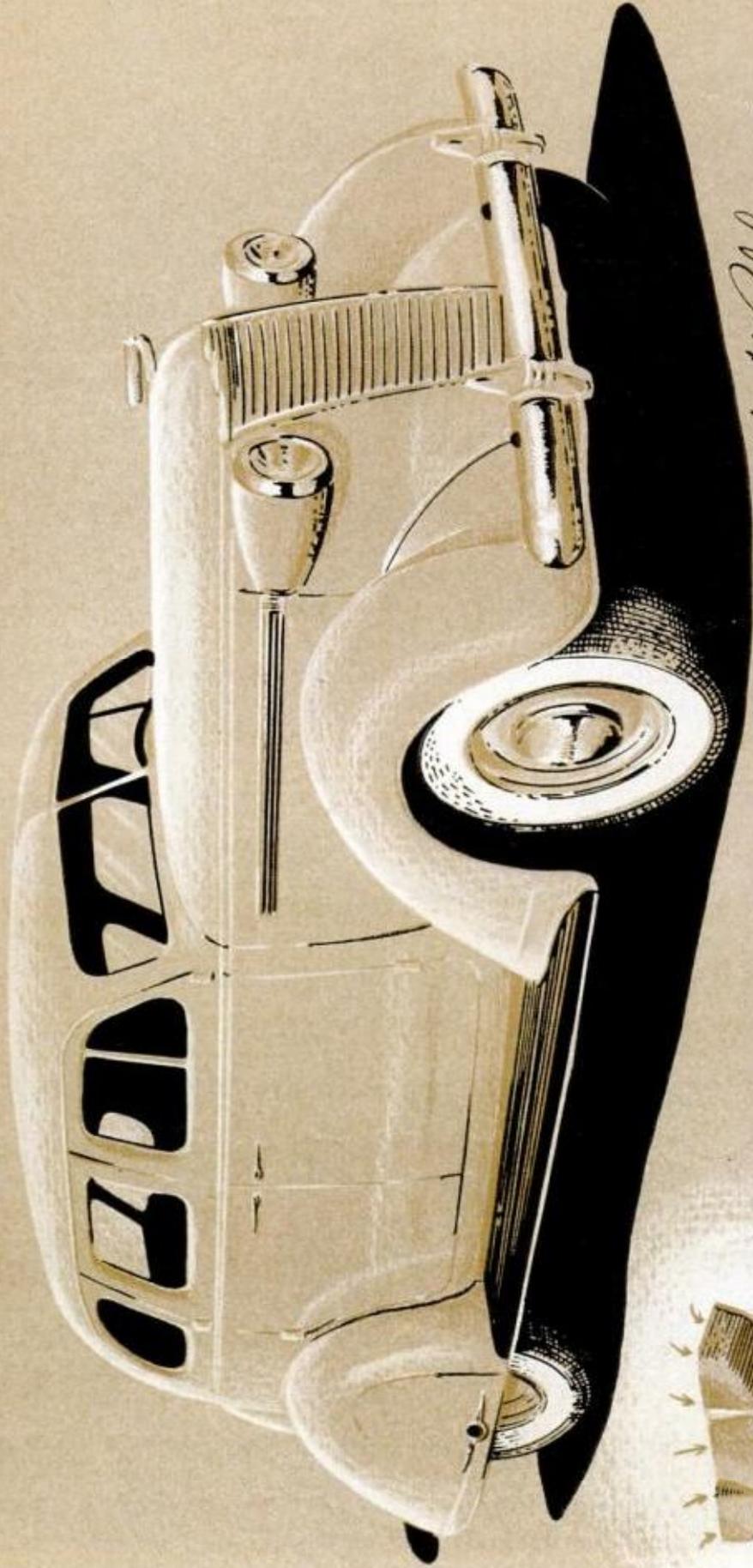
The "self-shifter," introduced as standard equipment on the Reo Motor Car Company's 1933 Royale, was an automatic transmission operating on a simple, effective principle. Both it and Reo have now faded from the passenger-car world. The self-shifter's downfall resulted from the near-total lack of mechanics able to service the unit



John M. Puckham '33

1938 Cadillac 60

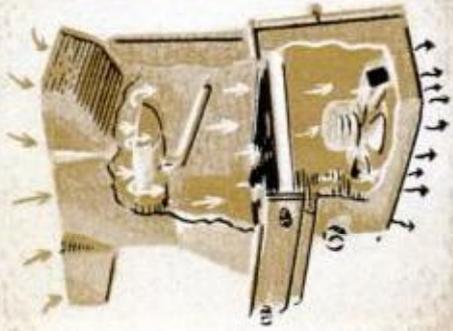
Cadillac's Model 60, first shown to the public in November 1937, broke the industry of its ancient running-board habit. Engineer-designer William Stout decided they were an unneeded leftover from horse-and-buggy days when a step was needed. After his campaign of goading, Cadillac broke the dam with no boards, six-passenger interior space



1938 Nash Ambassador

John M. Eckman '67

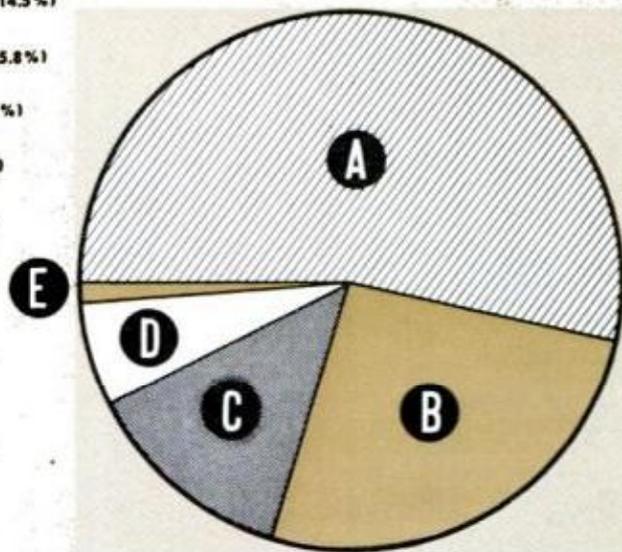
In 1938 Nash motor cars, in spite of the legendary frugality and Spartan approach of its president, introduced a combined heating and ventilating system. It spelled death for the old "oak stove system," in which stale air had been reheated over and over again. Charlie Nash was unenthusiastic about the developments of his chief engineer, Meade Moore. But Moore's heating system got a major boost when an aging Nash brought big, genial George Mason to Nash's presidency by merging with Mason's Kelyvinator Corporation. Mason backed the idea and it succeeded



PRODUCTION BOX SCORE 1963 versus 1962

Rank	Model	1963 Models Produced	1962 Models Produced	% Change
1.	Chevrolet	1,593,257	1,438,546	+11.0%
2.	Ford	845,292	704,775	+19.9%
3.	Pontiac	458,292	378,740	+21.1%
4.	Chevy II	375,627	326,599	+15.0%
5.	Oldsmobile	357,942	353,026	+1.4%
6.	Falcon	345,282	414,972	-16.5%
7.	Fairlane	343,887	298,116	+15.3%
8.	Rambler Classic	321,019	280,385	+14.5%
9.	Buick ¹	309,068	245,683	+25.8%
10.	Corvair ²	266,564	306,025	-12.9%
11.	Plymouth	244,395	172,134	+42%
12.	Valiant	198,399	145,353	+36.5%
13.	Dodge	181,575	148,356	+22.4%
14.	Cadillac	163,174	160,840	+1.5%
15.	Dart	153,921	64,271	+139.5%
16.	Buick Special	149,538	154,467	-3.2%
17.	Comet	134,623	165,305	-18.6%
18.	Tempest	131,490	143,193	-8.2%
19.	Mercury	121,048	107,009	+13.2%
20.	Chrysler	118,862	118,539	+0.3%
21.	Olds F-85	118,811	94,568	+25.6%
22.	American	105,296	125,678	-16.2%
23.	Studebaker ³	76,145	94,731	-19.6%
24.	Thunderbird	63,313	78,011	-18.8%
25.	Meteor	50,775	69,052	-26.5%
26.	Ambassador	37,811	36,163	+4.6%
27.	Lincoln	31,233	31,061	+0.6%
28.	Dodge 880	28,266	17,505	+61.5%
29.	Imperial	14,108	14,337	-1.6%

■ 1963 Models Produced
□ 1962 Models Produced



- A** General Motors 53.46%
Down from 53.9%
- B** Ford Motor Co. 26.38%
Down from 27.9%
- C** Chrysler Corp. 12.80%
Up from 10.3%
- D** American Motors 6.32%
Down from 6.6%
- E** Studebaker 1.04%
Down from 1.4%

Industry total of 1963 model year: 7,339,992,
up 9.77% from 1962 model year production

1. Includes Riviera 2. Includes Corvette 3. Includes all models

By production percentages, Chrysler Corp. cars were the stars of the '63 model year. Only Imperial lost ground—1.6 percent. Dart more than doubled production and Plymouth, Valiant and Dodge gained one fourth to one third over the '62 run. Valiant moved up from 16th place to 12th.

With a few thousand '63s around the country still unsold, final sales figures aren't in. All will be sold eventually, however, so production totals are a reasonable gauge of a model's success.

Chevrolet and Ford still lead the parade, but Falcon fell from third to sixth place. The full-sized Ford, which lost 11 percent with the '62s, reversed its field and picked up about 20 percent.

For their own purposes, manufacturers sometimes choose to lump together totals for various models. Our Buick figures, therefore, include Riviera. Similarly, Chevrolet includes Corvette. Studebaker production dropped almost 20 percent, but there's no indication of which models fared worst. Company production is lumped together. Even so, the total is in 23rd place. Unaided by its sisters, Lark alone held down 22nd place during the 1962 run.

Comparing in Depth the 1964 Falcon·Tempest·Studebaker

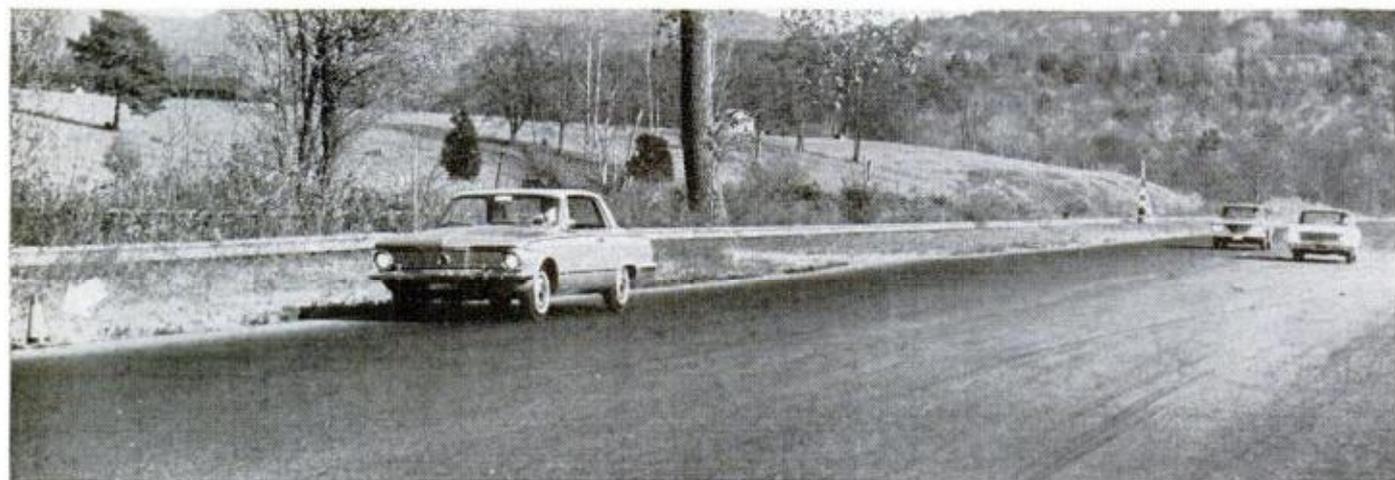
On a two-day shakedown over race track and tortuous highway Chevelle shows its ginger, Tempest its economy, Valiant its scat and Falcon its big car ride

By Jim Whipple

TO BALANCE SAM HANKS' "wild west" test of five "hot" '64's (page 88), this automotive shakedown deals with six low-cost, popular, compact and intermediate-sized cars. It's an on-the-spot road comparison made on the road racing course at Lime Rock, Conn., and on hilly highways. Comments, in many cases, are



QUARTER-MILE DRAG shows a scampering 145-hp. Valiant closing in on finish-line pylon (arrow) well ahead of 101-hp. Falcon (right lane) and 112-hp. Studebaker (center lane). All cars were Sixes with automatic shifts



Chevelle • Rambler • Valiant...

taken right from the tape that we recorded from the driver's seat in each car tested.

The cars chosen included Chevelle, a newcomer '64 hardtop with automatic transmission, power brakes and steering; three "founding father" compacts—Falcon, Rambler American and Studebaker—the cars that probably changed most

since they first appeared; Valiant, with little change since last year; Tempest, most radically changed of the new breed of "luxury compacts" (including Buick Special and Olds F-85).

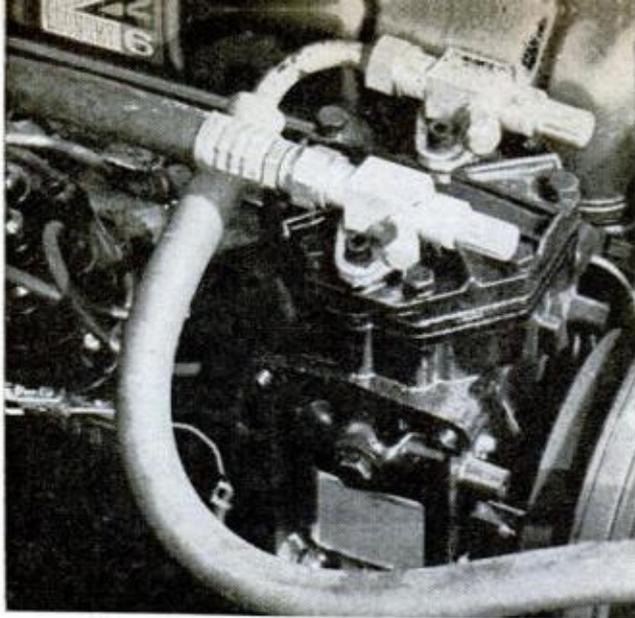
Our two-day shakedown cruise included:

1. Performance Tests, with 0-60 m.p.h. accelerations, standing 1/4-mile accelera-

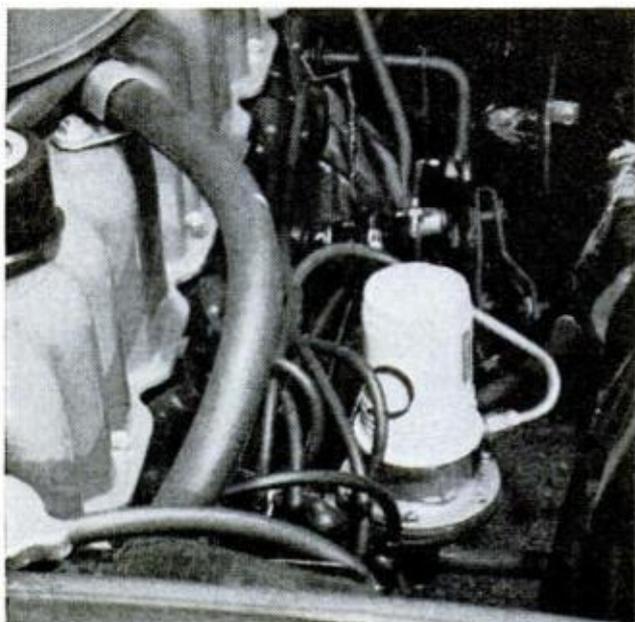


CHEVELLE's 195-hp., 283-cu.-in. V8 is predictable winner in quarter-mile drag over Valiant (right lane) and Tempest (middle lane). In another test, the Falcon and Tempest ran a dead heat nosing out the Rambler American





RAMBLER AMERICAN's Economy 6 engine was penalized by bulky air conditioner (foreground), whose extra poundage also hurt performance and handling



FALCON's thoughtfully-located disposable fuel filter screws into the fuel pump in a position which makes it very easy to reach and replace during servicing



HOOKING UP PM's fuel meter for the steady-speed fuel mileage tests. The Pontiac Tempest was the fuel economy champion of the six cars which we tested

VENT WINDOWS on Falcon (left) and Valiant (right) could be "fingered" easily and they operated smoothly. Chevelle's curved window (center) jumped its track as shown and the vent latches provided snug finger room



tions, passing times at 40-60 and 50-70 miles per hour.

2. Fuel Economy Tests that involved metered steady-speed mileage at 40 and 60 m.p.h. Over-the-road mileages were computed in a 57-mile tank-mileage highway run in convoy, all cars running the same speeds at a given time.

3. Ride and Handling Evaluations were made by one driver who rammed the cars over a 21-mile course of smooth highway, gravel, and rough, winding, secondary blacktop.

4. Livability Observations were made on practical details such as trunk space, bumper protection, ease of entry and general level of comfort and convenience.

Tire pressures on all cars were set at 32 pounds (8 to 10 pounds above recommended pressures) to get the best handling and economy performance possible.

Some differences were surprising. Chevelle, as the only V8 in the group (no Six was available to PM at test time) was a natural champ in the standing-start quarter mile (19.1 seconds)—but the Valiant wasn't far behind. In the 0-60 run, Chevelle was first, Tempest second, the Commander last. Chevelle's 283-cubic-inch V8 dominated the acceleration tests, too, but Valiant and Tempest were consistent runners up among the Sixes.

Because it is well-nigh impossible, so early in the year, to get six 1964 models which match closely in terms of engines, horsepower, transmissions and axle ratios, we don't pretend the comparison is perfect. This doesn't make the test results any less valid. But keep in mind that weights and horsepowers of the six cars varied widely. The 195-hp. Chevelle weighed 3155 pounds; the 145-hp. Valiant, 2888; the 112-hp. Studebaker Commander, 2955; the 101-hp. Falcon, 2596; the 140-hp. Tempest, 3139 and the 138-hp. American, 2788. With this in mind, here are the results:

HOW THEY PERFORMED

	Valiant	Chevelle	Tempest	Commander	American	Falcon
Standing start quarter mile, elapsed seconds	20.6	19.1	21.7	23.1	22.0	21.6
0-60 (corrected), avg elapsed time in seconds	17.05	12.6	16.2	24.0	17.4	17.6
40-60 (corrected), avg elapsed time in seconds	7.8	6.5	8.8	13.5	10.8	11.5
50-70 (corrected), avg elapsed time in seconds	11.7	7.3	12.2	18.2	13.5	15.7
WHO'S THE ECONOMY CHAMP?						
Highway economy, mpg	22.61	19.47	25.66	21.10	22.38	21.13
Steady 40 m.p.h., mpg	25.30	21.10	28.80	23.00	23.15	27.95
Steady 60 m.p.h., mpg	20.00	17.50	22.90	17.00	17.90	20.75

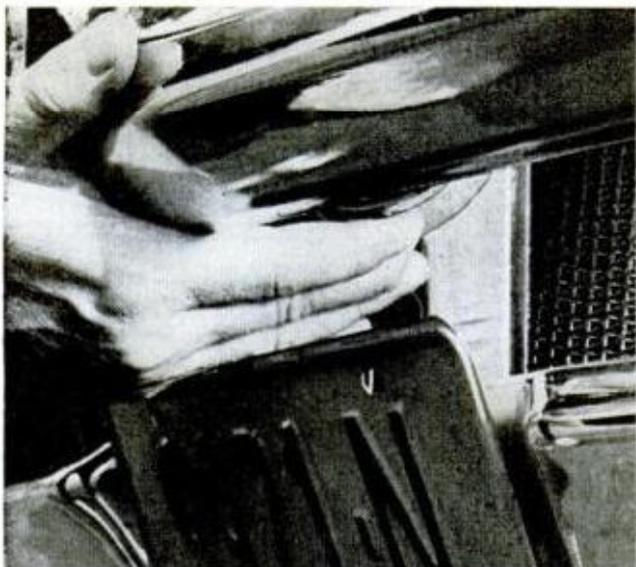
This Chevelle, by the way, got 19 plus m.p.g. on our road economy run and only

CHEVELLE BENDS its way through a nasty diminishing-radius curve on the Lime Rock race track at an indicated 45 m.p.h. There was no inherent instability and body roll seemed less than on some of the smaller cars tested





KNEEROOM CHAMPION of the six cars was this Studebaker with the Rambler American a finger-width behind. Same 185-pound six-footer was used in tests



VALIANT HOOD LATCH users met cutting edge of the license plate mounted as shown. Studebaker was the only one of the six cars with an inside hood release

11.9 m.p.g. when we hotrodded it around the test track, which shows how much difference driving habits can make.

Driver's Observations

Chevelle, Malibu Sport Coupe, V8, power steering, power brakes. This car has the heavy, solid feel of a big General Motors frame job, and there is a certain amount of shake when traveling on a very second-rate road. It's a heavy rear-axle car. The shake is more pronounced than in the Tempest. You've got a heavier engine working up forward.

The over-all ride is a well-controlled and pillowy one—not sloppy, but there's a slow rate of shock and spring action.

The acceleration with the 283 is very nice. This engine is quiet, smooth and well-perfected. Kickdown in the power glide is pretty good; it takes you up a hill with a solid punch, up into the 50s.

Steering power is satisfactory for maneuvering on these back roads. You can get car in and out of hairpins with ease.

The car is a nice size. It doesn't seem bulky, yet it's bigger in feel than most of the other compacts of the group.

There is rear-axle shake, but it isn't the heavy anvil-like pounding and bouncing that you'd expect when doing 50 m.p.h. on a bad back road. You can feel the pounding, but the total tuning job done on the frame, rubber-insulated suspension on this 115-in. wheelbase car is excellent.

Chevelle's combination of wheelbase, tread and control of the ride and handling

STUDEBAKER'S POWER-ACTIVATED DISK BRAKES produced a serene, straight-line panic stop from 45 m.p.h. Other cars showed no inherent braking weaknesses



gives it the big-car feeling, yet it's not overly heavy. With power steering, at any rate, it's got the response and maneuverability of a compact.

Falcon, 6-cylinder, automatic transmission, manual steering. This is a good deal less powerful than Chevelle's V8, of course, but it gets up there. I'm pushing it up to 65 and 70. The engine sounds busy.

Because of tire pressure—as in the Chevelle and others we have 32 lbs.—there is a feeling of body jiggle. But she's basically pretty good and solid. Steering control is fairly precise, almost to the point of being a little sensitive. The ratio is a little slower than the power steered Chevelle, but not too slow. There's no heaviness.

There isn't a heck of a lot of pickup beyond 50. You feel—I was just passing a big truck—that the cork is pretty well out of the bottle and wish for more.

The speedometer indicates 80 now and the car doesn't feel light. Full throttle is a true 80 m.p.h. and the car feels pretty controllable.

This Falcon seems more stable than the previous models in respect to wind effects and bobbing around on bad roads.

On rough dirt there's a good deal of vibration, but it's solid. That's this unit body; it vibrates as one piece. It's not overly harsh, however, or at all tinny. You can feel the difference from last year's Falcon. The extra rubber put into the suspension is more than psychological.

There is very little of the bad fore-and-aft pitching that you got in the early

Falcons. The absence of side roll is very good too. I would describe the ride as well-controlled and crisp. Excellent freedom from chop.

Studebaker Commander, 6-cylinder, automatic transmission, disk brakes with power booster, manual steering.

At 55 or 60 m.p.h. there's a little wind buffeting from an open window in a Commander. But when the window is buttoned up, most of the noise cuts off.

The feel of the power front disk brakes is one of the nicest we've experienced. On the medium-to-good blacktop road, the first impression is that the ride is a bit busy, but the body seems pretty solid.

The seat-to-pedal location isn't too great for a long-legged person. Instrument panel is one of the best in the group. It might be that very short people will find the steering wheel a bit intrusive; it cuts through the cluster and up into the windshield.

The ride impression is somewhat busy, as though this frame is bolted tightly to the body leaving little rubber hysteresis to soak up vibration.

Windows are nice and high and you get a good view of all corners of the car.

The seat is comfortably upholstered, but there's no thigh support and a six-footer's knee angle is a little too acute.

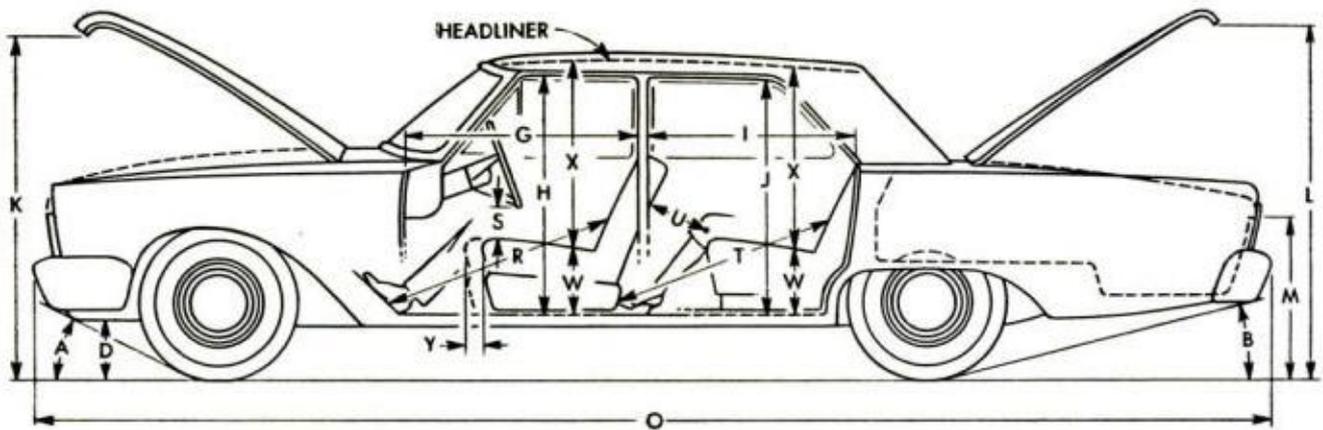
The engine has adequate power, but that's about all. Its economy should be more impressive to match its moderate output. Passing performance is nice, with the kickdown into intermediate carrying

[\(Please turn to page 224\)](#)

FALCON AT 45 MPH on same diminishing-radius curve Chevelle is negotiating on page 107. Body roll was more abrupt than Chevelle's but there was no loss of control or breakaway. Cornering is far better than on previous Falcons



Comfort-Convenience Index

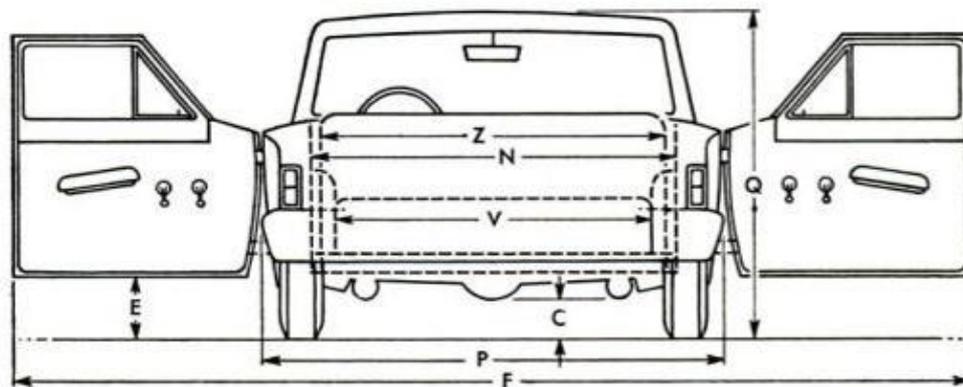


	A	B	C	D	E	F	G-H	I-J	K	L	M	N		
	Max. driveway approach angle	Max. driveway departure angle	Max. sill interference height	Min. road clearance	Min. front end curb clearance	Open door curb clearance	Open door wing-spread	Front-door opening, horizontal x vertical	Rear-door opening, horizontal x vertical	Clearance under hood	Clearance under trunk lid	Luggage lift height	Trunk opening width	Usable luggage capacity, cu. ft.
Avanti*	28°	22.0°	3.0	6.2	11	13	162.5	42x36.5	DNA	70	55	24.5	59.0	14.8
Buick	23.8°	12.9°	3.5	5.5	12	14	141.6	28x38	24x37	75	67	29.2	65.0	15.2
Buick Riviera*	23.8°	15.5°	5.0	5.3	13	14	75.2	39x37	DNA	75	69	28.4	63.5	10.2
Buick Special	25.1°	15.1°	4.0	6.0	13	13	134.1	26x37	26x36	69	74	30.0	70.5	16.1
Cadillac	21.3°	11.8°	4.0	5.3	11	14	147.2	34x38	28x38	79	70	26.2	70.5	15.8
Chevelle	29.1°	15.6°	4.5	6.0	14	13.5	133.9	26x36	28x36	71	63	22.8	72.0	16.9
Chevrolet	26.0°	13.0°	5.0	5.5	13	13	141.6	37.5x38.5	27x36	75	65	22.1	75.5	19.0
Chevy II	32.1°	16.3°	4.0	5.2	13.5	13.5	134.0	25x38	35x38	—	63	21.0	67.0	13.3
Chrysler	21.7°	12.1°	5.0	5.4	12	13	151.5	33x36	26x35	80	70	24.4	72.0	18.8
Comet	27.9°	13.5°	4.0	5.5	14	14.5	135.3	31.5x37	20.5x36.5	74	72	29.2	58.0	12.8
Corvaire	25.4°	14.5°	6.0	5.4	12	12	130.1	29x34	27x33	85	68	28.6	49.0	6.6
Corvette*	26.7°	17.4°	5.0	5.0	12.5	13	139.3	26.5x32	DNA	76	68	DNA	DNA	10.5
Cruiser-Daytona	23.5°	14.0°	0.0	4.8	12	13	146.0	28x42	28x42	72	65	24.6	58.0	13.6
Dodge	21.5°	13.6°	5.0	5.3	11.5	16	159.2	25.5x36	24.5x36	76	68	25.0	71.0	17.0
Dodge 800	24.3°	11.6°	5.0	5.4	12.5	15	154.0	33.5x36.5	28.5x38	78	72	27.8	71.0	19.6
Dodge Dart	21.8°	18.1°	5.5	5.5	11	14.5	139.2	29x36	21x36	72	66	23.2	65.0	17.3
Fairlane	22.7°	11.7°	5.0	5.6	13.5	13	148.5	30.5x38	28x37	72	67	28.2	68.5	14.1
Falcon	28.4°	16.6°	4.0	5.7	14	13	135.3	27x37	21x36	71	59	—	68.0	11.6
Ford	22.8°	11.5°	4.0	5.3	14.5	14	156.5	—	—	72	65	28.0	77.0	17.1
Hawk*	20.0°	17.0°	0.5	6.5	11	13	150.0	35x39	DNA	71	70	20.8	51.0	11.1
Imperial	19.2°	11.6°	5.0	5.6	13.5	16	154.0	31x38	18x37.5	78	70	26.3	76.0	17.8
Lincoln	23.1°	11.8°	5.5	5.2	12	14	147.1	29x37	27x36.5	80	67	24.0	72.0	14.6
Mercury	26.4°	11.9°	3.5	5.5	13	14	156.5	35x37	25x36	68	72	29.5	77.0	17.1
Olds F-85	25.2°	14.9°	4.0	5.8	13.0	14	134.0	30.0x36.5	28.0x36.0	73	75	30.1	71.5	18.3
Oldsmobile	24.7°	11.9°	5.0	5.4	13	14.5	141.6	31.5x37	31x37	79	70	27.6	74.0	17.1
Plymouth	22.6°	12.9°	5.5	5.3	11	14.5	159.2	29.5x36	30x36	72	67	27	72.5	17.3
Pontiac	20.3°	12.8°	4.4	6.0	12.5	14	141.8	27x37.5	25x36.5	78	65	25.9	66	—
Pontiac Tempest	16.0°	12.5°	3.0	6.0	12	13.5	134	27.5x36.5	23x37	73	72	27.2	71	30.1
Rambler American	31.0°	18.0°	5.0	6.0	13.5	13	137.1	30x36	23x36	64	64	26.1	67	12.1
Rambler Classic	25.4°	16.2°	4.4	6.0	12.5	14.5	140.0	31x36	23x36	69	65	22.6	69	13.7
Thunderbird*	19.5°	12.9°	5.0	5.5	9.5	11.5	—	44x37	DNA	68	65	—	67	11.5
Valiant	22.4°	13.8°	—	5.5	11	15	139.2	37x32	26x36	71	67	24.6	66	14.1

*Built as a two-door only.

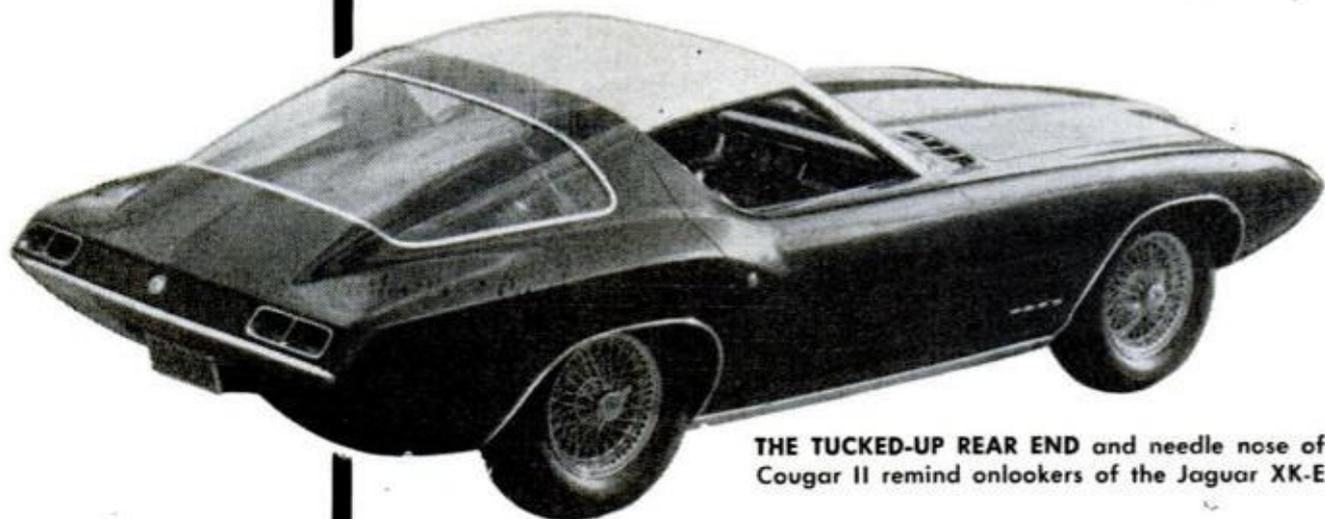
All dimensions refer to four-door sedans (lowest price) where possible and are expressed in inches unless otherwise specified.

to the 1964 Cars



	O-P-Q			R	S	T	U	V	W	X	Y	Z		
Steering ratio	Over-all length x width x height	Turning circle diameter, ft.	Wheel turns, lock to lock	Max./min. front leg room	Min. wheel-to-seat clearance	Min. rear leg room	Min. rear knee room	Front seat cushion width	Seat height, front/rear	Headroom, front/rear	Front seat travel	Min. shoulder room	Glove box depth x opening width x opening height	Wheelbase
24.5	124x70.4x53.9	37.0	5.0	42.3/36.3	2.3	26.3	2.5	50.3	7.5/10.9	37.5/34.8	6.0	51.5	5x14.0x3.5	109
33.0	218.8x78.0x56.4	43.9	5.0	40.8/36	3.1	38.7	5.4	57.6	8.2/11.5	39.3/33.8	4.8	57.9	9x12.0x4.5	123
20.5	208x76.6x53.2	43.6	3.5	40/35.2	2.8	34.9	3.3	Bkts	8.1/10.6	37.8/37.5	4.8	55.8	8x12.0x4	117
28.6	203.5x73.4x54.4	40.8	5.6	42/38	—	36.5	3.7	53.2	—/—	38.6/37.3	—	58.8	8x16.0x4.5	115
18.2	223.5x79.5x54.8	43.0	3.7	40.8/36.0	3.7	38.9	6.3	55.6	8.4/10.2	38.6/38.1	4.8	58.0	7x13.5x5	129.5
26.2	193.9x74.6x54.5	—	5.5	41.9/—	4.2	36.5	—	53.2	—/—	38.6/37.3	—	58.8	8x16.0x4.5	115
28.0	209.9x77.0x55.6	40.8	5.8	41.8/37	3.5	38.3	4.6	57.6	8.6/11.8	39.2/38.0	4.8	57.5	7x15.0x4	119
25.4	182.9x70.8x55.0	38.4	4.5	40.1/36.1	5.4	36.1	3.9	53.1	9.4/11.0	39.0/37.6	4.0	55.3	6.5x12.0x5	110
30.2	215.3x80.0x55.1	43.1	5.4	41.8/37.3	4.4	39.3	6.4	57.0	9.0/10.9	38.0/37.9	4.5	59.6	6x12.5x6.5	122
27.0	195.1x71.4x55.3	40.0	4.6	42.0/37.0	4.3	35.5	3.8	53.3	9.0/11.4	38.8/36.7	5.0	55.0	7x11.5x5	114
25.0	180x67.0x51.5	38.2	4.8	41.3/37.3	3.1	33.6	2.3	50.7	7.5/10.1	37.6/36.6	4.0	53.6	7x14.5x3.5	108
20.2	175.3x69.2x49.8	40.4	2.9	43.9/39.9	4.5	DNA	DNA	Bkts	8.2/DNA	36.3/DNA	4.0	—	6x15.5x4.5	98
26.5	194x71.5x54.8	—	4.7	39.9/34.4	3.3	35.8	7.1	56.0	7.6/9.5	39.0/38.0	5.9	55.0	4x17.5x6.0	113
18.8	209.8x75.0x55.1	41.7	3.5	41.9/37.4	3.9	38.1	5.7	55.0	8.1/11.0	39.1/38.3	4.5	57.5	6x15.5x4.5	119
30.2	214.8x79.0x55.2	43.1	5.4	41.8/37.3	4.0	39.3	6.4	57.0	9.0/10.9	38.0/37.9	4.5	59.6	6x12.5x6.5	122
28.7	196.3x69.8x53.5	38.6	5.3	40.0/35.5	3.1	36.6	5.5	52.0	8.6/11.6	38.3/37.2	4.5	54.2	6x10.5x5.0	111
27.8	197.6x72.2x55.4	40.2	4.7	42.1/38.1	4.2	36.9	4.6	53.4	9.8/11.7	38.7/37.9	4.0	56.2	4.5x13.0x4	115.5
27.0	181.6x71.6x54.5	38.8	4.6	41.5/37.5	4.1	34.7	2.7	53.3	9.1/11.4	38.7/36.9	4.0	55.0	7x11.5x5	109.5
30.0	209.8x80.0x56.5	41.0	5.5	41.9/36.4	3.9	36.7	5.5	58.8	8.7/11.0	39.1/38.4	5.5	58.9	5x13.0x4	119
24.5	204x71.0x54.7	42.5	4.6	41.8/35.8	3.6	33.2	3.5	52.3	7.8/8.5	38.6/36.6	5.9	52.4	9x11.0x4	120.5
19.4	227.8x80.0x56.8	47.6	3.5	41.5/36.5	3.4	—	8.1	57.0	8.5/11.3	39.3/38.7	5.0	62.0	5x15.0x4.5	129
20.5	216.3x78.6x54.2	54.7	3.8	41.1/37.1	3.9	40.5	7.8	54.3	9.2/10.5	39.0/38.4	4.0	59.3	5x14.5x5	126
30.0	215.5x80.0x56.7	41.6	5.5	41.9/36.4	4.2	38.6	6.7	58.8	8.7/11.6	39.1/38.3	5.5	59.6	4.5x13.0x4	120
28.3	203.0x73.8x54.5	41.0	5.6	41.4/37.4	3.8	36.1	3.5	53.8	8.7/10.8	38.2/37.3	4.0	58.8	9.0x9.0x5.5	115.0
33.2	215.3x77.4x55.9	42.8	6.1	42.0/37.2	5.2	36.8	3.2	57.6	9.0/11.6	39.4/37.7	4.8	58.2	7x14.0x5	123
28.7	206.5x75.6x55.1	40.8	5.3	41.9/37.4	3.9	36.6	4.4	55.0	8.1/11	39.1/38.4	4.5	57.5	6x15.5x4	116
29.1	213x79.2x55.8	42.8	5.5	41.5/—	—	38.7	—	—	—/—	39/38	—	58.8	7x15.5x4	120
28.3	203x73.3x54	40.9	5.0	42.3/—	—	36.5	—	—	—/—	38.6/37.3	—	58.8	6x12.0x4	115
29.0	177.3x70.8x54.5	36.0	6.0	41/35	4.1	34.8	3.4	50.5	9.7/11.0	39.3/37.5	6.0	54.8	4x13.0x6.5	106
28.3	180x73.8x54.6	37.0	6.0	41.0/35.0	4.7	36.3	4.7	53.5	9.7/10.9	39.3/37.7	6.0	57.8	6x14.5x5.5	112
20.4	205.4x77.1x52.6	40.2	3.6	39.7/35.7	3.2	33.2	2.8	Bkts	10.6/9.6	37.4/37.6	4.0	54.0	5x10.0x5.5	113.2
28.7	198.2x70.1x53.5	37.1	5.3	39.9/35.4	3.1	35	4	52	8.5/11.6	38.2/37.2	4.5	54.2	6x11.0x5	106

DNA: Does not apply
—: Dimension not available



THE TUCKED-UP REAR END and needle nose of Cougar II remind onlookers of the Jaguar XK-E

Airy Tricks on Cougar II

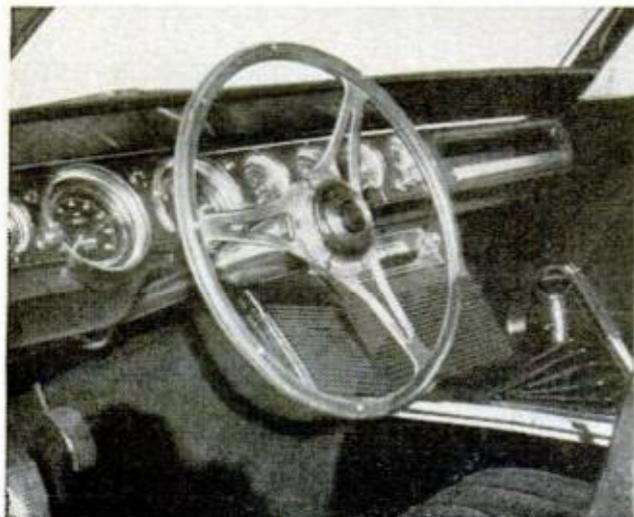
LATEST ADDITION to the Ford styling department's stable is the Cougar II, intended to test your reaction to items like crankless side windows (they operate with a sliding tab), a telescoping steering column (with three inches of adjustment), and retractable headlights.

With the top removed, Cougar II's integral roll bar and back window would form a speed-robbing air scoop, but pressure is vented through a panel below the window. It opens when cockpit area pressure passes 15 p.s.i.

Cougar II is something more than a display item. It runs. Although road-racing modifications haven't been made, the engine, chassis, and suspension are close to those of the Shelby AC Cobra. Gene Bordinat, Ford director of styling, claims Cougar II could be engineered to run, like the Cobra, in the 170-m.p.h. range. Its engine is a milder version of the 260-cubic-inch Fairlane V8 that nearly won at Indianapolis.

For comparison, the 90-inch Cougar II wheelbase is shorter than a VW's. The little two-seater is less than 4 feet high and only 66.6 inches wide. It measures 167.8 inches over all.

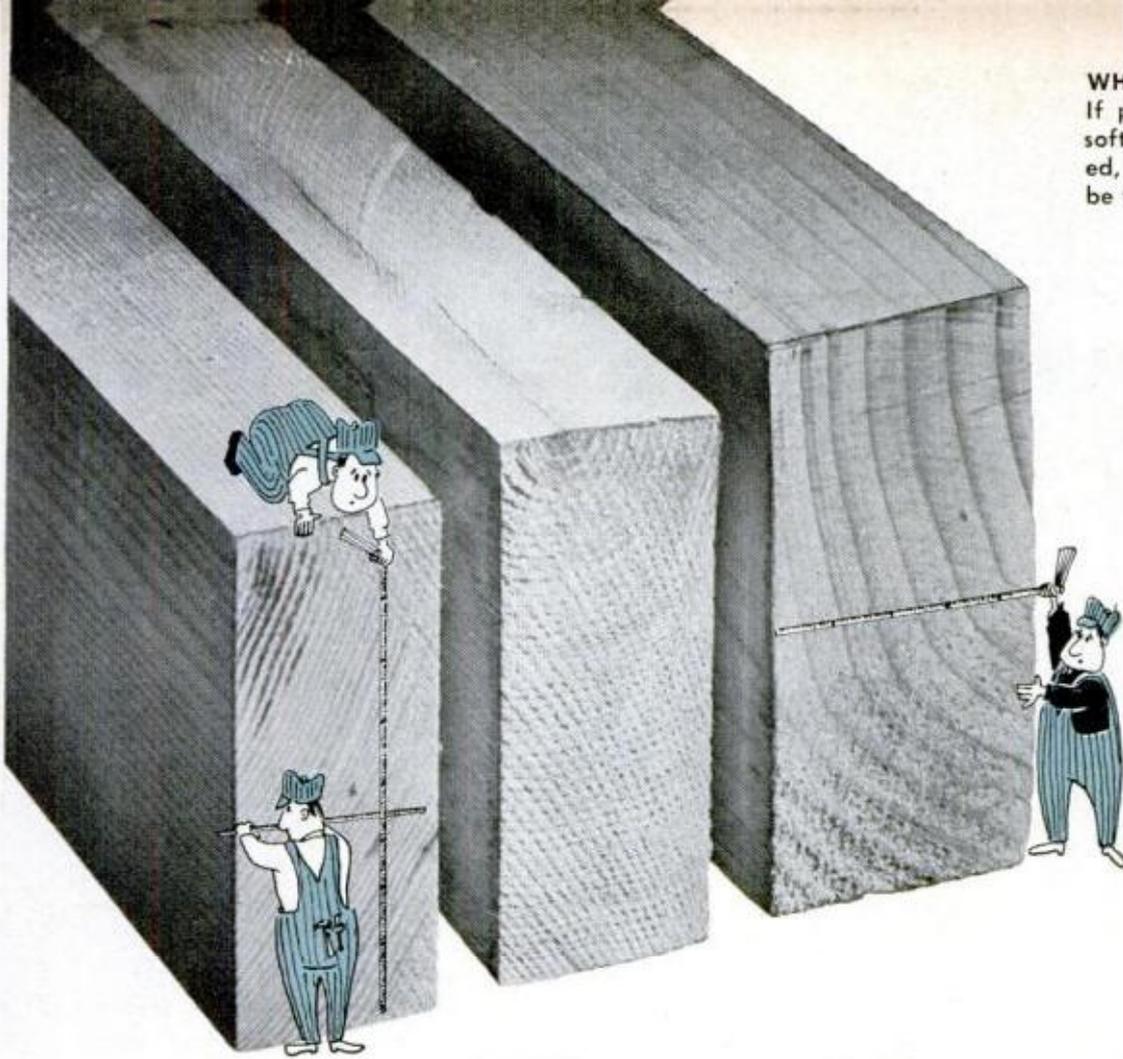
FULL INSTRUMENTATION HIGHLIGHTS the interior. Larger dials are for the speedometer and tachometer



HEADLAMPS ON THE COUGAR II tuck out of the way at the touch of a button activating two small motors



WHAT NEXT for the 2 x 4? If proposed new sizes for softwood lumber are adopted, tomorrow's studs will be trimmed another 1/8 inch



They May Trim The 2x4 Some More

Several sizes of lumber have masqueraded under the name 2x4. There's another on the way

By Arthur Mikesell

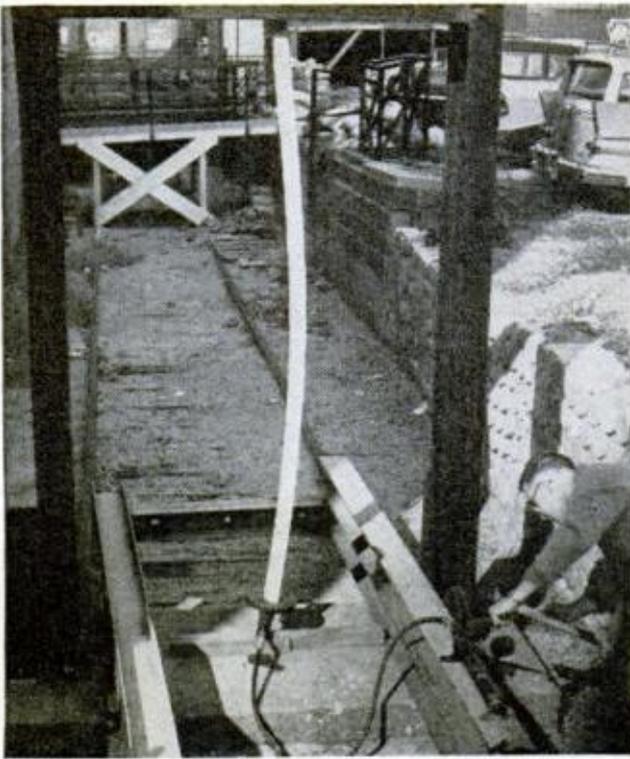
THAT OLD STRUCTURAL stand-by, the 2x4, may be in for another trimming.

If proposed new size standards for softwood lumber are adopted, today's 1⁵/₈-inch thickness will be shaved to 1¹/₂ inches, and for compatibility, this new thickness will be the standard for all dimension lumber—2x6, 2x8, etc. The 3⁵/₈-inch width will remain unchanged.

Another important feature of this proposal is that size would be related directly to moisture content. Thus, green lumber would have to be dressed slightly oversize at the mill so that, after the shrinkage

which accompanies seasoning, it would match the 1¹/₂-inch thickness of dry-milled lumber.

When word of these proposed changes reached *Popular Mechanics*, we hired U.S. Testing Co. to run some "stud tests" on this slim 2x4 of tomorrow to determine just how it stacks up against the 1⁵/₈-inch thickness of today, the old 2x4-inch lumber of bygone days, and an even more radical 1¹/₂ x 3¹/₂ standard which had been suggested by the West Coast Lumber Inspection Bureau. The results are given on page 115 and we think that you'll be surprised by them.



TESTING PROCEDURE to determine the compressive strengths of various size 2 x 4s involved placing the stud-length pieces in a specially constructed frame

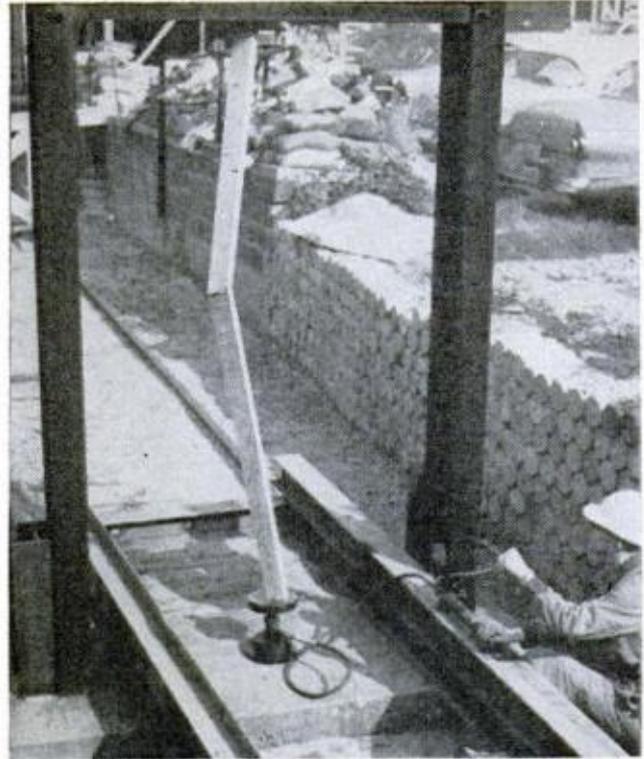
With full 2x4-inch lumber used as the standard against which all samples were compared, the proposed new size falls about 8½ percent below today's 2x4 in strength. Converting this to a direct comparison, the new 2x4 would be about 9½ percent weaker.

However, all of these tests involved dry-dressed lumber, while a great deal of the lumber used by builders today (most Douglas fir, for instance) is dressed green to the 1⅝ x 3⅝-inch standard. Shrinkage during seasoning cuts it back to approximately 1⅞ x 3½ inches.

Tests conducted by the U.S. Forest Products Laboratory have proven that in joist and rafter use, where width is more important than thickness, the new 3⅝-inch-wide 2x4 would actually be stronger than today's green-milled 2x4.

Samples cut to the 1½ x 3½-inch standard which had been proposed by the West Coast Lumber Inspection Bureau showed up quite poorly, falling over 17 percent below today's 2x4. However, an obvious weakness in two of these samples affected the average load figure for this size lumber, exaggerating the difference between it and the proposed 1½ x 3⅝-inch size.

Our original tests included only three sizes of lumber: full 2 x 4 inches; today's 1⅝ x 3⅝ inches; and the proposed (but



PRESSURE APPLIED by means of a calibrated hydraulic jack made it possible to determine the maximum load which could be supported by such a stud

not accepted) 1½ x 3½ inches. To achieve maximum consistency within the tests, five samples of each of these three sizes were cut from five pieces of Douglas Fir measuring 3 x 6 inches x 24 feet.

The moisture content of each section of wood tested was measured using the Tag Wood Meter, and ranged between 11 and 13 percent. Since the average moisture in air-dried wood is 12 percent, the samples were typical of dry-dressed lumber.

As for the testing methods, each stud was placed vertically in a steel frame and force was applied at the base by means of a calibrated hydraulic jack.

Later, a separate series of tests was made involving the proposed 1½ x 3⅝-inch standard. These duplicated the original tests, except that all samples were cut from a single piece of Douglas fir.

Keep in mind that today's standard lumber sizes *are not* based on a specified moisture content. Prior to World War II, the American Lumber Standards Committee's minimum dressed sizes were generally understood to mean lumber dressed in a seasoned condition. However, the war effort placed tremendous pressures on the lumber industry, making it necessary to substitute green lumber for seasoned lumber while milling to the same dimensions. This practice became firmly established

COMPRESSIVE STRENGTH OF VARIOUS STUD-LENGTH 2 x 4s

DIMENSIONS OF SAMPLE	% OF AREA	LOAD (LBS.)	% STRENGTH
2" x 4" x 8'	100.0	6740	100.0
1 5/8" x 3 5/8" x 8'	73.6	6110	90.7
1 1/2" x 3 5/8" x 8'	68.0	5540	82.2
1 1/2" x 3 1/2" x 8'	65.6	4960	73.6

TEST DATA

SAMPLE 2" x 4"	LOAD (LBS.)	SAMPLE 1 5/8" x 3 5/8"	LOAD (LBS.)	SAMPLE 1 1/2" x 3 5/8"	LOAD (LBS.)	SAMPLE 1 1/2" x 3 1/2"	LOAD (LBS.)
A	7830	A	7260	A	5670	A	6330
B	7630	B	7260	B	5390	B	5220
C	6700	C	6520	C	5670	C	5220
D	6330	D	4840	D	5300	D	4100
E	5220	E	4660	E	5670	E	3930
AVERAGE	6740	AVERAGE	6110*	AVERAGE**	5540	AVERAGE	4960***

* Samples a & b turned out to be quite a bit stronger than the average, but this was balanced by the unusual weakness of samples d & e. The average load figure checks out against previous research data concerning lumber of this dimension.

** All samples of this size were cut from the same piece of lumber.

***The average load figure obtained here is actually somewhat lower than what might be expected. Unlike the test of today's standard dimension, the obvious weakness of samples d & e wasn't balanced by sufficient above-average strength in other samples. Further tests would undoubtedly bring the average load figure much closer to that of the proposed new dimensions.

and lived on after the war when thousands of homes were built from green lumber.

Today, if you were to inspect a stud used in one of these post war homes, it's doubtful that it would measure a full 1 5/8 x 3 5/8 inches—shrinkage would have reduced the cross-sectional area to where it would be near that of the proposed 1 1/2-inch-thick 2x4. While this use of green lumber often resulted in cracking plaster and sticking doors, these houses were still quite solid and safe due to the heavy safety factor incorporated in modern building codes.

In addition to standardizing the final in-use dimensions of both dry-milled and green-milled lumber, the proposed new standards would incorporate a definition of the term "dry" for the industry.

Moisture content is measured by comparing the *weight* of a given piece of lumber with that of a bone-dry piece of the same species having the same dimen-

sions. Weight of moist lumber can run as high as twice that of dry lumber.

At present, it is generally recognized that a moisture content of 30 percent or more is enough to tag any piece of lumber as green. The most common standard for dry lumber is 19 percent average with 25 percent maximum for individual pieces.

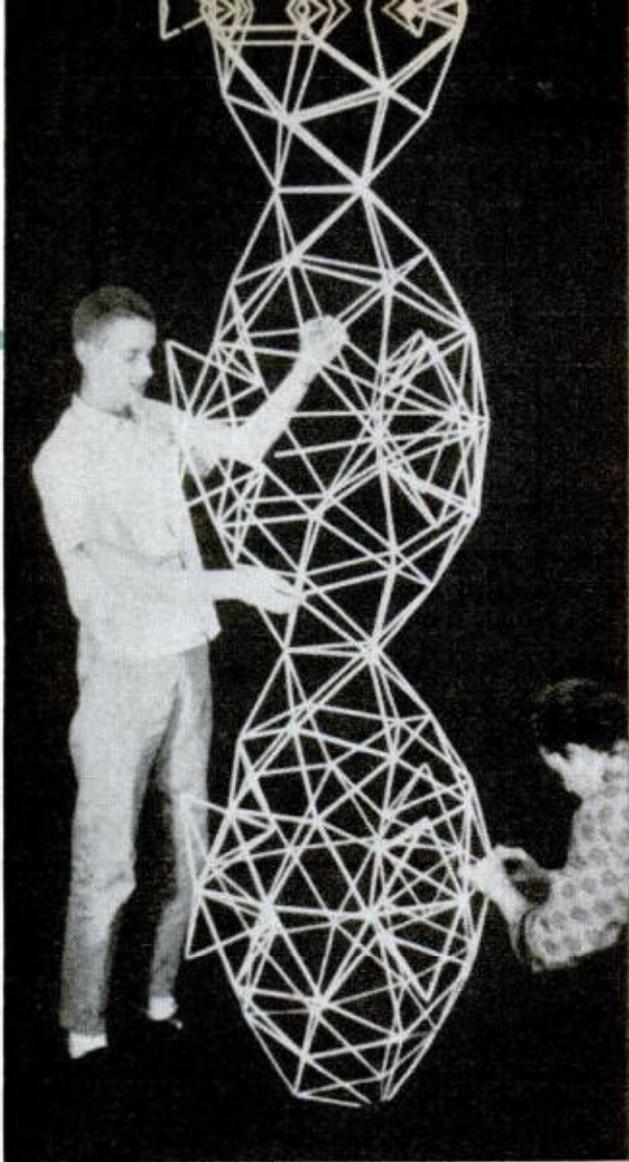
Under the new standard, this would be pushed back to 15 percent average and 19 percent maximum, bringing it much closer to the average equilibrium moisture content of between 10 and 12 percent which it eventually reaches in use. The net result would be a more stable piece of lumber with less built-in shrinkage.

A poll is now being conducted by the National Bureau of Standards to determine whether this new standard should be adopted. There is a better-than-even chance that they will be adopted, so watch your paper for results. It could mean more money in your pocket.

NATURE OF BREAKS occurring under compressive pressure demonstrates the lack of uniformity in structure of wood. Flaw in lumber produces ragged vertical break



Imagination



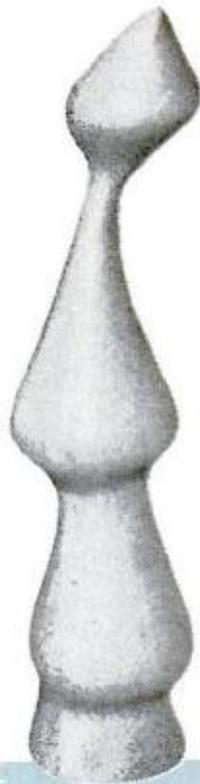
... of this shop class, where students learn to use tools and ordinary materials—such as wood molding and bowling pins—in exciting, creative ways. You can use the same tricks and techniques

By Clifford B. Hicks

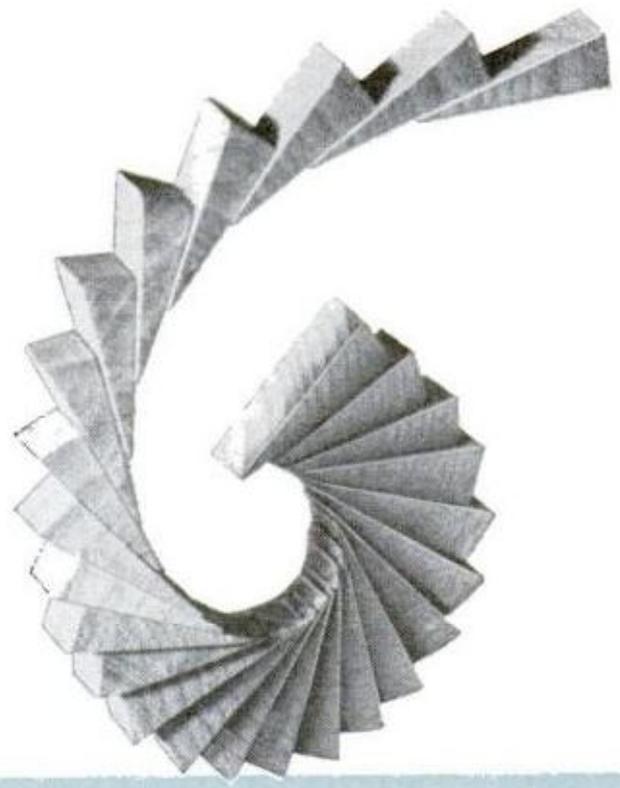
INTRODUCTION to creativity confronts each student when he's handed a box of soda straws and told to "build something." At left is typical straw creation



A



B



C

is the Product . . .

TAKE A CLOSE LOOK at the unusual objects shown on these pages. They were made with ordinary power tools, and in most cases *they were made by students who had never operated such tools before they walked into the classroom.*

They are the imaginative results of a remarkable teacher's philosophy. Ray Pearson, now 42 years old, set out to be an architect because he liked the smell of sawdust. Fortunately for hundreds of students, he found himself at one point in his career working over a drafting board on the 39th floor of a Chicago skyscraper, miles from the smell of sawdust. He walked away from the job 12 years ago to search for a world of clean pine boards and power tools.

Ray found that environment at the Institute of Design at the Illinois Institute of Technology, where he was hired to instruct students in shop techniques. From

the start, his course was called, simply, "Basic Workshop." It has become the Institute's classic course in fundamentals.

Through the years Ray Pearson has guided some 1100 students, from homesick 17-year-olds to middle-aged matrons, through "Workshop." In his expert hands the course has developed far beyond instruction in shop techniques. His goal: to develop an environment that encourages creativity. His greatest scorn: any form of imitation.

"You can't teach anyone by forcing him to imitate," he says—so emphatically that his crew cut and moustache seem to bristle at the idea. "You can't say, 'Here, watch me. I'm being creative. Now you imitate me, and be creative too.'"

As a result of this philosophy, the objects that come out of "Workshop" may be simple or intricate, ugly or surprisingly beautiful. But every one is *original*.

TOOL TECHNIQUES make offbeat patterns. Overlapping cuts on table saw produced slotted tower (A); off-center lathe-turning created a free form object (B); "fragmentation," using strips cut from molding, made (C). Students also cut up and re-make familiar objects like salad bowl (D); and bowling pin (E)



D



E

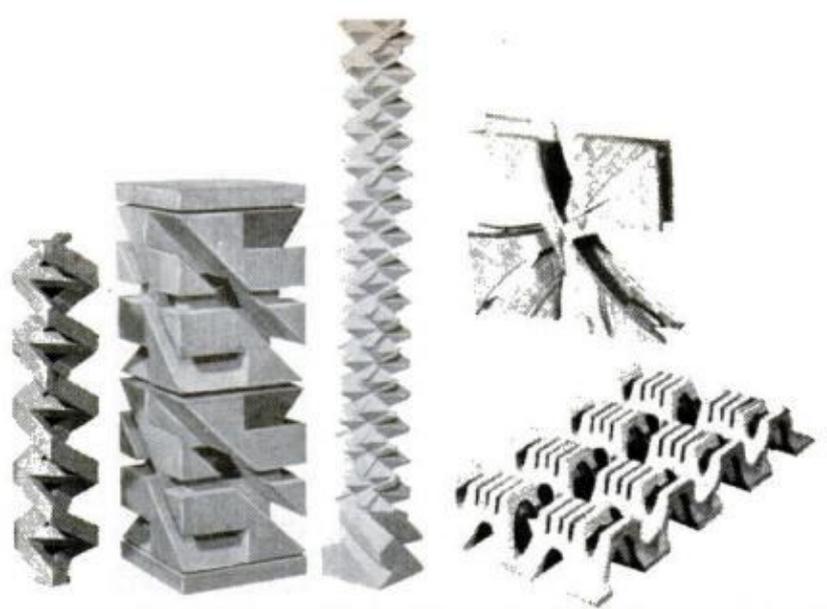
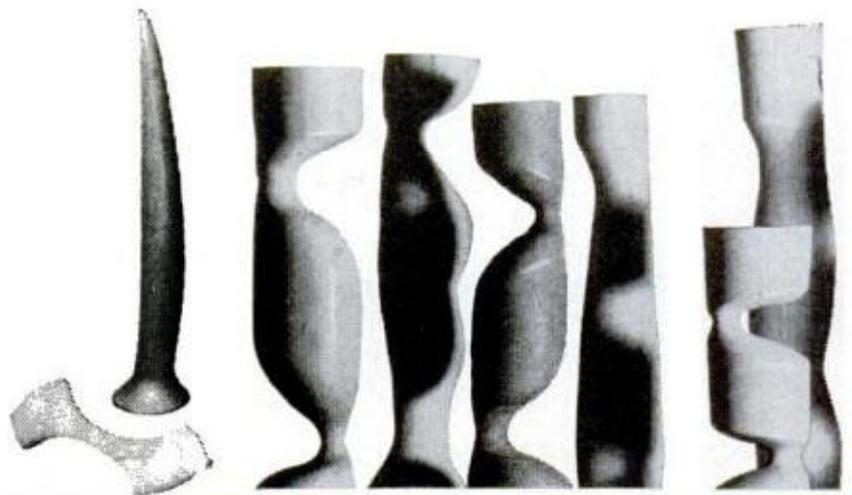
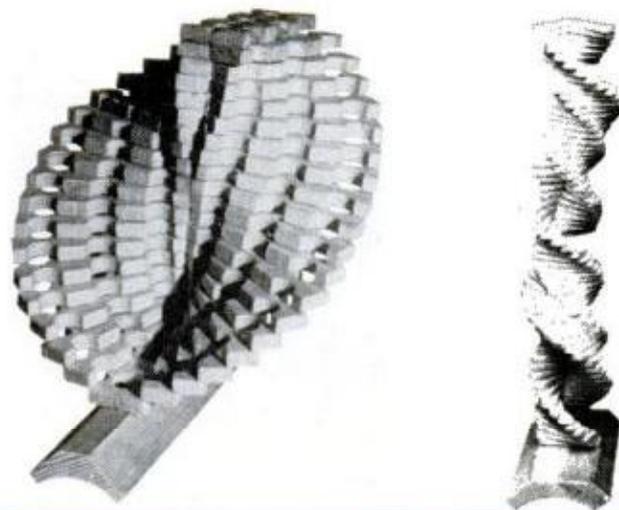
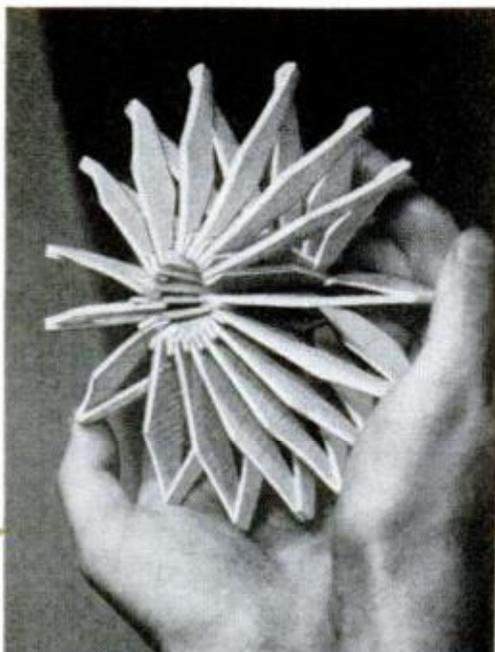


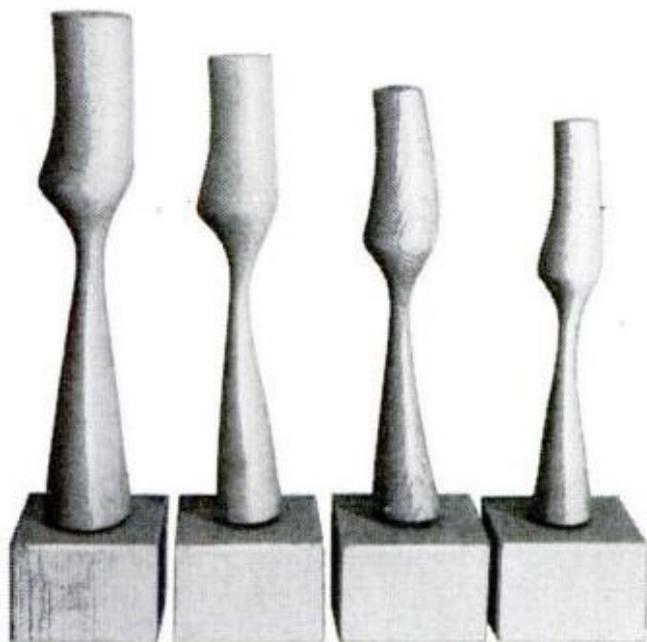
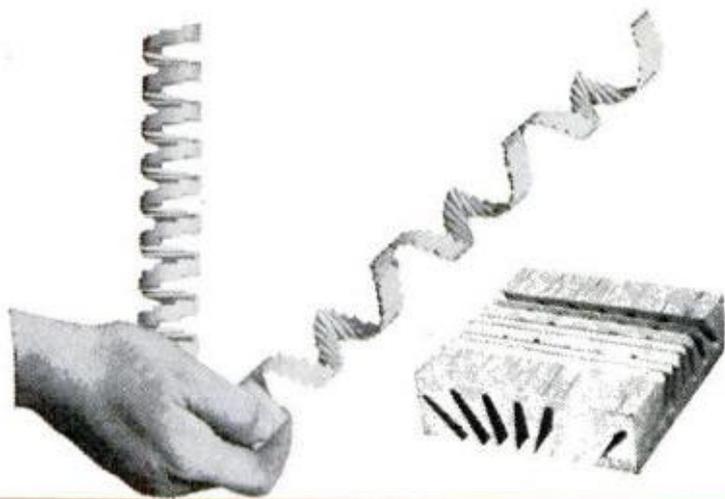
TABLE-SAW SCULPTURE, demonstrated by Pearson (left) using special fence, produces infinite variations, including spirals at far right. All of these shapes and patterns were cut by students with no previous experience in using the tool or the technique



OFF-CENTER LATHE TURNING produces the graceful forms in this row of objects. Technique, demonstrated at left, involves turning the block once to get the basic form, then remounting it on different centers and superimposing a whole new pattern



STRIPS cut from ordinary moldings can take the form of anything from objects like paper cutouts (left) to the wobbly spirals at right. Most of this type of work is accomplished on band saw, with student letting his imagination run away



And in most cases they do nothing functionally.

They do nothing because Ray wants it that way. "If you tell a student to design a chair, he'll look at the nearest chair and come up with an imitation of that chair, with a few changes. On the other hand, if you give him a block of wood and tell him to sculpture it on a table saw or a lathe, he'll come up with something original. In the process, he'll trim a lot of inhibitions out of his mind while he's cutting corners off the block. Later, when he *does* start designing functional objects, he'll subconsciously draw on his shop experiences. The result is almost sure to embody beauty as well as functional design."

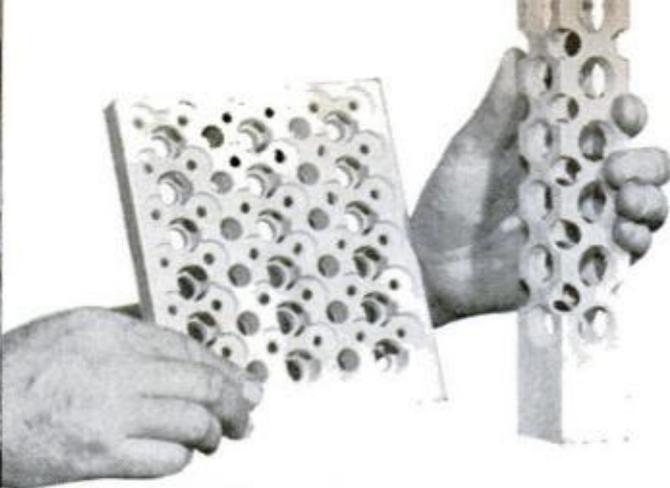
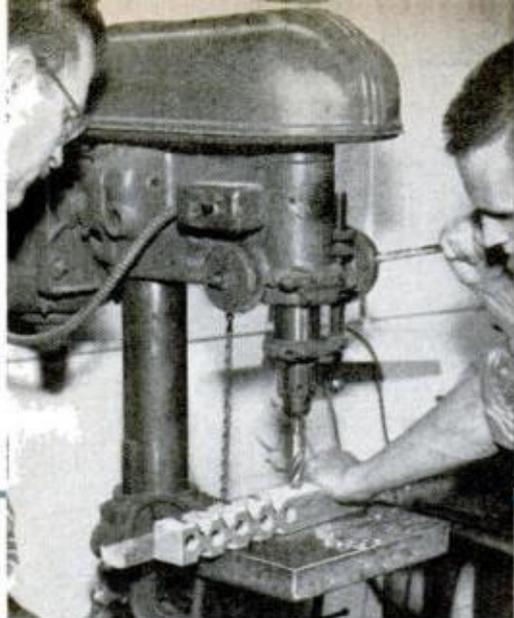
Most of Ray's students are college freshmen who have set their sights on being designers. But "Workshop" also is a favorite course of art teachers and school principals. Walk into the class, and you may find every type of student, from a plump matron in a flowery dress bending intently over a lathe, to a bearded beatnik who is enthralled at working with his hands for the first time in his life.

"Some students," says Ray, "have never seen tools before except in the hands of janitors."

At the first session of the two-semester course, Ray pitches a highly imaginative problem at his startled class. (He never gives "assignments" or "projects"; they are always "problems," carefully designed so there is an infinite variety of solutions.)

Each student is handed a box of ordinary soda straws, and told to build a structure bigger than himself. The student soon discovers that if he cuts a few of the straws into short lengths and crushes them, he can use the lengths as joint fasteners by inserting them into the other straws. He then proceeds to build a huge geometrical shape.

In most cases the structures grow to such large proportions that students eventually have to stand on bench tops or ladders to complete them. One middle-aged woman—an art instructor—became so engrossed in her work that she forgot where she was standing, walked off the top of a bench and fell into her structure, completely demolishing it. She wasn't hurt. But it was such a crushing blow to her pride in the structure that she became hysterical. She had to be led from the class by a nun (also a student) who was completing *her*



SUPERVISED by Pearson, a student learns to use drill press to bore pattern holes in a block of wood. Using this technique, entire core of block can be carved out without boring from either end. Results of the process are shown above

structure nearby (it had the undeniable though unplanned lines of a church).

"Learning what you *can't* do with structures is what I call it," said student Art Kube as he patiently slipped a soda straw into place. "This is the fourth one I've started. I had one 5½ feet tall—sort of an abstract Jayne Mansfield—when she started to crumble. Man, I kicked her six feet and walked out."

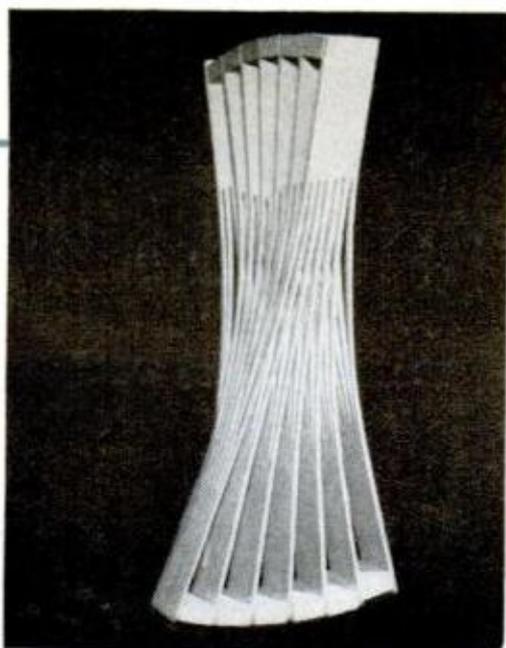
From these huge three-dimensional structures the students move on to the use of hand tools, then power tools. Ray gives detailed instructions in *using* the tools (there hasn't been a serious accident since he started teaching the course). But once instructed, the students are on their own. In Ray's opinion "skill with tools can't be used as a substitute for creativity."

In one case, a middle-aged nun—a com-

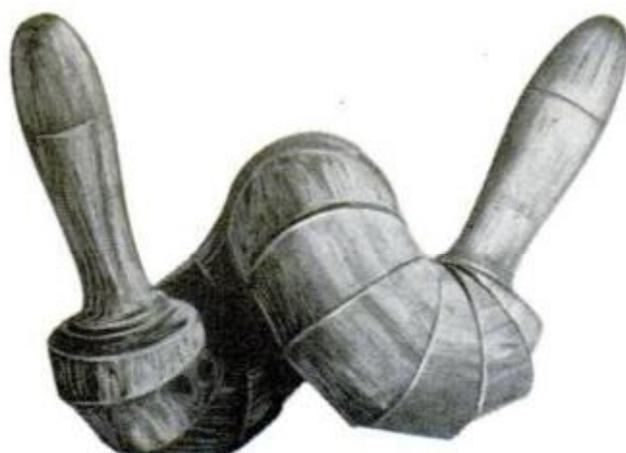
panion of the other one—took more from a power-tool problem than she imagined. When she returned to the convent in the evening and tipped her head down during prayers before dinner, at least a pound of sawdust poured out of her headpiece across the table.

Interspersed with the tool exercise are some highly imaginative problems that, at first glance, appear somewhat ridiculous. "Take any object," says Ray to his students, "cut it apart, and reassemble it in a different way." This results in such weirdies as pencils tied in knots, rolling pins that look like they're made of rubber, and light bulbs that look as though they've had too much to drink. The problem's great value lies in teaching the student to perceive all sorts of possible shapes in every object he sees.

[\(Please turn to page 220\)](#)



BANDSAW CUTS into both faces of a wood block produce thin strips which can be twisted into pattern (left) and held by end blocks. "Fragmentation" problem, below, is a student's revision of wood rolling pin, created and tooled with ingenuity

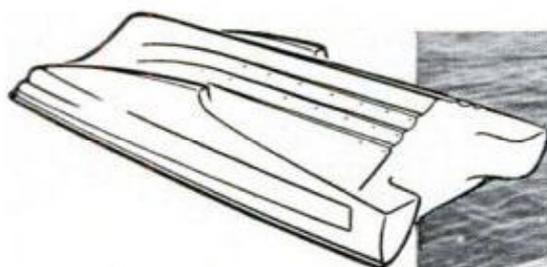
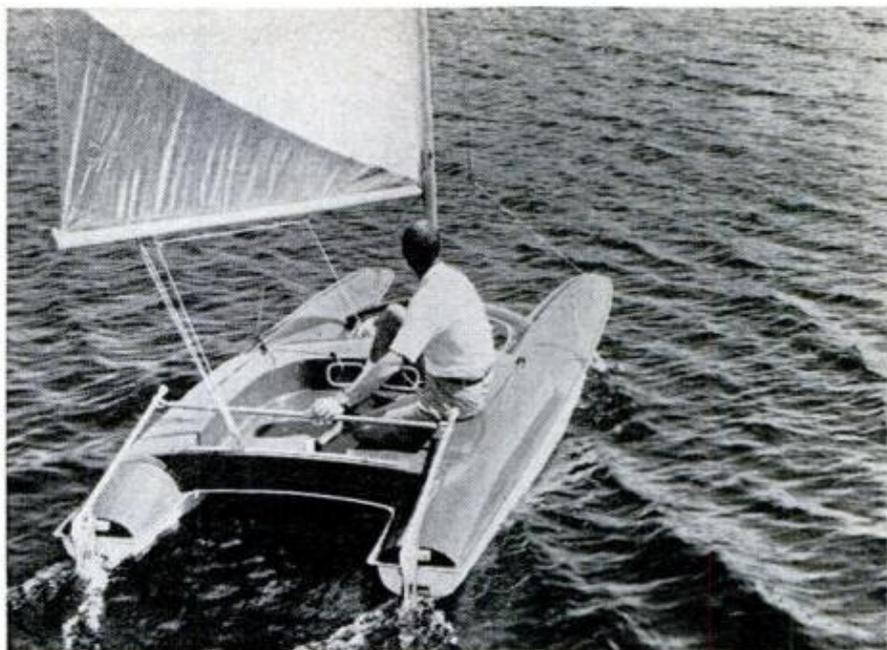


Glass Catfish

A new 13-foot fiberglass sailing catamaran features flip-up rudders that are controlled from the cockpit.

The cat has a six-foot beam. It carries a 105-square-foot four-batten dacron sail with polyurethane masthead flotation built into the leading edge.

Designed by George Patterson, the Catfish is made by Alcort, Inc., Box 1345, Waterbury, Conn. It's priced at \$896.



Deep-V with Paws

The Flying Ray 19 is a Deep-V with a difference: It has stabilizing "side paws" sculptured into the hull.

The manufacturer is Custom Craft, Commodore Harbor, Buff. 17, N.Y.

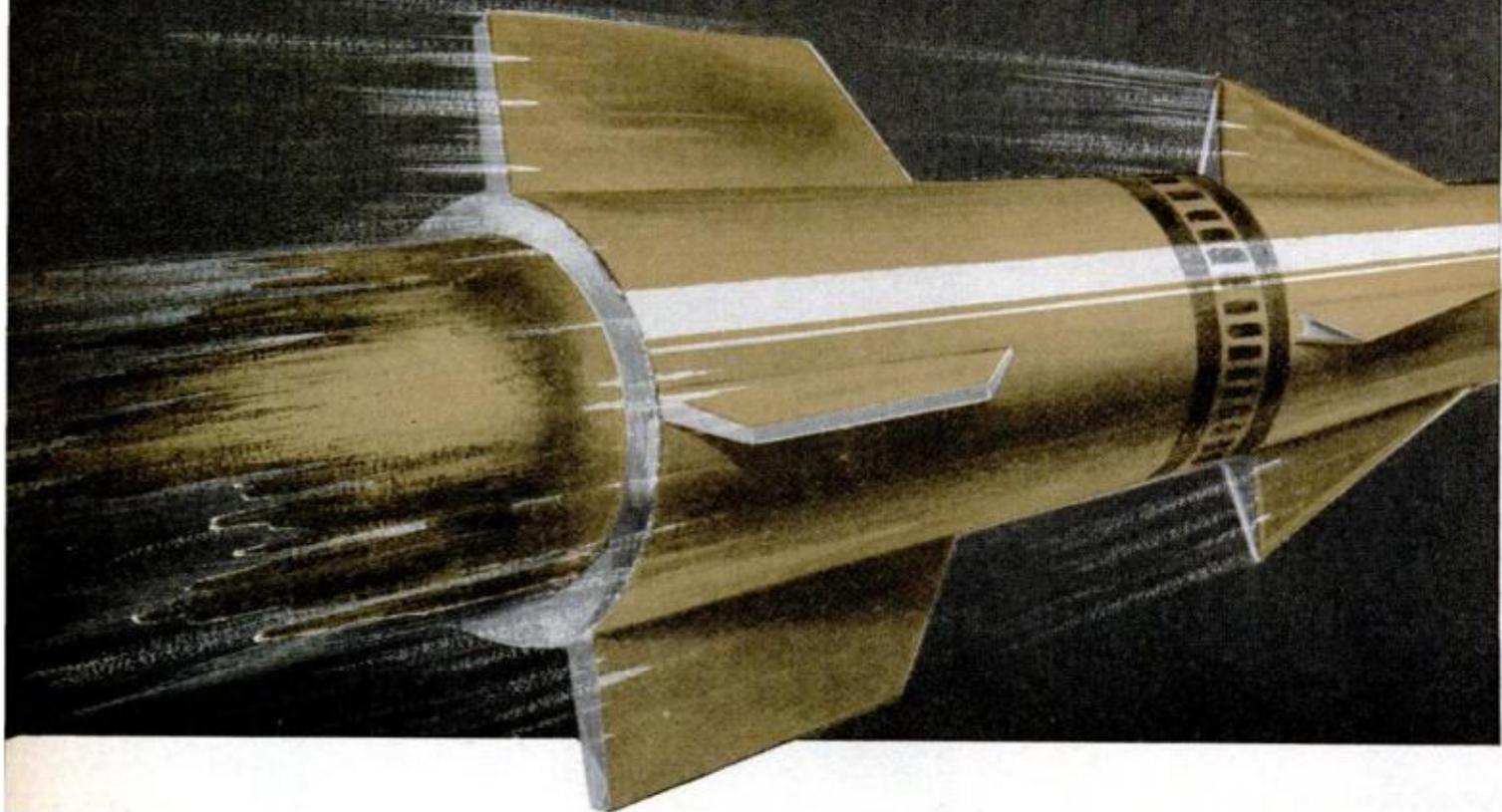


No Dunking

A doughnut-shaped boat which can be powered by sail or outboard is new for '64. According to the manufacturer, this 120-pound foam-filled fiberglass Whirly-Bird will support 1500 pounds.

Accessories include a table and beach umbrella, swimming ladder, tripod with winch (for salvage work), motor bracket and sail kit. The 15½-in.-deep float sells for \$289 f.o.b. Viking Engineering and Mfg., Lakeville, Minn.





Cold War Race for a

Foolproof anti-missile missiles could swing the scales of war decisively in favor of the side that wins the race to develop one. We have no such weapon—yet. The Reds say they do. Do they?

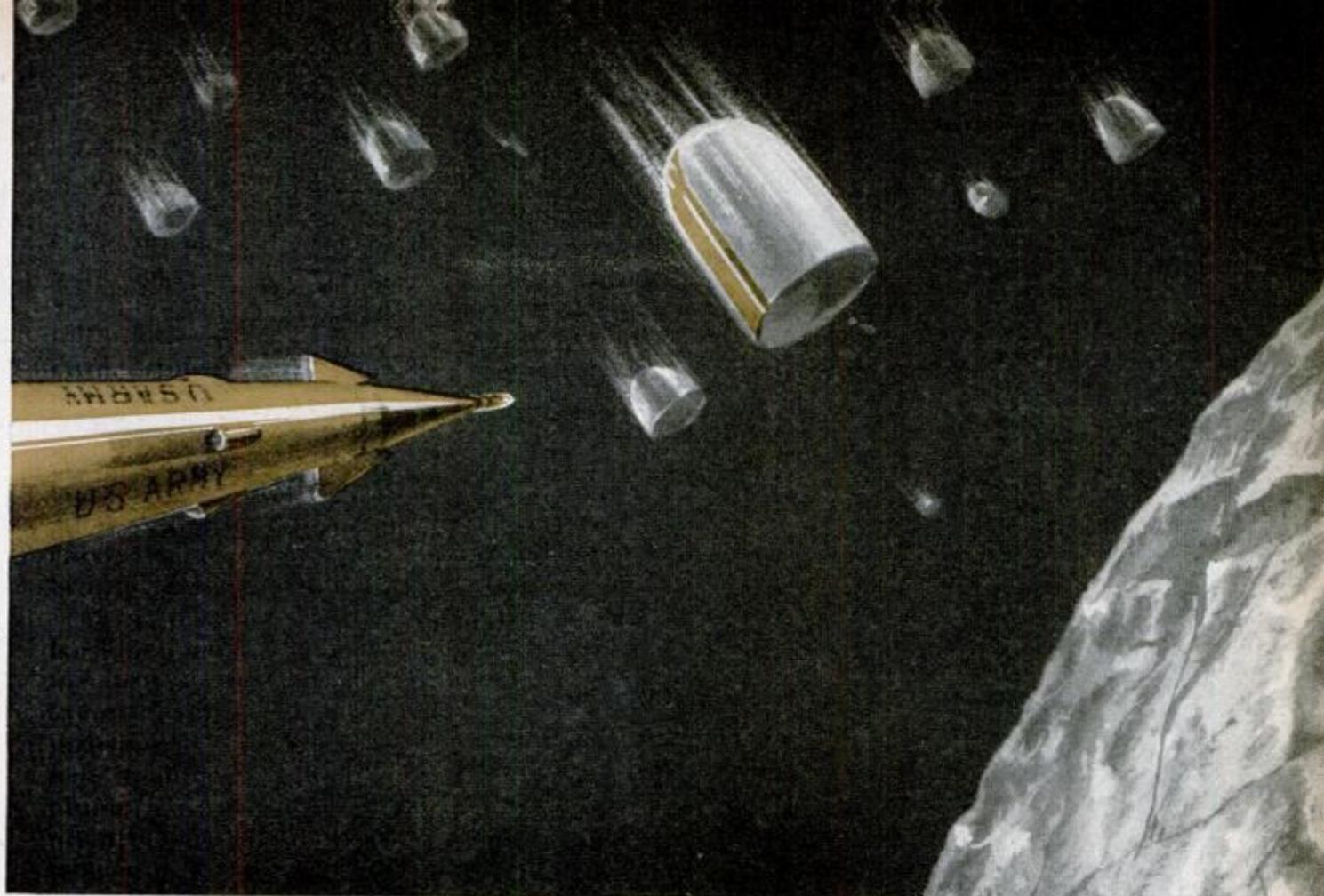
By S. David Pursglove

EARLY LAST YEAR, the U.S. intelligence system picked up reports of strange missile installations being rushed to completion around Leningrad, Russia's second largest city.

The new sites were much too elaborate for any anti-aircraft weapons system; but they weren't giant long-range ballistic missiles either. What could they be?

About the time that our Cold War gumshoes were busy scouting these ominous-looking missiles, our spy-in-the-sky satellite was sent aloft. That orbital Peeping Tom has since plotted the installations with pinpoint accuracy.

Soviet intelligence maintained tight security around the bases. But sprawling installations near a great city could not be kept secret. Western observers became



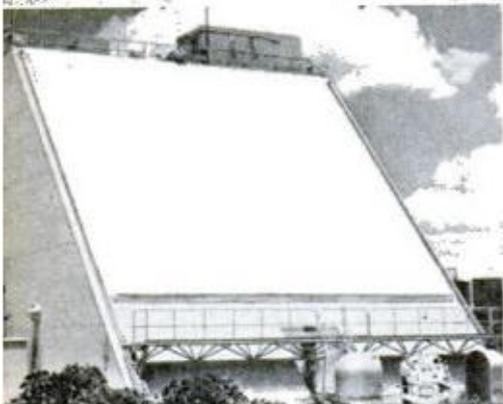
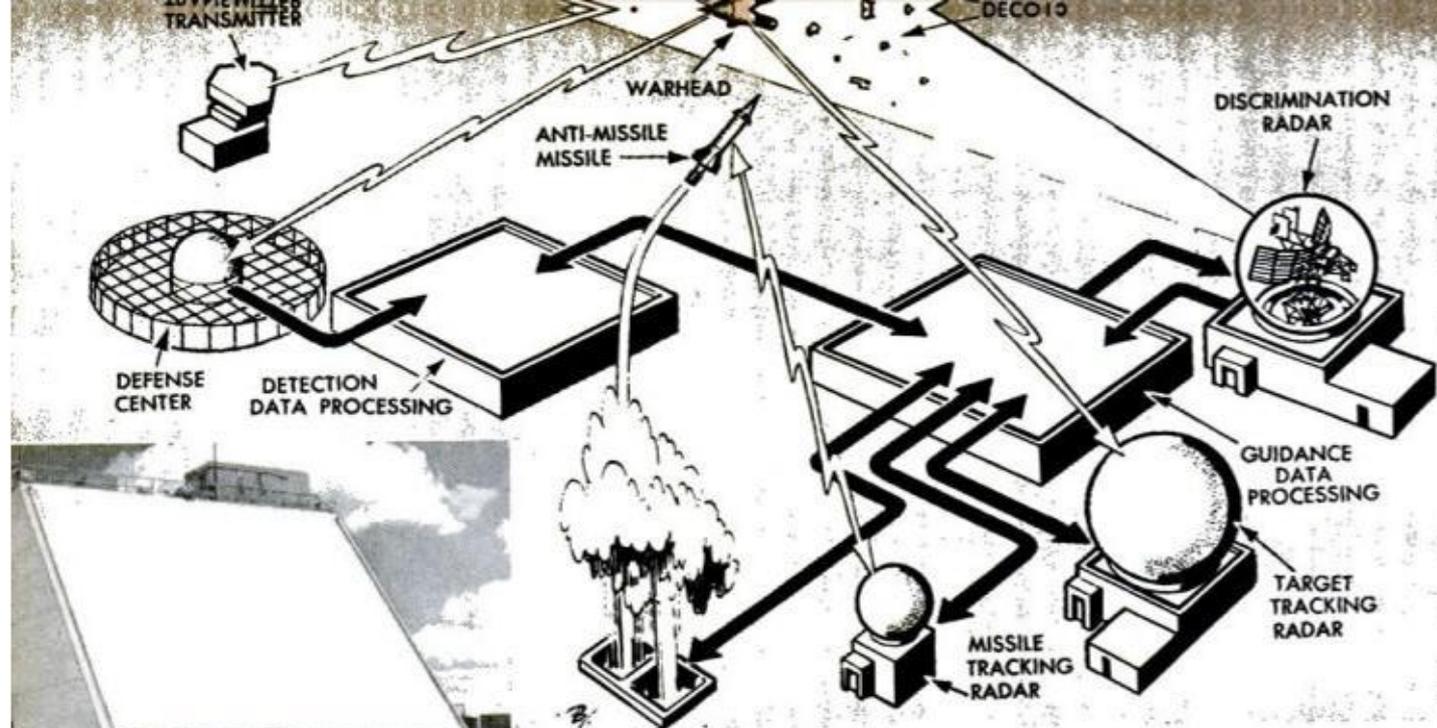
Missile Killer

convinced that the Russians *intended* the mysterious missiles to be seen.

That meant only one thing to military experts: An anti-missile missile—the weapon that could tip the balance of power. When the Russians recently broke silence on the new installations, that's exactly what they claimed to have.

To the West, the big question is: how effective are they? Can they handle a massive attack by hundreds of nuclear warheads coming from all points? Or are they first-generation weapons with limited effectiveness? If the Russians *have* won the race for an anti-missile missile, it would give them a massive advantage in any nuclear war.

Pentagon officials say that Russia has far from won the race. They compare the



NIKE-ZEUS anti-missile missile complex could probably handle up to nine incoming warheads, not enough to make it a feasible defense system. Its successor, the Nike-X (inset), combines all Zeus functions in one unit

Russian anti-missile system with a U.S. weapons system that is not considered effective enough to put into production—the Army's bug-ridden Nike-Zeus. It's now considered only an experimental system leading to a more sophisticated weapon, the Nike-X.

Just what have we got?

Our defense strategy for at least five years to come is based on something called "strategic deterrence." It means that both sides could do so much damage to the other that neither would start a war.

Deterrence breaks down, though, if one side finds a way to ward off the counter-blow. For instance, if one country develops a way to intercept or to fool anti-missile missiles, then it can launch a surprise attack without fear of the consequences.

A Nike-Zeus battery can take on eight or nine warheads at the same time. But it can't stop dozens of missiles swarming from several directions, each warhead spewing out a cluster of realistic decoys in addition to the live payload. And that's the way nuclear tactics are planned today.

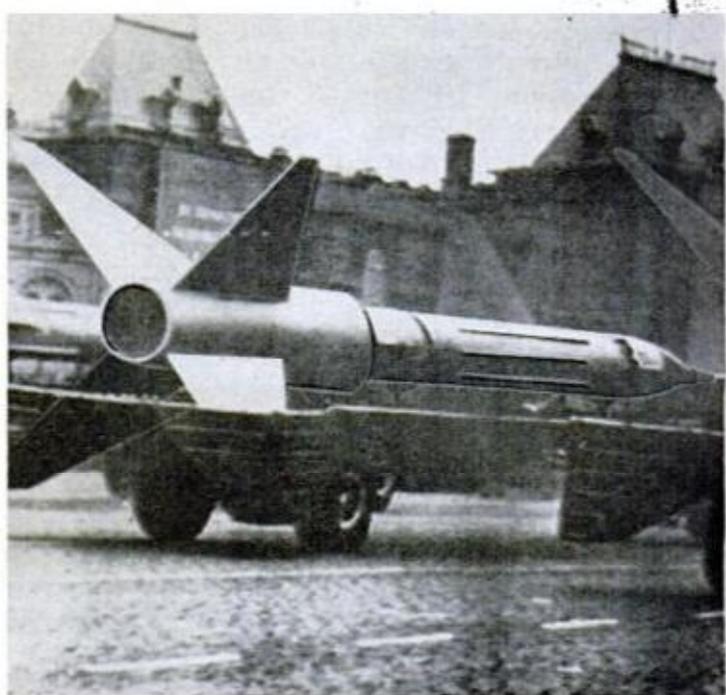
The Nike-Zeus complex includes a high-powered radar that scans the skies with a wide beam; it can spot threatening objects hundreds of miles away. The "acquisition radar" turns the objects it spots, or "acquires," over to another radar with a narrow beam.

In today's Zeus system the latter is the "discrimination radar," which tries to separate ICBM warheads from the accom-

panying clutch of chaff, and junk decoys. If the system's computer decides that an object is a real ICBM, it launches the Nike-Zeus missile in the general direction of the target. Simultaneously, the computer turns the target over to an extremely narrow-beam "target tracking radar" (TTR) which locks onto the ICBM, follows it precisely and helps the computer determine the exact trajectory.

At the same time, the computer receives

WESTERN OBSERVERS got a close look at the weapon Khrushchev claims can "hit a fly in space" at the Bolshevik anniversary parade in Moscow in November





ZEUS MISSILE KILLER blasts out of its protective styrofoam cover (left). At right, two lines of light intersect where spotting charge (arrow) indicates

"kill" of target sent aloft over Kwajalein Island by a Titan ICBM. Huge finger of light below the "X" is the Titan booster burning up in atmosphere

information on the Zeus missile's location and course from a "missile tracking radar" (MTR). Grinding the two sets of data together, the computer picks the best intercept point. Through MTR, it guides the Zeus close to that point and detonates its nuclear warhead.

That's the way Nike-Zeus actually worked in an early test. Happy developers of the anti-missile system starting pumping a cheerful calliope to the tune of "Let's

build and deploy the Nike-Zeus."

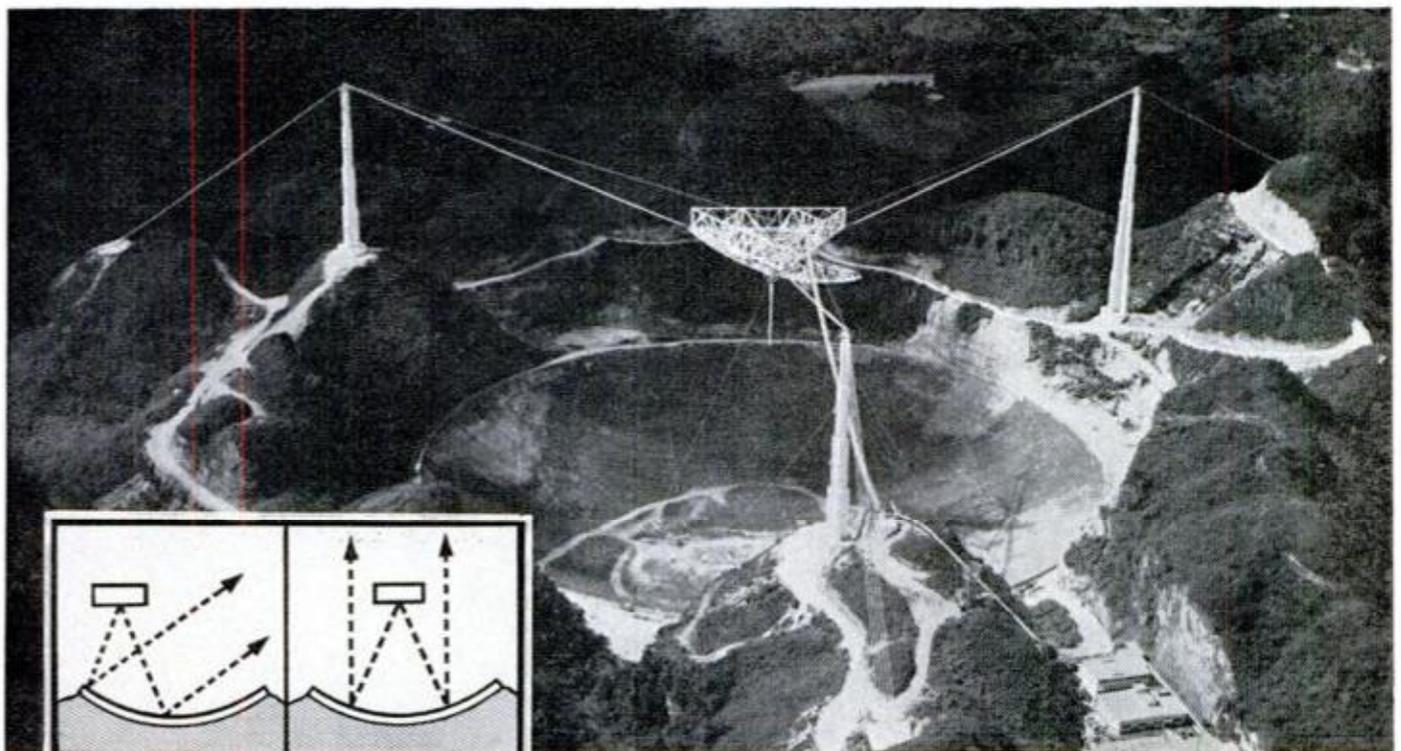
But the system's drawbacks in mass attack soon became apparent. Eight years ago an attack of six or seven missiles against, say, a city like Chicago, could have been handled by a cluster of nine Zeus installations.

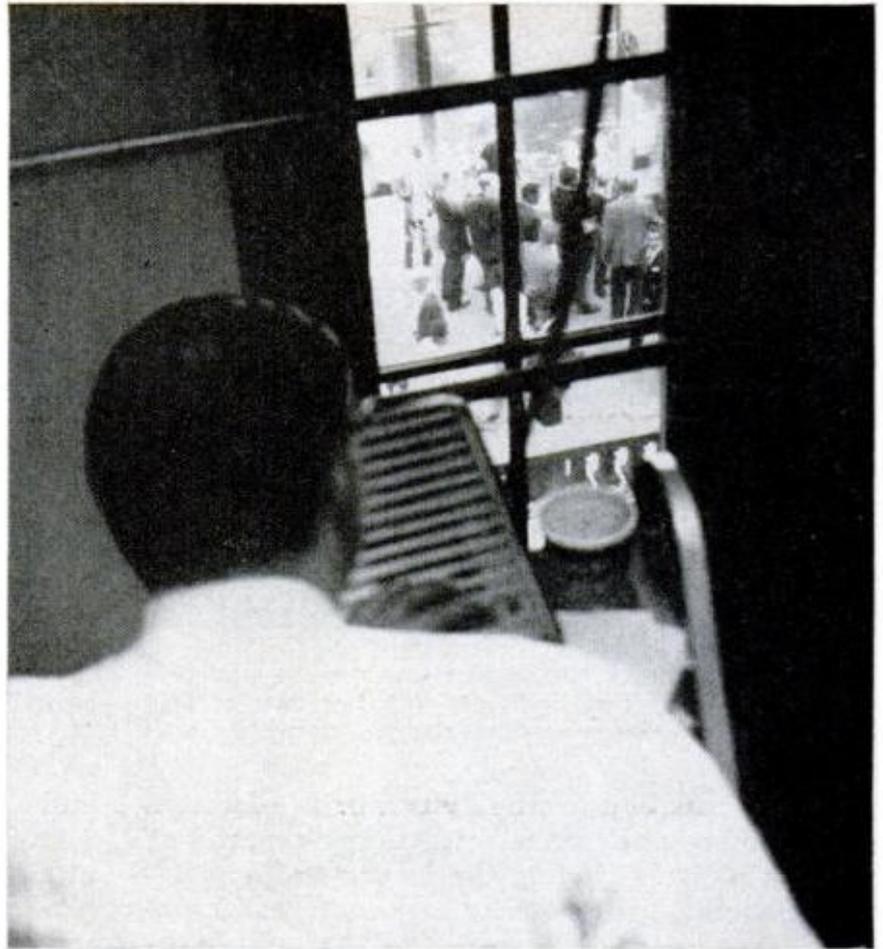
Today, Chicago would need about 100 missiles in a system of this type to handle every warhead. And the warheads, plus

[\(Please turn to page 216\)](#)

BIG DISH radio telescope/radar at Arecibo, Puerto Rico, is used by the Advanced Research Projects Agency to study the "signatures" of reentering war-

heads, nose cones and decoys; results will help Nike-X make rapid selection of targets. A traveling horn suspended over fixed dish "aims" 'scope (inset)





Garrulous Trash Can Drums Up City's Clean-Up Trade

"Hey, you in the blue tie. Don't throw that empty cigarette pack on the sidewalk. Throw it in here!"

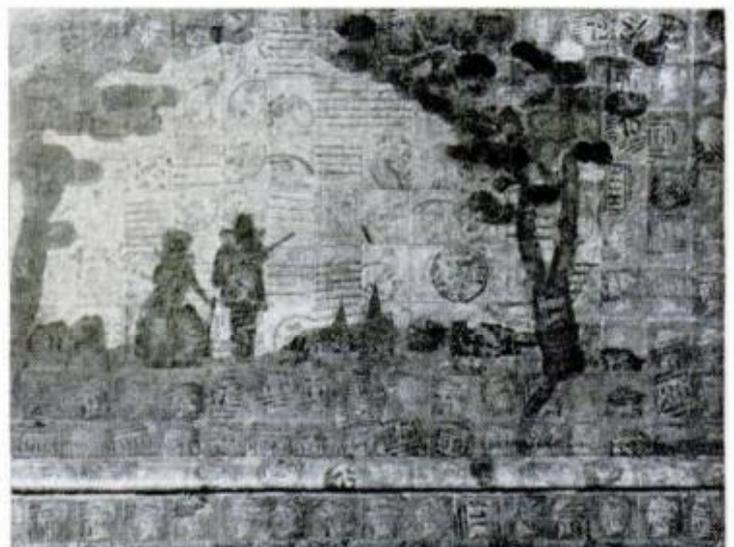
Spotted around New York City are a few talking litter baskets, part of a cam-

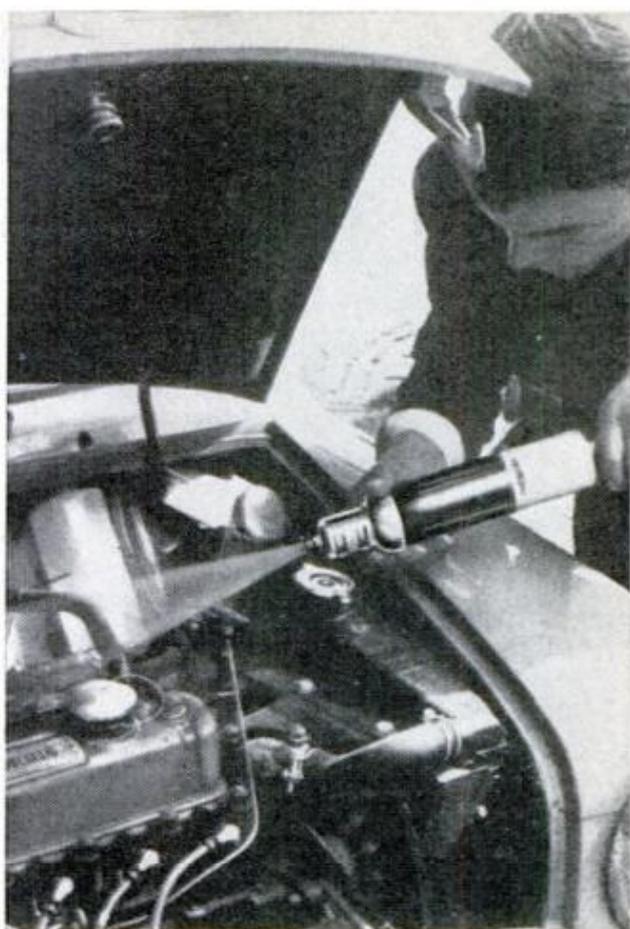
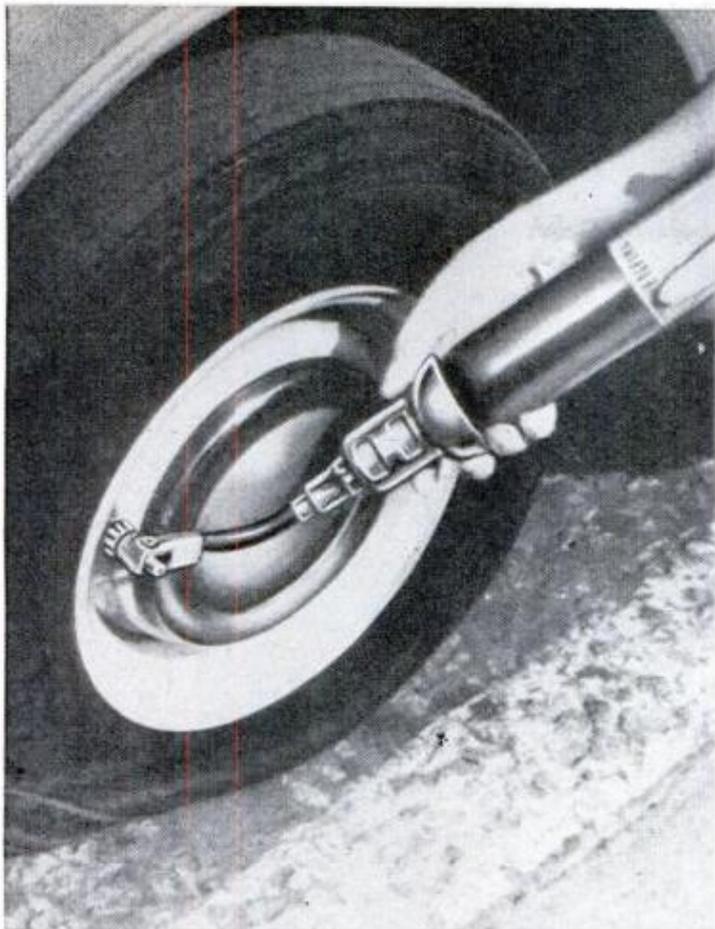
paign to clean up the city. Moved from day to day, the cans are placed in positions where a man from the sanitation department can watch it and talk, from a hidden position, to the people who gather around.

Collects 40,000,000 Stamps—On His Furniture

Stamps from all over the world, collected during 40 years as a clown with a traveling circus, are used to cover furniture in the home of Alfred Schafer in London, England.

Collected at the rate of a million a year, the stamps cover a harpsichord, including its keys, a table, dishware, a bookcase, a fireplace, spinning wheel and a whole potted palm, including each leaf.





Portable Tire Inflator Doubles as Fire Deflator

Using carbon-dioxide gas, a rapid tire inflator can also be used to extinguish small fires. Made in England, it contains enough gas to inflate quickly five tires on an average car. It is used primarily for

slow leaks and punctures in tubeless tires.

As a fire extinguisher, the stream of gas can be directed at the blaze to smother it. The manufacturer is Colebrook Engineering, Colebrook Row, London.

Molded Plastic Trailer Converts into Houseboat

Made of molded thermoplastic with a foam core, a four-place trailer converts immediately into a houseboat. Molded in one piece, it has no seams. The only adjustment is to attach a pontoon unit on the

sides and rear. The wheels and tires stay on. The houseboat, which has a draft of only six inches, is powered by a 7½-hp. outboard motor. The trailer was developed by Stewart Coach Industries, Bristol, Ind.



Camping at Thirty Below

Expecting perils and frostbite, a PM editor finds couples, birdwatchers and Boy Scouts challenging nature's deep freeze. Their Secret? They know the ropes of winter survival

By Stuart James

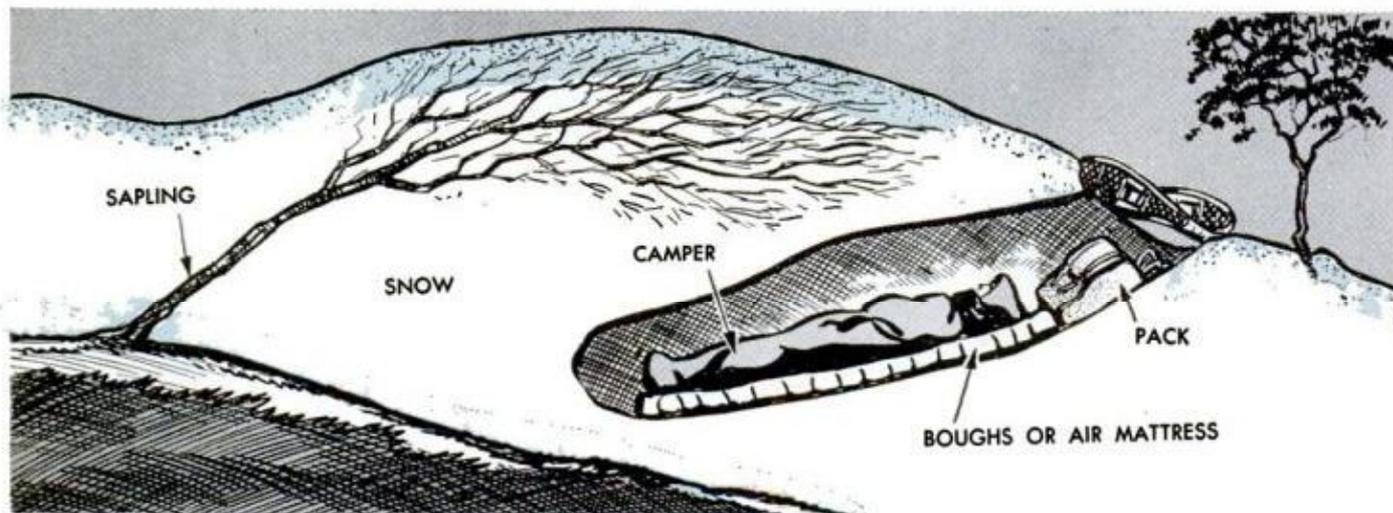
POISED ON A MOUNTAIN TOP during a snowshoe trek, a member of the Adirondack Mountain Club surveys the private world of the winter camper

WHO NEEDS to go camping in the snow—or anytime during the bleak winter months for that matter? Some people do, but I'd always figured it was some form of suicidal compulsion—like the rite of breaking ice to go for a refreshing swim up north in February.

What is it that drives some outdoors types to the snow-capped peaks in mid-winter?

To answer that question I found myself on the side of Noonmark Mountain in the Adirondacks one recent winter day. I was on a hike with members of the Adiron-

EMERGENCY SHELTER for sub-zero weather can be a snow cave dug beneath a buried sapling to utilize the branches as roof support. Easily fashioned in less than an hour, the cave is warmed by the body heat of the camper



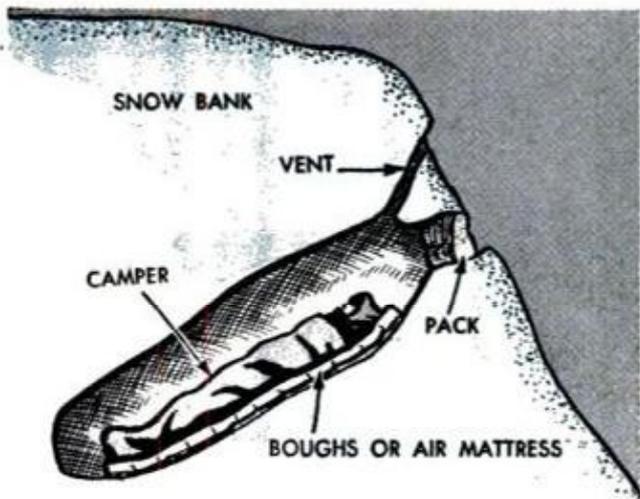


RESEMBLING MUFFS, GI hand warmers used in the antarctic give insulation and free use of the hands

dack Mountain Club, and I was learning all about winter camping. We were coming down.

When the snowshoes began to slide I leaned forward, as you would do on skis. The toes dug into the soft snow and I dived head-first into the white stuff, a 60-pound

WHERE HEAVY SNOW is available, a snow cave can be dug into the side of a hill. The slant angle lessens the danger of the top caving in on the sleeper



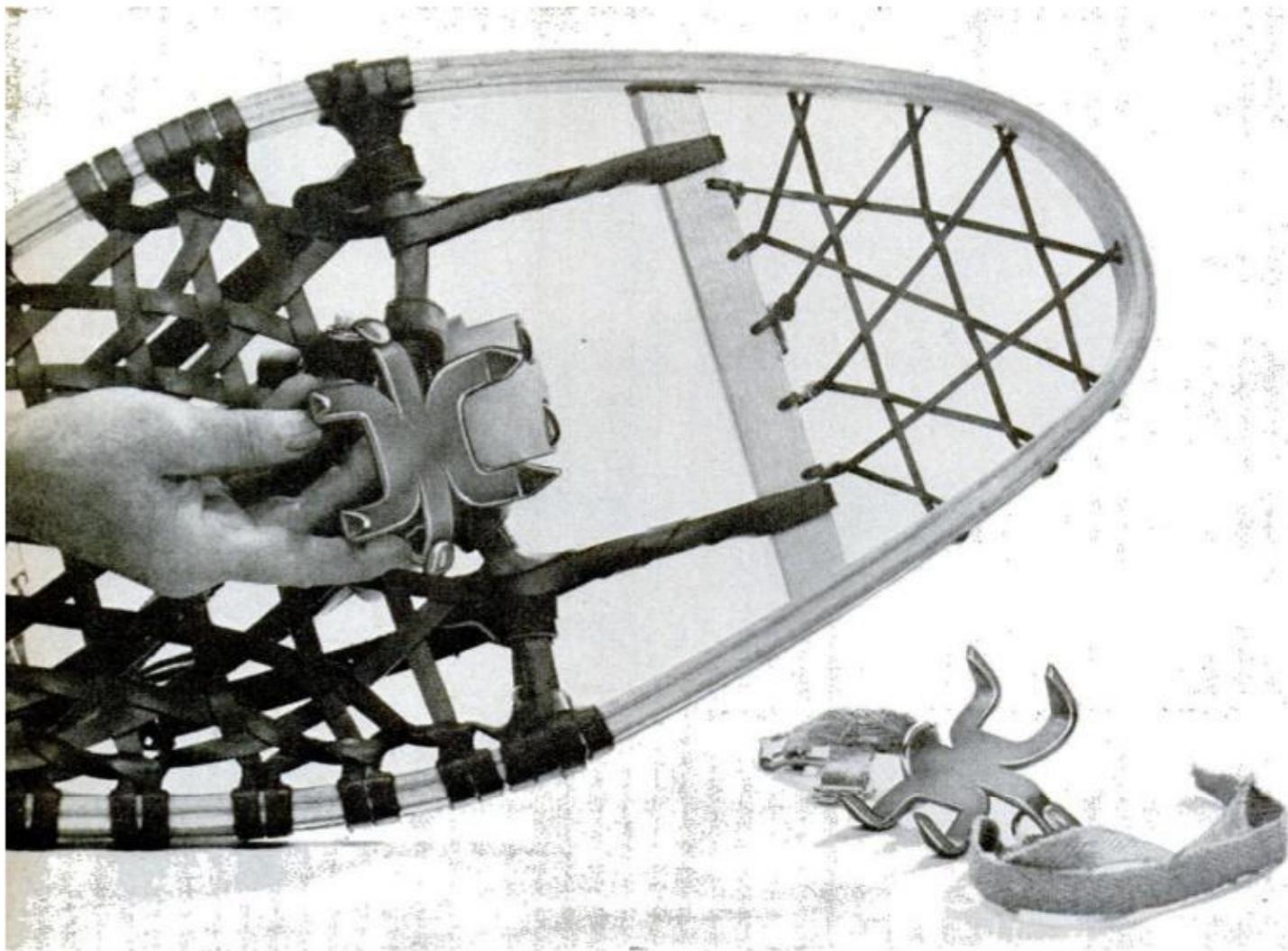
JANUARY 1964



BENDING A SAPLING through the head opening of a poncho (above) and tying down corners creates an improvised lean-to shelter. Fire at front circulates heat into enclosure that will keep camper (below) warm throughout the cold night



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SNOWSHOES ARE UNWIELDY on hard crust and ice. Strapped to the bottom of the snowshoe, the small instep crampon designed for glacier climbing gives needed stability and does not impede progress for hiking in the soft snow

pack driving me deep into a drift.

Gasping for breath and eating snow, I couldn't move until a companion came along and pulled me out.

That's how I learned that when you're going downhill on snowshoes—lean back!

Crossing a stretch of ice-covered rock, I removed my snowshoes and buckled crampons (a shoe of steel spikes) to my boots. It made the going easier. Then, I stepped off the rock and sank in the snow to my armpits. My friends had to laboriously dig me out.

That's how I learned that it is wise to use the small instep crampon that attaches directly to the bottom of the snowshoe.

On a brisk morning in the Catskills—it was still 15 below—I came out of a warm sleeping bag and shivered into my boots. The water in the canteens was frozen solid, the bacon was like a small slab of oak, and the eggs were round chunks of ice.

That's how I learned that you let the water freeze in an open pan, bring dried

eggs and take the bacon into the sleeping bag with you.

I lit my alcohol stove to thaw things out, and learned that an alcohol stove doesn't give out enough heat at extremely low temperatures to do the job. You need gas or kerosene, and I had neither.

By now my partner, an experienced winter camper, was poking at the fire and laughing at me openly. The day before I had moaned and groaned about the labor of sawing 12-inch logs. And now the fire that had burned all night was coming to life. And soon there was the invigorating smell of bacon cooking.

The Long John Twist

Later that day I fell through a snow cornice (don't walk out to the edge of a snow bank to see the view) and floundered through deep drifts for more than an hour getting back on the trail. When I got back to camp the corduroy trousers I had chosen to wear were soaked through and



TUNNEL OPENING of A-frame tent keeps heat trapped within. The simple frame eliminates the task of securing upright poles and guy lines in soft snow



INSULATED rubber boots (top) enclose a layer of air for warmth at lowest temperatures. Steel crampons (above) attach to boots for climbing on ice

frozen. I did a nimble version of the twist in my long johns while the trousers dried over the fire.

Always carry an extra pair of trousers, and they should be wool and nylon to shed the snow.

Yes, I was learning all right; learning that you haven't really camped until you've spent the night in a snowbank in the middle of January.

When it was first suggested that I abandon the warmth of home and hearth for an exodus into the mountains and the dubious comforts of a snowdrift, I was less than enthusiastic.

But I stifled fears of wandering lost and freezing to death in the North woods, and went camping in both the Catskills and the Adirondacks. I even slept in a pile of snow at 30 below zero—and now I'm hooked. Never again will I store my gear at the end of the summer.

I'm not alone. While no figures are available on the number of avid winter

campers, it is estimated by equipment dealers with whom I spoke that they run into the thousands. From Maine to the Sierras, as soon as the snows are deep and the woods jeweled with the crisp glaze of winter, they bring out their snowshoes and head for the high hills. The four-day Winter Mountaineering School of the Adirondack Mountain Club, for instance, cannot handle the deluge of applicants they receive each year from as far away as North Carolina. They turn down twice as many as they accept.

Hairy Chests Not Needed

When I first traveled up the Spruceton Trail in the Catskills, staggering under the burden of a 60-pound pack and a pair of snowshoes that seemed to have a will of their own, I expected to encounter a rugged breed of man, elemental, bristling with the will to challenge nature's worst. The first person I met was a 13-year-old school girl who had been there for three



HIKING in the Catskills, a camper pulls his pack on a child's saucer sled. At camp, disc is used for hauling wood and an occasional downhill slide

days in temperatures reaching 27 below. Later I met middle-age couples, high school teachers, Boy Scouts, and one elderly (female) bird watcher.

None of these people fit the popular concept of "rugged," but they all had one thing in common. Besides a deep love of the outdoors, they had a healthy respect for the dangers of sub-zero weather, and had taken precautions to cope with it.

There definitely are dangers in winter camping, but they are easily avoided with common sense and good equipment.

Keeping warm is a prime consideration. To this end the winter camper must choose his equipment carefully. Two or three layers of light clothing that will trap air for insulation are much warmer than one heavy layer. A baggy over-size parka that lets air circulate to cut down sweating when hiking, will be warmer when you stop to rest.

Two Important Items

There are many tricks the winter camper learns from experience, but there are two things he must have before he goes near the snow: A good pair of insulated boots and a good down-filled sleeping bag. The boots should be the type used by the U.S. Forces in Korea, and in the antarctic. The commercial variety is called "Thermo Boot," it is made on a thermal barrier principle—consisting of sealed, waterproof rubber inside and out sand-



TABLE MANNERS in the sub-zero camp are limited to not getting the gloves in the soup. Meals are hot one-pot dishes eaten from the pan or canteen cup

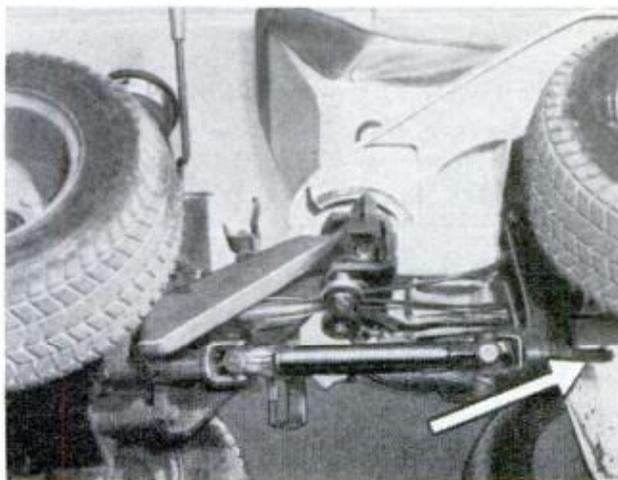
wiching air insulation material of air cells in the middle, which can't get wet and freeze. The sleeping bag should be a mummy type bag with water repellent outer fabric, filled with a minimum of three pounds of down. With these two items and a supply of emergency food you can get lost in a blizzard without danger. You can hole-up in a snowbank (see sketch) in a good sleeping bag and it is just as comfortable as your bed at home.

Night in a Snow Cave

On my second excursion to the Catskills I decided to forego the comfort of the lean-to and sleep in a snow cave. The snow was deep, and I chose a spot near a stand of evergreens. Using my mess kit, I scooped out a trench about three feet wide and two feet deep. It was easy work and I took my time so as not to work up a sweat that would freeze when I stopped.

I lined the bottom and sides of the trench with evergreen boughs. I placed my poncho over the boughs and my heavy parka on top of that. I covered the trench with my snowshoes and heavy evergreen branches. I placed a plastic sheet over this and added a thick mound of snow. I dug out an entrance, put my pack in position to close the opening, removed my boots and slipped into the sleeping bag, pulling the pack around to close the opening. The temperature went to 30 below that night,

[\(Please turn to page 210\)](#)



Lawn Tractor Can Do the Twist as It Mows

Built in two pivoted sections, a new lawn tractor has a turning radius of only 22 inches. This permits the operator, when mowing, to trim around small shrubs (photo, left) and zigzag along lawn borders.

Powered attachments—including reel and rotary mowers, a snow caster and

dozer blade—are coupled to a power take-off between the front wheels (arrow, lower right). A universal-jointed shaft leads from the 7¼-horsepower engine in the rear to the power takeoff.

The Estate Keeper, made by Bolens, has six speeds forward and two in reverse.



Sit-Down Skiing

Now you can hit the slopes sitting down, and substitute handle-bar steering for stem christies.

Imported from Europe, Ski-Bob is built on the principle of the bicycle, with a seat on a runner and a single steerable ski that acts like the front wheel of a bike.

The rider maintains balance with two short skis attached to his boots.

Priced at \$98.50, the Ski-Bob is available from Sig Buchmayr, 18 E. 53rd St., New York, N.Y.

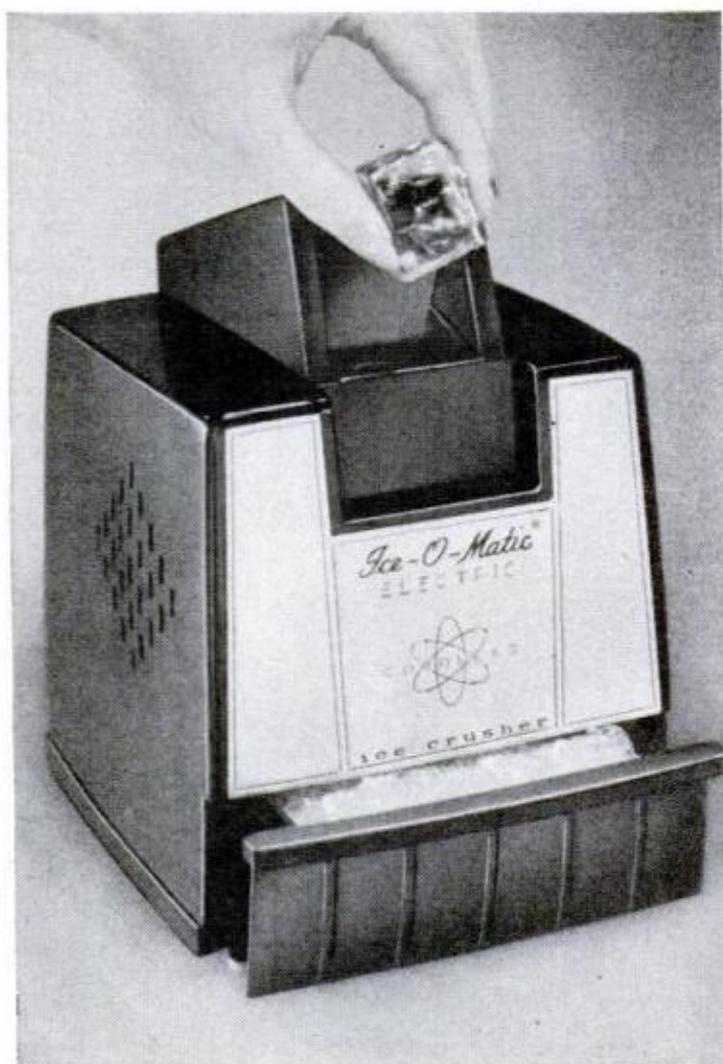
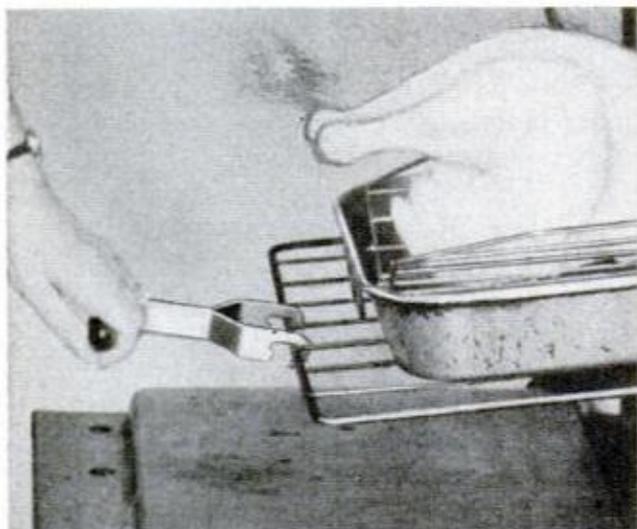
New for Your Home

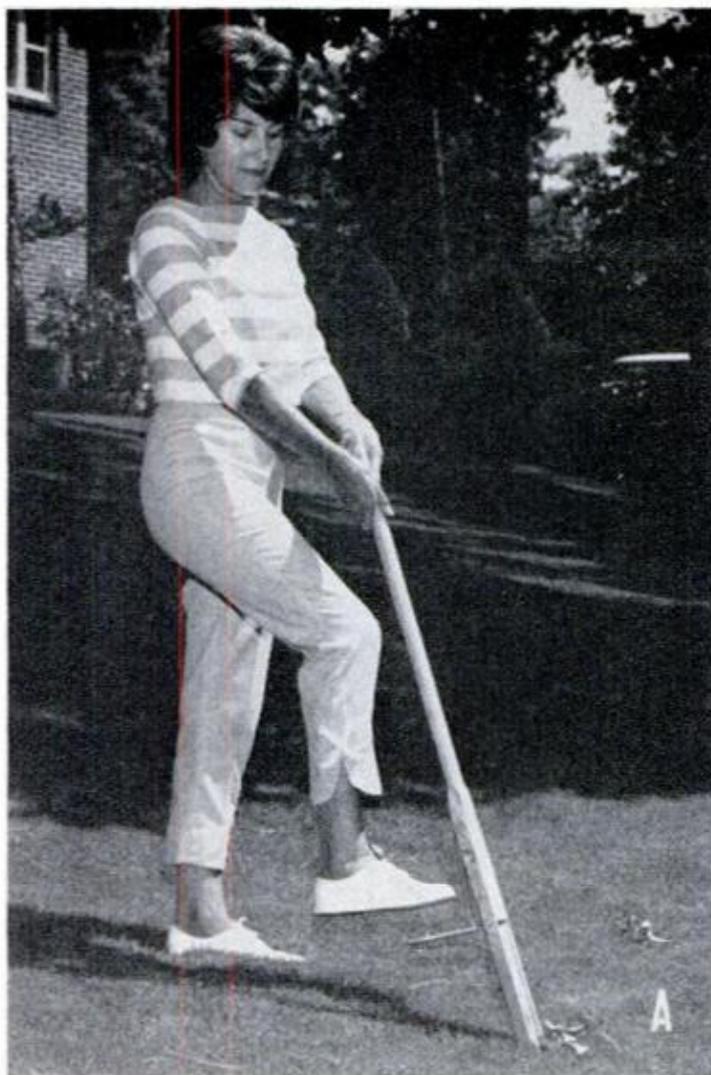


LOG STAND CARRIER of birch and canvas lets you gather from the woodpile and store logs by the hearth. It folds flat for summer storage. 20 inches long by 10 high. In maple finish, it's \$9.95. Yield House, N. Conway, N.H.

KITCHEN KLAW keeps hands at a safe distance from hot stove and utensils. Use it to lift roasting pans, slide out oven racks. Of aluminum and hardwood, they're \$2 a pair; Gerd Sales, Box 36-PM, Planetarium Sta., N.Y. 24, N.Y.

CORDLESS ELECTRIC ICE CRUSHER runs on rechargeable batteries. To operate, raise hopper; motor starts, cubes are crushed by stainless blades, drop into built-in drawer. Size: 8 cu. inches. \$49.95; Rival Mfg., Kansas City, Mo.



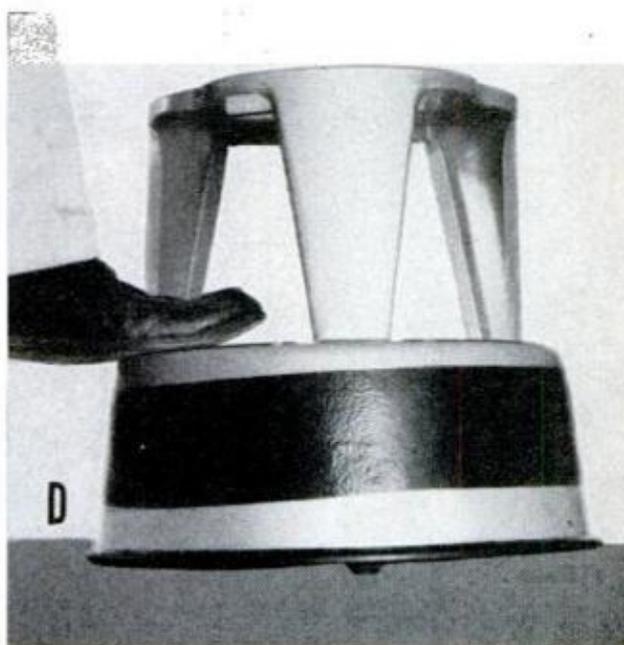
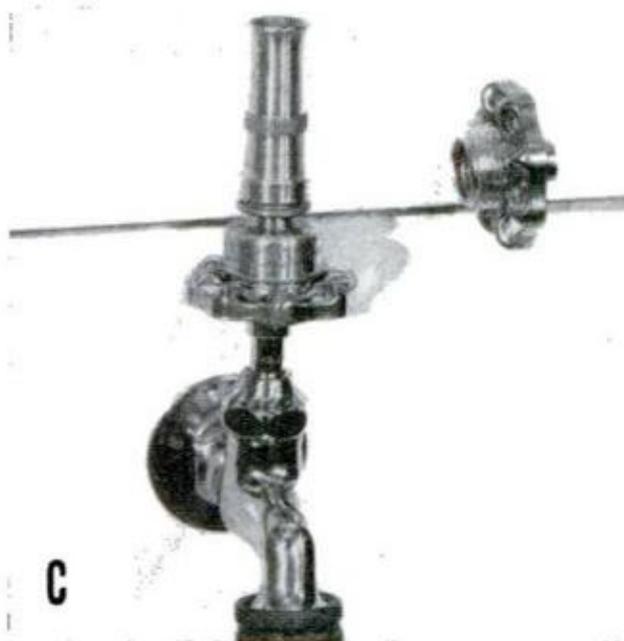


A. WEED KICKER takes out any lawn or garden weed by the roots. Place points of the kicker at base of weed, then kick the pedal sharply; weed comes out with roots intact. 4-pound unit costs \$5.98. Cochran Corp., Birmingham, Ala.

B. STIRRING SPOON THERMOMETER measures heat of liquid it's stirring (from 50° to 450°). Thermometer in handle is undamaged by deep frying or dishwashing. Price: \$5. Made by Gaydell, Inc., Pacific Palisades, Calif.

C. HOSE NOZZLE HOLDER installs in seconds by removing outdoor faucet handle and putting this on. Serves as faucet handle and convenient storage place for hose nozzle. 85 cents from Len Mil Products, Box 7527-B, St. Paul, Minn.

D. ROLLING FOOT STOOL rolls with touch of toe, but holds position when mounted. Spring casters retract with weight of user, grip stool to ground. 14-inch stool has treaded platforms. \$14.95: Cornelia Sales, Dept. K-8, Cornelia, Ga.



Electronic Bartender

Joe, the friendly bartender, may soon be reading want ads. A German firm has developed an electronic bar that produces drinks—any drink—by pushbutton.

The drinker chooses one of the drinks on the list, presses the appropriate button, and the drink is delivered, ready mixed, into a glass already placed under the delivery tube.

There is no need to keep to the printed list, since you can push any combination and invent your own drink.

Also, as a safety device, the machine refuses to work unless the person pushing the button has a steady hand. That eliminates some people after a few buttons.



Magnetic Asbestos Cloth

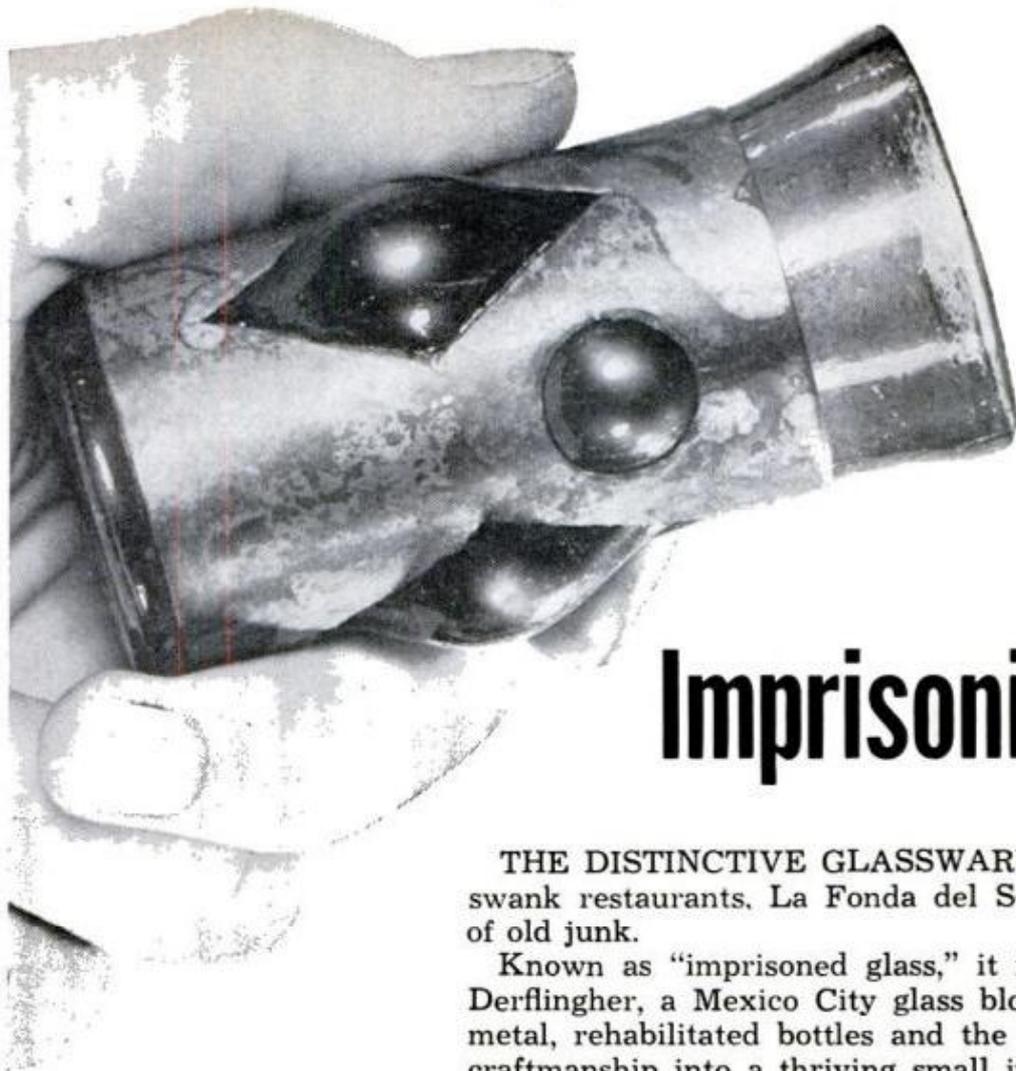
Heat-resistant asbestos cloth that clings to metal magnetically protects workmen's hands from hot surfaces, where wearing gloves would be inconvenient. It also shields delicate parts from welding heat. Available from Magna-Mat, 11414 Mines Blvd., Whittier, Calif., for \$3.95, the 6 by 14-inch pieces of asbestos are covered with flexible plastic with magnets attached.



Automatic Easel

Pressing one of two buttons moves the artist's canvas up or down on this easel, which is powered by a small electric motor. It is held in place by eight pins, allowing the artist to paint all the way to the edges of a bare canvas. The holder also swivels to permit tilting if necessary. Manufacturer is Tolegian Enterprises, Sherman Oaks, Calif. Price is \$175.





GLASS melted from old bottles is blown into a metal cylinder so it bulges through pre-cut openings, giving every piece a distinctive handmade look

Imprisoning Glass

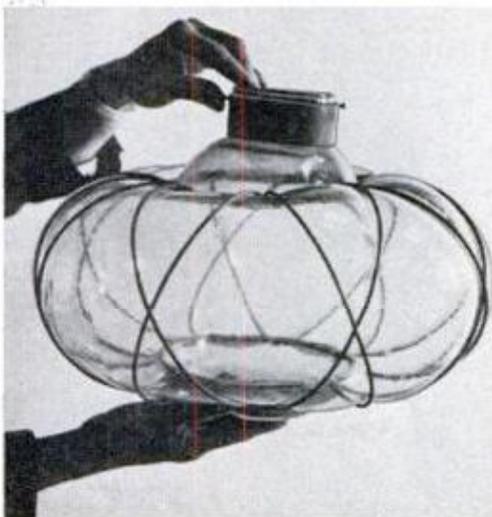
THE DISTINCTIVE GLASSWARE at one of New York's swank restaurants, La Fonda del Sol, is actually just a lot of old junk.

Known as "imprisoned glass," it is the creation of Filipe Derflinger, a Mexico City glass blower, who has combined metal, rehabilitated bottles and the unique beauty of crude craftsmanship into a thriving small industry.

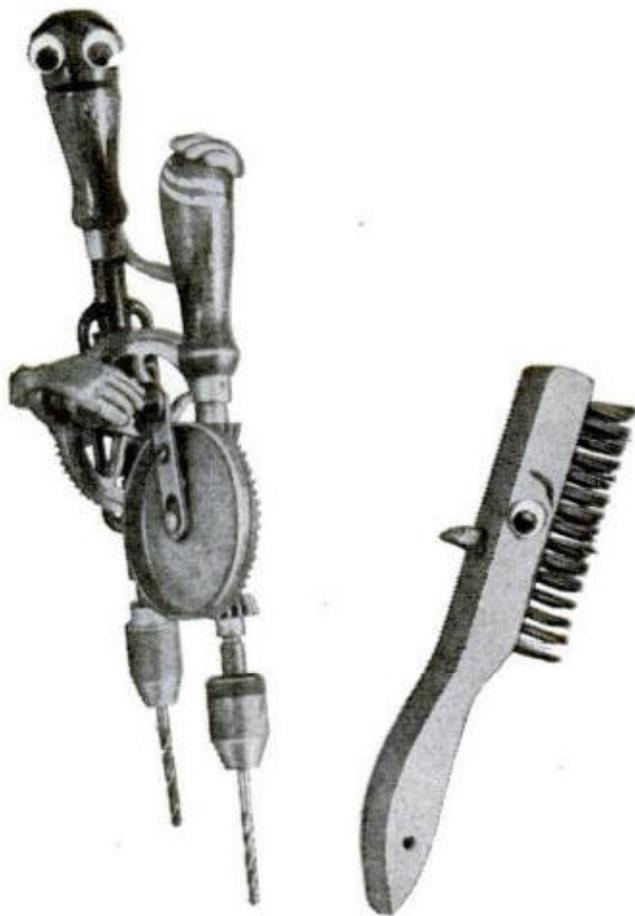
Glasses are made by first welding into cylinders metal that has had cutouts stamped in the shape of circles, diamonds and squares. Molten glass from broken bottles is blown into the cylinder so it bulges unevenly through the openings. The metal is then discolored under intense heat to give it the look of medieval craftsmanship.

Besides glasses, Derflinger's 20-man factory produces chandeliers, bottles, pitchers and lamps for a clientele that is now spread across the world.

CHANDELIER (left) is glass blown into thin wire frame, as is cylindrical hurricane lamp (center). A bubble of molten glass (right) is placed into a metal "cage" sitting on a wooden block and slowly worked into shape



MORE PHOTO FUN



TOOLS FROM THE WORKSHOP are as animated a group of photographer's models as you can find—and there isn't a bit of temperament in any of them, says Jack Eisner, artist-photographer.

Last January in *PM* Eisner showed how household utensils can shift from mundane tasks to the glamor world of photographers and models (*Photo Fun*, page 124). This time he has recruited his models from the workshop.

Eisner adds such parts as eyes salvaged from dolls, and arms and legs made of wax or modeling clay.

To illuminate the models evenly, Eisner builds a paper tent around them and uses two lights. The bounce light inside the tent softens shadows. He generally suspends the figures by a lightweight transparent fishing line. Most of his closeup work is with a 4 by 5 view camera.

"SHALL I CUT IN or will I get a brushoff?" muses the wallflower. Obviously, he'll have to stand by for a later dance; he's not the type for the twist

"I WON'T SQUEAL NOW, so you can forget your oily ways," murmurs the startled electric drill, perhaps relieved to find that's all there is to this hatchet job





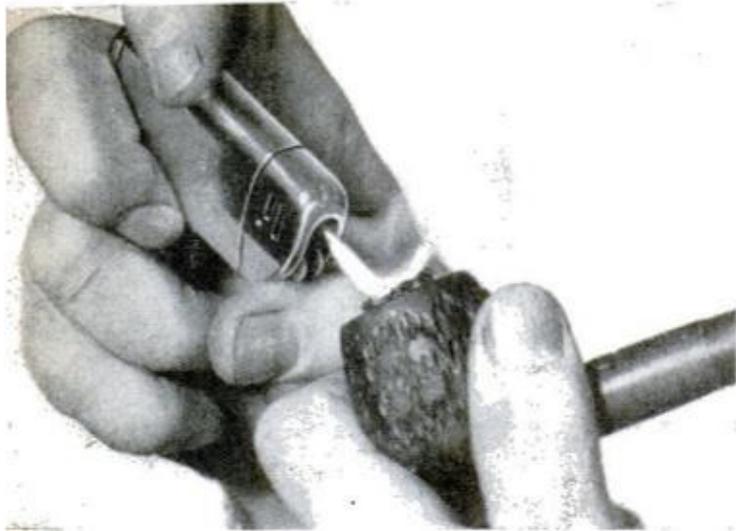
"IRON-JAWED DISCIPLINE is what you need, kid," goes the lecture. "Get hold of yourself." But obviously someone's got to clamp down on that lad



"FOR A LITTLE SHAVER, your reading voice is surprisingly plane," comments the old-timer as they read about pals in their favorite magazine

PEOPLE AREN'T THE ONLY ONES who have fun do-it-yourselfing. Sometimes pliers do—particularly those that have eyes, arms and tiny saws





Flame Thrower

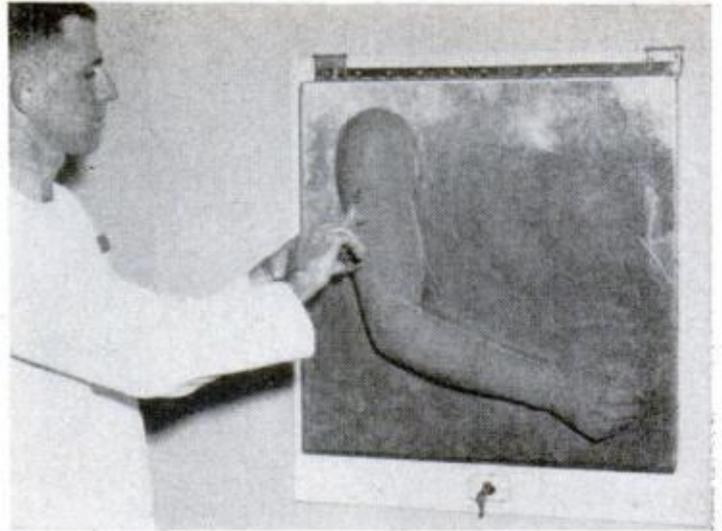
Tilted down, a butane lighter shoots out a flame for lighting pipes. Held erect it operates normally for lighting cigars and cigarettes. Made by Kaywoodie, it reportedly gives more than 3000 lights from one tank of butane fuel. Price is \$9.95.

Ocean Liner on a Lake

Scaled down from the 22,000-ton ocean liner, *Northern Star*, a miniature replica, carries 36 passengers on pleasure cruises around a small lake on an English estate. Trips are made twice a week when the estate and grounds are open to the public.

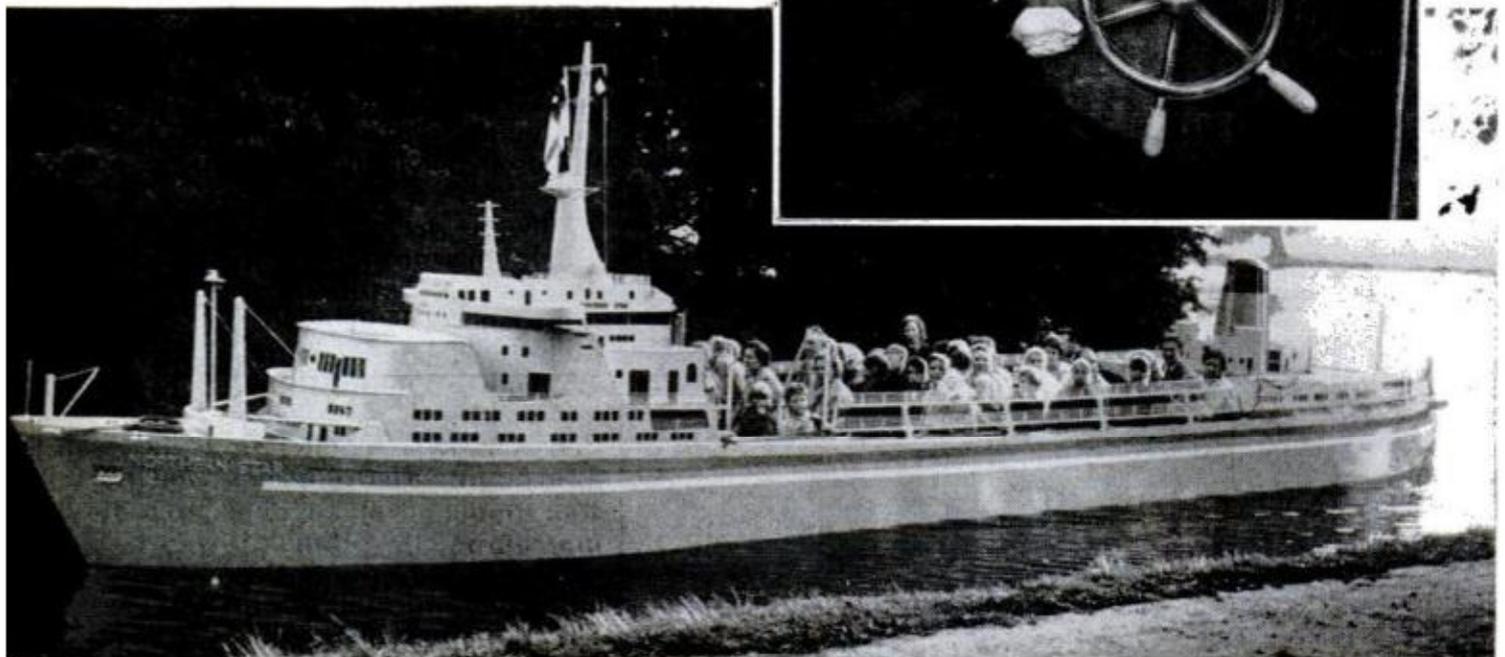
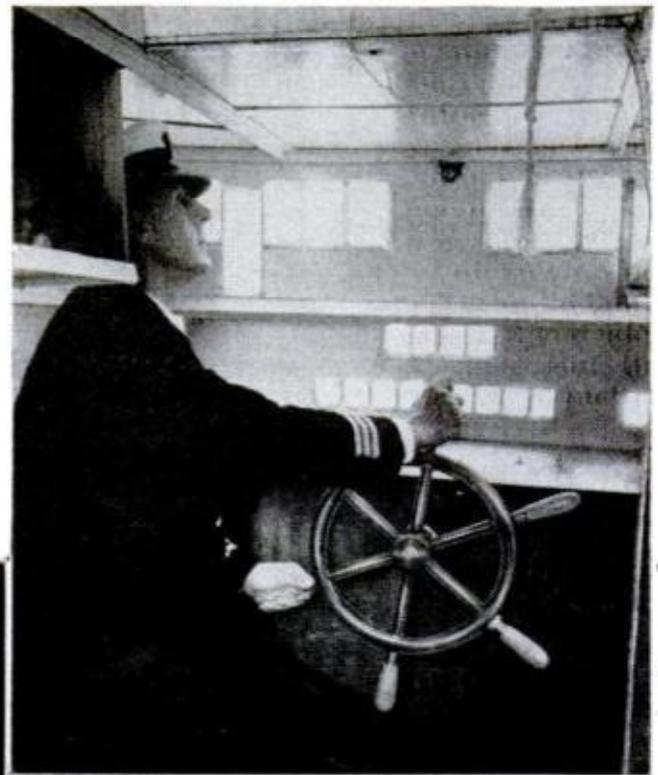
The miniature liner, which cost £2000 to build, is piloted by a former sea captain. It plies its route on a lake at Stapleford Park, the home of Lord Gretton, near Melton Mowbray, Leicestershire.

English estates now vie with one another to attract visitors who pay an entrance fee:

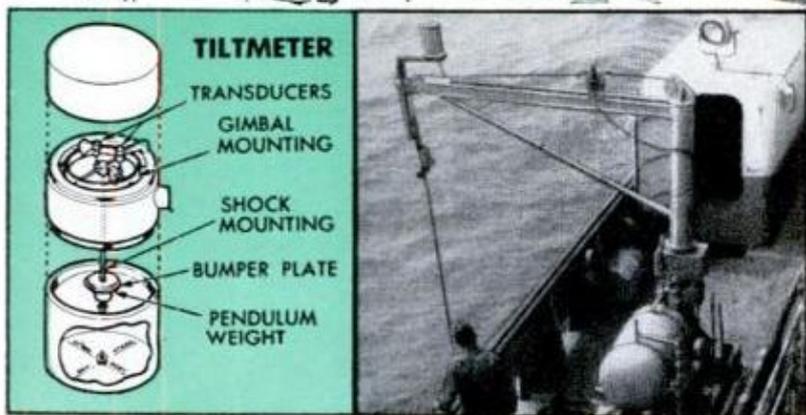
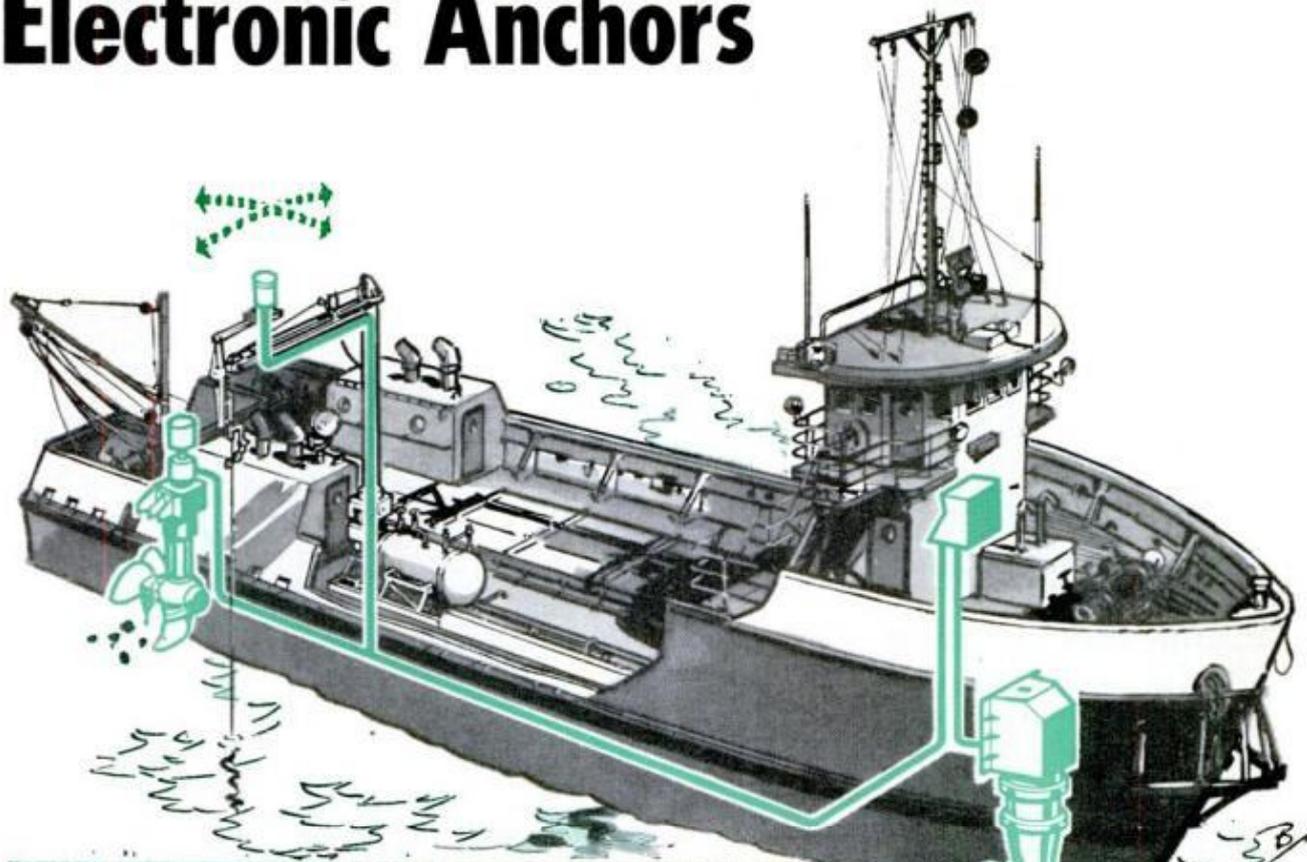


Navy's Good Right Arm

To save wear and tear on the arms of hospital corpsmen who once practiced on each other, hypodermic shots are now injected into an artificial arm. It's made of latex skin and plastic foam and used at the Navy's regional training-devices center.



Electronic Anchors



GIMBAL-MOUNTED tilt-meter sits on the outboard tip of the boom which carries the reference line overside. Two linear differential transformers translate pendulum action into changing drift-signal voltages which are fed into the shipboard computer

TEAMING UP a computer with a pair of outboard motors, a revolutionary new automatic anchoring system can glue a boat in position despite 40-knot winds and 20-foot waves.

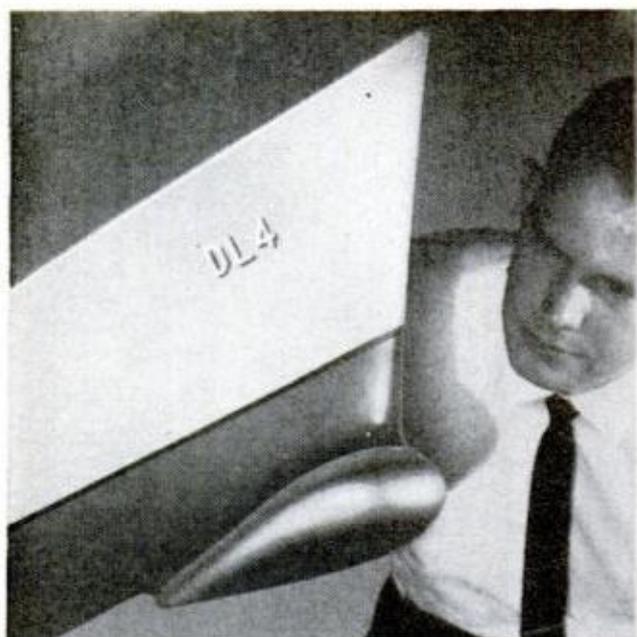
Dubbed APE (Automatic Positioning Equipment) by its developer, Shell Oil Company, the system is already installed aboard Shell's 136-foot offshore core-drilling vessel, *Eureka*, where it has proven itself in 18 months of continuous use.

Basically, the system consists of four parts—a taut reference line running to the bottom; a tilt-meter which rides the line and senses any deviation from vertical; a computer which receives the tilt-meter's signals and decides what changes in direction and speed are required to correct the boat's drift; and two outboard "anchor"

motors. One motor in a bow well and another at the stern are constantly changing direction and thrust in response to the computer's commands.

The 450-ton *Eureka* uses a $\frac{1}{8}$ -inch line attached to a 400-pound weight as a reference. Since this line must be kept taut, regardless of how the ship rolls and pitches, it runs over a series of sheaves to a 10-foot-long piston which "plays" the line, absorbing shocks while maintaining a constant 300-pound tension.

According to company engineers, APE holds its anchor point within a tolerance of three percent of water depth. In an emergency, it's possible for an operator to correct the drift manually from the control console by working a "joystick" which controls the motors.—James Joseph



Rubber Bow Bumper

Made of "transparent rubber," a pressurized dome under the bow of Navy subchasers will house electronic gear.

The rubber is a special compound that matches the acoustical properties of sea water, allowing undistorted reception.



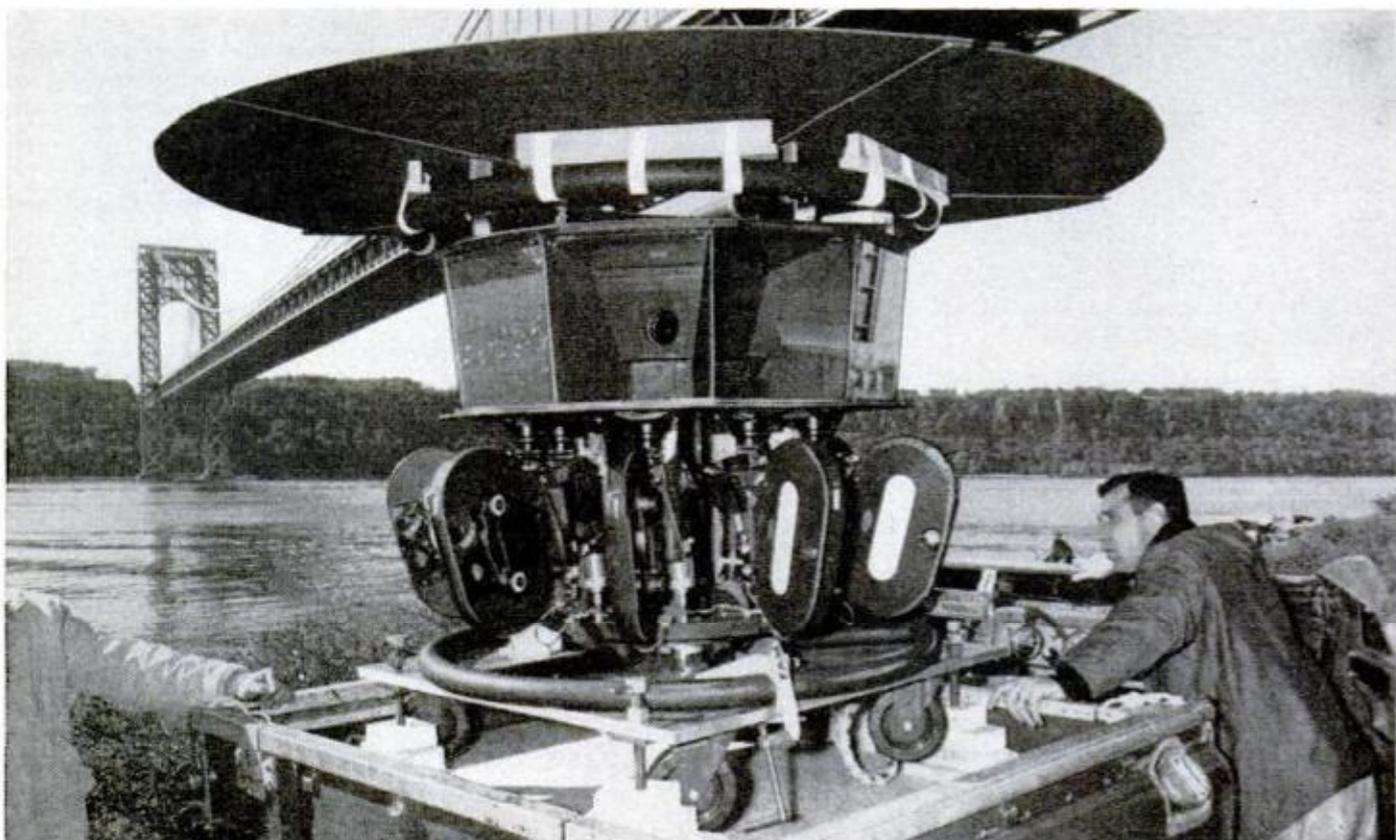
Yes, His Bark Is Worse Than . . .

The dog is made of plastic and rubber, but he can spot night intruders and set up furious barking to drive them away. The watchdog, creation of a West German homeowner, has "black light" eyes that trigger barking when the beam is broken.

Theater-in-the-Round Updated at World's Fair

A movie theater in which a standing audience is surrounded by a circular screen 13½ feet high will be featured at New York's 1964-65 World's Fair. A 15-minute film on the Port of New York will be shown

to groups of up to 400 people in the Port of New York-New Jersey Building. The film is being made with a ring of 10 16-mm. cameras which shoot simultaneously through a periscopelike device (below).





Skinny Spare

Less than an inch thick when deflated, a new spare tire can be inflated in three seconds and put in use on a car.

Called the **Standby Wheel**, the new spare is actually $\frac{7}{8}$ inch thick, and can be stored easily in the trunk of an automobile (top photo).

When it's needed, the tire of the spare is inflated with a cylinder of carbon dioxide gas. The wheel is then bolted in place, and the car may be driven until the flat is repaired. The manufacturer says that an auto may be cornered at high speed on the Standby Wheel.

The maker is Dunlop Rim & Wheel Co., Coventry, England.

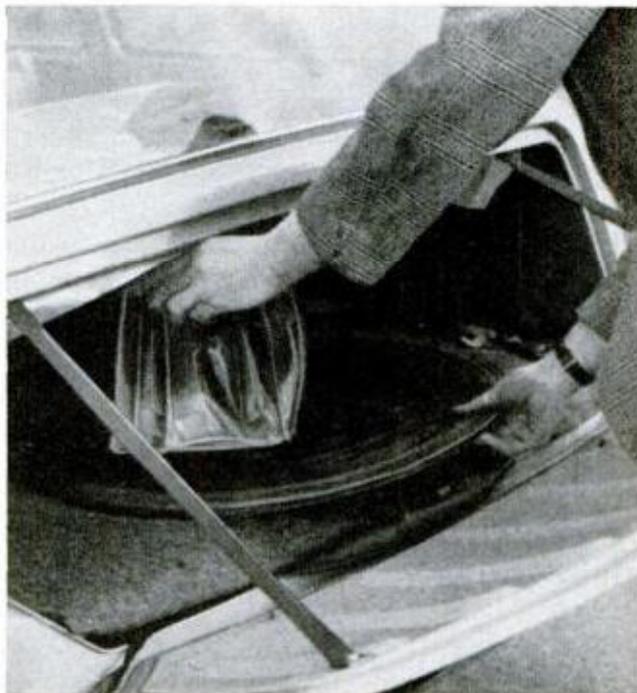
Overload Latch



When there's an oversize load to fit in a car trunk, the driver can keep the trunk lid from flopping—and also display a warning flag—with the Saf-T-Hold. Hooks hold its chain securely. Price is \$1.98 from Franzen Gifts, Dept. 292, Flanagan, Ill.

Portable Movie Light

A cordless movie lamp is powered by a rechargeable battery that permits 10 minutes of shooting on one charge—enough for two 50-foot rolls of 8-mm. film. Sylvania's Sun Gun sells for under \$80.





ARC WELDING BASICS

YOU CAN MASTER IN SIX HOURS

By Art Youngquist

IF YOU'VE ALWAYS shied away from "down-hand" arc welding as a skill beyond your abilities, you may doubt our claim that you can learn it in six short hours. Perhaps—somewhere in the distant past—you've tried to strike an arc, without notable success.

No reason to be discouraged. Ironically, this very first step in learning arc welding is the toughest hurdle of all. Though the arc principle, as sketched on the next page, is quite simple, it takes practice to strike one because the welding rod has a tendency to stick (or "freeze") to the work. It's no great problem, since you can free it by quickly wobbling it from side to side, but until you can strike an arc *without* freezing, you can't lay a bead. With a few tips, you can master the first step in about 10 minutes. From then on, it's simply a

matter of controlling the rate of feed to maintain the correct arc length as the welding rod melts off, then synchronizing this movement with the rate of travel required for a uniform bead. (See sketch at bottom right.)

We aren't trying to suggest, of course, that you can become a professional all-position welder in six hours. But you'll be able to lay a good weld in the horizontal position ("down-hand")—and 98% of all the welding jobs you're likely to face can be done in this position.

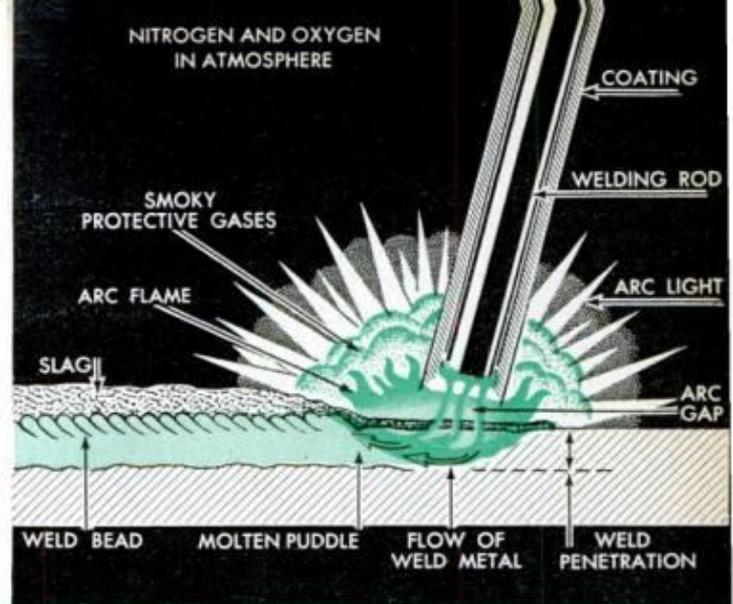
First of all, you'll need a welder. You can buy a new 180-amp. size for around \$100—not expensive as large shop tools go. This size will handle all garage and farm welding jobs. If you intend to do only hobby welding, the 100-amp. machine shown on page 147 is big enough, and costs

a few dollars less. Set your welder within reach of your workbench, as shown at left, so you can experiment with various amperage settings.

To protect a wooden bench from scorching, place a fairly large scrap of sheet steel on top of it. Clamp the end of the ground cable to this scrap. Then place the smaller scrap that you'll use for practice on top of the grounded piece; this automatically grounds the work-piece to the welding circuit. The work-piece should be at least 1/8-in. thick and reasonably free of rust or paint.

Now, grip the bared end of a 3/32-in.-dia. welding rod or electrode in the jaws of the rod holder. The rod must be one made for welding mild steel with an AC welder (see the chart or page 149). Fleetweld 37 is a good choice for the beginner. Adjust the current setting on the welding machine to 70-75 amps. Then lower the welding hood over your face (or don your safety goggles) and gently touch the practice piece with the tip of the welding rod, using a scratching motion as if you were striking a match. This will cause the tip of the rod to spark and sputter like a short-circuited wire about to blow a fuse. As soon as the sparks occur, raise the rod slightly making at least an 1/8-in. gap between the tip of the rod and the practice piece. If your lift isn't quick, the molten tip won't have a chance to drop off and will actually weld the rod to the workpiece. The thing that's so frustrating for the beginner is that this takes place in a split second and the rod must be worked free at once.

Don't let a sticking rod discourage you because it happens to experienced welders too, and sometimes it's necessary to free a rod several times before starting to weld. But remember: you must free a stuck rod right away because it creates a direct short across the welding circuit that will heat up the rod and burn off the coating, rendering the rod useless. If you cannot free the rod by bending it from side to side, de-



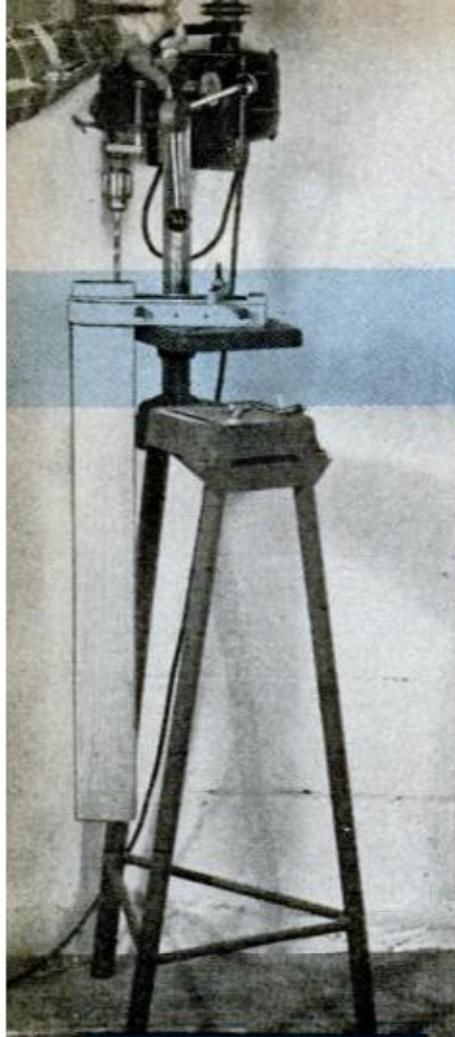
WHAT GOES ON INSIDE THE ARC

Immediately after you strike an arc, the intense heat generated melts the steel under the welding rod, forming a small pool of molten metal. The heat of the arc also melts the tip of the rod, and this molten rod metal is carried across the arc and deposited in the molten pool beneath. The blast of the arc forms a crater at the center of the pool and forces some of the weld metal out; this becomes the weld bead. The depth of this pool is the depth the weld has penetrated.

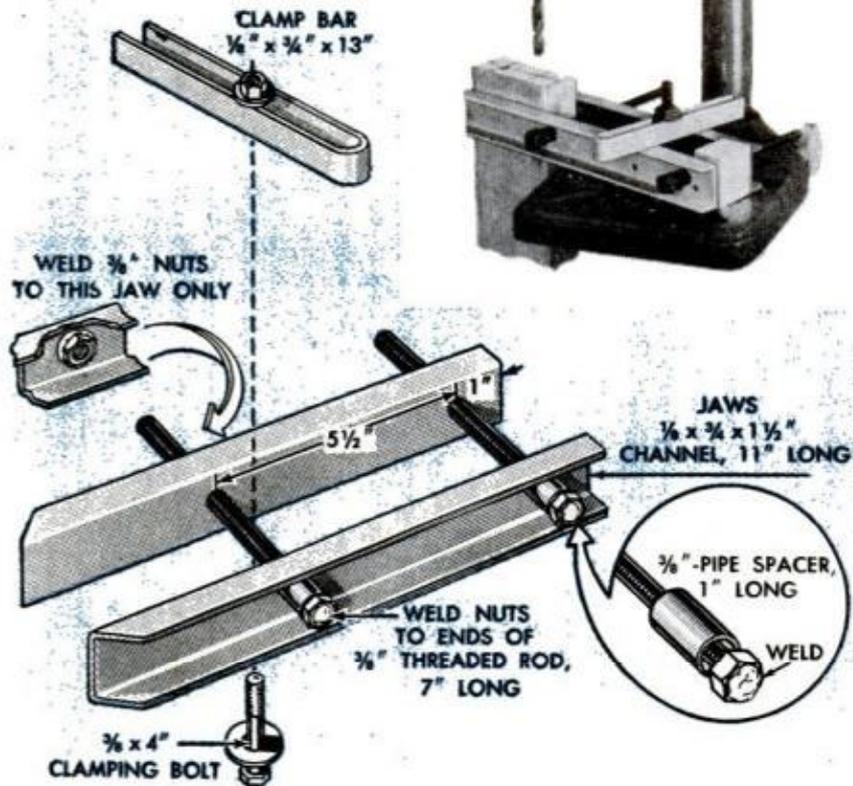
Simultaneous with the melting of the rod-tip and the metal to be welded, some of the rod's coating burns to form an envelope of protective smoky gases around the arc and molten pool. This smoke screen shields the molten weld metal from harmful absorption of the oxygen and nitrogen in the air.

The remaining part of the rod coating melts to form a liquid flux that mixes with the molten metal and combines with impurities in the metal. The resulting molten slag then floats to the top of the molten weld metal and forms a coating which completely covers the weld bead, further sealing it off from the atmosphere as the weld metal solidifies.

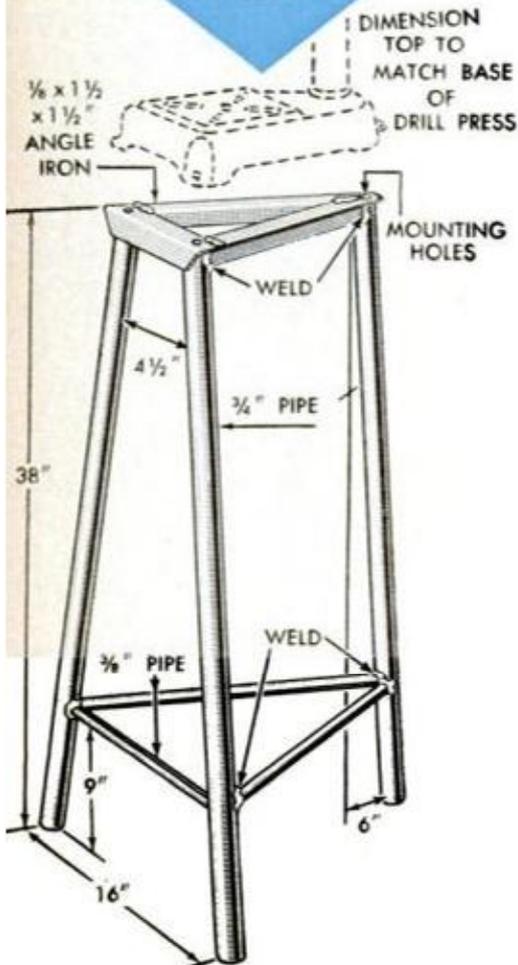




OFF-THE-SIDE DRILL PRESS VISE



FLOOR STAND FOR BENCH DRILL PRESS



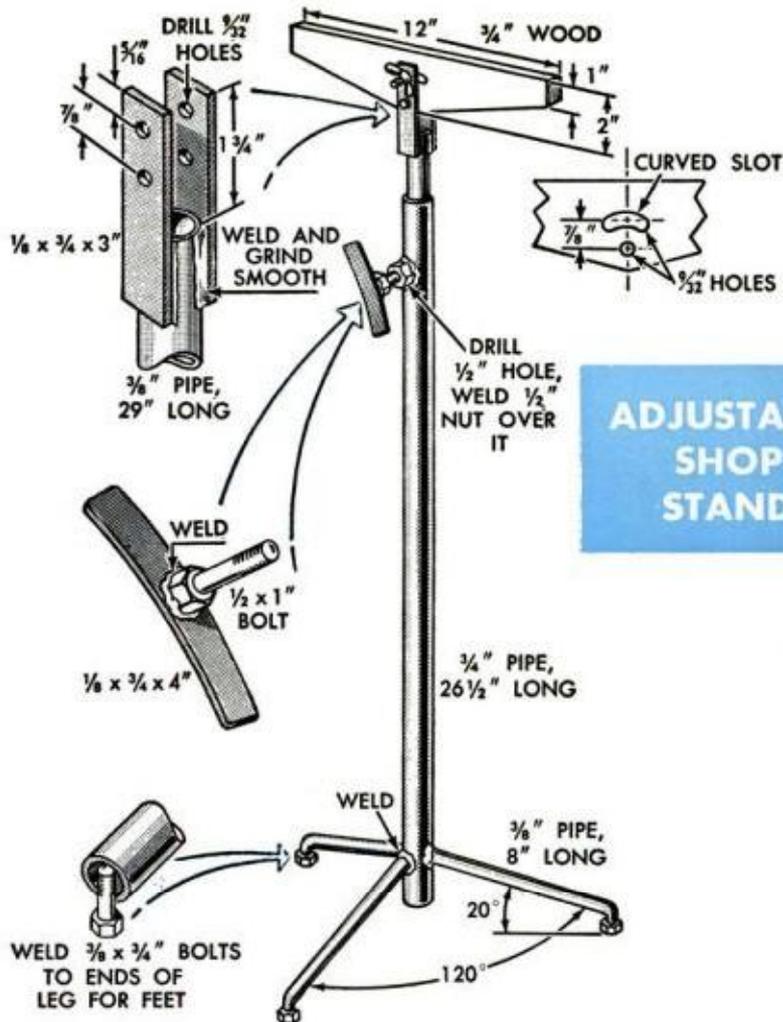
FOUR PROJECTS TO

press the rod-holder's thumb lever grip and free the rod from the holder jaws. Use this method only as a last resort, though—it causes arcing at the holder jaws that would eventually ruin them.

If, after 8 or 10 starts, the rod persists in sticking, increase the welding current to the next highest amperage setting. Line loads vary in different localities and it could be you're not getting enough current to maintain an arc. If this doesn't help, don't give up—there's still another way you can learn to strike an arc: switch from steel to brass. A small piece at least $\frac{1}{4}$ -in. thick will do the trick. Place the brass on the metal table top, as you did the steel scrap, and try striking an arc on it. You will notice that you can practically bury the arc in the brass before it sticks. This, of course, is a "crutch" and shouldn't be used any longer than it takes you to develop the skill of striking and maintaining an arc.

Don't attempt to run a weld bead at this time. Keep practicing the art of striking an arc and maintaining it for a few seconds' duration over and over again. To stop or break the arc, rapidly pull the rod away from the work, then switch off the welder if you're through.

If you can't even arouse a spark when attempting to strike an arc, inspect the tip of the rod. Sometimes the rod burns off faster than the coating and the coating prevents the rod tip from touching the practice piece. When this occurs, vigorous scraping or striking the rod



ADJUSTABLE SHOP STAND



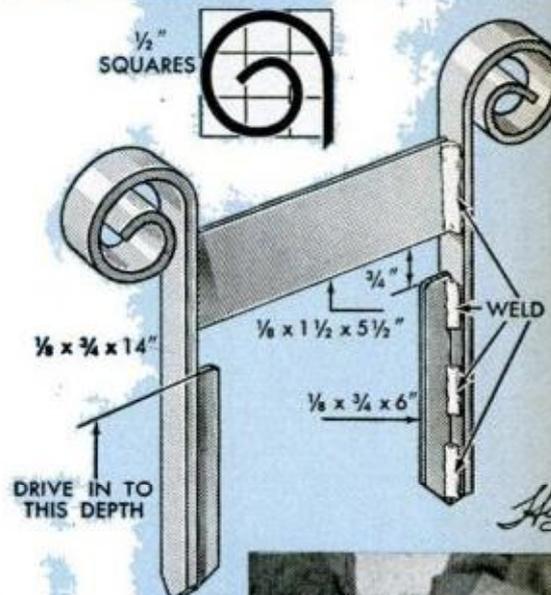
GET YOU STARTED

tip against the work usually breaks away the coating at the tip. A loose ground-cable clamp could also be the trouble. Check the clamp and fasten it directly to the practice piece if necessary. Also make sure the welder's switched on.

Once you've mastered the technique of striking and holding an arc for a few seconds, you're ready to practice the dual arm movement. The big trick here is maintaining correct arc length by feeding the rod downward. You can't judge an arc gap by *looking* at it (though an experienced welder can look at the puddle of molten weld metal and tell if the arc length is right). The best way for a beginner to judge the correct length is to listen to the noise of the arc. When an arc gap is too long, it makes a hissing or singing noise. A correct arc gap makes a uniform crackling noise—rather like eggs frying in a pan that's too hot. Too-short an arc gap also makes a crackling noise, but it's not uniform because the molten metal dropping from the rod momentarily shorts the circuit, during which time the crackling is smothered into silence. Practice holding a large arc and then a short arc to familiarize yourself with the warning sounds.

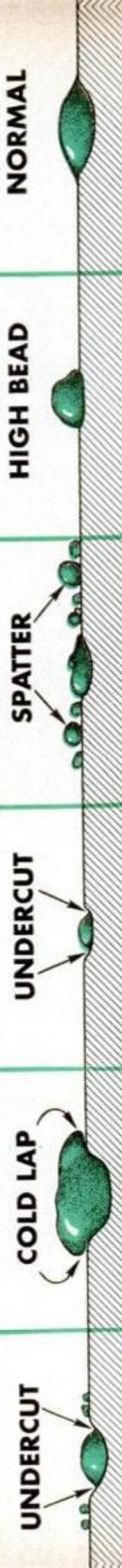
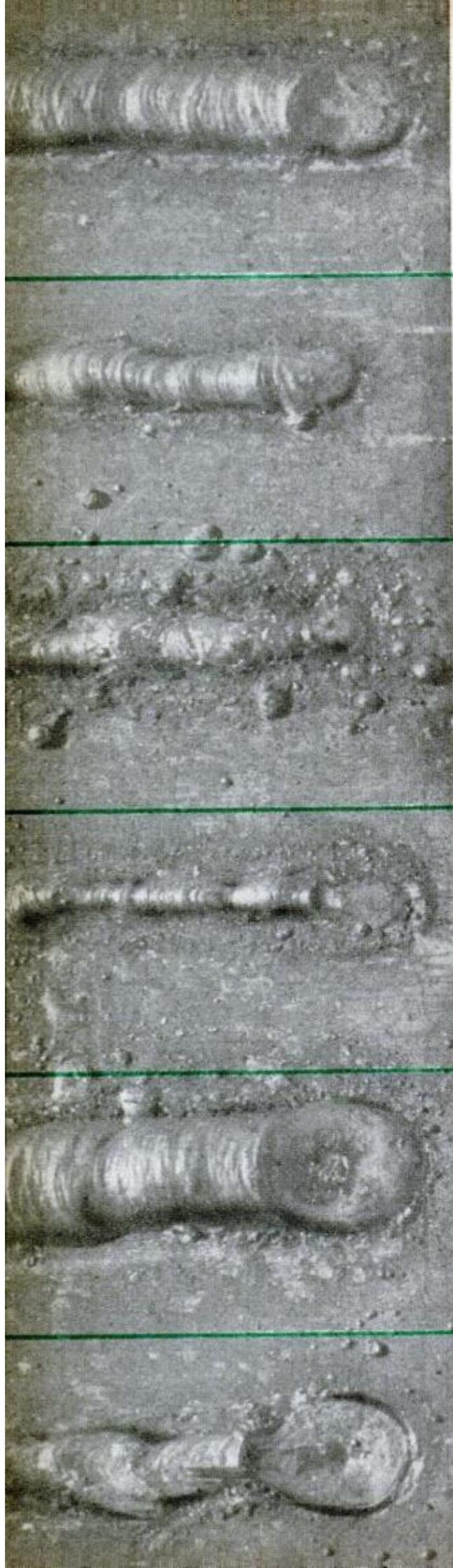
Lay the bead from left to right (right to left

[\(Text continued on page 206\)](#)



FOOT SCRAPER





UNDERCUT

CURRENT TOO HIGH

ARC makes hissing sound; long and pointed crater. Rod melts off fast, becomes red before being used up. Wide crater leaves the bead undercut



COLD LAP

TRAVEL TOO SLOW

EXCESS WELD metal piles up, overflows crater to cause cold laps. Molten slag flowing in front of crater could cause gas packets, slag inclusions



TOO LONG AN ARC gives off very bright white light and makes a hissing sound. Globules of molten weld metal can be seen dropping from rod. Spatter surrounds the puddle

UNDERCUT

TRAVEL TOO FAST

CRATER hasn't had time enough to penetrate the metal; small bead does not fill even this shallow crater in all spots, resulting in undercutting

SPATTER

ARC TOO HIGH

GLOBULES of molten metal from rod appear to be sprayed against steel, resulting in spatter. As with excess current, the arc makes hissing sound



ARC OF CORRECT LENGTH gives off less white light than long arc, makes a steady crackling sound. No globules of molten metal can be seen; puddle appears to be boiling quietly

HIGH BEAD

CURRENT TOO LOW

ARC is hard to strike and hold; weld metal merely lays on steel, with little or no penetration. Crater is too narrow, much too shallow



NORMAL

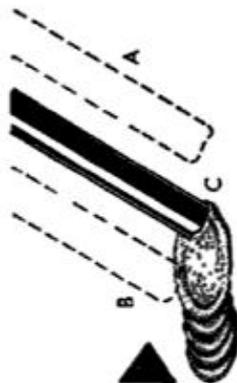
CORRECT CONDITIONS

ARC makes a crackling sound, indicating correct arc length; weld metal fills crater from edge to edge as rod is moved along at a uniform pace



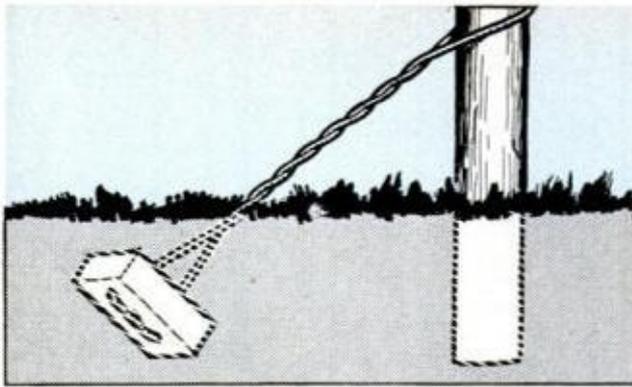
← **RATE OF TRAVEL** should be fast enough to prevent slag from flowing in front of puddle, causing gas pockets, slag inclusions. Slag coat behind is chipped away with cold chisel

TO AVOID HUMP in bead when starting new rod, strike arc at front of puddle (A), quickly move rod to back of puddle (B), then to center of crater to resume former rate of travel



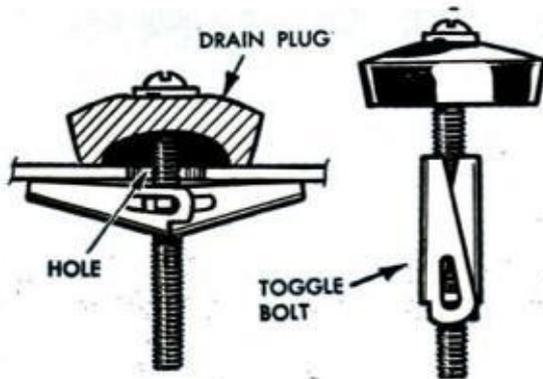
YOUR CHOICE OF ELECTRODES FOR 180 AMP A.C. WELDERS

ELECTRODE TYPES	SIZES (ROD DIA.)	CURRENT RANGE (AMPS.)	SPOT COLOR IDENTIFICATION	USE AND WELDING CHARACTERISTICS
Fleetweld 37*	5/64 3/32 1/8 5/32	40-75 65-100 90-140 120-180	Brown	For general-purpose welding of mild steel in all positions. Widely used on sheet metal lap and fillet welds where appearance and ease of operation are more important than speed
Fleetweld 180	3/32 1/8 5/32	40-90 60-120 115-150	Blue	Best all-round electrode for repair of mild steel, particularly if work is dirty and rusty. Can be used in all positions. Has fast freeze characteristics with deep penetration and light slag. Good for welding galvanized steel
Jetweld 1 for AC	3/32 1/8	80-110 130-180	Yellow	For high speed welding of mild steel in down-hand position only. Arc is soft and spatter-free. Thick, dense slag, which is easily removed, produces exceptionally smooth-appearing weld bead
Jetweld LH-70	3/32 1/8	80-120 115-165	Orange	An all-position electrode for welding high carbon or sulphur steels and low-alloy, high-tensile steels which cannot be preheated
Ferroweld	1/8	80-100	No spot color. End of rod orange	For making all types of cast iron repairs where machining of weld is not required
Softweld	1/8	65-120	End of rod orange. Spot color blue	For welding cast iron which must be machined after welding
Abrasoweld	1/8	40-150	No color code	For hard-surfacing steel that is subjected to abrasive wear of sand, stone and other gritty materials
Stainweld A7	5/64 3/32 1/8 5/32	20-45 30-60 55-95 80-135	No spot color. End of rod yellow	An all-position electrode for welding stainless steel and hard-to-weld steels
				*All welds in photo made with this electrode



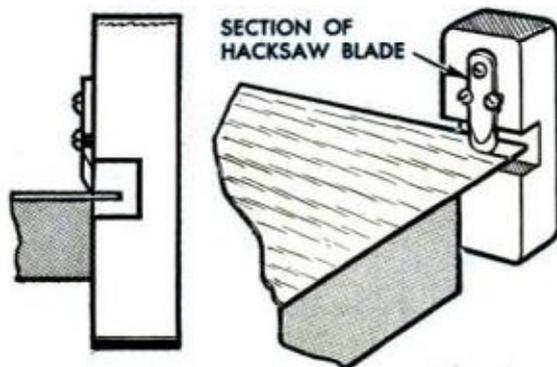
Bricks Anchor Posts

The next time you erect a wire fence which requires the use of "deadmen" to anchor posts at the corners or ends, try using face bricks. Their size and ready-made holes make these bricks ideal for the purpose. Just slip the brace wire through the holes in the brick before burying it, then attach the wire to the post and tighten to the desired tension.
—G. E. Hendrickson



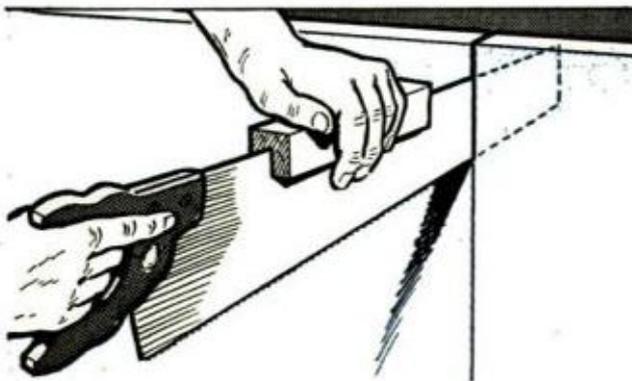
Relieve for Doomed Tank

When a hot-water tank, which is on its last legs, develops a leak, here's a good way to patch it when you find that the metal surrounding the hole is so corroded and thin that it can't be plugged with a regular patching screw. All you need is a steel washer, a sink stopper and a toggle bolt. After drilling a hole through the stopper, roughen the edge with sandpaper and coat the washer under the bolt head with rubber cement.—Nelson Hall



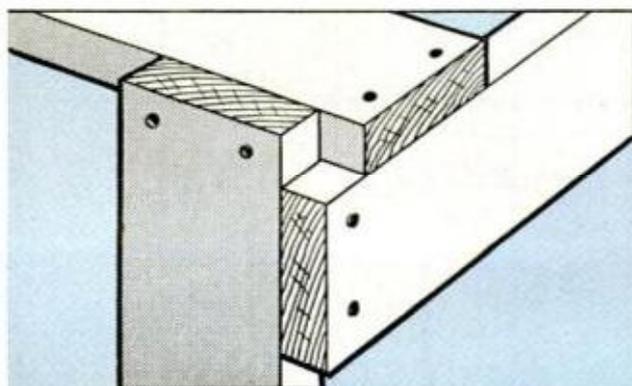
Veneer Edge Trimmer

Trimming veneer exactly flush with the edge is important in lapping veneers at corners and it will pay you to make this "can't miss" edge trimmer. It's simply a small block of hardwood which has been notched to fit over the projecting veneer. The cutter is a section of hacksaw blade ground razor-sharp and mounted over the notch. In use, the block is simply pulled along in contact with the edge of the work surface.—W. L. Merilles



Pressure Pad for Hand Saw

When hand sawing $\frac{3}{4}$ -in. plywood panels standing on edge, pressure on the back of the saw with the left hand will make the saw cut faster. To make a comfortable pad for the hand, run a sawcut in one side of a wood block so that it can be slipped over the back of the blade. It's a real timesaver when a number of panels must be cut by hand to a workable size on workshop machines.



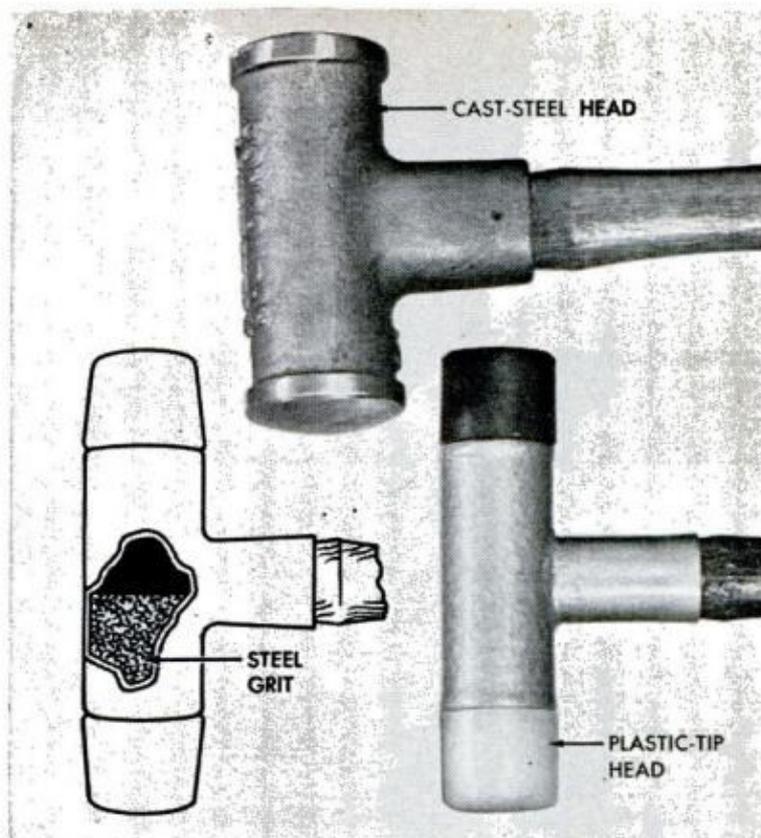
Tips on Crate Making

The most important secret in making wooden boxes or crates that will stand rough handling is to avoid driving any nails into the end grain. You can plan the construction so that all nails will be anchored in edge grain. The corners thus formed won't pull apart unless the wood splits or breaks. To open a crate of this type, simply remove all nails from two boards at each corner with a conventional nail puller.—R. S.

Now They're Loaded

What's new in hammers? The Tahlen no-bounce hammer. Available in both cast steel and plastic tipped models, these loaded hammers have tubular heads filled with special steel grit to absorb the bounce and give 50 percent greater striking impact than conventional sledge and lead-type hammers. The plastic tips of tenite and nylon are replaceable and won't raise burrs.

In testing the cast-steel model, we found that the loaded head gave complete control of the blow, and we were able to transfer a full blow from almost any striking angle due to the convex faces. Hardware dealers have these new hammers from 6 oz. in the plastic-tip type on up to 3 lbs. in cast steel. Prices start around \$3.00. Made by Tahlen Hammer Co., 1214 Poplar Place So., Seattle, Wash.

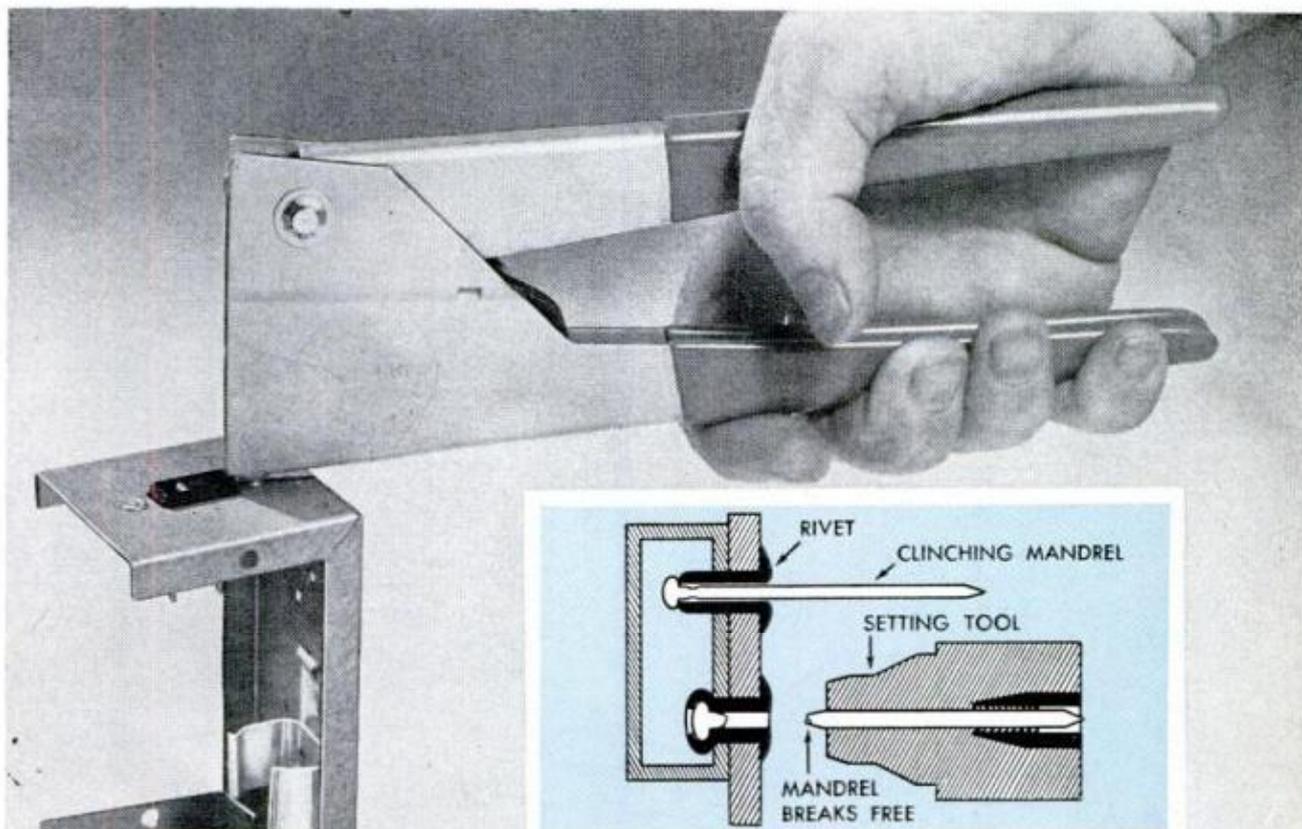


New Riveter Works Like a Pair of Pliers

Pop riveting, an industrial technique for blind fastening, is now practical for the do-it-yourselfer—thanks to United Shoe Machinery's new "POP" RiveTool. This device makes child's play out of light repair jobs on house gutters, toys, appliances, luggage—any number of items. It requires no heat, no threading, no hammering. All you do is drill a hole, insert

the mandrel of a rivet into the tool, put the rivet in the hole and squeeze the handles of the RiveTool. Jaws draw the mandrel back as shown in the drawing, leaving the expanded rivet in the hole.

The new tool, available at hardware stores, sells for \$5.95 with a box of rivets. Additional rivets, in 1/8, 1/4 and 1/2-in. sizes, will cost you 49 cents a box.





春 夏

SPRING

SUMMER

POPULAR MECHANICS

FOUR SEASONS

Challenging project for the advanced woodworker who likes to sink his chisel into a fine piece of lathe work

By John Burroughs

TO ORIENTALS, calligraphy—fine brush and ink handwriting—is an esteemed art. The smoothly flowing symbols of the Asiatic languages have beauty in themselves, a decorative value apart from the meaning expressed. Families in Japan, China and Korea hang expertly brushed mottoes or verses on the walls of their homes, just as we hang paintings.

The individual written characters, picturesque even to Westerners, evolved from age-old Chinese picture writing. Unlike the letters of our own alphabet, which indicate sounds, oriental language-characters at one time portrayed ideas, and so were called ideographs. But through the centuries, the primitive picture-symbols have

become so stylized that it is no longer easy to recognize what they represent. In a sense they have become abstract designs.

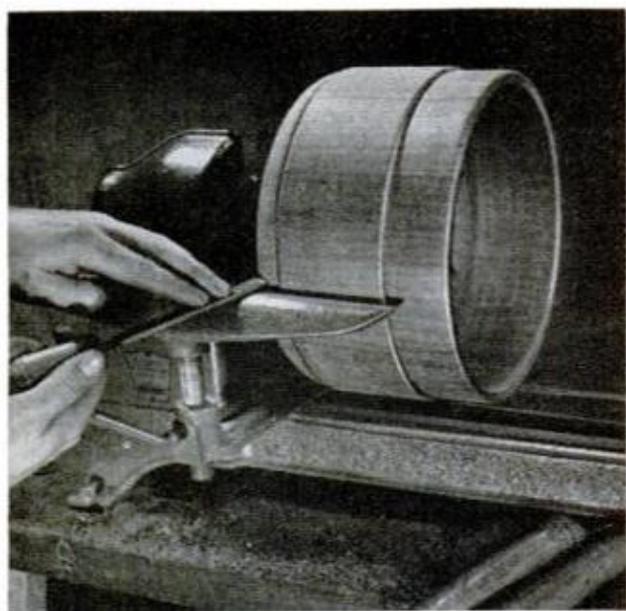
The oriental symbols representing the four seasons of the year can be utilized to create a striking ornamental motif for a woodworking project. They are particularly eye-catching when carved in relief as was done on this stunning lathe-turned fruit bowl.

To make the blank for turning, the edges of eight pieces of 1-in.-thick walnut stock are mitered on a table saw at an exact angle of $22\frac{1}{2}$ degrees. This is most important since the fine craftsmanship of the finished bowl depends largely on the fit of the segment joints. The segments are

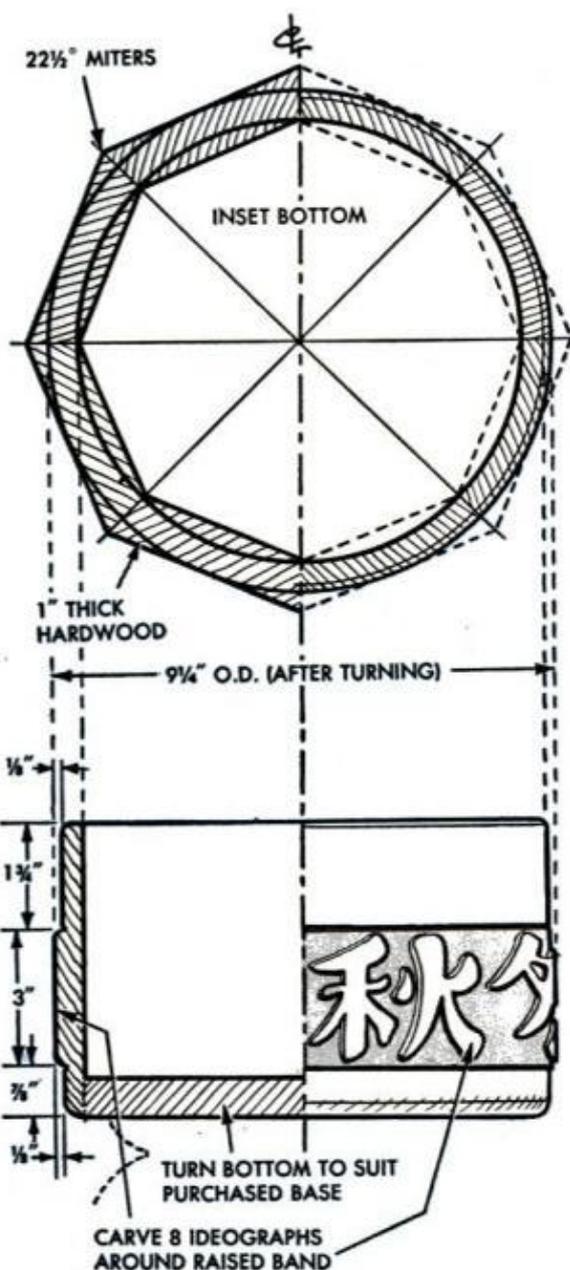




STURDY TWINE effectively holds together the eight segments of the four seasons fruit bowl while the glue dries. Be certain that the alignment of the segments remains correct after the cord is tightened



glued to each other and to an octagonal bottom, which likewise must be accurately cut. Because strong joints are essential in this project it is best to use a resorcinol or plastic resin glue. A band clamp makes it easy to hold the pieces snugly while the glue is drying, but if you lack this tool, some strong twine can serve as a substitute. After the glue has dried thoroughly, attach the blank to a lathe faceplate, being careful that the screws do not poke through the $\frac{3}{4}$ -in. bottom. Operate the lathe at low speed while first working the blank into the round. Then increase the speed for the finishing cuts in turning it into a smooth cylinder, inside and out. A $\frac{1}{8}$ -in.-high band is left on the outside to provide for the raised designs. The blank's



glue lines divide this band into eight segments, just right to accommodate two sets of spring-summer-autumn-winter ideographs. The four seasons symbols are given actual size and may be traced directly from the magazine for transferring to the bowl. The best way to hold the bowl for carving the symbols is to leave it attached to the lathe faceplate. Relief-carving the designs is simply a matter of incising the outlines and gouging the background flush with the bowl's rim-band. The edges of the carving tools should of course be kept as keen as possible so that the cuts will be clean and the symbols will stand out sharply. Though you may never before have tried your hand at carving you are not likely to encounter any difficulty



THE EASY WAY to carve the symbols is to leave the bowl in the lathe after completing the turning. The bowl is held steady, yet may be revolved by hand so the area being carved is at the most comfortable position

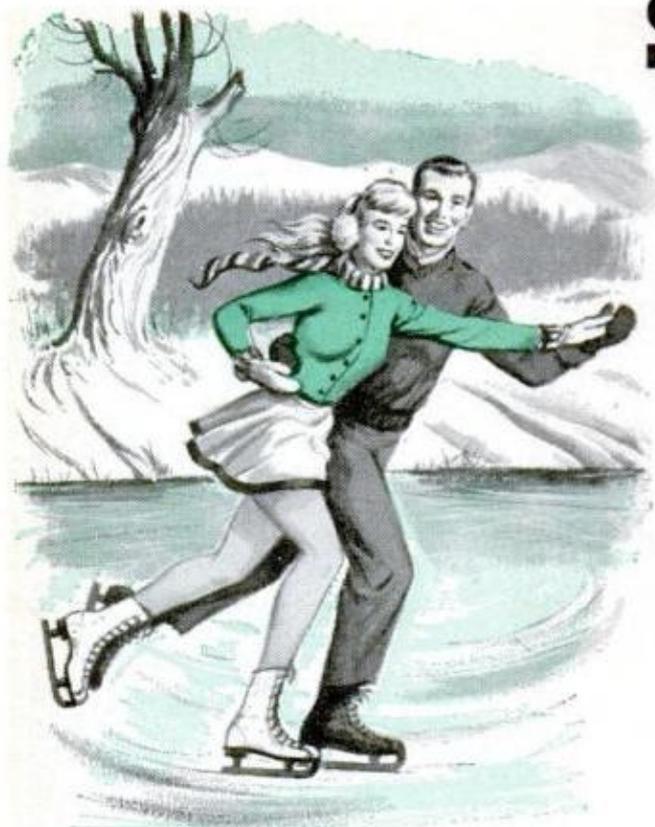
if you work slowly and make light, shallow cuts. Since the final appearance of the fruit bowl is a direct result of the care used in smoothing the surface, it is important to do a meticulous sanding job. The areas around the symbols are difficult to sand, but your efforts will be well rewarded when the project is completed.

The bowl may be finished in various ways, but rubbed varnish is perhaps the most attractive choice. The first step is to apply a coat of sealer which is allowed to dry thoroughly and then sanded with 4/0 or even finer paper. After sanding, a tack rag should be used to wipe the surface of the bowl so that no dust will be imbedded

in the rubbing varnish which is next applied. The best results are obtained with spray equipment, but if this is unavailable, a satisfactory job may be done with a high quality varnish brush. At least four coats should be applied, with a light sanding and thorough use of the tack rag between coats. A minimum of three days should be allowed for drying before the bowl is polished with pumice and water.

The base shown with the bowl wasn't homemade. It's an imported carved-wood vase stand of a type sold by many stores dealing in oriental novelties. After selecting a base of appropriate design and size, attach it with epoxy. ★★★

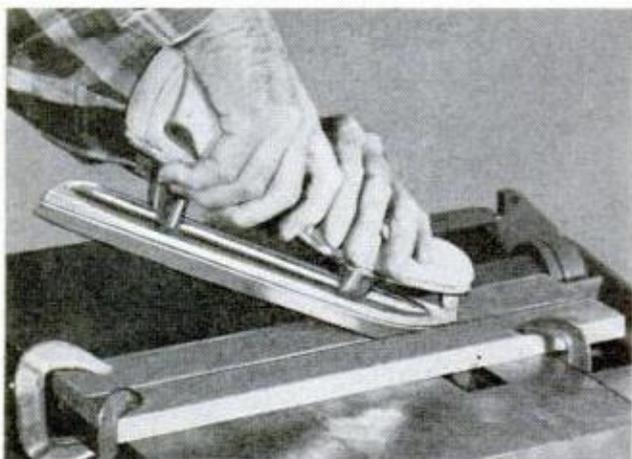
Sharpen your



WHETHER you want to sharpen only one pair of ice skates or go into the skate sharpening business, this simple jig for your circular saw will enable you to turn out a perfect hollow-ground job.

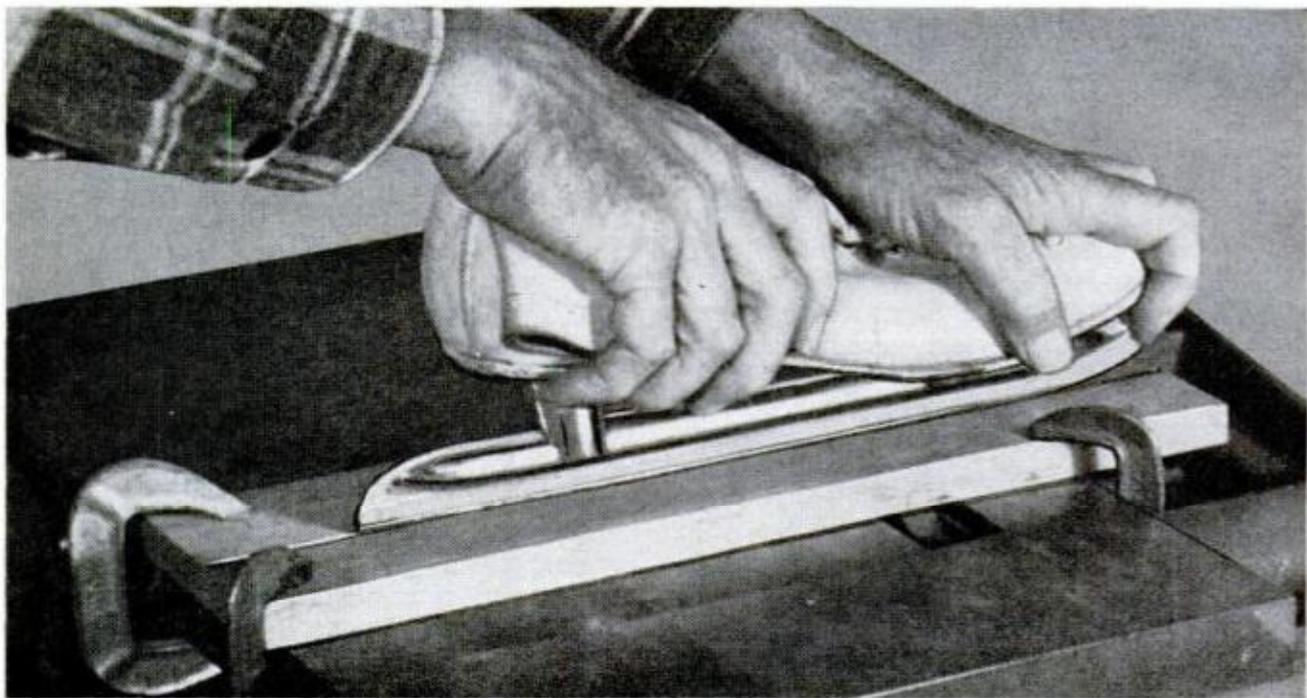
Two pieces of $\frac{3}{4}$ -in. scrap wood, long enough to reach across the saw table, are all you need to make the jig. After determining the "X" dimension indicated in the drawing, saw the rabbetted edges with a dado head (or make two cuts at 90 deg. with an ordinary saw blade). Then temporarily tack the two pieces together so you can cut the groove for the grinding wheel. Set the saw blade to make a $\frac{7}{16}$ -in.-deep cut and slowly lower the jig over the whirling blade. Take side-by-side cuts until you have made a semi-circular groove $\frac{5}{8}$ in. wide.

Next, place a $\frac{1}{2}$ x 5-in., 80-grit abrasive wheel on the saw arbor and mark its exact center on the edge of the wheel. Then place part "A" of the jig over the wheel and position it so that the vertical face of the rabbet is offset from the wheel's centerline, a distance equal to half the thickness of the skate blade. Clamp part "A" to the saw table, square with the



TO SHARPEN TIP of the blade, just raise the back of the skate while holding the toe in the groove

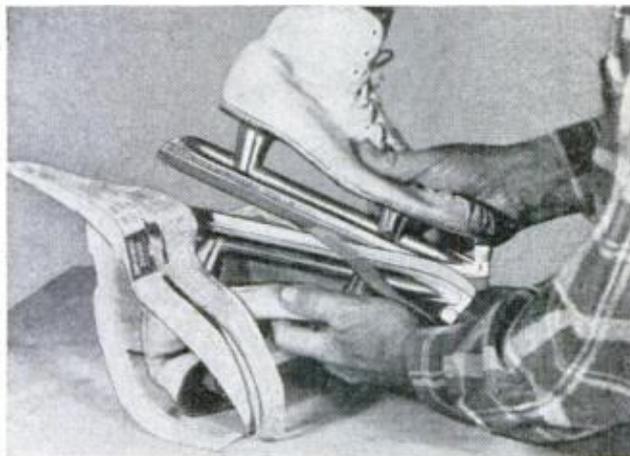
SLOTTED JIG clamped to your circular saw table holds the skate perpendicular and centered over the abrasive wheel to produce a hollow-ground edge



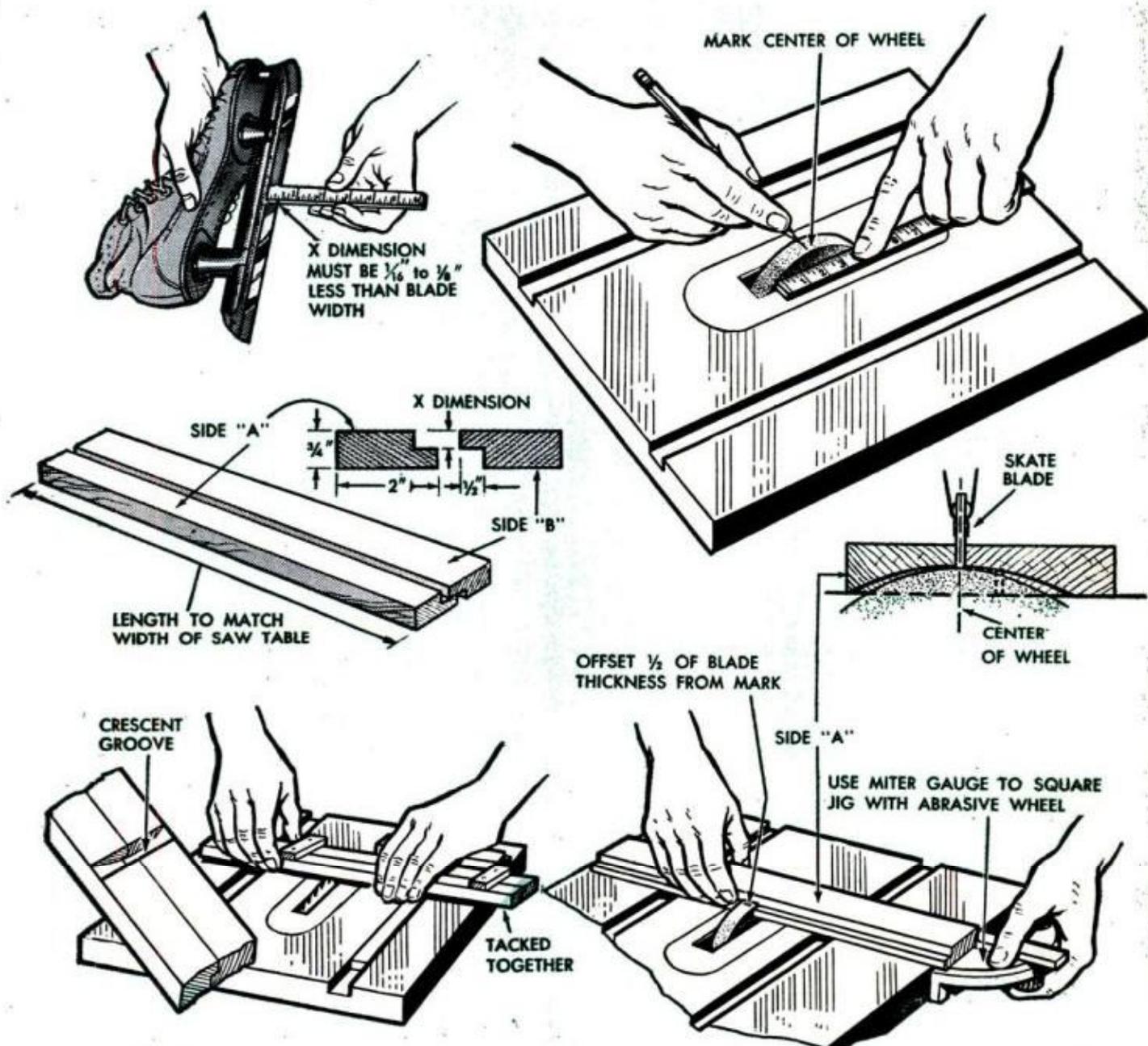
Skates on a Circular Saw

grinding wheel, place a skate in the rabbit and locate part "B" so that it forms a slot for the skate blade.

After clamping part "B" to the table, slowly raise the grinding wheel until it just barely touches the skate blade. To sharpen, turn on the saw and slide the skate back and forth across the wheel. Paraffin or paste wax in the groove will make the skate slide freely if it binds at all. Inspect the edge occasionally. If it had a wavy edge before you started, you may have to raise the wheel slightly and grind off a bit more. Grinding marks should show along the entire edge of the blade. To sharpen the curved tip, lift the back of the skate. ★ ★ ★



PROOF OF SHARPNESS is a simple test. When blades are right for skating, you can hold them together like a pair of scissors and cut strips of newspaper with ease



GAME-BIRD SAVERS

When the shooting season ends, leftovers in game-bird populations still face survival problems should deep snows bury their food supply. Feeding stations can save these wild birds



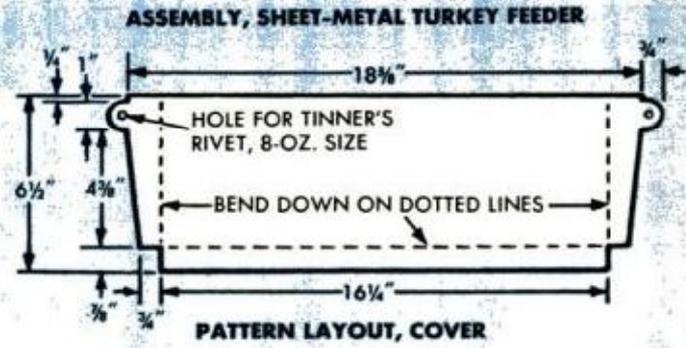
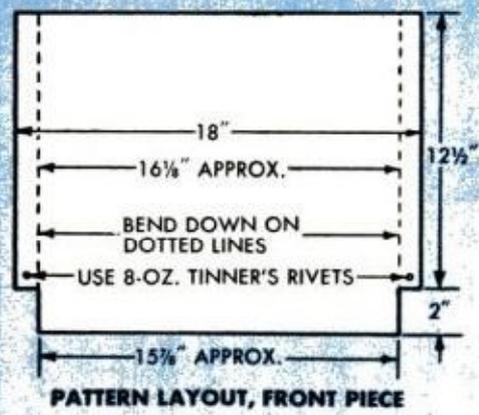
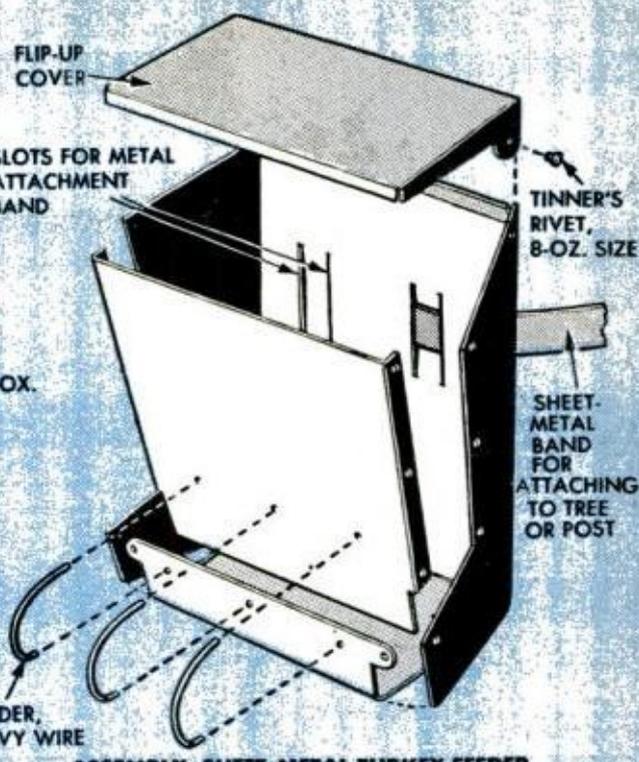
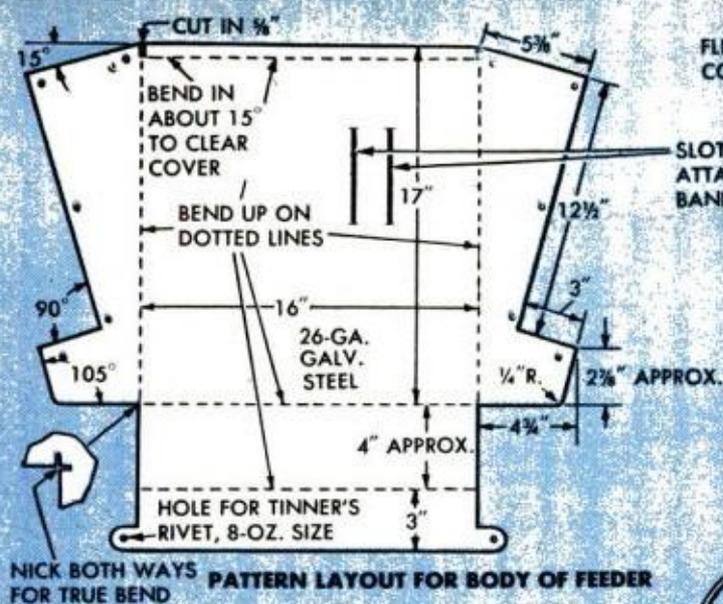
CORNSTALK FEEDING STATION for pheasants should be wired securely to a small tree for support. It offers both feed and shelter in extremely cold, stormy weather when normal food supply is covered with deep snow

By W. Clyde Lammey

IN ANY REGION where heavy snowfalls and prolonged periods of severe cold are likely during the winter months, non-migrating game birds by the hundreds and often by the thousands may die of starvation. This is especially true of the ground feeders who must rely on seeds, grain scatterings from fall harvesting, and, in forested regions, on mast, such as acorns, berries and certain small nuts. In some seasons game-bird losses from a lack of

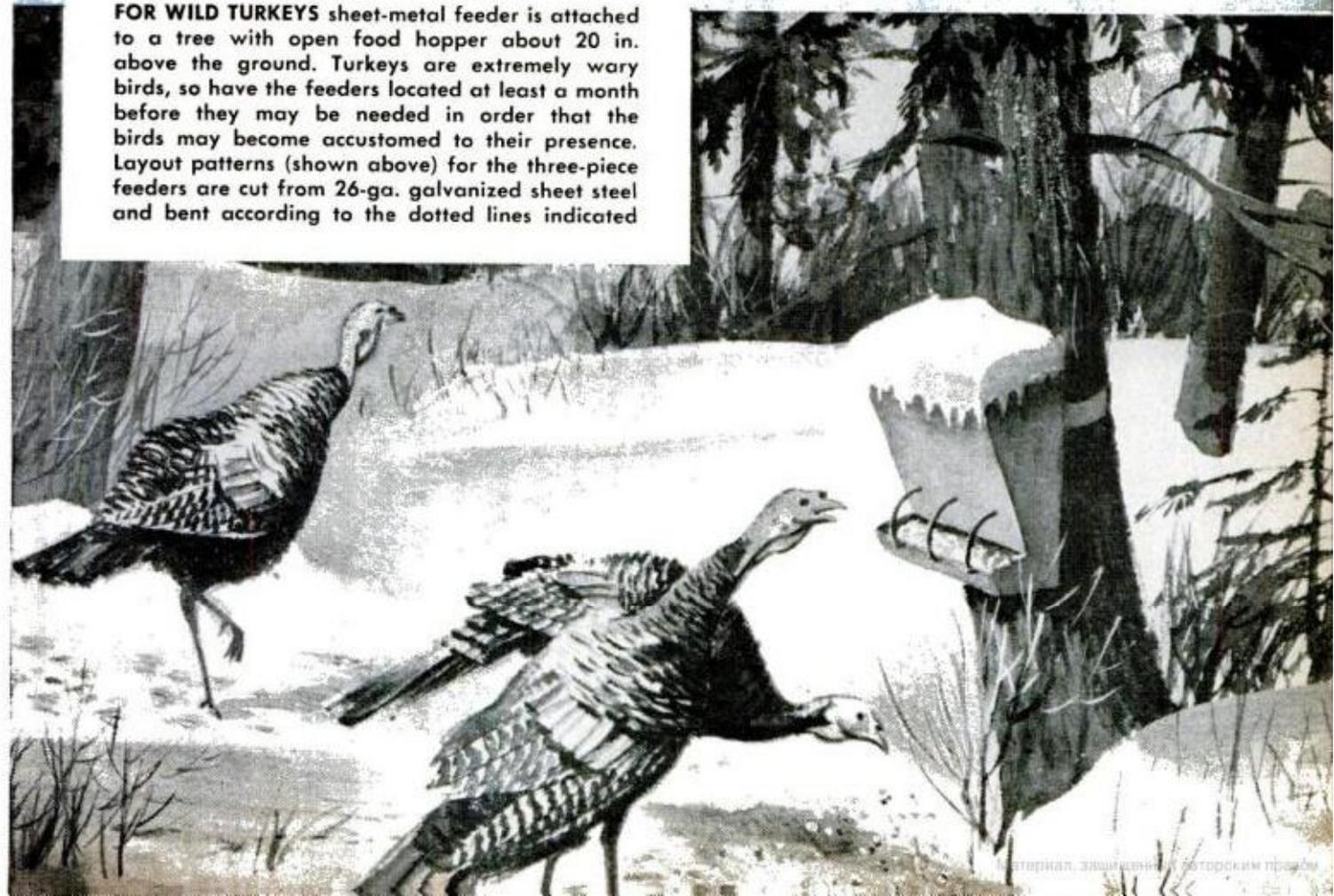
food during long spells of severe weather can greatly exceed the normal take of natural predators, may even wipe out entire local bird populations.

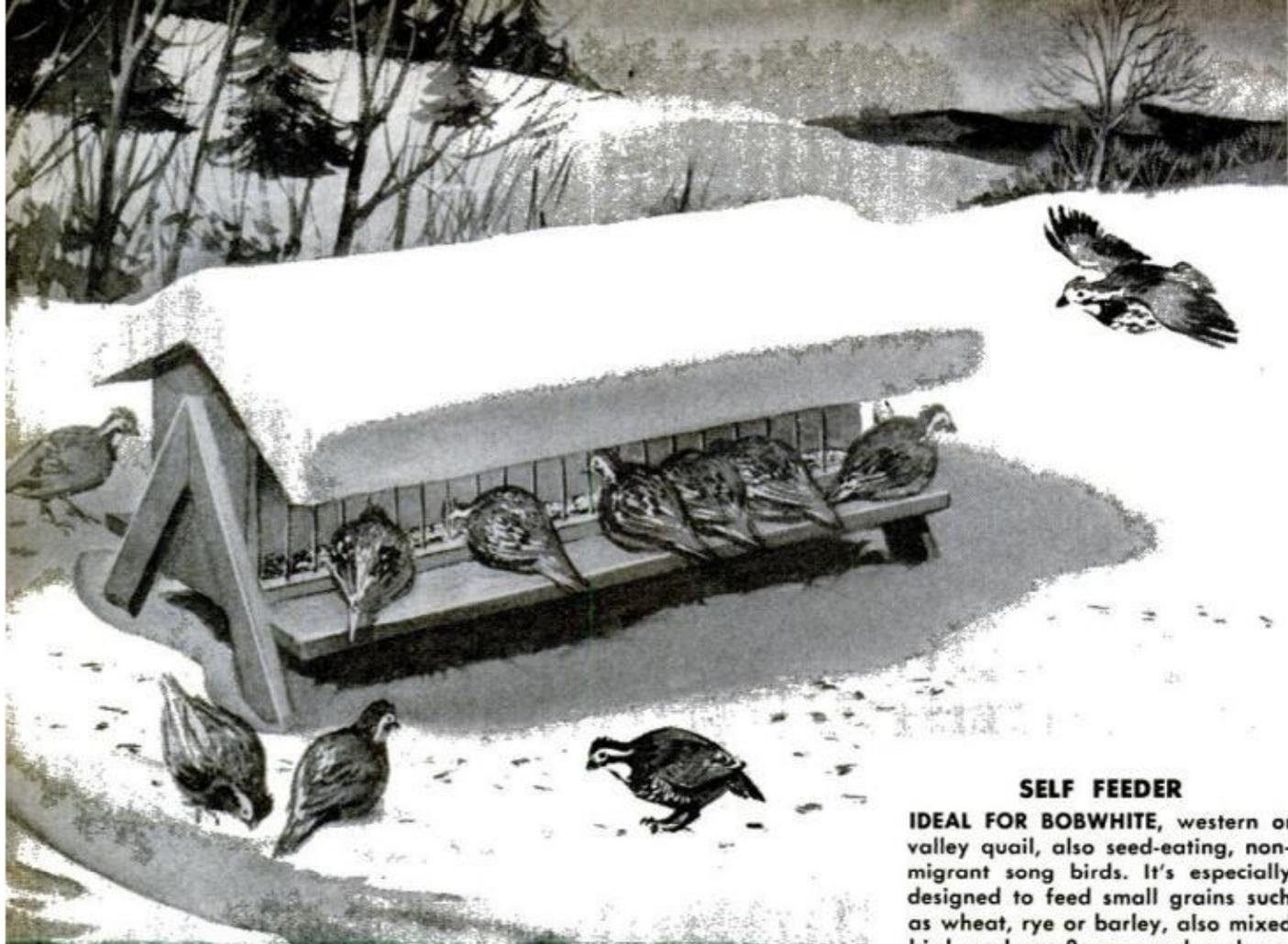
The time to get game-bird feeders built and located is long before they are needed. As a rule truly wild game birds (those hatched in the wild) are extremely wary and won't approach newly placed feeders until they become accustomed to them by long association. This means that feeders



SELF FEEDER

FOR WILD TURKEYS sheet-metal feeder is attached to a tree with open food hopper about 20 in. above the ground. Turkeys are extremely wary birds, so have the feeders located at least a month before they may be needed in order that the birds may become accustomed to their presence. Layout patterns (shown above) for the three-piece feeders are cut from 26-ga. galvanized sheet steel and bent according to the dotted lines indicated



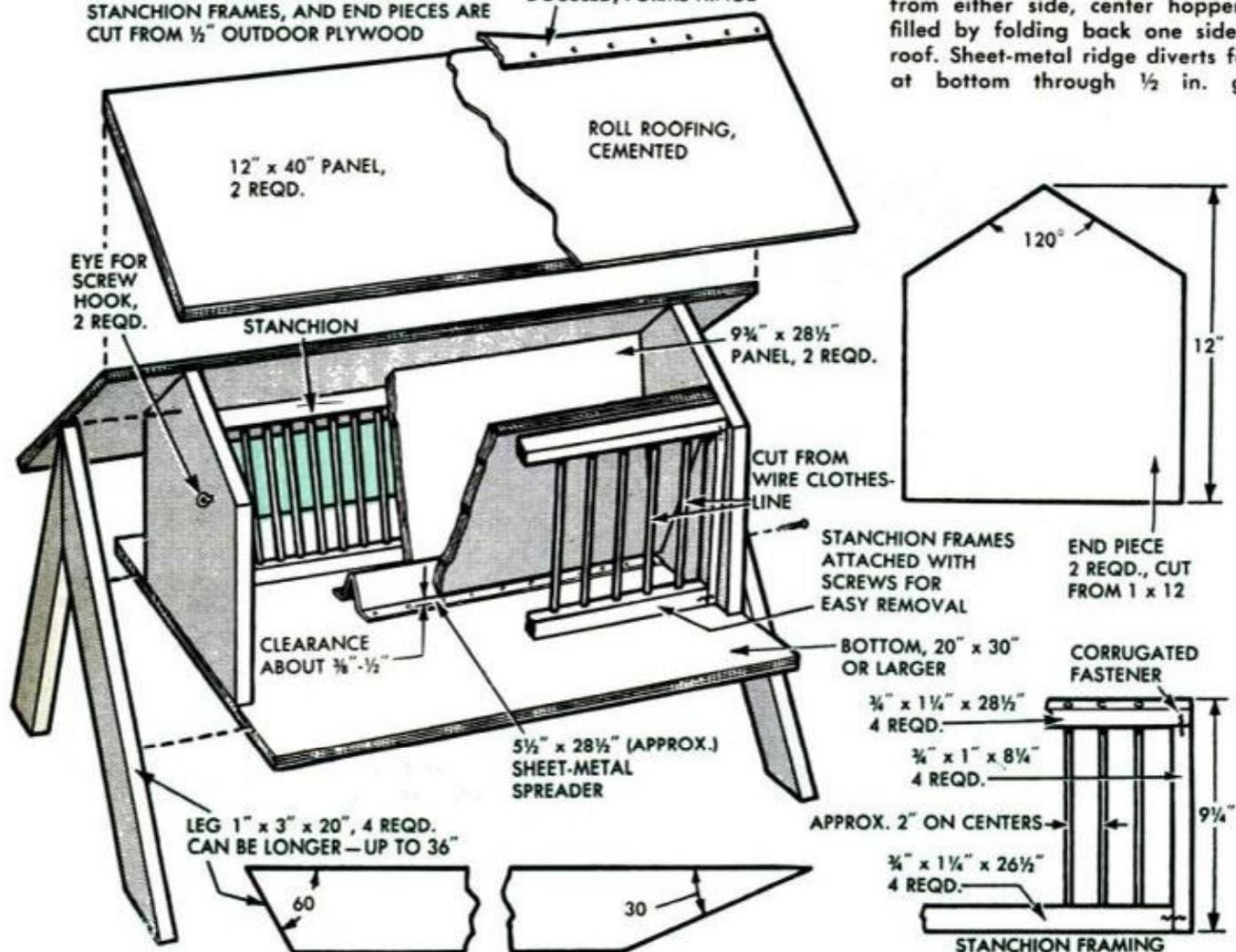


SELF FEEDER

IDEAL FOR BOBWHITE, western or valley quail, also seed-eating, non-migrant song birds. It's especially designed to feed small grains such as wheat, rye or barley, also mixed bird seed, sunflower seed and any of the seeds of the kaffirs. Accessible from either side, center hopper is filled by folding back one side of roof. Sheet-metal ridge diverts feed at bottom through $\frac{1}{2}$ in. gap

NOTE—ALL PARTS EXCEPT LEGS, STANCHION FRAMES, AND END PIECES ARE CUT FROM $\frac{1}{2}$ " OUTDOOR PLYWOOD

3" RUBBER BELTING, OR CANVAS DOUBLED, FORMS HINGE



should be placed at least a month before heavy snows and cold are due. And to make sure that the feeders will be strategically located where most needed, one must know the daily range of the birds, their feeding habits morning and evening, where they roost and how far they may range in search of food during any single day. This is easily determined by observation or from landowners, most of whom will gladly grant you permission to locate feeders on their properties.

Several pointers in the placement of the feeders are important to observe: As a rule, individual feeders should be located near natural cover frequented by the birds, such as a ditch or small waterway overgrown with shrubbery in which birds normally shelter during stormy winter weather. In the open near a thicket or at the edge of a wooded area also is usually a good location. But before you locate the feeder take careful note of the immediate area, and remember the quarter from which the most severe storms are likely to come. Don't place the feeder where drifting snow may cover it completely and remember to place it far enough from heavy cover so that predators will be forced into the open before they can come within striking distance of feeding birds. In some cases it may be best, because of an otherwise favorable location, to place the feeder close to natural cover and then erect a length of temporary woven-wire fencing which will force predators to make a detour and thus reveal themselves in time for the birds to get airborne. A few long stakes and a discarded



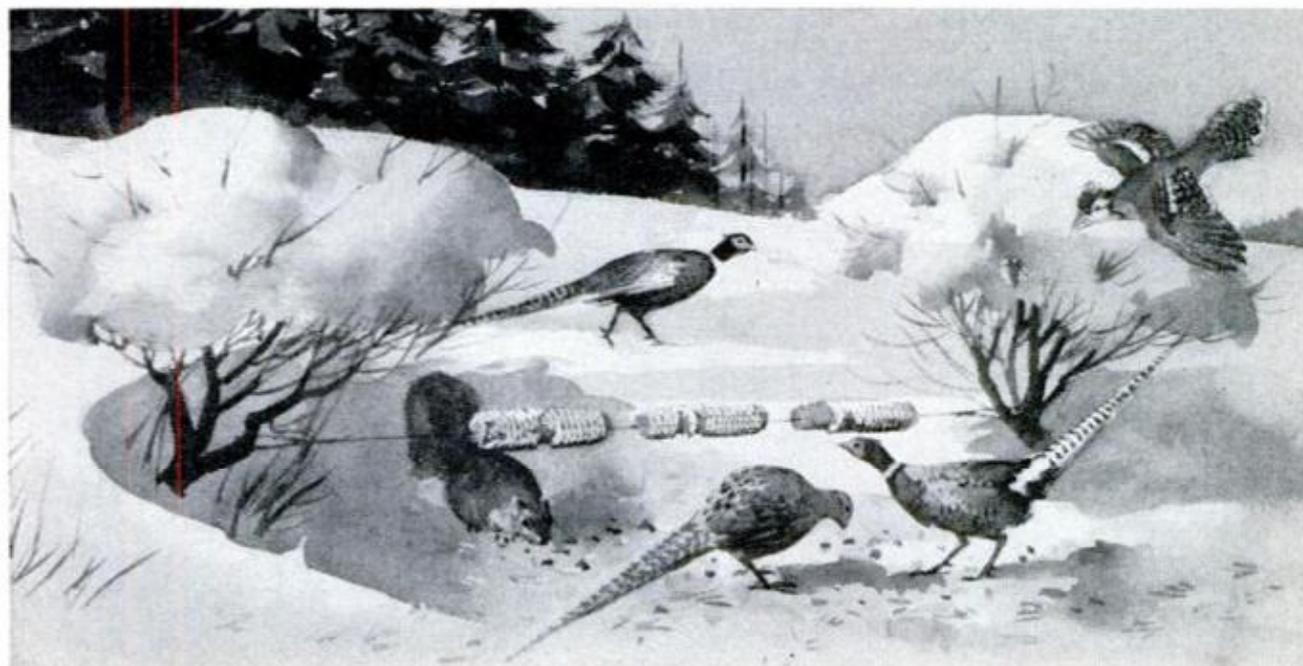
QUICKLY IMPROVED station for feeding prairie grouse, chukar partridge, pheasant, also suitable for quail and other smaller birds. Canvas or plastic supports tree branches to protect feed from drifting snow

length of poultry netting are all the materials you need for this protective screen against predators. Also, the feeders should, so far as possible, be placed in areas not frequented by livestock. Where this is unavoidable, it may be advisable to fence a small area in which to place the feeder. Get your landowner friend's permission before building a fence enclosing even a small area.

Several different types of feeders and feeding stations suitable for nearly all common non-migratory, ground-feeding game birds are shown here. Some of these are

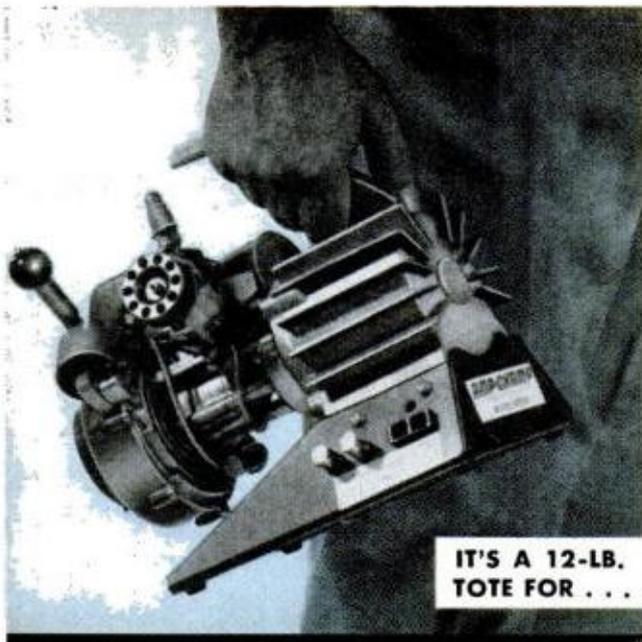
[\(Please turn to page 204\)](#)

STRING EAR CORN on a length of heavy wire and support the wire between two sturdy shrubs, one end of the wire attached to a spring to maintain sufficient tension to keep the corn above the snow. All feeders, of course, will attract other birds, even some undesirables such as crow, starlings which cannot be avoided

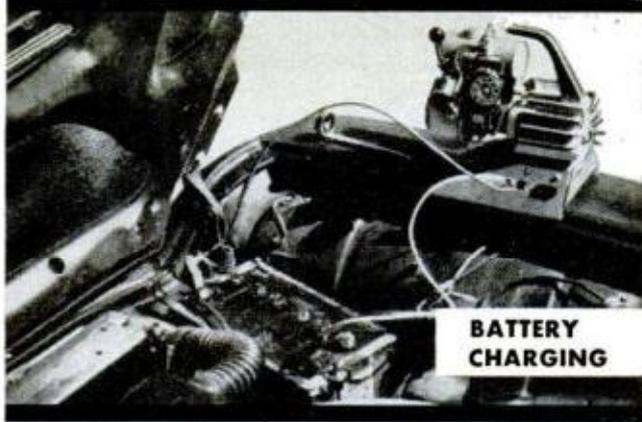


You Can Take It With You

Electric power, that is. Midget gasoline generator lets you plug into 350 watts for way-out jobs



IT'S A 12-LB.
TOTE FOR . . .



BATTERY
CHARGING



DECK
SANDING

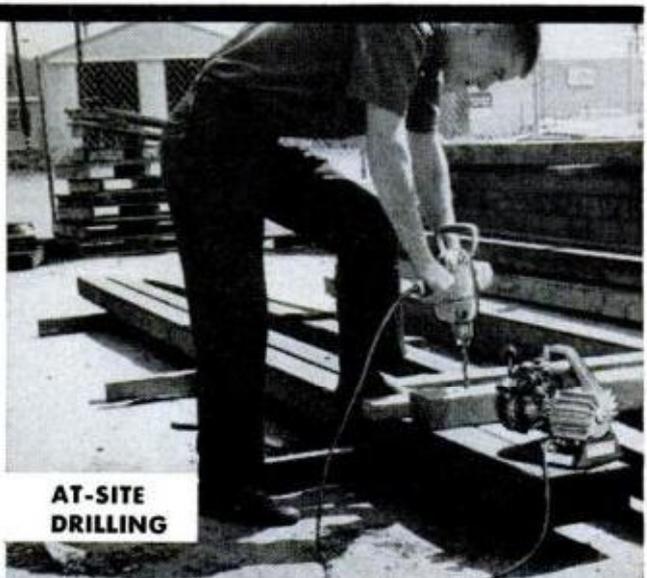


HEDGE
TRIMMING

YOU'RE NEVER BEYOND the reach of electricity with this portable power plant. Tuck it in with your camping gear, and you bring the comforts of home into the wilderness: your electric razor, hot plate, radio—even a plug-in blanket. Closer to home, the unit eliminates long, snarling extension cords for outdoor power-tool jobs. It will light up to seven 50-watt bulbs or three 100-watters, and power spotlights, spray guns or small pumps. For maximum efficiency, it's got three separate outlets—two 115-volt (one a.c., the other d.c.) plus a 12-volt d.c. for charging 6- or 12-volt batteries. Why two 115-volt take-offs? The 630-cycle a.c. output is fine for resistive loads such as lights and heating elements, but this frequency reduces the power of the universal motors on most portable tools; d.c. runs these best.

The detachable $\frac{3}{4}$ -hp. 2-cycle Ohlsson and Rice engine runs 5 hours on a gallon of regular gas, but you'll have to refill the tiny tank every 45 minutes.

Called Amp-Champ, the complete unit is sold at \$114.50 through a nation-wide chain of dealers. The manufacturer, Varo Inc., Box 1500, Santa Barbara, Calif., will supply the name of your nearest dealer.

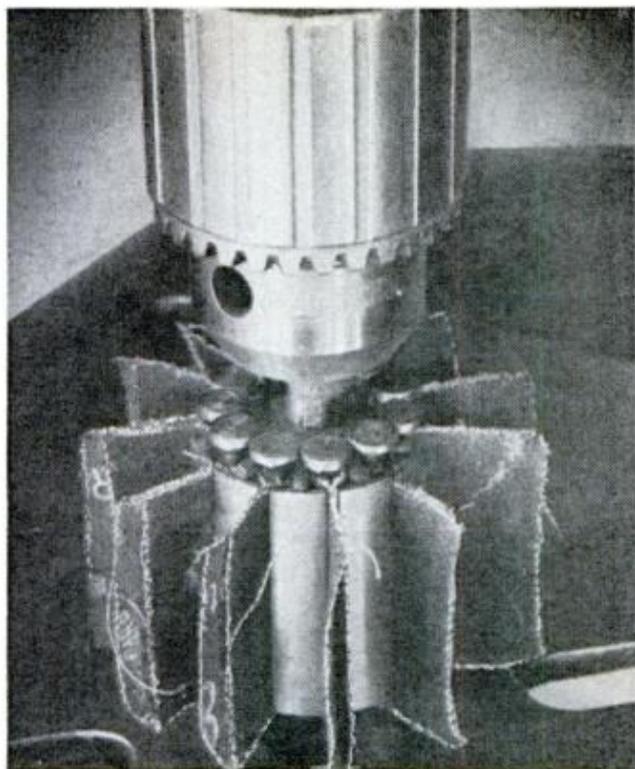


AT-SITE
DRILLING

From Armature to Sander

The armature in any small junk motor will make a dandy contour sander for your drill press. It's so readymade as an arbor that it requires little more than removing the copper windings and sawing off the commutator (photos below) to adapt it to the drill chuck. The equally spaced slots around the laminated core provide a perfect means for inserting loops of cloth-backed abrasive strips and locking them securely with retaining pins made from common nails.

Pick an armature having a $\frac{1}{4}$ or $\frac{3}{8}$ -in. shaft and slots wide enough to accept the doubled abrasive strips. After stripping off the wire windings and sawing off the commutator, shorten the pulley end of the shaft. Then insert the looped strips in the slots with the abrasive side out. A contour sander such as this makes quick work of sanding round and concave surfaces.—C. B. Dombrowski



NEXT MONTH IN SHOP AND CRAFTS

- ★ **WHO SAYS YOU CAN'T LAY CERAMIC TILE?** Many tile contractors contend that the average homeowner can't install ceramic tile himself. *PM* thinks otherwise, and in next month's issue you'll find a photo-packed, how-to article giving you the low-down on just how to go about it. For the full story on this material, get the February issue
- ★ **PORTRAITS LIKE THE PROS.** You can make studio-quality portraits with amateur camera equipment and inexpensive floodlights. Sound impossible? The secret is in the setup you use, and next month *PM* brings you a batch of valuable tips from a pro on the fine art of portrait photography. It's a must for shutterbugs, so be sure to pick up a copy next month
- ★ **OUTRIGGER SKI SLED.** Here's a sled design that is ideal for light snow. Instead of bogging down like a normal steel-runner sled, this novel speedster glides along like greased lightning on its broad center runner. It steers by leaning, just like a skier, and includes slim outrigger skis to prevent spills. Don't miss this winter special for the kids
- ★ **DIAL THE RIGHT SPEED.** No longer need you switch the belt. This variable motor control for your drill press will provide a range of speeds from below 1000 r.p.m. all the way up to 10,000 r.p.m. at the twist of a knob. It's made from a pair of old vacuum-cleaner motors, a silicon rectifier (SCR) and a few other low-cost parts. Watch for this shop special



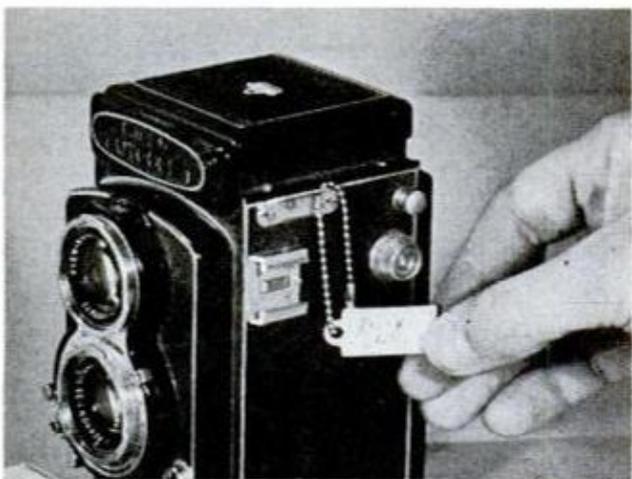
Jar Keeps Meter Dry

The home aquarium is a favorite photographic subject. It is especially striking when color film is used, but determining the proper exposure is a tricky job. You can get perfect underwater readings if you place your exposure meter in an airtight jar such as is used for home canning, and submerge the jar in the aquarium. In using this technique, the best results are obtained with an incident light meter or a reflected light meter fitted with an incident attachment.—*Peter E. Lunt*



Leader Tells All

Photo fans who bulk load their own 35-mm film often use a variety of cartridges that originally contained films of different types. This can lead to uncertainty as to the type of emulsion, length of film that has been loaded and the speed rating. In order to avoid confusion, use a felt marking pen to record on the leader the type of film, exposure index and the number of exposures. If desired, a code may be used to make it possible to abbreviate this information.—*Ken Patterson*



Film Reminder

If you use your camera infrequently and only take a shot now and then, there is always the chance of forgetting what type of film is in it. A miniature automobile license tag serves as a reminder. Open the tag and discard the paper indicating the license number. Replace it with a strip of paper showing the type of film being used. It is a good idea to make separate tags for each type of film that you ordinarily use. When you load a new roll fasten the proper tag to your camera with a key chain.



Polaroid Print Straightener

For Polaroid-Land camera users here's a jig to straighten prints instead of using the edge of the camera. It is made from a sheet of $\frac{1}{8} \times 2\frac{1}{2} \times 4$ -in. plastic. The top edge is rounded and smoothed. Two clothespins are used for supports. The heads and bodies of the pins are filed flat on one side. The plastic is then attached with roundhead screws. The jig is extremely compact, fits snugly on the camera case when in use and gives much better results than the usual straightening techniques.—*Peter Legon*



New for Camera Buffs

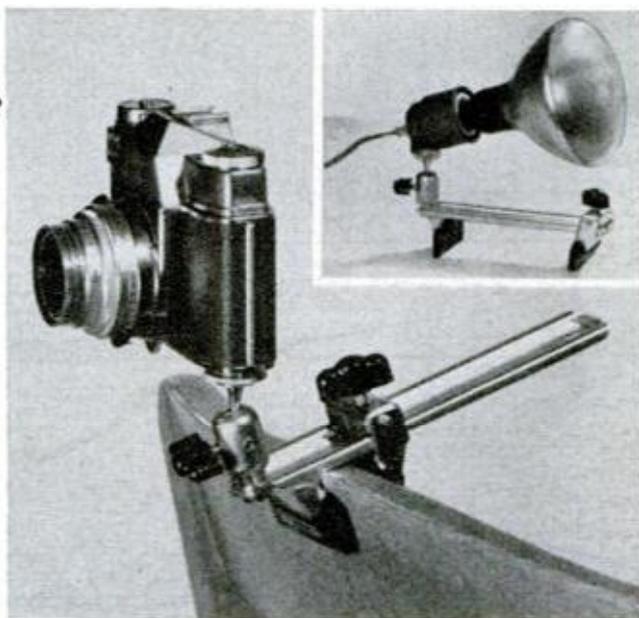
LATEST WESTON METER, the Master V, features a film speed lock which prevents accidental changing of ASA setting. Reads up to ASA 16,000. The calculator dial is calibrated in $\frac{1}{2}$ stops, for easy reading with any camera. Price is \$36.95. Weston Instruments, 614 Frelinghuysen Avenue, Newark 4, N.J.

THE CLAMP-IT makes a tripod or light stand out of almost any object up to 5-in. thick. PM editors found the clamping action of the jaws gave excellent rigidity when used on chairs, table edges, door frames, etc. With jaws spread apart, it becomes a handy table-top stand. Sells for \$6.95 with light cord and socket. Imported by Accura Ltd., 708 Byron Avenue, Franklin Square, Long Island, N.Y.

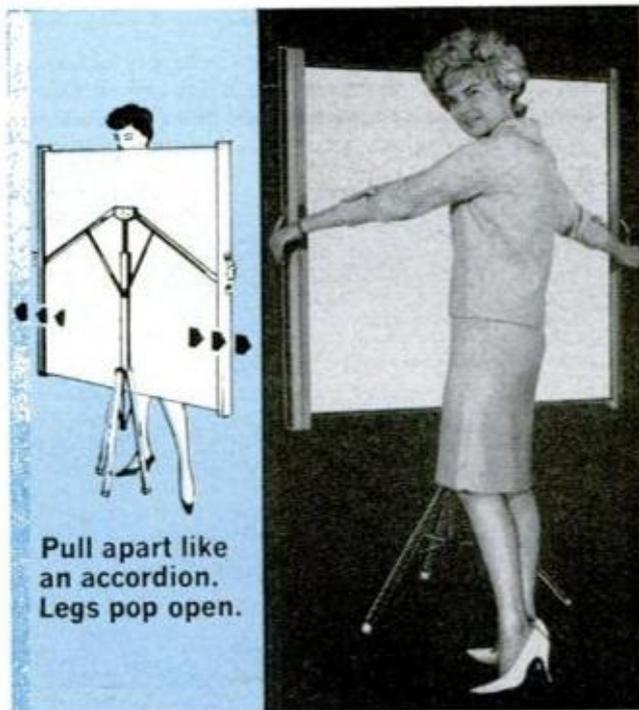
ROTOWASHER removes hypo from any size print up to 11x14 in. Its rotating inner tank repeatedly passes the prints under jets of water which keep them separated while washing them. Retail for \$29.95, at dealers. Made by Columbian, Terre Haute, Ind.



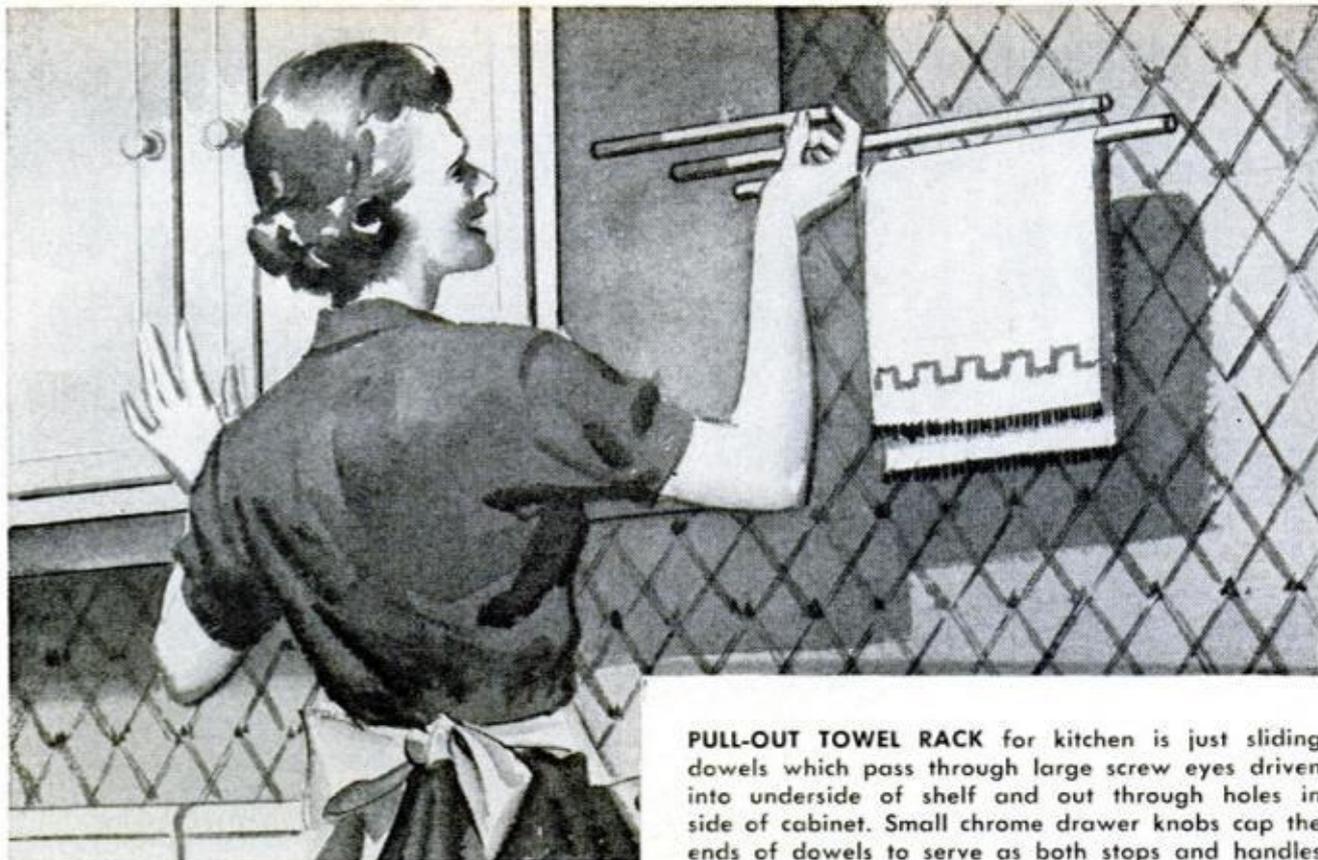
COOLEST PHOTO ACCESSORY GOING is the Bantam Fridge, which will protect your color film in hot weather. Operates off house current or the cigarette lighter socket of your car. Holds up to 204 cartridges of 35-mm film. Retail price is \$64.95. From Bernzomatic, 740 Driving Park Avenue, Rochester 13, N.Y.



AUTOMASTER PROJECTION SCREEN is said to open in 2 seconds. You hold the screen case by the handles and pull apart. Tripod legs spring open automatically and full screen is exposed. Made in 40x40 and 48x48-in. sizes, for \$44.95 and \$54.95. Radiant Mfg. Corporation, 8220 N. Austin Ave., Morton Grove, Ill.



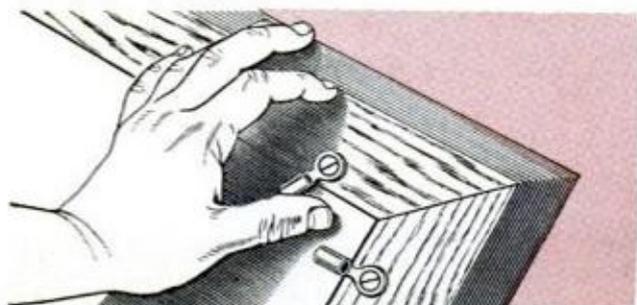
Pull apart like
an accordion.
Legs pop open.



PULL-OUT TOWEL RACK for kitchen is just sliding dowels which pass through large screw eyes driven into underside of shelf and out through holes in side of cabinet. Small chrome drawer knobs cap the ends of dowels to serve as both stops and handles

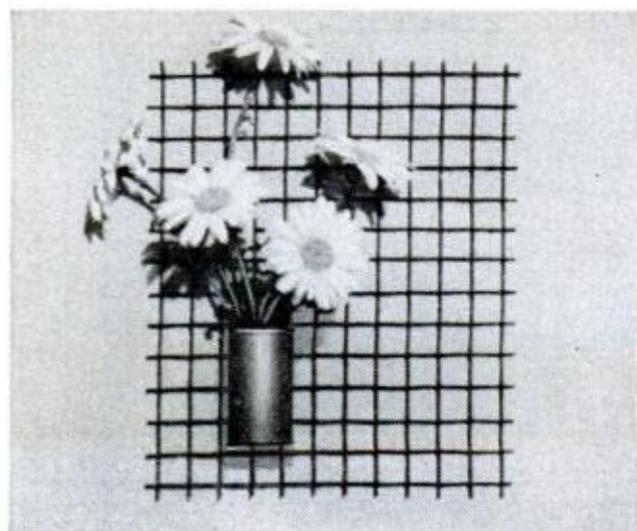
NEED A QUICK-CHANGE fastener for holding pictures in frames? Try using electrical terminal lugs. Just drive a short screw through the flat part leaving it loose enough so the tail will still pivot easily

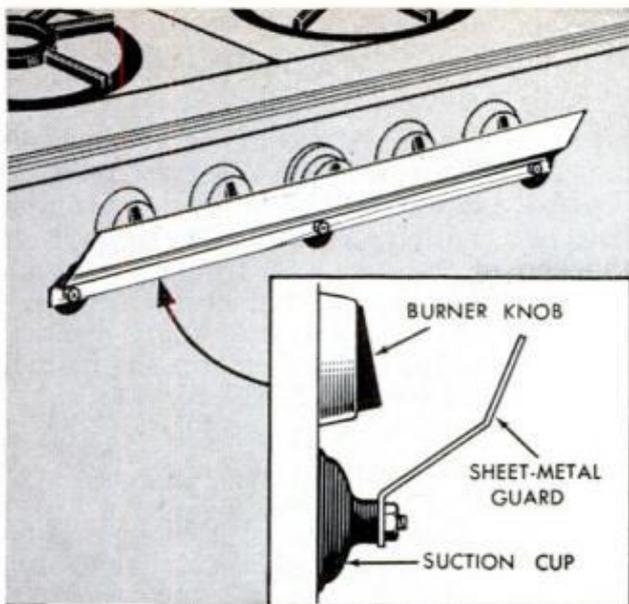
Solving HOME PROBLEMS



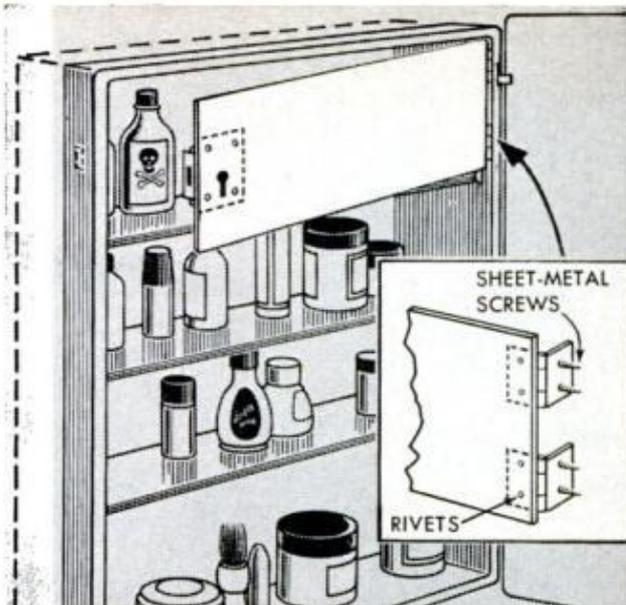
MOTH STRIPS can be hung anywhere protection is needed. To make them, press strips of invisible mending tape into camphor flakes, then drape them over hangers on which you store woolen garments

YOU CAN MAKE an attractive hanging wall vase by mounting a small can (the type in which frozen fruit juice is sold) on 1-in. mesh hardware cloth. Simply wire can to cloth and finish with flat black enamel



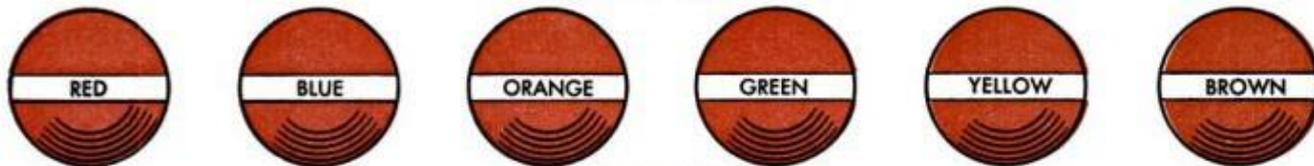


CHILD-PROOF the controls of your gas stove with a shield which makes them inaccessible from below. To make it, cut and bend a piece of sheet metal as shown above, then add suction cups for mounting

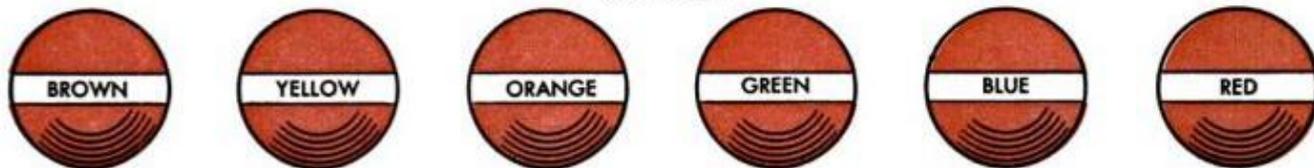


SAFETY SHELF for your medicine chest holds dangerous medicines under lock and key. Just cut a sheet-metal door large enough to cover the top shelf, mount it as shown and add a small cabinet lock

ORIGINAL COLORS

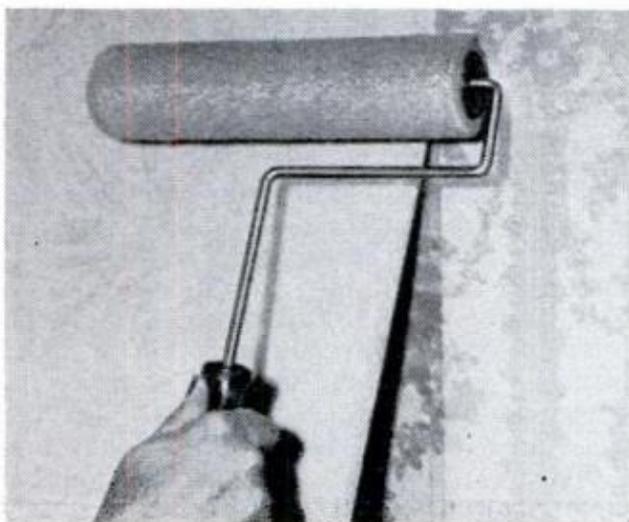


REPAINTED

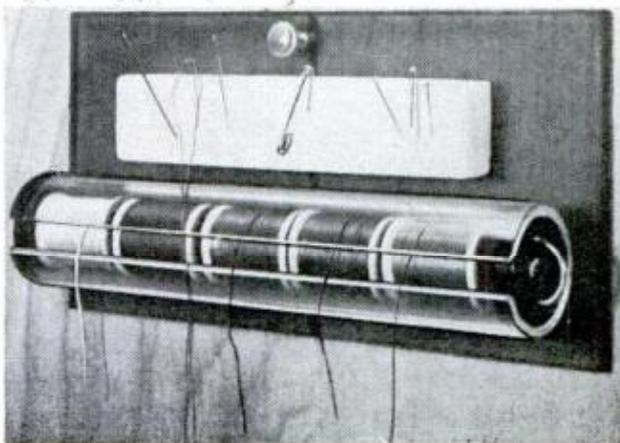


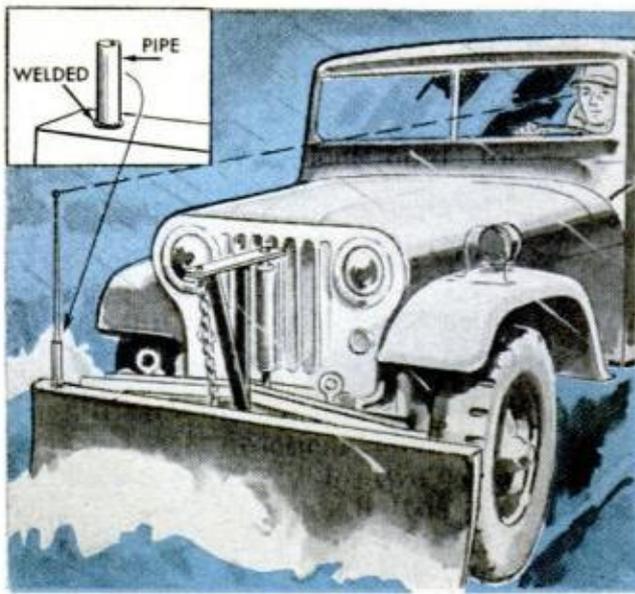
NOBODY KNOWS WHY, but in any croquet game red and blue are the most popular colors, so after a season's play these two balls will begin to show excessive wear. You can add years to the life of your croquet set if you repaint the balls every season, switching the colors as shown so wear is evenly spread

HERE'S A TIP that might come in handy if your spring redecorating plans include wallpapering. A paint roller of the type used to apply enamel makes a fine tool for smoothing out bubbles under the paper



HANGING SEWING CADDY has foam-plastic block for pins and needles, 1½-in. slotted plastic tube to dispense thread. Dowel with push-on end caps fits snugly inside tube. To hold as many as five spools.





Antenna Aids Snowplowing

The hood on a vehicle used for snowplowing may block the driver's view and make it difficult for him to see the plow. A discarded automobile radio antenna can be used as a marker to indicate the position of the end of the blade. A pipe about 5-in. long, having an inside diameter which permits a snug fit for the antenna, is welded to the top of the blade. The antenna is then inserted and extended.—*Victor Lamoy*

A beer can opener is a handy item for your toolkit. Use the pointed end for stripping old putty from window sash or widening cracks in plaster walls before patching. The other end can flip off paint can lids.



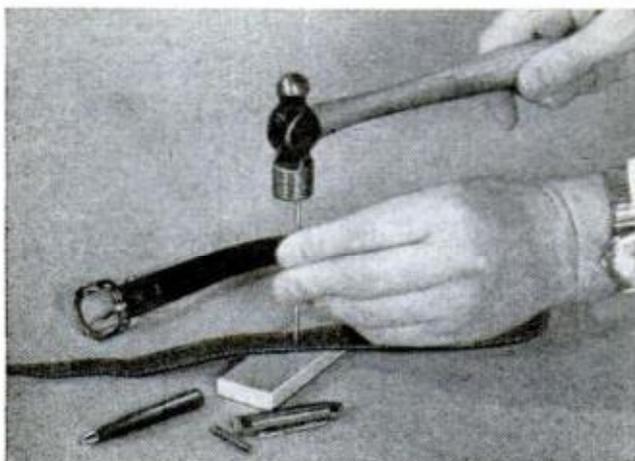
Brush on Joint Cement

When putting up gypsum board, it is difficult to obtain a smooth joint at the corners unless you are very experienced at smoothing the tape and joint cement. To overcome this, mix up a small quantity of joint cement to about the consistency of a thin pancake batter, then apply this mixture to the corners with a small paint brush. This will fill the corners neatly, leaving a concave fillet and also fill in small holes caused by air bubbles.



Easy Car Wash

Does your car need a bath? If you've been putting off the job because of the elbow grease that's required, here's a way to make it a real breeze. Just add a couple of drops of turpentine to the wash water. This will effectively cut through road grime, tar and bird droppings and also prevent spots from drying on the car's finish. After washing and a thorough rinsing, wipe the car with a damp cloth. The result is a high shine with absolutely no spotting.—*Duane C. Honsowetz*

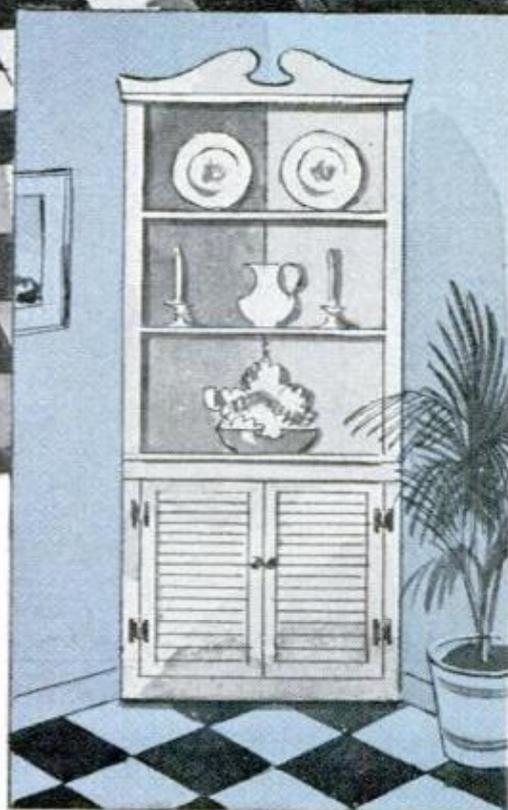
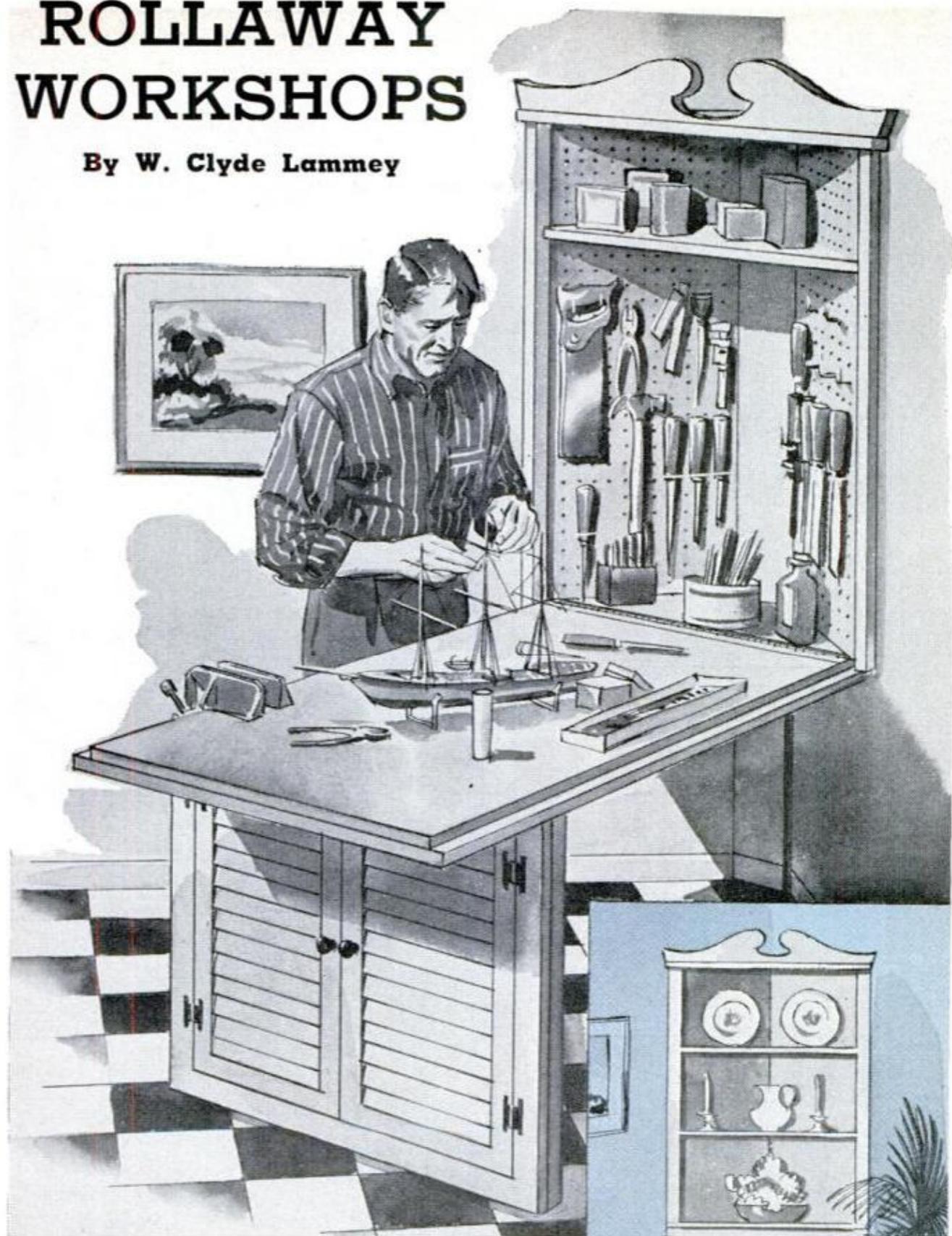


Pen Leather Punch

When your ball-point pen runs dry and it's time to put in a refill, don't discard the empty cartridge. It makes a handy tool for punching extra holes in leather or plastic belts and straps. Place a piece of scrap softwood under the material that is being punched to cushion the point of the refill when it cuts through. Then hammer the refill as shown in the photograph. A few light taps are all that is needed to cut a clean, round hole, even in fairly heavy leather.—*Ken Patterson*

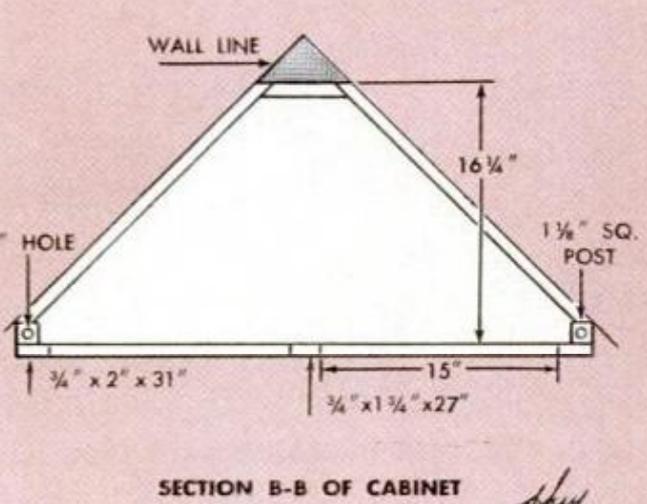
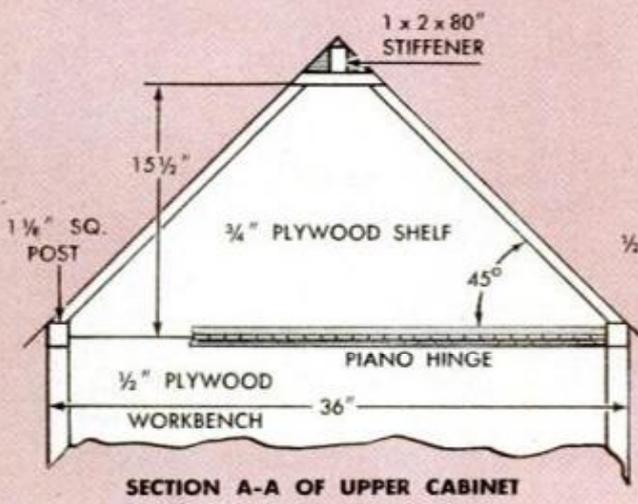
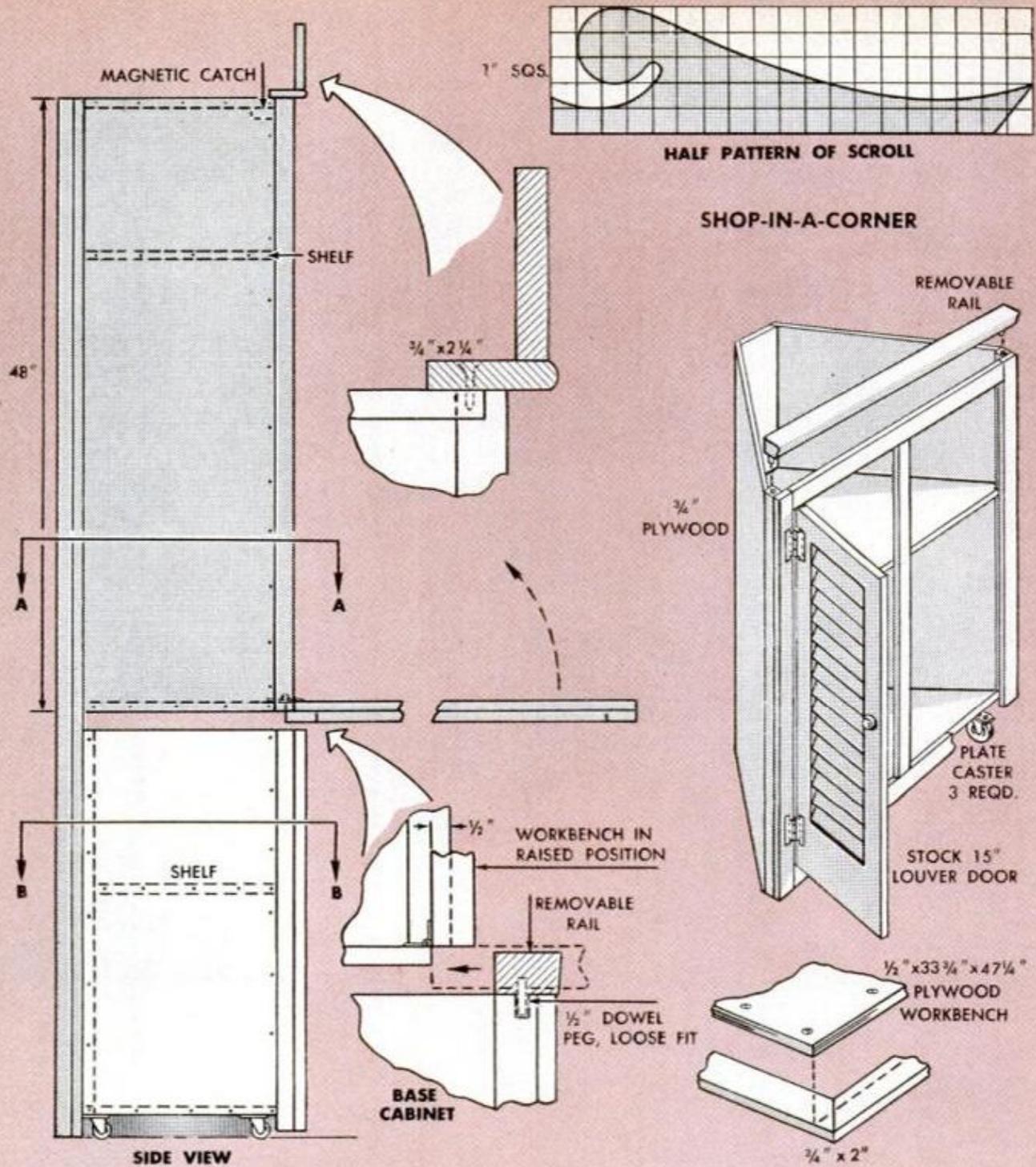
ROLLAWAY WORKSHOPS

By W. Clyde Lamme

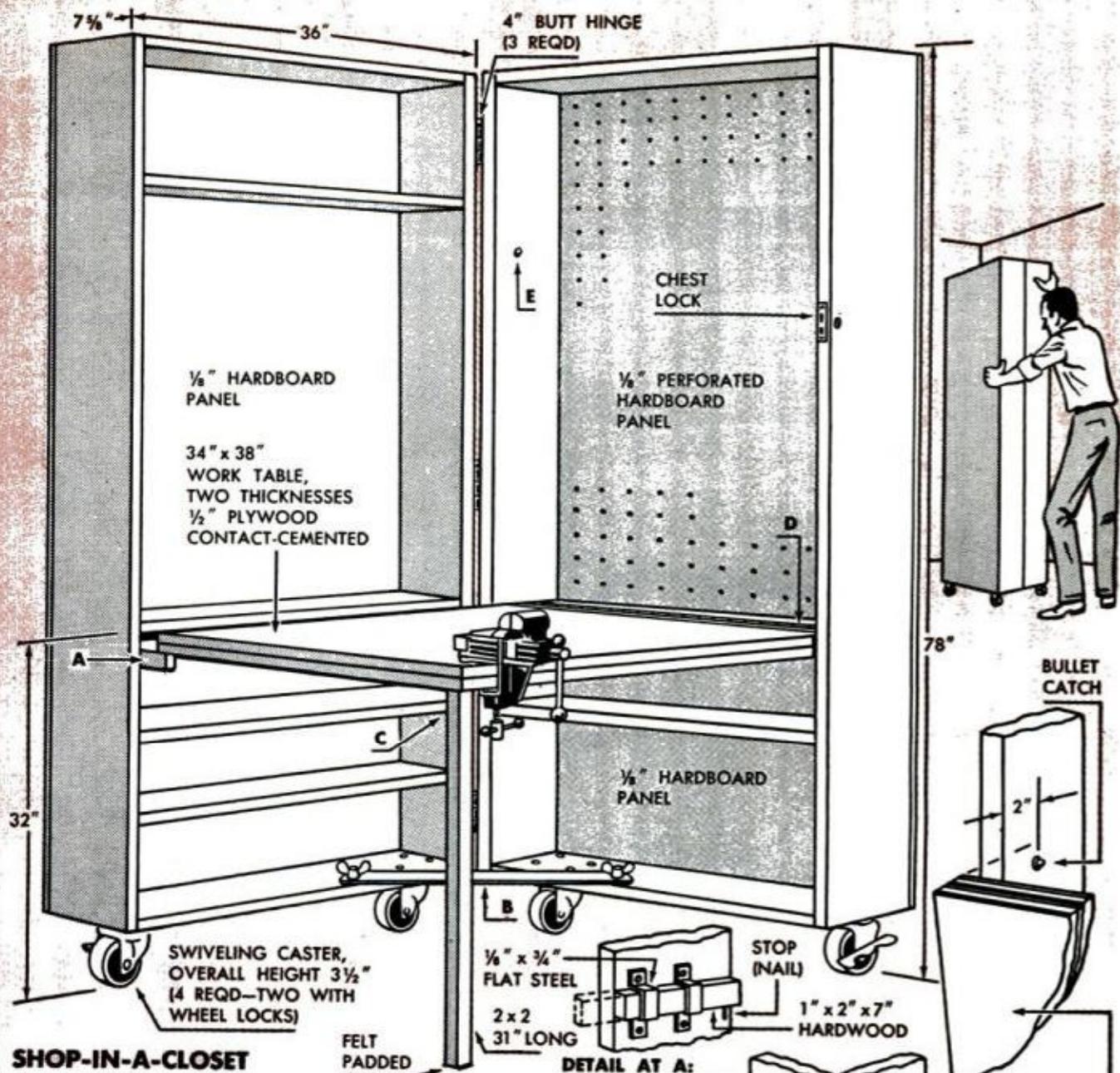


WHERE there is no basement or even a garage, and when nearly every foot of available space is in daily use, how can one hope to find room in a small home for a place to keep things in repair?

The answer may be a stow-away workshop which can be closed up like a salesman's sample case and parked in a closet like a roll-away bed. Or, one that masquerades as a corner cabinet when put away. On the next few pages, you have your choice of two



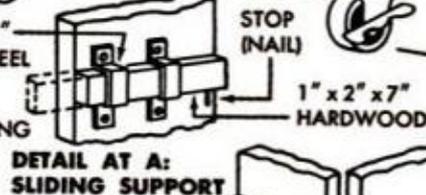
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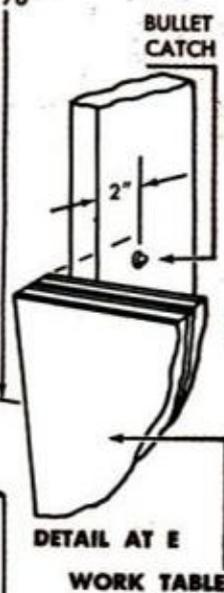
SHOP-IN-A-CLOSET

such compact workshops, plus a tool caddy which you can park behind a door and roll out when something needs fixing.

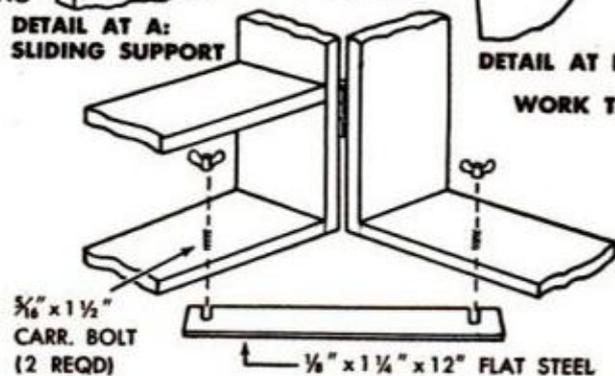
The shop-in-a-closet detailed on this page, opens and closes like a book on wheels. When closed, it's a mere 16 in. thin, yet when open it provides a workbench, a built-in toolrack and shelves where you can keep everything right before you. The supporting outboard leg for the double-thick bench is attached with a special self-locking bracket which keeps it from being kicked out from under, yet lets the leg fold flat against the underside of the bench when stored. A pullout slide bar supports the opposite corner of the hinged bench. The two halves of the unit are held at right angles with a detachable steel brace, and casters with wheel locks keep the unit from rolling about while you're using it. The whole thing is of simple box con-



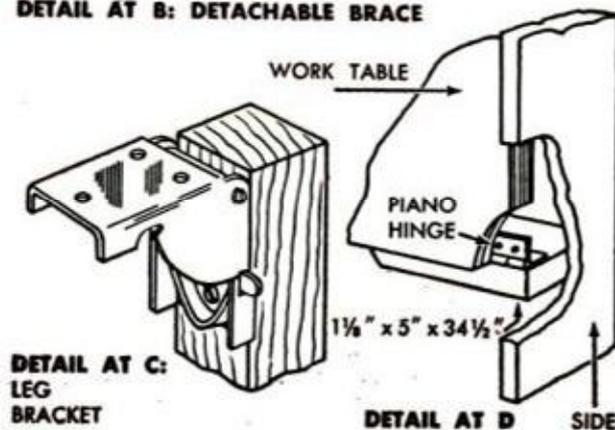
DETAIL AT A: SLIDING SUPPORT



DETAIL AT E: WORK TABLE



DETAIL AT B: DETACHABLE BRACE



DETAIL AT C: LEG BRACKET

DETAIL AT D: SIDE

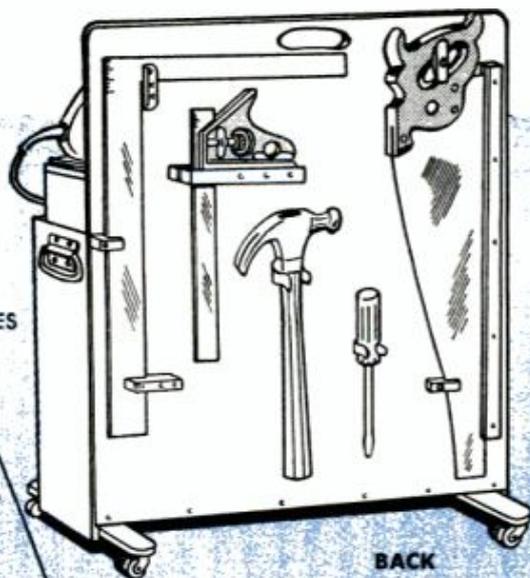
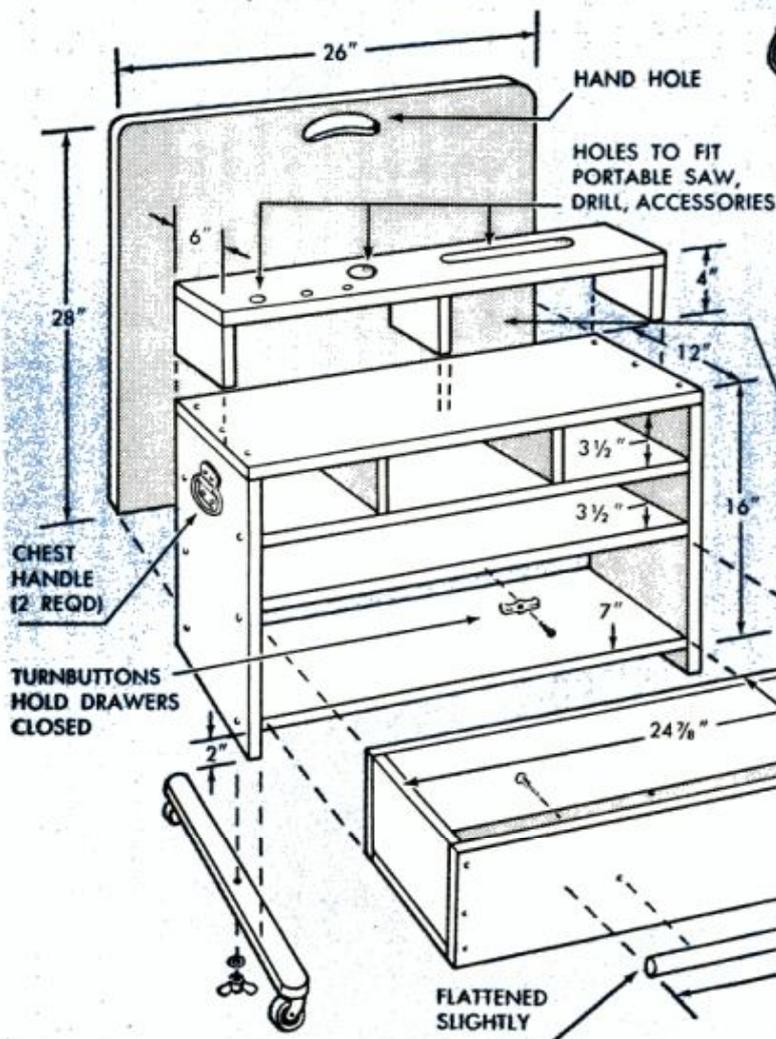


FRONT

struction, with butt joints merely glued and nailed. Note that a portion of one section is covered with perforated hardboard to provide a tool panel. A regular mortise-type chest lock holds the two sections closed.

Posing as a china cabinet, the shop-in-a-corner makes the most of waste space and has everyone fooled until a close look reveals that the front is false and the "china" is merely cemented on. As a fix-it center or hobby bench, it's a most practical idea. The cabinet is actually in two separate parts. The upper half is permanently attached to the wall, while the lower half is on casters so it can be pulled out to support the drop-front bench. The rail across the top of the lower section serves to fill the gap between the two sections when in the closed position. Held with pegs, it's a loose fit and is removed

SHOP-IN-A-CART



BACK

FOR CORD STORAGE

ALL PARTS MADE FROM 1/2" PLYWOOD AND SOLID STOCK BUTT-JOINED WITH SCREWS AND GLUE

each time to permit the bench to rest level. The plywood side pieces of both upper and lower sections are joined to 1½-in.-square posts at the front. Note that the back piece of the upper cabinet extends to the floor as a leg and is fitted with a 1 x 2 stiffener its full length. This member helps support the weight, and provides a stop when the lower cabinet is parked under the upper one. Both cabinets measure 36 in. wide and are built around triangular shelves cut to size from a full-size wrapping-paper pattern.

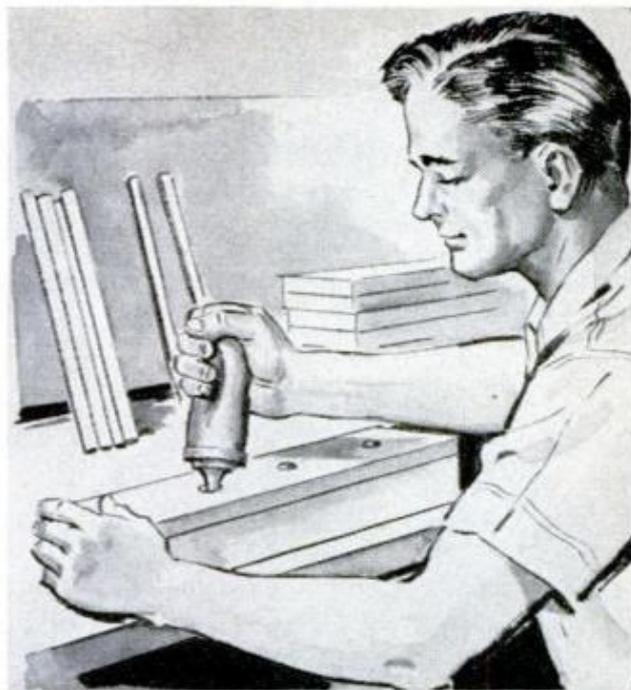
The drop-front workbench is a ½-in. plywood panel to which ¾ x 2-in. trim pieces are applied to the face side all around. Note that the pieces are kept flush at the top and bottom but overhang the sides so as to lap the posts and appear as continuing pieces of the lower cabinet when the front is swung up. The workbench surface is hinged to and flush with the bottom shelf of the upper cabinet and is held shut by a magnetic catch installed at the top.

Lagscrews are used to hold the upper half of the cabinet to the wall. One turned through each side of the cabinet so it enters a wall stud will be adequate since most of the weight is carried by the corner leg. Use washers under the lagscrews so you can pull the heads up tight against the plywood sides.

Shelves for the china are merely ¾-in.-sq. strips applied across the face of the plywood and the illusion of depth is created by painting one half of the panel a slightly darker color. Plates of plastic dinnerware are merely cemented in place with epoxy cement. Such pieces as cups, bowls and the like can be sawed down the middle and the halves cemented in place. These pieces should be placed on the lower "shelves" so they are not in the way when the front is lowered to rest on the pull-out base.

Minimum Shop

The shop-in-a-cart detailed at the left, is about the bare minimum in a work center. However, it does fill the bill as a place to keep tools and supplies even though it does not provide any kind of a work bench. It does feature five handy storage drawers, detachable casters, a rack for portable electric drill and saw with accessories, and a place to hang hand tools on the back. Heavy chest handles enable you to pick up the whole thing and carry it wherever it may be needed. Use ½-in. plywood for the cabinet and back piece, solid stock for the drawers (except bottoms), and the tool rack. Join all butt joints with glue and screws for maximum strength. ★★★

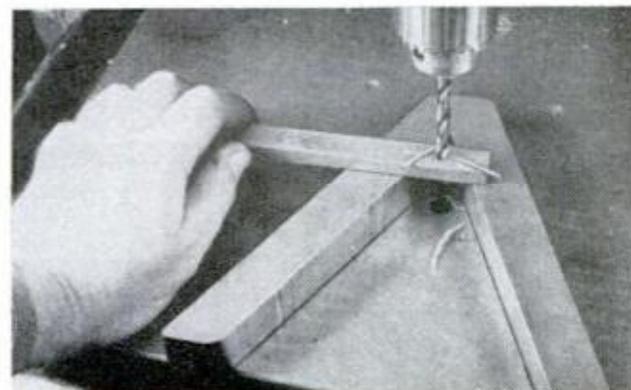


Glue Bottle for Holes

What happens when you apply glue to dowel holes with a regular squeeze bottle?—most of it spurts to the bottom of the hole, with little on the wall where it counts. In our toy factory we made our own special glue dispensers for coating holes. We took catsup squeeze bottles, bored four ⅛-in. holes around each spout and plugged the end. Now a squeeze of the bottle shoots glue out the side of the spout to coat the sides of the hole, not the bottom.—*John J. Maendel*

One-Piece "Parallel"

This V-shaped one-piece "parallel" is a big improvement over the conventional separate type. It is very stable and adaptable to many different sizes of work. When you are drilling small holes, you simply work close to the apex of the V. For larger holes, the work is moved toward the wider section. I made mine by sawing it out of a piece of scrap plate stock on a metal-cutting bandsaw. If you prefer, two separate pieces may be welded.—*H. J. Gerber*



New on the Market

RE-STYLED SAFETY GLASSES look like ordinary spectacles and weigh only $\frac{3}{4}$ oz.—considerably less than standard safety goggles. Recommended for spot welding, buffing, woodworking and other semi-hazardous jobs. Cost \$6.00 a dozen. General Scientific Equipment, Limekiln Pike & Williams Ave., Philadelphia, Pa.

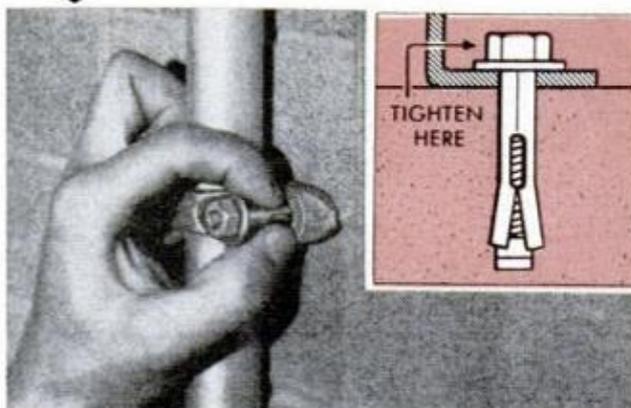


MASONRY ANCHORS, called Dynabolts, give up to 15,000 lbs. of holding power, according to the manufacturer. When you drop one into a hole and tighten the head, the bottom expands as shown. Made in over 50 sizes and styles, selling for 14¢ to \$1.75 each. Winchester-Western Div. of Olin, New Haven 4, Conn.

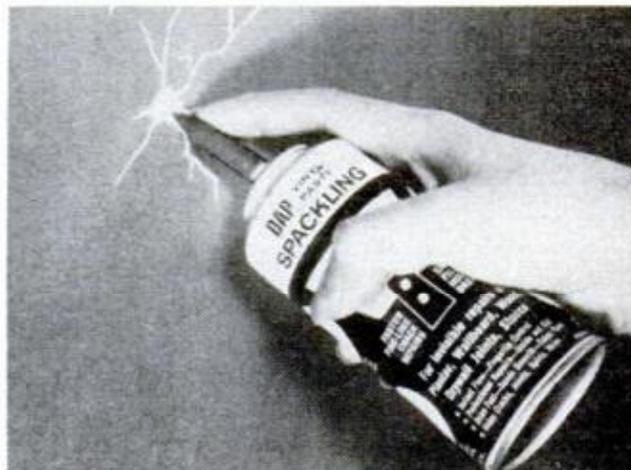
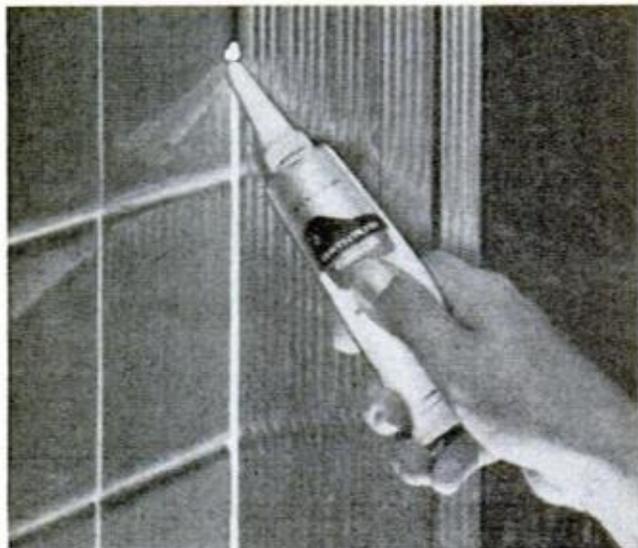


MAKE AN UNUSUAL WALL CLOCK from a discarded phonograph record with this parts kit. Includes hands, hour markers, colored disc for end of second hand and a U.L. approved electric movement. Price is \$4.95. Kits available to fit any standard-sized record. Morse Products, 12960 Bradley Avenue, Sylmar, Calif.

WHITE BATHTUB CALK hardens into a permanently flexible silicone rubber bead that is said to compress and stretch readily to accommodate swelling or shrinking of wood, vibration of the wall or other movement. Bonds to tile, metal, brick, most plastics, glass, etc. Costs \$1.98. Dow Corning, Midland, Mich.



WHITE VINYL SPACKLING COMPOUND now comes in this pressure can for greater convenience. Two interchangeable nozzles adapt flow to the job you're doing—needle-nosed for small cracks, flat-nosed for joints and patches. Compound can be painted almost immediately. Sells for \$1.39 a can. Dap Inc., Dayton, Ohio



AUTO CLINIC

Q Why does my 1957 Chevrolet V8 overheat in winter and not in summer? In cold weather, I put in a 180-degree thermostat in place of my usual 160. No cooling system problems here—I've checked. And this is the second 180-degree thermostat I've used in two years.—J.C.A., Penna.

A Bet you're buying a bellows-type thermostat. This model Chevy has a gooseneck affair in which the thermostat sets. This gooseneck won't let the cover of the bellows open all the way, so overheating results. Switch to a pellet type thermostat. It has a little door on top that opens by tipping sideways, and the gooseneck can't interfere.

Q Tire wear on my 1962 Pontiac Tempest station wagon is knocking holes in my budget. Is this a problem with this car because of the transaxle?—R.L., Mo.

A No it isn't—unless you're carrying a load in that wagon most of the time. The independent suspension system would cause excessive tire wear only if a load were placed on it constantly. And this could happen even if you'd just had the wheels aligned, since alignment is usually done with no load on the vehicle. Weight can throw alignment off. The best solution is to add a helper spring or stiffener bar to offset the weight.

Q I've changed fuel pumps in my '58 Dynamic Olds four times in 32,000 miles. After about six months of use, each of these sent oil spewing out their vent openings. What's up?—E.J.P., Calif.

A Apparently the diaphragms of these pumps are rupturing, due to a build-up of internal pressure. The first thing to do is have the road draft tube (which drops down vertically from the rear of the engine) cleaned out. Then clean the oil filler cap in gasoline. It's through these two that an engine breathes. When clogged, they would cause pressure build-up. If this doesn't work, clean the engine with a commercial chemical engine cleaner. As a last resort, you may have to take the car to an engine specialist for a thorough internal cleaning.

Q I've got a strange problem with my 1958 Plymouth. The car starts right up on even the coldest mornings. But after I run it awhile and stop, it's a chore to

start it again. If it sits long enough to get absolutely cold, no trouble. I've had the car to several mechanics at quite an expense. I'm going broke. Help!—T.J.H., Vt.

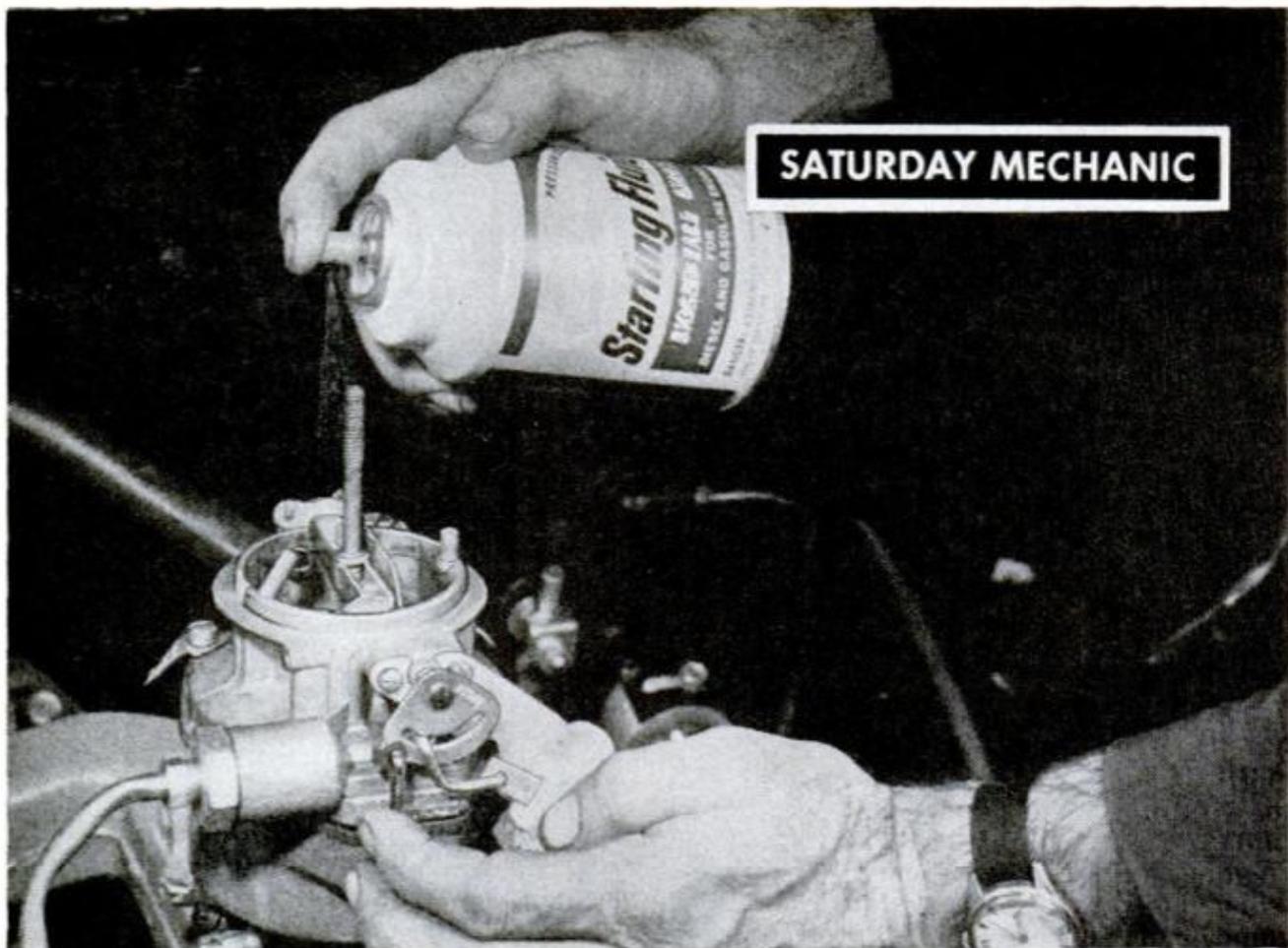
A In pure and simple terms, the engine's flooding. These cars (the problem extends to the Valiant, too) build up a great deal of pressure in the fuel system . . . anywhere from 6 to 9 pounds. The pressure bears against the carburetor needle valve and causes carburetor flooding. This explains why the problem occurs after the car's been run and not when it's first started. Pressure builds up on the run and gradually recedes as the engine sits in a shut-off condition. Check your fuel line to see if it has an in-line fuel filter. No? Adding one may take the pressure off the needle valve. If not, you'll have to drill a 20,000ths hole in the fuel pump between the intake and outlet valves. Drill the hole through the small wall separating the two valves. Pressure will escape through here, taking it off the needle valve.

Q I've isolated and corrected all rattles on my '60 Chevrolet but one. It seems to come from the steering column and occurs only at low acceleration in third gear. I've tightened and lubed all linkages, but it doesn't help. What will?—P.J.O., N. Y.

A The rattle is probably coming from the shifting tube beneath the firewall at the lower part of the steering column. There's an adjustment here which has to be made. If you'll examine the area, you'll see two $\frac{7}{16}$ -in. cap screws. Loosen both and rotate the column to tighten up and put a drag on the two levers protruding from the column. Tighten the cap screws once again, but back them off so only a slight drag is left on them.

MONTHLY SERVICE TIP

★ If you're experiencing hard starting, no starting or engine cut-out with your 1963 Plymouth, Valiant, Chrysler or Imperial, look first to the coil. Check for two numbers—the coil identification number, which is printed on the coil housing, and the build date code, which is located to the right of the identification number where the coil towers upright. If your coil identification number is 2095223 and the build date code is anywhere from 08-3 through 18-3, replace the coil with a new one, (part no. 2084847). The old coils are said to be faulty. However, all coils that have an identification number of 2095223 but a build date code of 19-3 or later are OK.



QUICK—BUT RISKY? If the first squirt or two of ether spray doesn't work, carb icing isn't your problem

Hot Tips for Cold Starts

Of the many home remedies and commercial gimmicks for getting your car started these mornings, some are useless, some dangerous—but some really work

By Morton J. Schultz and Harris Edward Dark

IT'S A FREEZING MORNING, and you stayed beneath the warm covers a bit too long. Not long enough to be late for work, but there's no time to linger.

A quick shave, a quicker gulp at the coffee, and you're off like a shot, trailing puffs of breath-vapor as you race to the garage. But that's when the "shot" fizzles. As you twist the car's ignition key, the engine gives a few short gasps as if it too wants to stay "in bed" on this biting-cold day, and then . . . silence, broken only by *your* gasps of anger and frustration.

You could, of course, call the local service station. But you know there are probably hundreds of others in the same fix this morning. The service truck will get there, sure . . . along about noon.

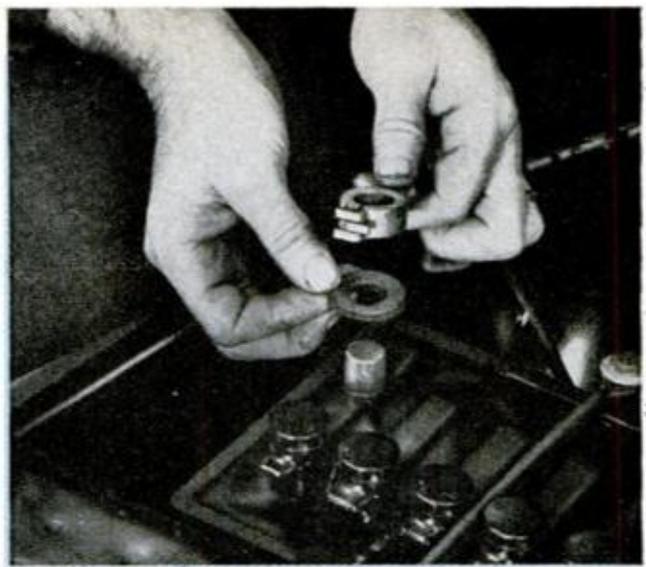
Or you could put some simple automo-

tive know-how to work and get yourself started. After all, there isn't much a local mechanic can do away from his shop that an average driver couldn't do for himself.

PM polled road service men throughout the U.S. cold belt and found that their cold-start procedures were pretty standard: If your car won't crank, they first hook up a booster battery. If your engine doesn't respond at once, off comes the air filter so the choke can be held either open or closed (opposite the position it was found in) while the engine is given another whirl. If this fails, the distributor cap is removed and the engine cranked again to see if the points are making and breaking. If they aren't, an adjustment is made. And if that doesn't do the trick, up backs the tow truck.



TRICKLE CHARGERS range in price from \$6 to \$30. One above is cheaper type you can use only with a 12-volt battery. Others work with 6-volters as well



BATTERY TERMINAL pad fits under clamp to cut down corrosion. Best type are treated to neutralize acid—and change color when they ought to be replaced

Once in the shop, your car will almost always get a spark plug job. If you won't stand still for complete replacement, it'll be cleaning and regapping. Meanwhile, somebody's probably hooked up the battery to a fast charger—and this can damage it if it's still at zero-or-below.

By the time you drive out of there, you may have spent good dough for plugs, points, battery charge, oil change, carburetor adjustment or one of the many cold-weather additives or gimmicks for sale at garages. One thing you *won't* drive out with is a guarantee your car will start on the *next* cold morning. So it pays you to know what you can do for yourself.

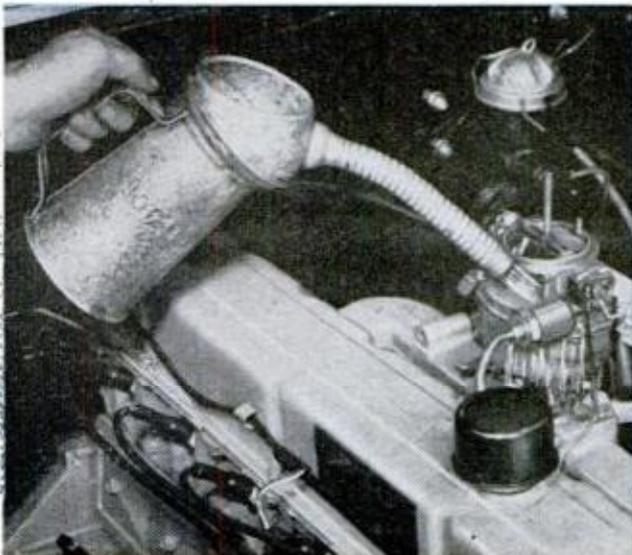
You pinpoint the cause of cold weather no-start much the same way a doctor diagnoses a patient's ailments. You first find the reason for the car's malfunction, then

try various cures in the likeliest order.

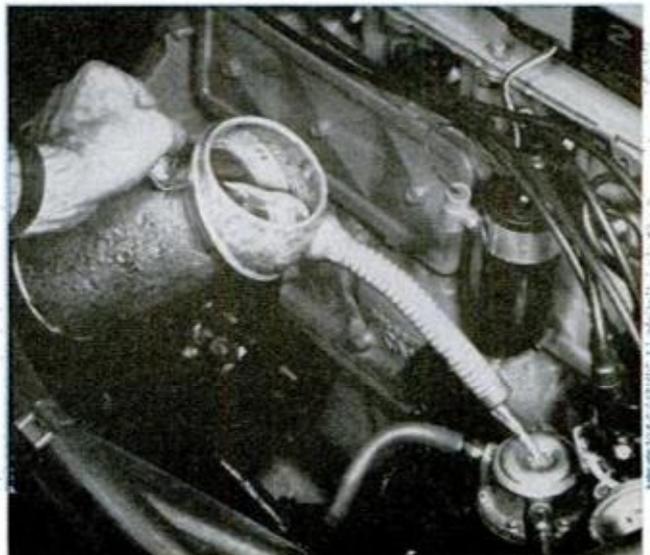
But, as with the patient, an ounce of *prevention* is worth all the cures you can try. That car should have been winterized and tuned *before* the cold weather hit—and should have another tune up performed midway through the winter. If you've neglected this care and have yet to experience a cold weather starting problem, consider yourself in luck. But don't press it. Mid-winter service may not prevent no-start, but it gives you top odds.

Such cautions aren't much comfort, however, while you're sitting in that refrigerator-on-wheels, wondering how to get it started. Still, for the sake of this article, we must assume your car's been properly winterized, since we're going to cover only *problems which arise as a result of cold weather*.

POUR WARM WATER over carburetor fuel bowl to free frozen parts. Long-spout can like this one helps you keep from getting water into carburetor throat



ICE IN FUEL PUMP is prime cause of fuel's not reaching the carburetor. You should be able to melt it this way—but this time water must be hot



Now let's go back to that fatal moment you turned the ignition key. Those lifeless growls strongly suggest this diagnosis:

An Ailing Battery

Reports from AAA's Emergency Road Service department put batteries at the top of the list of no-start causes. Normally, battery trouble is the cause of 25 to 46% of their emergency calls; but during the cold snap of January, 1963, the national battery figure jumped to nearly 70%—dramatic proof that winter takes dire toll of battery efficiency.

Even a new battery can fail you at low temperatures. At zero degrees, a fully charged battery is only about 50% efficient. And it's not only the cold that saps a battery's strength all winter long: you're putting a heavier drain on it with prolonged use of accessories such as the heater, defroster—and headlights that must be switched on much earlier in the day. It's likely, too, that you're doing much more short-range driving, giving the battery less chance to rejuvenate itself.

A battery in top condition, then, is vital. (So vital that *PM* devoted an entire Saturday Mechanic article to it in the November issue.) The most important thing is to keep your battery at full charge. Why? To prevent freezing. When a battery is partly run down, the acid has moved from the electrolyte into the plates. Since it's the acid that acts as antifreeze, the greater the discharge, the more likely the battery water will turn to ice. Any battery with less than three-quarter charge can freeze when the mercury takes a dive.

It's important to note that 12-volters, being more easily run down, are in greater

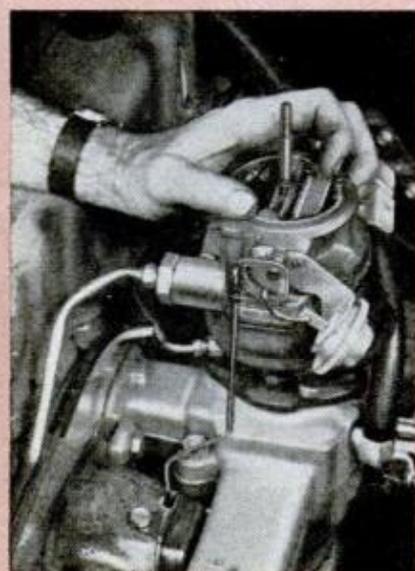
danger of freezing. This is a major paradox of the automotive industry. In the early 50s, Detroit engineers recommended a switch to the 12-volt system because of the increasing electrical loads in modern cars. But the new 12-volt batteries were made practically the same size as the six-volters they replaced, so as not to increase the bulk, weight or cost. The result: In doubling the number of cells, the design *halved* the ampere-hour capacity. The new 12-volt batteries had much less lead, active material, water and acid *per volt* than the old type. Yet the accessory load continued to increase and engines went right on growing, with ever higher compression ratios requiring much greater cranking effort to get them started.

Do 12-Volters Invite Trouble?

Consider these figures supplied by Chet Figg, engineer in Delco-Remy's Design and Application Section: Under a test load of 300 amps. at 0° F., a typical 6-volt battery reaches its out point in 3.8 minutes. Under the same conditions, an equivalent 12-volter reaches its out point in exactly *one* minute. It's the ampere-hour capacity that counts, here. And the electrolyte of a 12-volt battery is much weaker at out point (and thus more vulnerable to freezing) than a 6-volter's electrolyte. A good 6-volt battery will cease cranking while there's still a safe "anti-freeze" value in the electrolyte. The 12-volter, on the contrary, will keep cranking up to a point of near-total discharge.

The record of the 12-volt system hasn't looked good, in recent years. By 1956, most American cars had made the switch. Since that time, the annual reports from

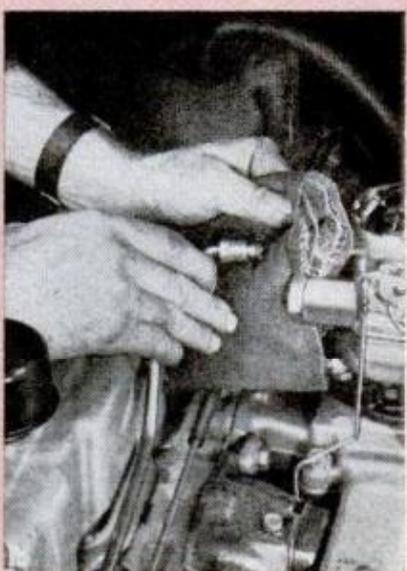
FINGER TEST of choke plate will let you know if gum is restricting movement. Move it to position opposite to one you find it in



WORK THROTTLE LINKAGE to find if gas is getting into carburetor. Go easy; excessive pumping will thoroughly flood the engine



DETACH FUEL LINE. If rag becomes wet when you crank engine, fuel is blocked from carburetor by ice on screen, needle valve or float



AAA's emergency service show that battery and electrical failures have taken a wide lead over all other causes of stall-calls. Is it only coincidence that the battery grabbed top spot during the decade the 12-volt system became standard?

This sidelight only points up the importance of keeping a full charge during cold weather. Even so, it's a wise precaution to have a booster on hand. A booster, of course, is nothing but a good, fully charged reconditioned battery, and a set of jumper cables. A used 12-volt battery will cost you from \$4 to \$7. You might save a couple of dollars by buying a 6-volter; it will work on a 12-volt system, and as we've seen, it'll hold a charge better than its big brother.

To use your booster, hook the two batteries in parallel—that is, positive terminal to positive terminal and negative to negative (as in the photo below right). The jumper cables are also negative and positive, and must be properly connected to their respective battery posts. Many are marked with plus and minus signs; others are color-coded—a red cable is always connected to the positive battery post.

If you connect the two batteries wrong in a generator-charged car, it isn't too serious. The engine just won't respond until you switch the leads. But in a car with an alternator, a wrong hook-up—even for a second—can send current back to ruin the diodes and voltage regulator.

Keep the booster fully charged and store it where it won't freeze or overheat—the cellar's fine. If you tote the booster and cables along as insurance when you park in a lot or on the street, remember to tuck the battery back in a heated niche when

you get home. A frozen booster is as useless as a frozen car battery.

In the absence of a booster, there are a couple of tricks that might get a car with a cold battery started. First, try to warm up the battery by turning on all accessories (heater, radio, headlights, etc.) for about 30 seconds. This will cause current to begin its flow—a flow that might thaw the battery somewhat. Then, with the accessories turned off, try starting the car. Crank the engine for no more than 15 seconds, let it rest for a minute or two, and then try again.

Pocket a Few Plugs

If this doesn't start the engine, remove every other plug in firing order (to keep the engine in balance). This may reduce cranking resistance enough to get the battery to turn the engine over. It works best with an eight-cylinder car.

If the engine does start, let it run for a minute or two with your foot holding the accelerator pedal a quarter- to half-way to the floor so the battery thaws out and gets some charge. Then, shut off the engine and replace the three plugs.

If none of these methods is successful, you'll have to remove the battery from the car, bring it inside and set it in a tub about half-full of warm (not hot) water. As the cold battery chills this water, replace with hot (but not scalding) water. It'll take about an hour to warm the battery sufficiently, but when it's replaced in the car, it should spin the engine.

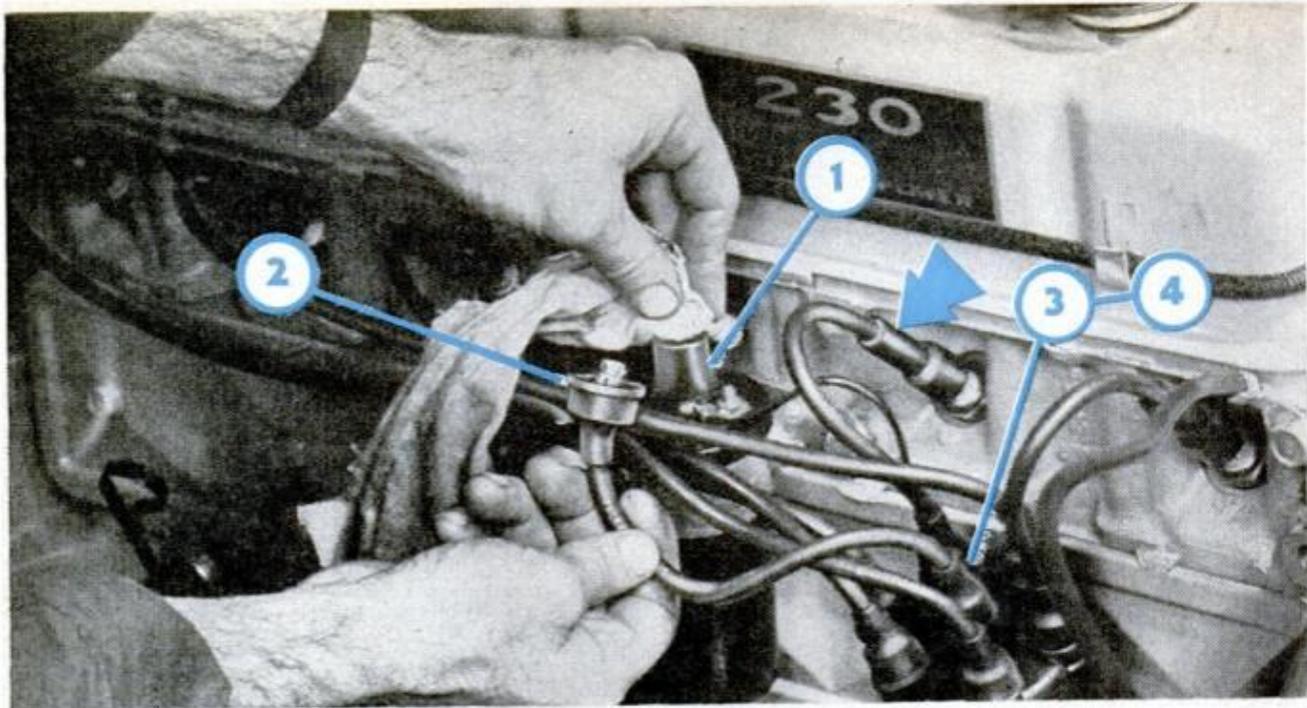
On occasion, the cause of those low, lifeless growls is not the battery at all, but the battery cables. Any corrosion that might develop between cable and battery

ICED FUEL INLET SCREEN your problem? If you can't thaw it, remove it, wrap it in rag, and drive home with it in the glove compartment



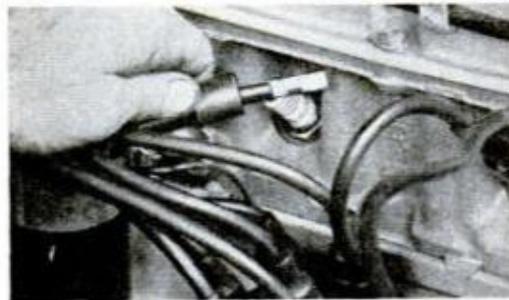
COMMONEST CONQUEROR of cold-start problem is spare battery and set of jumper cables. You can tote this booster along for parking-lot emergencies. At home, though, store it in the cellar





DRY IGNITION SYSTEM is essential. Four most important spots are: (1) central tower of coil, (2) primary terminal that fits it, (3 & 4) the equivalent parts at the distributor. Rubber spark plug jackets (arrow) protect plugs from moisture, but after severe wetting down, you may have to pull each wire and wipe plugs

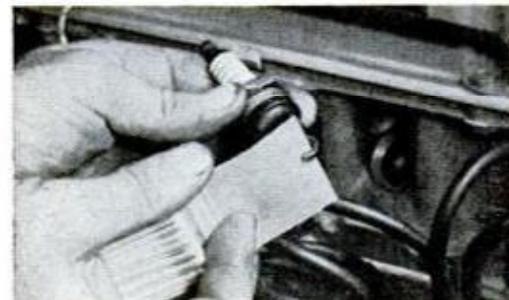
TEST IGNITION SPARK by holding plug terminal near engine block—or near plug



TO CLOSE GAP if plug tool isn't available, tap ground electrode on solid mass



NO FEELER GAUGE? Then close plug gaps to width of match-book cover, as below



post could choke off a winter-weakened charge.

Remove the cable from the battery and scrape out the inside of the terminal with a pocket knife. Also scrape the battery post. When replacing the cable, make sure connections are tight, not only at the battery but also where the ground cable connects to ground on the block or frame, and where the "hot" cable connects to the starter.

Now let's assume that when you try to start the engine it cranks just fine, but doesn't start. You can rule out the battery as the cause. The next logical diagnosis might be:

A Faulty Fuel System

Any time of year, three things are needed to start a car: the proper fuel mixture, a hot spark and good compression. Check now to make sure you have all three, beginning at the fuel system. You can be getting either too much gas or none at all. And the chief cold-weather cause of either condition is a binding choke plate. That's why this is the second thing a road-service man checks.

If your car has an automatic choke, you'll have to remove the carburetor air cleaner and operate the choke plate by hand. If the plate is stuck shut, a gummy shaft may be keeping it from moving, thus letting too much raw gas flow into the cylinders, flooding the engine. On the other hand, if the plate is stuck open, the cylinders are not getting enough gas.

You can usually free the plate of an automatic choke by working it back and forth with your fingers. (With a hand choke, try working it by cable from the dash.) To start an engine flooded by a closed choke plate, work the plate to an open or partially open position. With an automatic choke, you'll have to *hold* it open while someone else stomps the accelerator pedal to the floorboard (to unload

the carburetor), and then cranks the engine while his foot's still on the pedal. The engine will usually start on the second or third try, since air is now pouring into the carburetor and diluting the raw gas in the cylinders. If the engine doesn't start, it's probably too badly flooded; let it sit awhile before trying again.

If the choke plate is stuck open when you first examine it, close it with your fingers. Crank the engine. After it starts, go back to the choke and open it slightly to prevent flooding.

But what if your check of the choke plate finds it moving freely? The trouble may still be in the fuel system, so give the throttle linkage one or two quick pulls. You should get a spit of gas into the carburetor (you can see, hear or smell it), which tells you that fuel is getting to the cylinders. This fact eliminates the fuel system as the cause of your problem.

And If There's No Spit—?

If no gas is getting to the carburetor, there's a stoppage either at the entrance to the carburetor or somewhere back in the fuel system. To find out where it is, follow the steps shown in the photos at the bottom of page 178. If your check indicates an ice clog, remove the filter screen from the carburetor port and wash it. Now, pour a kettle of *warm* water slowly over the carburetor fuel bowl, which contains the needle valve and float.

If no fuel shows up on the rag it means that the gas is being blocked somewhere along the line to the carburetor. The trouble is probably ice in the fuel line, in the fuel filter (if you have one) or in the fuel pump. To thaw out these parts, pour *hot* water over them.

But, how do you thaw them when there's no hot water handy? An alternate heat source—one that's *always* available (though not of top efficiency)—is *you*. If you can pin-point the ice clog, simple hand-warming may melt it enough to let fuel pass. Water, being heavier than gasoline, settles in the low spots of the system. So look for a likely dip or loop in the fuel line and grip this spot in your fist. Of course, in cold severe enough to ice a fuel line, you may not be able to stand contact with bare metal long enough to do much good, but it's worth a try.

But, if the kitchen's nearby, you can create quicker, more comfortable sources by heating a half brick on the range—or by forking a baked potato directly from the oven. The latter is especially effective since it can be slit and pressed around the line. The main disadvantage (our research indicates) is that few people have hot potatoes in the oven at breakfast.

Is an electric outlet handy? Then borrow your wife's hair dryer. It might even pay you to buy her one of the newer models with a flexible hose and a 250-400 watt capacity. They're great thawers.

How Lethal is Ether?

Do we, at this point, hear a voice from the back of the hall asking: "How about ether sprays? Aren't *they* supposed to dry up condensation and melt ice in the carburetor?" Perhaps we hoped to avoid that controversy. But since these supplementary fuels are so widely available in aerosol cans, we can't duck the issue.

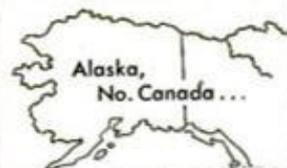
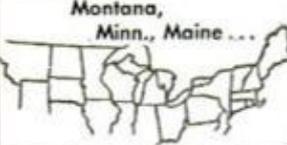
There's no argument about the stuff's being very inflammable. But so's the hair spray your wife uses daily. So, for that matter, is the raw gas that pumps into your carburetor. And where the ether's concerned, you're dealing with a mere squirt or two of fine mist.

But there's a catch. We asked the fleet maintenance supervisor of a large mid-western trucking firm about his shop's use of ether sprays. He tells us that his mechanics use them with great success in starting cold diesels, but wouldn't consider using them on a passenger car engine. With gasoline engines, he claims, the ether has a nasty habit of working itself up past the valve guides and collecting under the rocker-arm covers. When the right concentration builds up—*blam!* goes the cover. "Stuff should never have been put on the open market," he says.

Some health authorities tend to agree, pointing out that whenever ether must be used in a hospital (it's now largely replaced by newer anesthetics), extreme precautions are taken to protect the patient. A doctor we interviewed told us that if a user sprayed his bare hand in sub-zero weather, it would freeze. And one eye specialist warned that a blast of ether in the eye can permanently "frost" the cornea.

Yet the stuff is sold without restriction and—in most cases—with few words of caution on the label. We asked the National Safety Council and the National Fire Protection Assn. if ether sprays have built up any sort of accident history. Neither could supply hard statistics on fires, explosions or injuries caused by the spray, but the NFPA suggested it might be too new. "Far more consumers will be using starting sprays this winter," we were told. "We hope we'll have a little to tell you by Spring."

Meanwhile, you're bound to hear a lot of praise from motorists who find that ether *works*. Perhaps you're a booster, yourself. If so, the word is: **CAUTION**. Don't use this product in a confined space,

YOUR AREA	WINTER TEMPERATURES	OIL TO USE
 <p>Alaska, No. Canada...</p>	<p>VERY COLD</p>  <p>-10° and under</p>	5W or 5W-20
 <p>Montana, Minn., Maine...</p>	<p>COLD</p>  <p>0° to -10°</p>	10W or 10W-30
 <p>Kansas, Ohio, Maryland...</p>	<p>NORMAL</p>  <p>-10° to +32°</p>	20W or 20W-40
 <p>So. Calif., Texas, Florida...</p>	<p>BALMY</p>  <p>Above 32°</p>	Oil you normally use



DIPSTICK WARMER is nothing more than an electric heating element and costs less than \$5, but plugged in overnight it guarantees that congealed oil won't be the cause of no-start next morning

or while you're smoking. It's safer, too, if you remove the air cleaner. The Automobile Manufacturers Assn. tells us there have been cases of carburetor fires due to backfiring, but damage can be minimized if the air cleaner's off.

One or two short sprays should be enough, though some motorists persist until they force a start. (In such cases, the final start may have nothing to do with ether.) Some users spray down into the carburetor throat; others claim that spraying across the air horn is more effective.

Manufacturers of most sprays guarantee results at temperatures as low as 60 below! But once the weather begins to warm up, get rid of that aerosol can. It could explode at temperatures of about 120 degrees—and your glove compartment or trunk can get that hot in the summer. So, when winter's over, store the can in a cool place, bury it, or toss it on a city dump.

Another type of product is sold to cut down on icing in the fuel system. It's a liquid containing chemicals that prevent condensation woes; you add a can to every other tankful of fuel. There's something to be careful of here, too. The liquid picks up a lot of sediment, and this is carried to the fuel system's filters. These should be cleaned quite often during the three or four month period that you use such a fuel anti-freeze (often called "dry gas").

How About the Ignition System?

As long as your battery's in good shape, there's little reason to suspect your ignition system of being the cause of cold start problems. After all, sparks can't freeze.

One thing that would cause hard starting, though, is wind-driven snow or sleet that settles on the distributor cap and plugs, wetting them down. The photo at the top of page 180 shows how to dry them out.

Many motorists swear by a spark intensifier. This item, when introduced into the system at the distributor or coil, supposedly builds up the current going to the plugs, giving them a hotter jolt.

Such gadgets can't hurt anything, but some mechanics dispute their worth, contending that a properly tuned ignition system is the only guarantee one has against ignition breakdown.

Suppose your ignition system does fail, though—not because of cold weather necessarily, but because of a faulty part whose failure is speeded by the cold. How can you at least get the car to a shop?

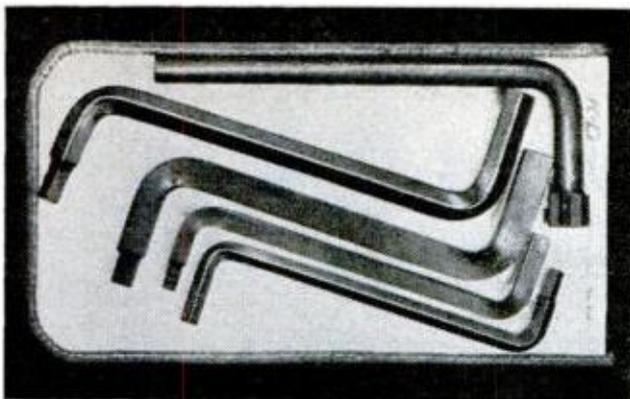
Test for a Fat Spark

The first thing to do is make sure the trouble is really with the ignition. Disconnect an ignition wire from a plug and hold it near the block while someone cranks the engine. If you get a fat, crackling spark about ½ inch in length, there's nothing wrong with the ignition except, possibly, moisture at the plugs. (If you get no spark, you'll have to check the entire system right then and there, isolate the bad component and replace or repair it. You won't get the car started if there's no spark at all.)

If, however, the spark is weak, you can try one method of getting started: Remove two or three plugs and close their gaps as shown on page 180. When you put the

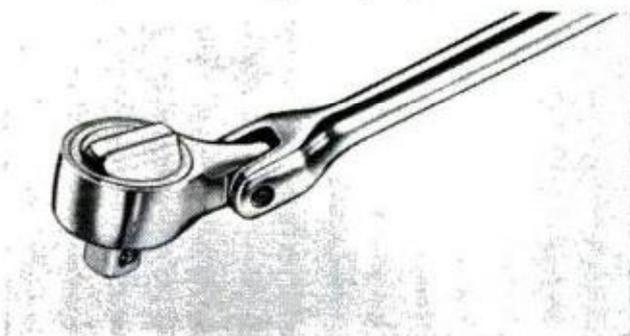
[\(Please turn to page 208\)](#)

Shopping for Tools

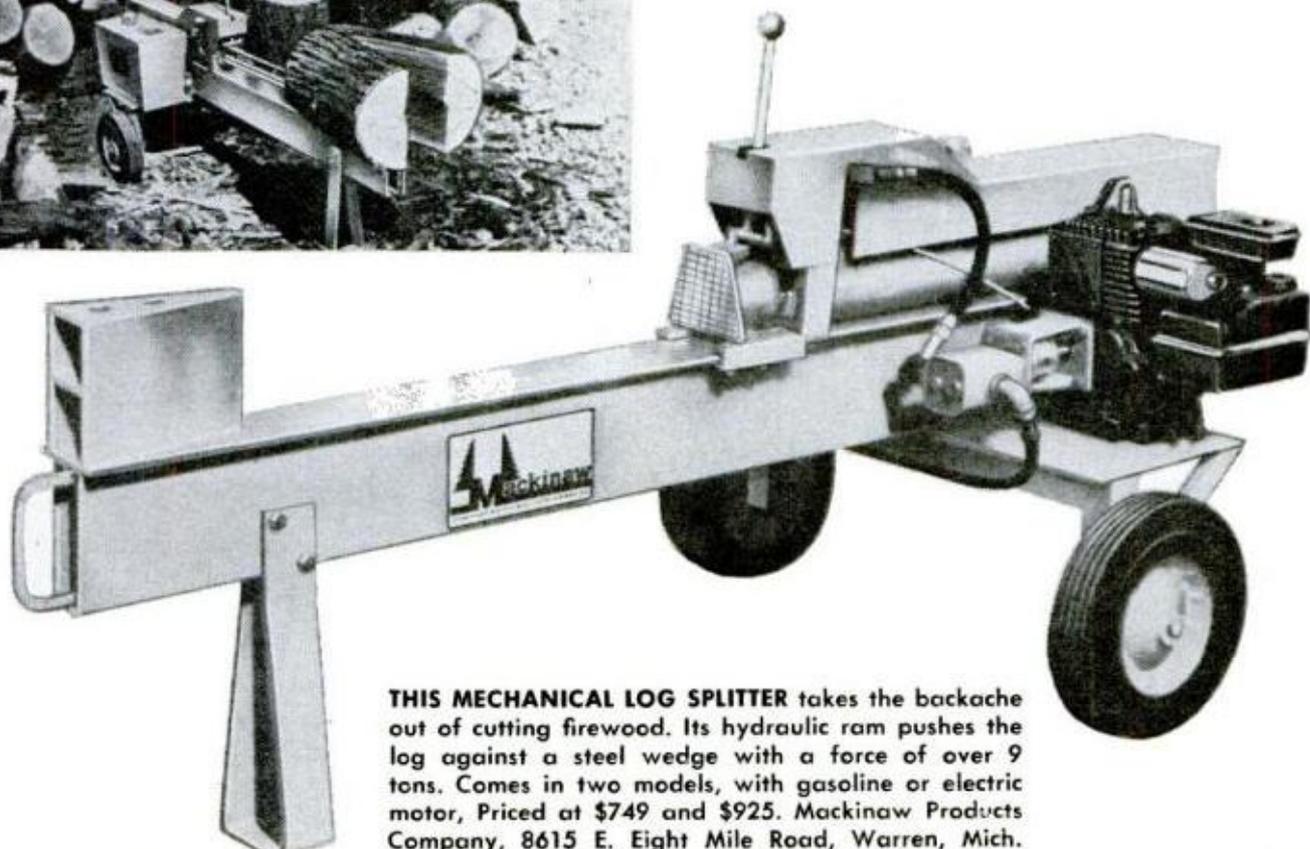
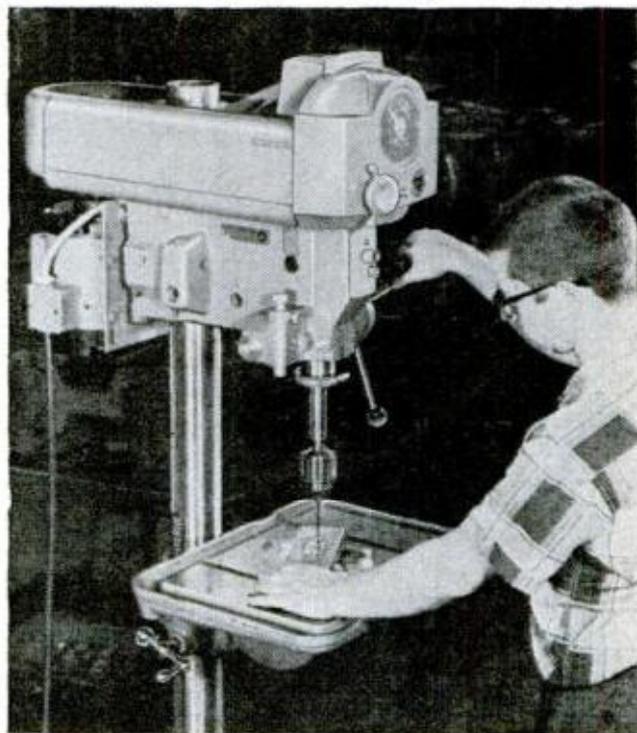


NEW KIT contains all the socket wrenches needed for removing internal drain plugs from crankcase, transmission and differential of most cars. Sizes are: $\frac{1}{4}$ - $\frac{5}{16}$ -in. square end; $\frac{3}{8}$ - $\frac{1}{2}$ -in. square end; $\frac{1}{4}$ - $\frac{7}{16}$ -in. hex; $\frac{3}{8}$ - $\frac{1}{2}$ -in. hex; plus an 8-point wrench. Costs \$6.85. Made by K-D Manufacturing Company, Lancaster, Pa.

DRIVE FLEX RATCHET has a $\frac{3}{8}$ -in. square drive in a 1- $\frac{1}{4}$ -in. diameter head which pivots 90 deg. in either direction. This feature, since it facilitates working in tight places, reduces the number of extension changes required to clear various obstacles. Costs \$8.80. The Wright Tool & Forge Company, Barberton, Ohio



THE 12-TO-1 SPEED RATIO of this variable speed 17-in. Delta drill press is said to be the widest range available today. With an 1140-r.p.m. motor, the machine gives speeds of 230 to 2830 r.p.m. A 1725-r.p.m. motor gives 350 to 4250. Chuck capacity is $\frac{3}{4}$ -in. Rockwell Mfg. Co., Rockwell Bldg., Pittsburgh, Pa.



THIS MECHANICAL LOG SPLITTER takes the backache out of cutting firewood. Its hydraulic ram pushes the log against a steel wedge with a force of over 9 tons. Comes in two models, with gasoline or electric motor. Priced at \$749 and \$925. Mackinaw Products Company, 8615 E. Eight Mile Road, Warren, Mich.

MOTORIZE YOUR TURNING CHISEL

Portable electric router takes place of hand-held chisel to produce glass-smooth lathe turnings semiautomatically

By R. J. DeCristoforo

MOST LATHE JIGS are designed to enable the machine to do double duty as a sander, shaper or other tool. This one lets you use a portable electric router to take the place of the chisel itself.

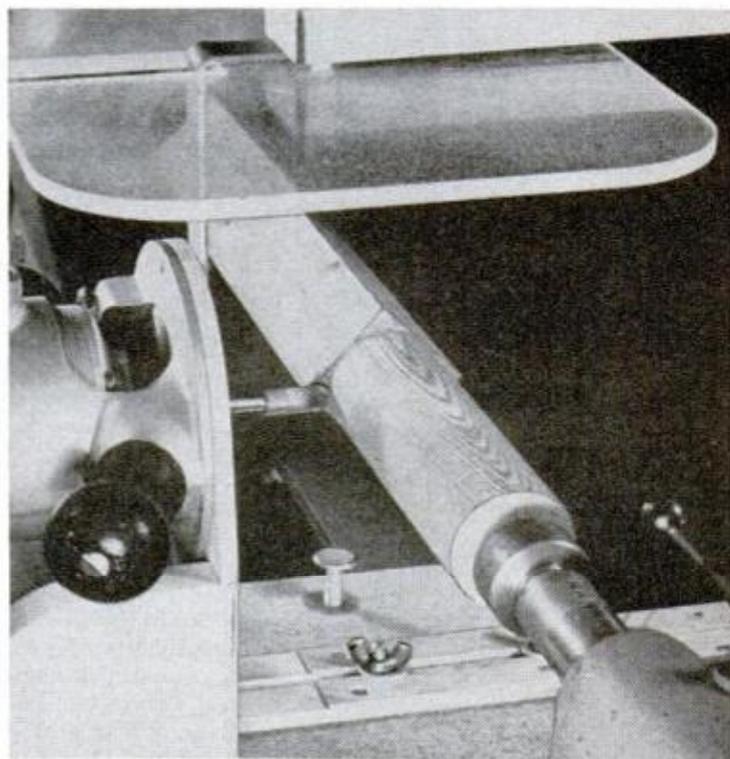
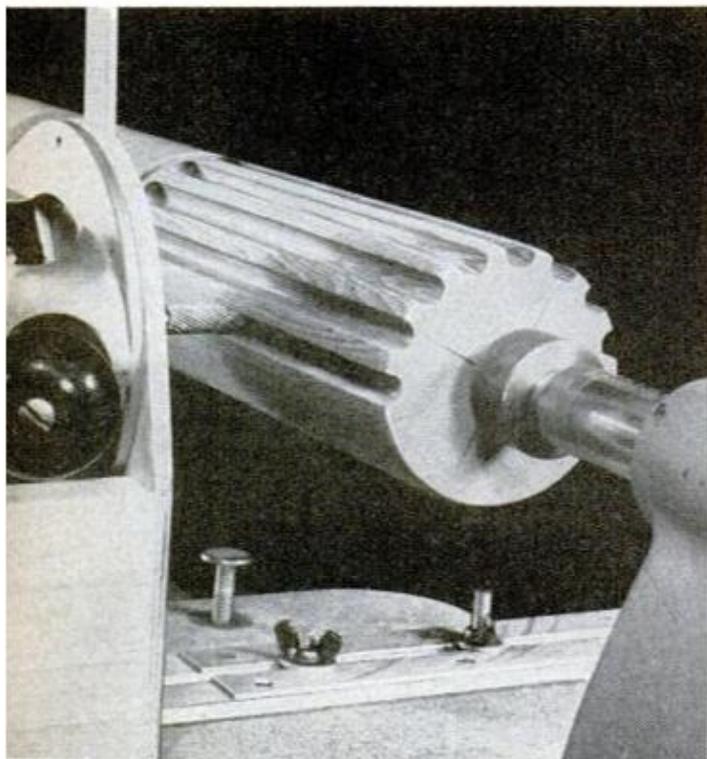
The advantages of such a setup are obvious. Most important, you can easily and mechanically duplicate cuts. Also, since you utilize the speed of both the lathe and the router, very little sanding is required to make the work glass-smooth. The specific shapes you can duplicate are limited only by the number of cutters available. Using the jig free-hand with a round-nose rotary burr, you can form almost any shape.

The jig moves along the lathe bed to permit cuts to be made anywhere on a spindle turning. When the parallel lock is used, the cutting tool will move parallel to the lathe centerline. The depth lock will control the distance from the cutting tool to the work center. Using the depth lock only, you can pivot the entire tool on a controlled radius. The router seat can be locked firmly in place or loosened to allow the router to pivot independent of the rest of the jig. The depth control on the router itself may also be brought into play. By using these actions singly or in combination, the jig provides a considerable amount of flexibility.

LATHE SPEED SHOULD BE CONSISTENT WITH SIZE OF WORK

FOR FLUTING CUTS and other similar operations, the parallel lock controls the line of cut, keeping it parallel to the lathe centerline. The depth of the cut is controlled by the depth lock. In operations of this type, of course, the lathe work doesn't turn

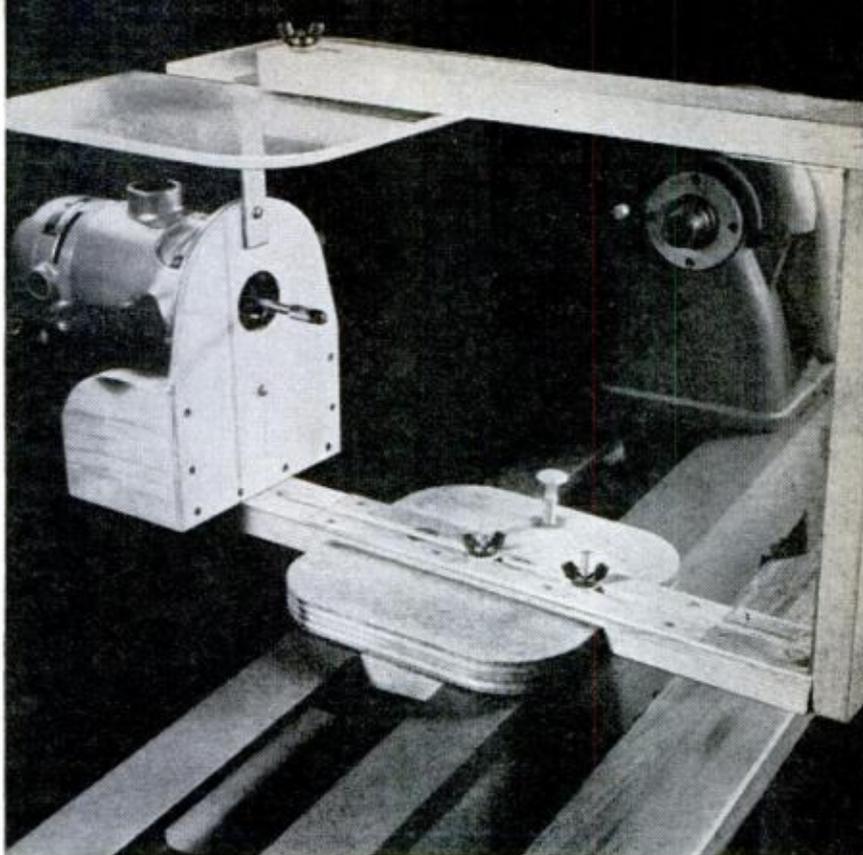
WHEN ROUNDING OFF square stock, the same setup is used as in fluting. The blank shown above was being formed in one pass. Note that the router is moved from right to left so that its cutting action will be against the direction of the lathe's rotation



The size and shape of your router will affect the cutter access hole and the attachment holes in the router-seat front. Lathe size will determine the height of the cutter access hole and the dimensions of the lathe slide. Make the lathe slide and jig pivot first, setting all Tee-nuts in shallow counterbores so they will be flush with the surface. Next, make the jig slide and install the aluminum protector to prevent the depth lock from digging into the wood. The aluminum should be smooth and polished for easy action.

When making the router seat assembly, keep your router close at hand so dimensioning will be correct. Once you have completed the seat, assemble these parts and run a test on the lathe. Test all actions, because at this point you can actually do work with the jig.

The remainder of the parts called for merely add stability to the unit and provide a place to hang the eye shield. The upright is joined to both the jig slide

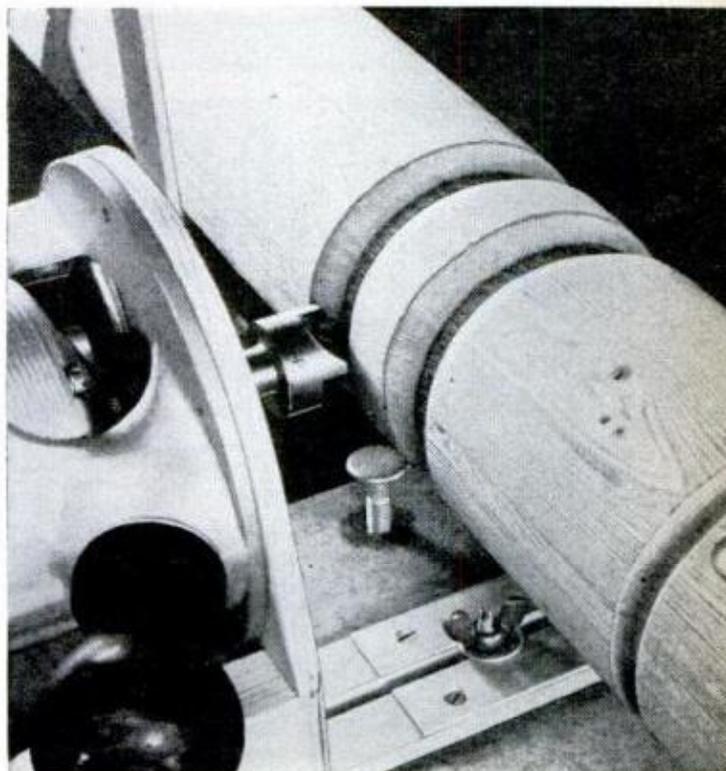
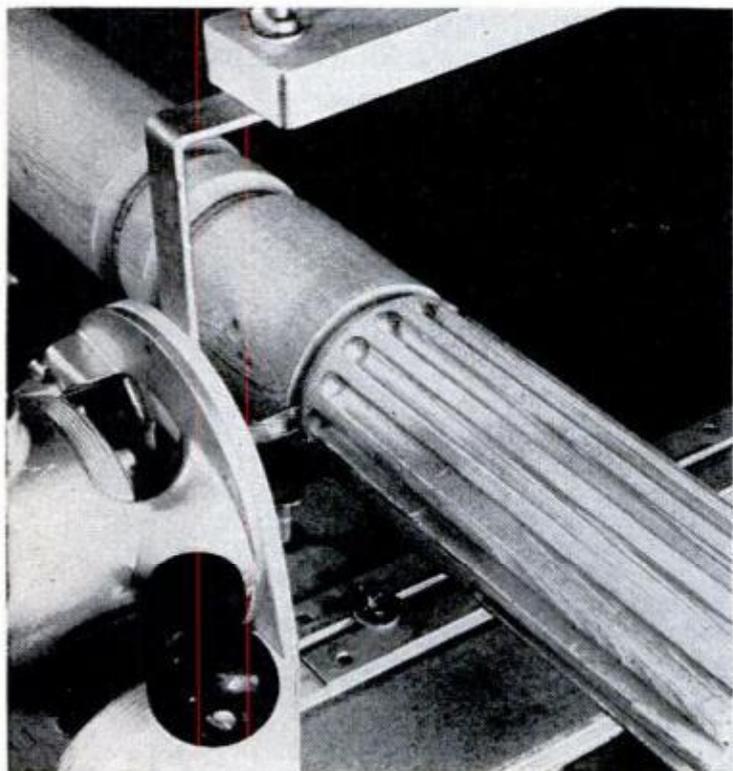


VERSATILE LATHE JIG will do almost anything you can do with hand-held chisels, and also make it possible for you to handle many operations right on the lathe that would normally call for a special setup on another machine. The normal lathe rotation combined with the high speed of the router produces extremely smooth cuts which will require very little additional sanding

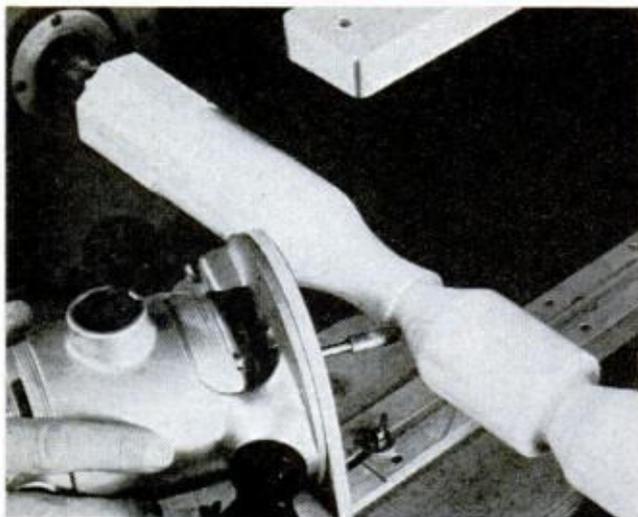
LATHE INDEX HEAD IS USED TO LOCK WORK WHEN FORMING FLUTES

GREAT VARIETY of cuts can be made using just the standard router bits. By using the depth control lock on the jig with the depth control on the router itself, you can achieve a high degree of precision in duplicating any of the cuts possible with these bits

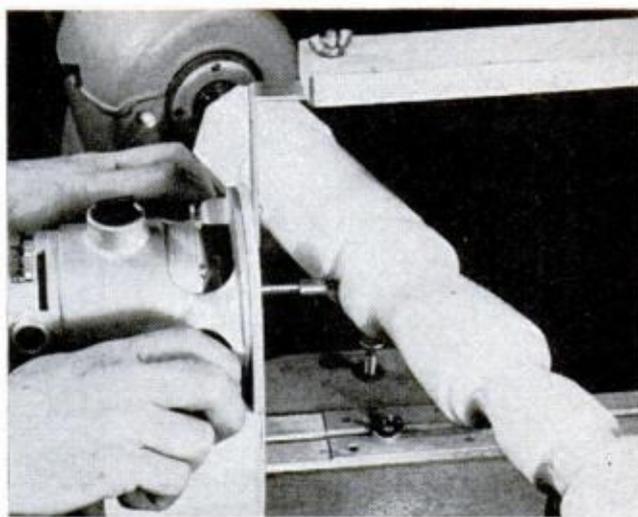
OVERSIZE COUNTERSINK in the router may be used to make duplicate V-grooves. Simply remember the number of turns you advance the cutter and you'll be able to duplicate cuts any number of times. As in any turning operation, control lathe speed by size of work



FOR FREE-HAND OPERATION ALL LOCKS ARE LOOSENED A BIT



COVE CUT with its radius mechanically held is simple to make with this jig. Pivot and depth lock are both used, but the router-seat lock should be loosened slightly so the router can pivot to make the cut



FOR FREE-HAND operation, all locks are loosened slightly so that any controlled action of the jig may be utilized. Always use sharp cutters, and wherever possible, a right-to-left feed action

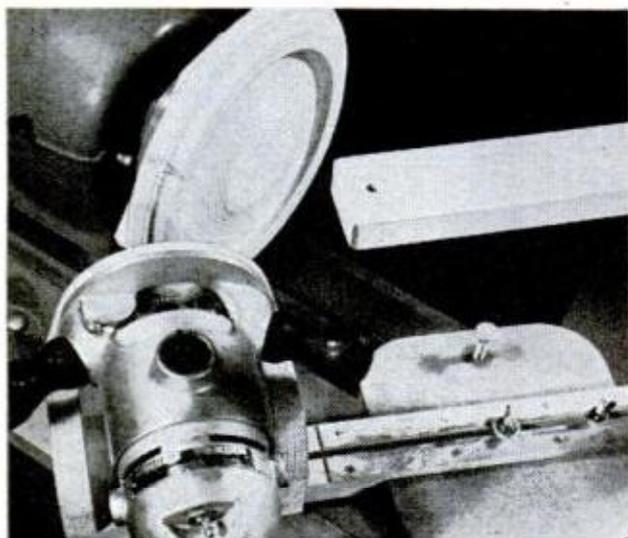


PARALLEL LOCK holds the lathe slide and jig pivot together so the cutting tool will move parallel to the lathe centerline. It's a $\frac{5}{16}$ -in. bolt turned in registering holes in the lathe slide and jig pivot

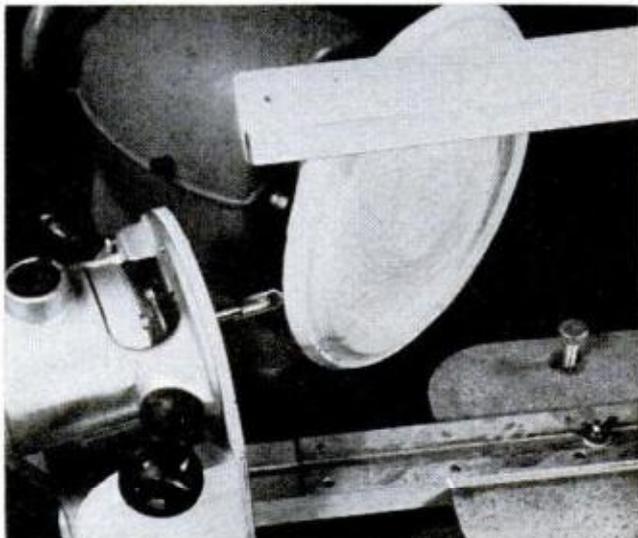
and the upper brace with corner angles. Make certain the angles are square before you attach them. Cut the upright and brace to fit what you've already assembled. The link that completes this bracing frame is another angle, bridging the gap between the brace and the router-seat front. You may have to make this angle from flat steel since its dimensions must be exact to permit proper pivoting. Attach it with a single screw and a single bolt.

Finally, make the clear plastic eyeshield. You'll need it, for this motorized turning chisel will throw sawdust and chips like you've never seen before. ★★★

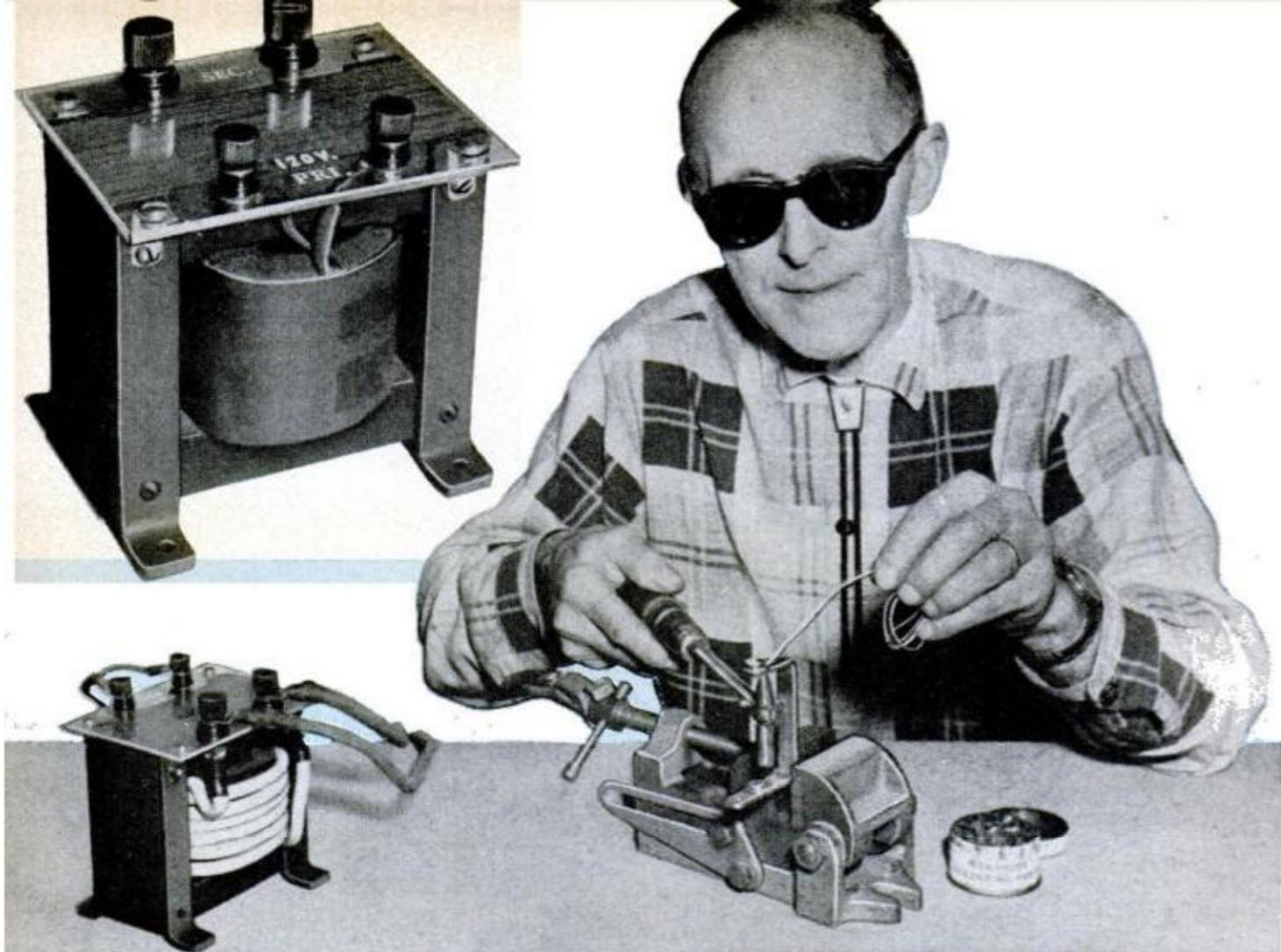
SWIVEL ACTION OF JIG PERMITS UNLIMITED FACEPLATE WORK



ACTION OF JIG is so flexible that you will find it possible to do many kinds of face-plate turning. (The eyeshield was removed when taking some of these photos in order to show the operation more clearly)



WHILE YOU PROBABLY won't find it necessary to do this very often, it's possible to make some cuts on the back of work mounted on a face plate. However, the headstock limits pivoting in such operations



You can TRANSFORM This TRANSFORMER

... by simply changing the secondary winding around the permanent primary core, to adapt the unit to such uses as a soldering transformer or a d.c. power source

By Harold P. Strand

MANY TIMES around the electrical shop or experimental lab you may require a certain low a.c. voltage with a specific current value. Often the correct transformer is not at hand, and sometimes it isn't even available commercially. Here's a versatile easy-to-build transformer with interchangeable secondary windings which will provide any voltage you need, and if necessary, handle quite heavy current.

Basically, it consists of a laminated iron core around which only a primary is wound. The space usually taken up by the secondary is left vacant so that wire of suitable size and number of turns can be threaded through the space around the

primary. The obvious advantage of this construction is that you can tailor the secondary winding to meet the requirements of any particular application. For temporary test set-ups, you can remove the winding and reuse the unit later with a different secondary.

The transformer shown here was built around an old TV power transformer which was burned out in an incinerator so the laminations could be easily removed. This rather large core was selected so as to provide a high wattage rating which would cover a wide range of uses in the shop. The width of the center leg was 1½ in. and the stacking was 2 in. Multiplying

these two factors gives a cross-sectional core area of 3 sq. in. The space for the winding openings measured $\frac{7}{8} \times 2\frac{3}{8}$ in. Such a core should be good for about 400-500 watts with a suitable primary winding.

The primary winding is calculated by use of the following formula which provides a flux density of 65,000 lines in the core, a good average value for general use:

- N —number of wire turns
- f —frequency in cycles per second
- A —cross-sectional area of core
- E —counter emf (use line voltage)
- B —maximum flux density in lines per square inch

$$N = \frac{10^8 \times E}{4.44 \times f \times A \times B_{\text{m}}} = \frac{100,000,000 \times 120}{4.44 \times 60 \times 3 \times 65,000} = 226$$

For ease of computation, we will round this off to 230

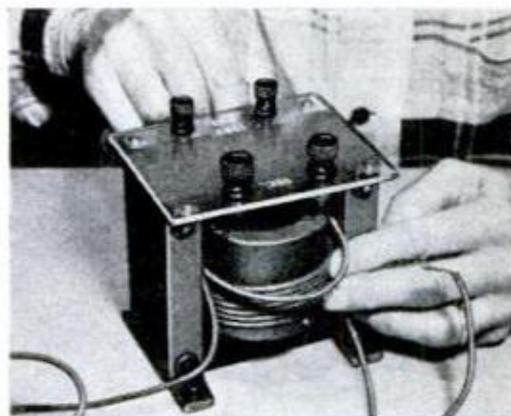
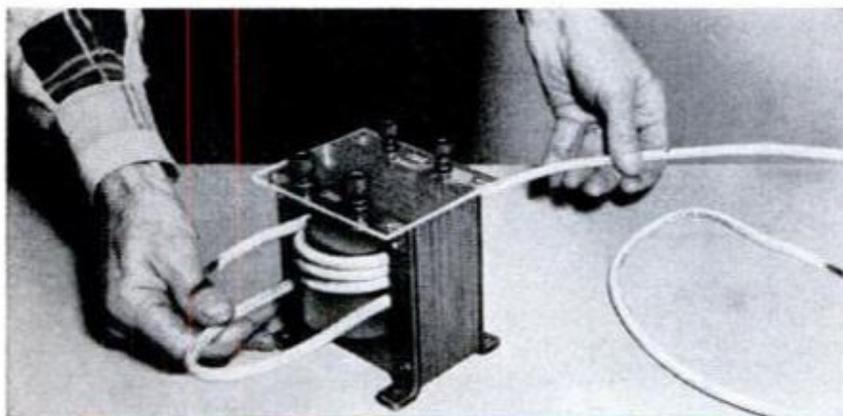
With a line voltage of 120 volts, we divide 230 by 120 to get a value of 1.9 turns per volt. This same ratio holds true for a secondary winding also, so in order to determine how many secondary turns will be required for a certain output voltage, multiply 1.9 by that voltage. For example if 9.6 volts are desired: $9.6 \times 1.9 = 18.2$. To allow for losses and also for regulation (difference between no load and full load) we'd try a winding of 19 turns.

The wire size required for the secondary

will depend on the load in amperes. For constant use a value of 1000 circular mils per ampere will assure adequate wire size, but for intermittent use, 500 circular mils would be sufficient. This can be determined by consulting a wire table giving the circular mil area of each size; simply point off three places to the left to find the current capacity for permanent use and double the current for intermittent use. Connect a voltmeter to the ends of the wire before cutting it off to get the no load voltage.

This transformer can also be used with rectifier elements in changing a.c. to d.c. at comparatively low voltages. To do this, the secondary was wound with 36 turns of #15 Formvar wire (a 1-lb. spool is plenty), and tapped at 18 turns where a loop of the wire was brought out. A piece of #16 flexible wire was soldered at the loop as a tap. Since there is normally a voltage drop through the rectifier, a few more turns were required. This also allowed for losses present in the iron core and copper, plus the regulation factor.

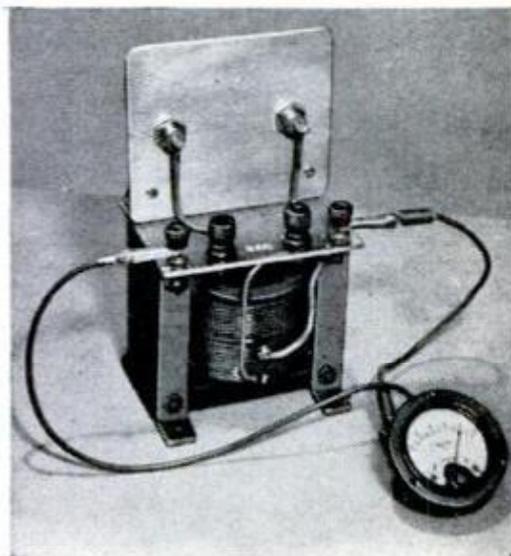
The six illustrations on the preceding page show in detail how it was built. In Fig. 2 the coil is being wound for the primary on a homemade winding machine. A turn of .010 in. armature paper

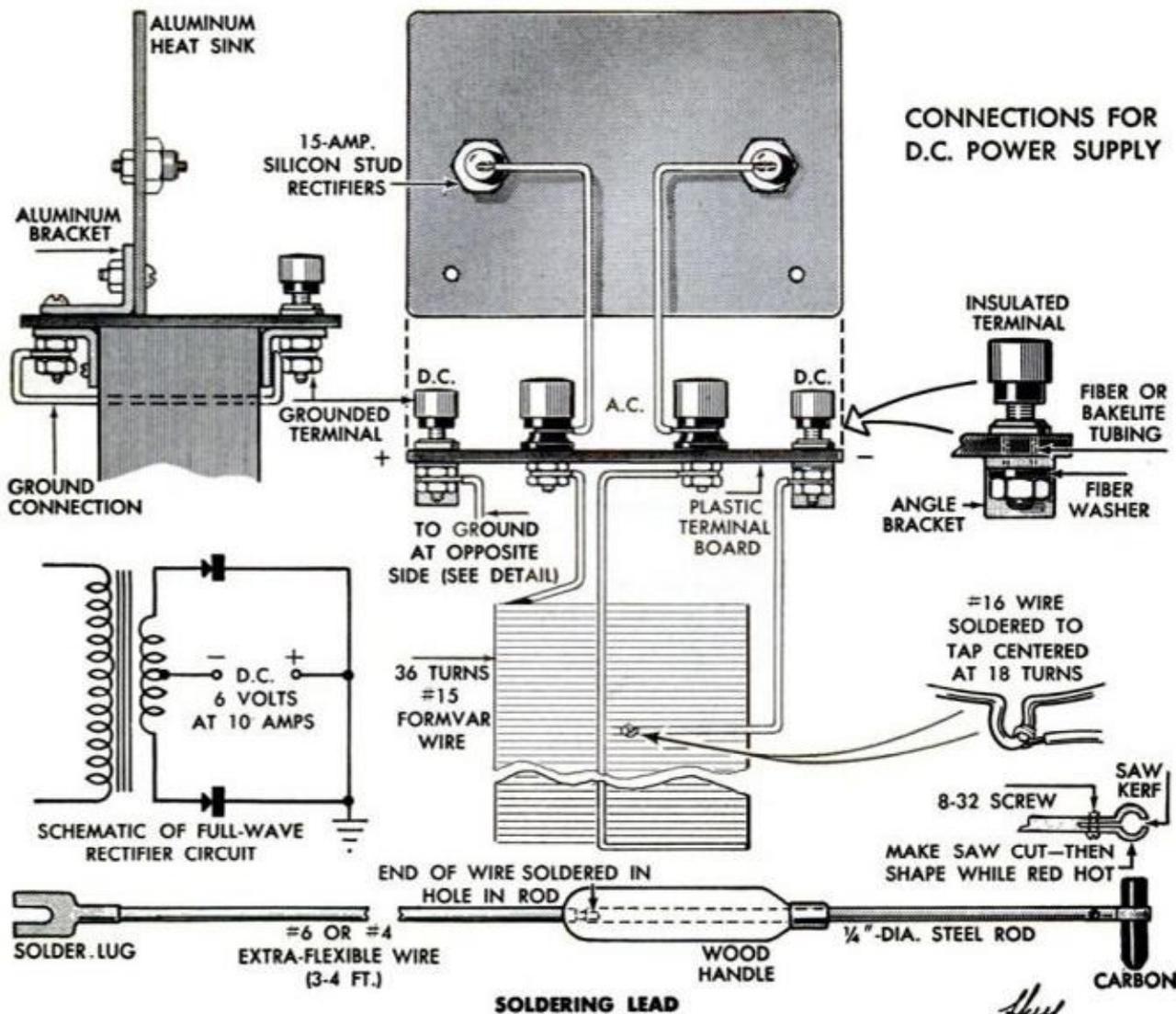
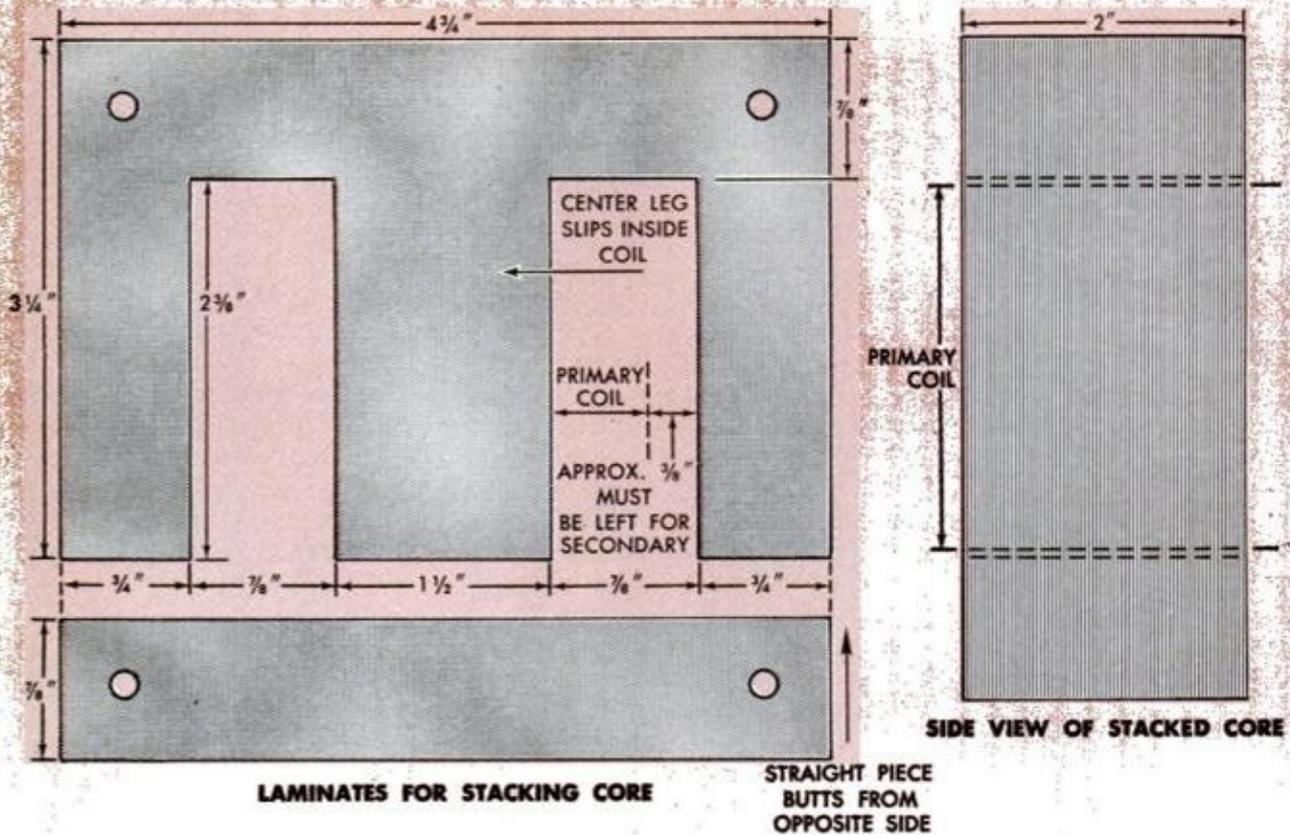


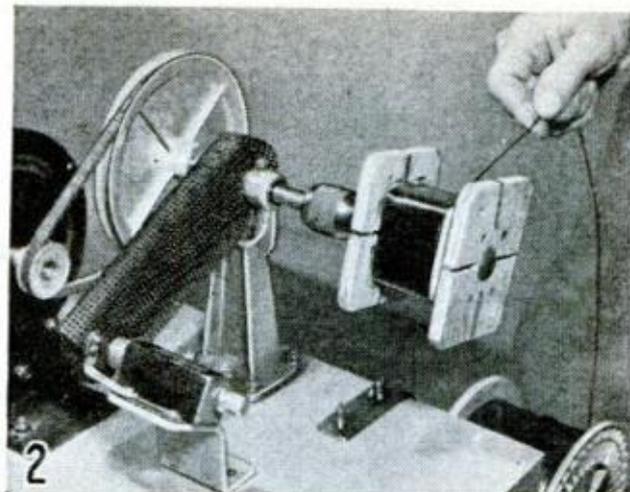
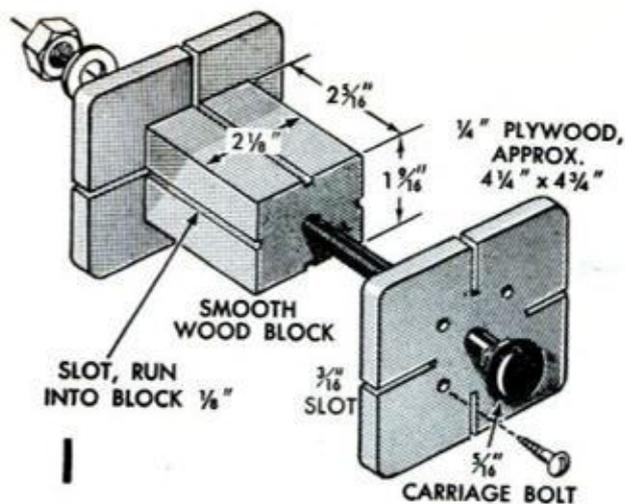
TO WIND SECONDARY, simply thread wire through space around primary coil and pull turns tight. Winding shown above was for use as a soldering transformer requiring high current but only 3 volts. Seven turns of heavy wire were enough, but more could be added for higher voltage

LIGHTER WIRE—#14 in this case—is easier to pass through core openings. Nine turns did this job. Note armature paper placed around primary coil to serve as insulation

COMPACT DC POWER unit, with 36 turns of #15 wire, requires heat sink. It registers 8 v. at no load. This no-load reading was found to be necessary in order to achieve 6 v. when operating at full load. Note tap wire explained next page. Primary connections at rear binding posts don't show







1. WINDING FORM for winding the primary coil is basically just a grooved block having same dimensions as core of transformer (drawing at left)

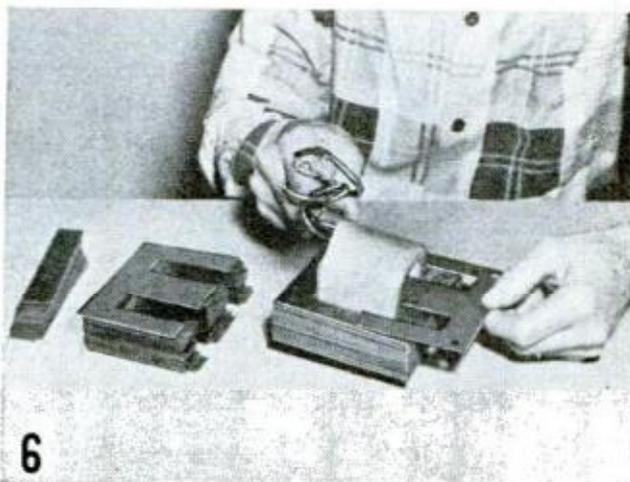
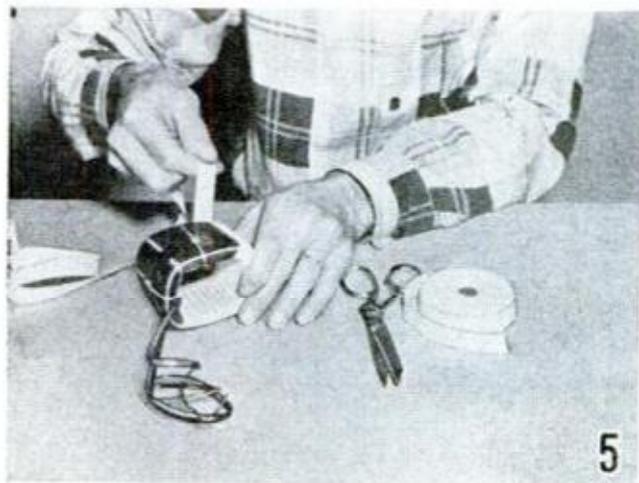
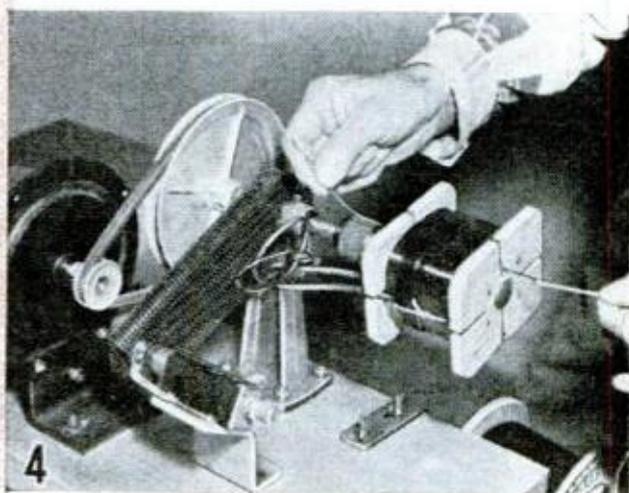
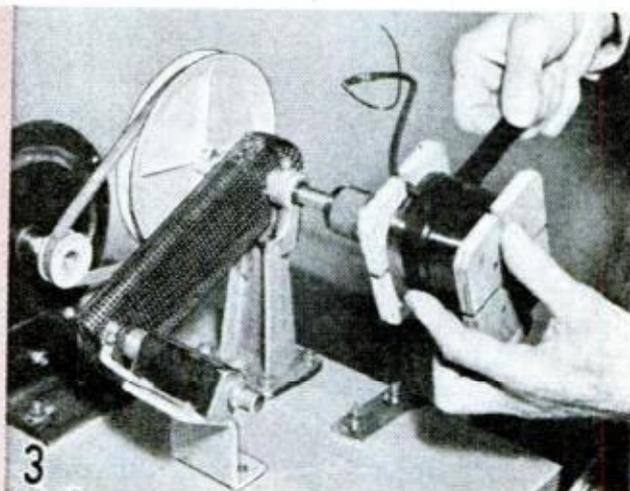
2. HOMEMADE WINDING rig is connected to turn counter, but job could be done on lathe operating at low speed with visual count of turns

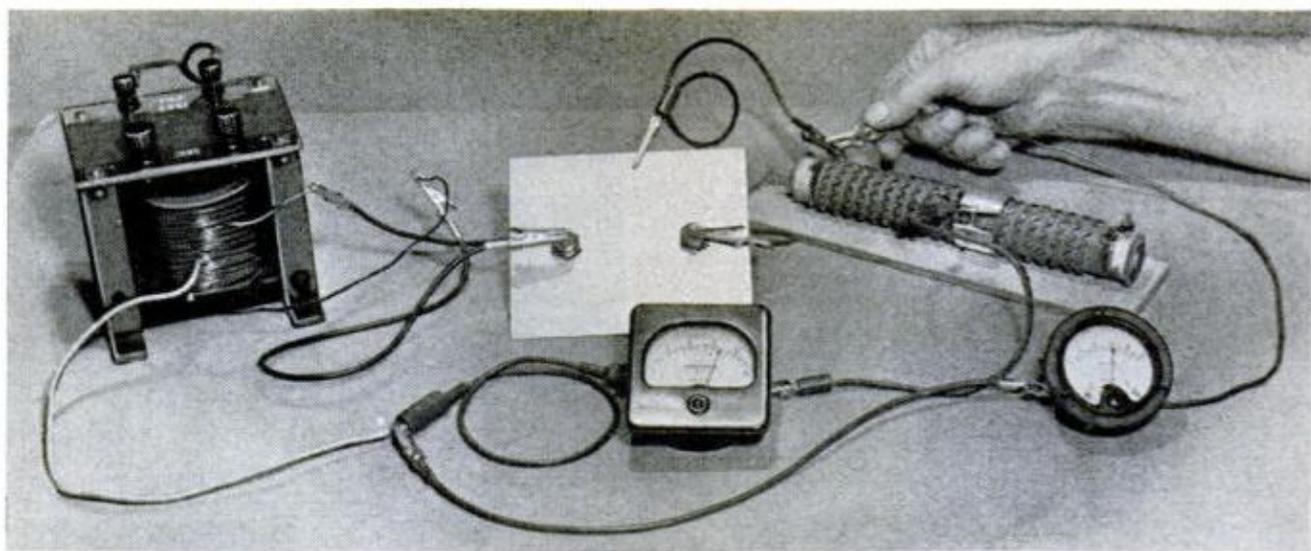
3. FINISH END of completed winding may be held in place with tape. Note that both start and finish ends have been brought out same side slot

4. AFTER TYING the coil by using a hooked wire to pull a string through slots in forming block, the coil may be removed from the form

5. ONCE YOU REMOVE the coil from the form, tape it with cotton coil tape. This not only holds it together but also provides outside insulation

6. TAKE A TURN of armature paper around the coil, then stack the core inside, alternating the E-shaped pieces so that the butt joints are staggered





TO TEST LOAD on experimental secondary winding, circuit can be connected to an adjustable resistance with an ammeter and voltmeter. Circuit includes two rectifiers to convert a.c. to 6 volts d.c. at 10 amp load

is first placed around the form block to act as insulation between the primary and the iron core. The starting end of the #15 wire has been equipped with a short piece of spaghetti tubing which is carried out through a form slot at one of the narrow sides. A piece of tubing is used on the finish end. This is brought out the same form slot and taped in place, Fig. 3.

The next step is to tie up the coil, Fig. 4. After tying the string tightly at each of the four points, the form can be taken apart and the coil removed. (If you rub some wax on the form block before wrapping it with insulation and wire, it will be much easier to tap the block out of the finished coil.)

The coil is now taped, Fig 5, using cotton coil tape sold just for this purpose. As the strings are approached by the tape, cut them off; secure the end of the tape with a needle and thread.

If the transformer is to be used in a permanent installation, the coil should now be dipped in insulating varnish and baked. However, for intermittent duty on the

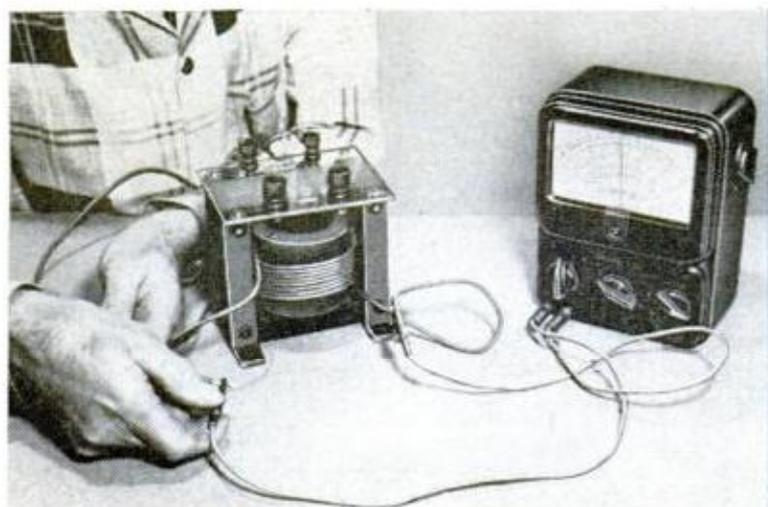
test bench you can skip this step.

One of the E-shaped pieces of the core can be tried in the coil opening to make sure it will fit properly. If the coil has spread apart, place it between two pieces of wood in a vise and carefully compress it. Be sure to leave sufficient space so that the laminations will pass in the full height of the opening.

To stack the core, Fig. 6, pass the E-shaped pieces in from alternate ends of the coil so that the butt joints formed with the straight pieces will be covered.

A turn of armature paper placed around the coil acts as insulation between the primary and the secondary; narrow strips of this paper should be placed at the edges of the coil so the laminations will not cut into the latter.

When the stacking is completed, square up the core by tapping with a hammer and block of hardwood. Next, make up four side brackets from $\frac{1}{8} \times \frac{5}{8}$ in. steel and bolt them in place. Finally, tap the laminations to bring the joints together and give the bracket screws a final tightening. ★★

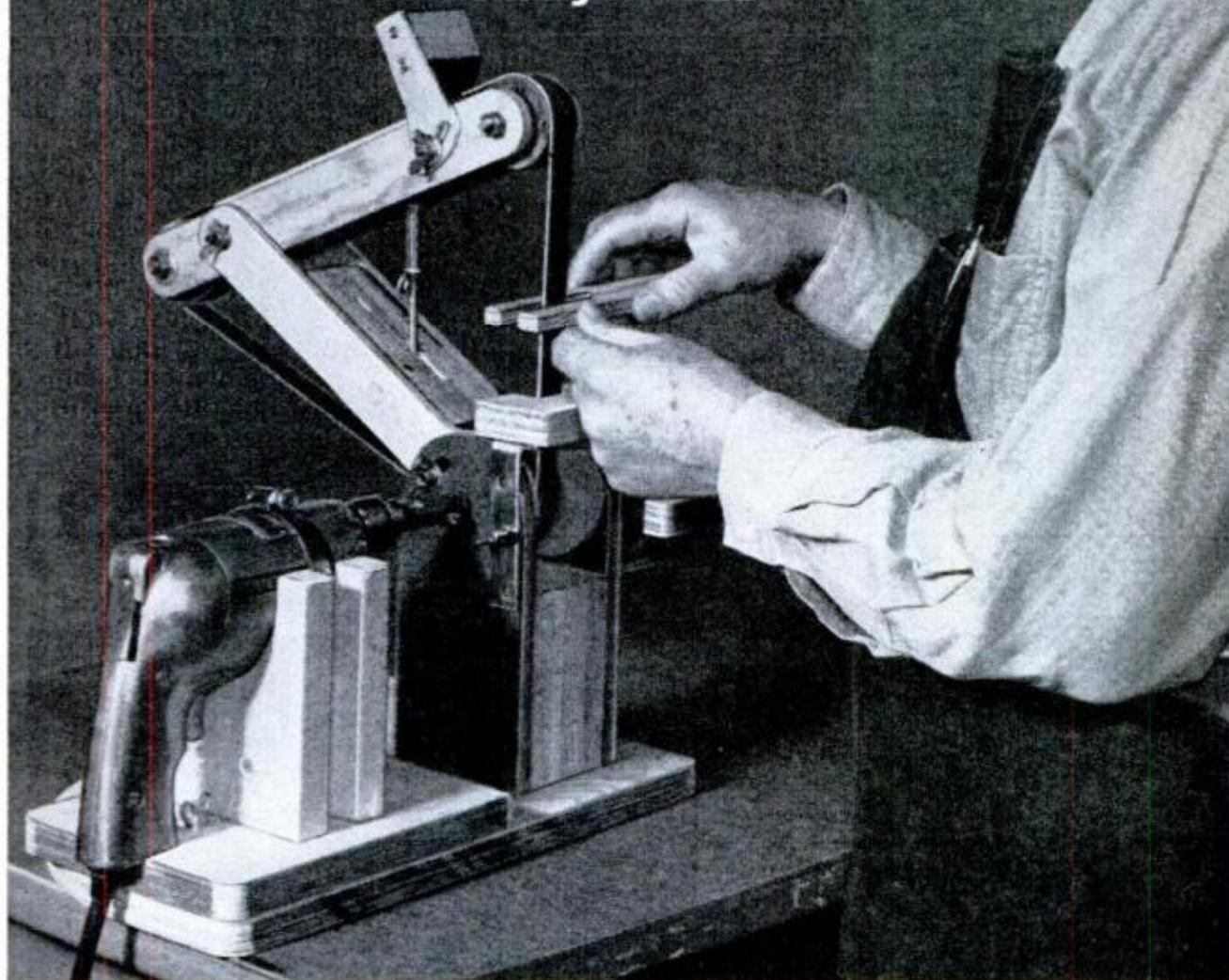


VOLTMETER records a no-load voltage of 4.4 v. With a load of about 5 amps, this winding should yield close to 4 v. —the amount desired. Since the wire hasn't been cut off yet, it would be a simple matter to add another turn or two if such should prove necessary

BELT-DISK SANDER

By Howard R. Clark

Shaping, deburring, sharpening or sanding—you can do any of these on this easy-to-build finishing machine. And it costs almost nothing to build

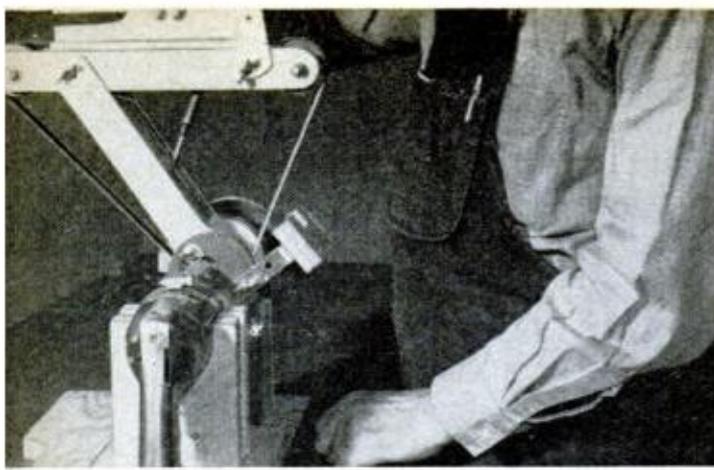


IF YOU OWN a portable electric drill, you not only have the tool you'll need to help *build* this versatile little machine, but you have the motor to *drive* it. Cradled in a stand, the drill is coupled directly to drive the belt, then backed away and swung around to operate a 4-in. disk.

Make the drill stand first so you can accurately spot the location of the centerline of the drive shaft. Wherever possible, shape and drill matching parts as a unit to insure accuracy. For instance, the three pulleys should be turned simultaneously from a single block of wood,

leaving a slight crown to assure correct tracking of the belt. Once shaped, they can be cut apart and drilled. Holes in the idler pulleys may have to be enlarged slightly to receive the outer bearing races. These should be a snug press fit.

In the case of the drive-shaft bearings, it's the inner races that rotate. The $\frac{3}{16}$ -in. threaded rod is a rather loose fit in these bearings, so it should be centered with two $\frac{3}{16}$ -in. compression sleeves (one on each side) of the type used in making joints in copper tubing. The inner bearing races are already countersunk, and

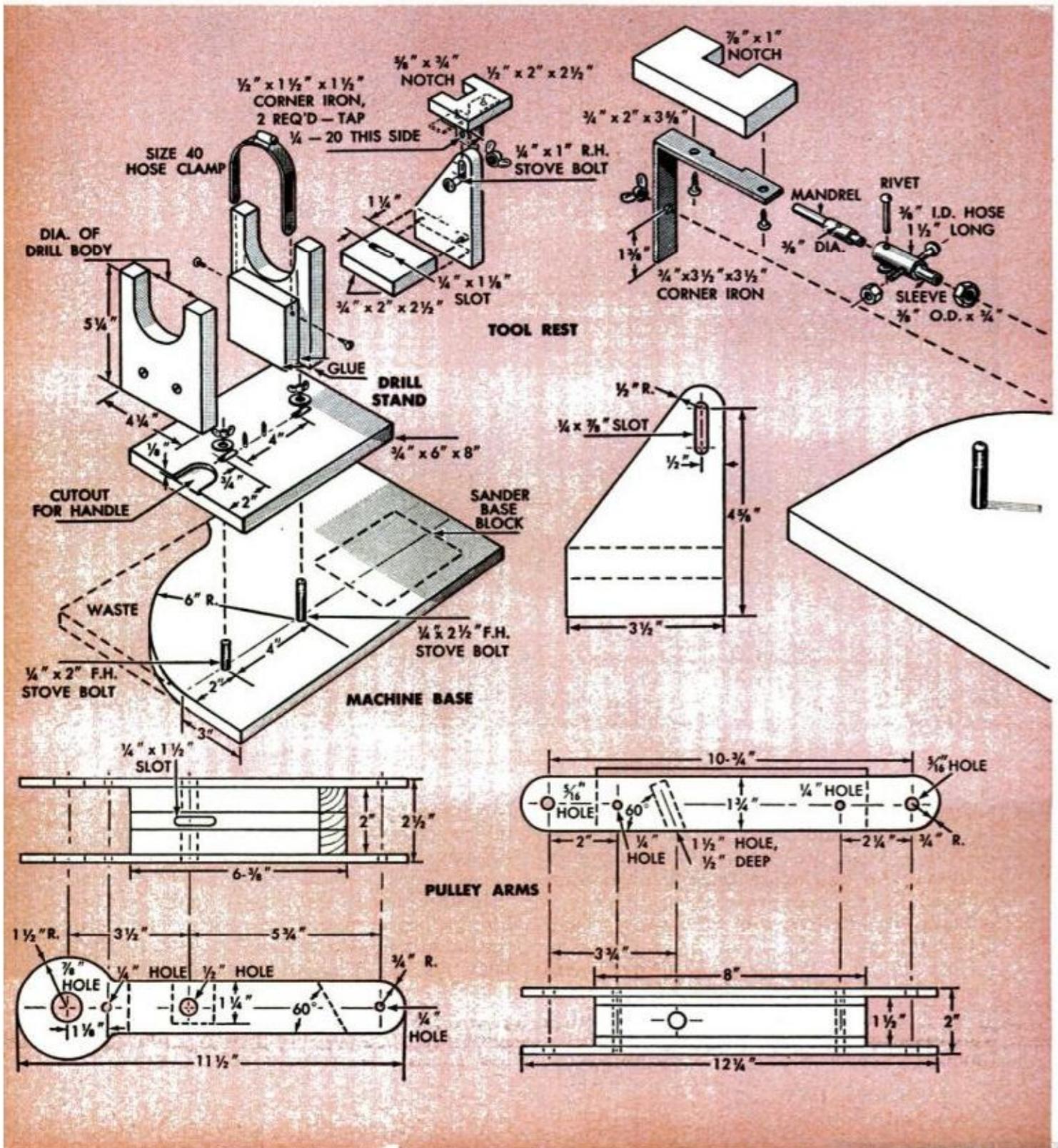


FOR EDGE SANDING, bring the sanding platen up to a horizontal position and attach the stop block

you may have to countersink the lock nuts slightly also.

When assembling the idler pulleys in the idler arm, tighten the nuts only enough to prevent the inner races from rotating. Then stake the nuts in place with a center punch. Bearings (Standard Conveyor Co. No. 100FC) and compression sleeves are available from industrial supply firms.

Belts for the sander are custom made from cloth-backed lathe sanding tape which comes in 1/2 and 3/4-in.-width rolls. In cementing the lapped ends, the ends are first cut at an angle and the abrasive scraped off for about 1 in. before clamping together with a small C-clamp. ★★



Punch for Portables

Give your transistor radio the power of a table model with this add-on amplifier and speaker

By Arthur Kennedy

POCKET-SIZE TRANSISTOR RADIOS are marvelous inventions. Ask any teenager! They are small enough to slip into anybody's pocket and they do bring in the stations. But they have one severe limitation—power. They are fine for personal listening and almost useless for anything else.

A pocket transistor radio just can't be loud. The maximum audio output of the average set is a fifth of a watt. For more power and louder sound—table-radio use, patio dance parties, on the beach—an additional outboard speaker with its own

self-contained transistor power amplifier is a must.

Here is just such an accessory. The two-transistor amplifier is built right into the speaker case and delivers up to 10 watts of audio power. The amplifier is driven by the signal from the pocket radio by plugging a modified earphone cord into the radio and speaker.

To make my transistor-radio power booster, I started with a Sound Piper Portable Patio Speaker. It is weatherproof, has an aluminum case and is not expensive. Similar units can also be used. But

PLUG-IN connecting cord couples the speaker to the amplifier. Then turn on the power, tune in a station and supply music for a party



for simple wiring, a compact speaker that has a metal case is a big help.

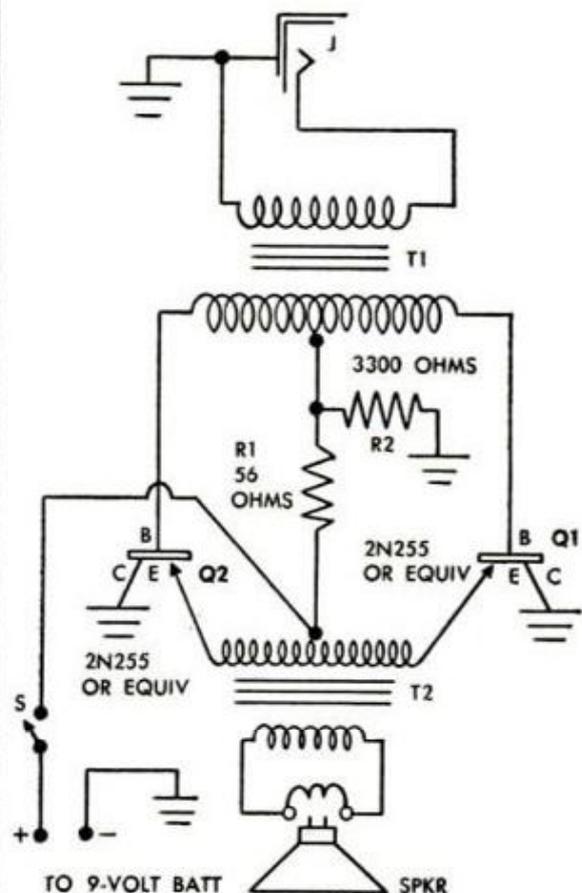
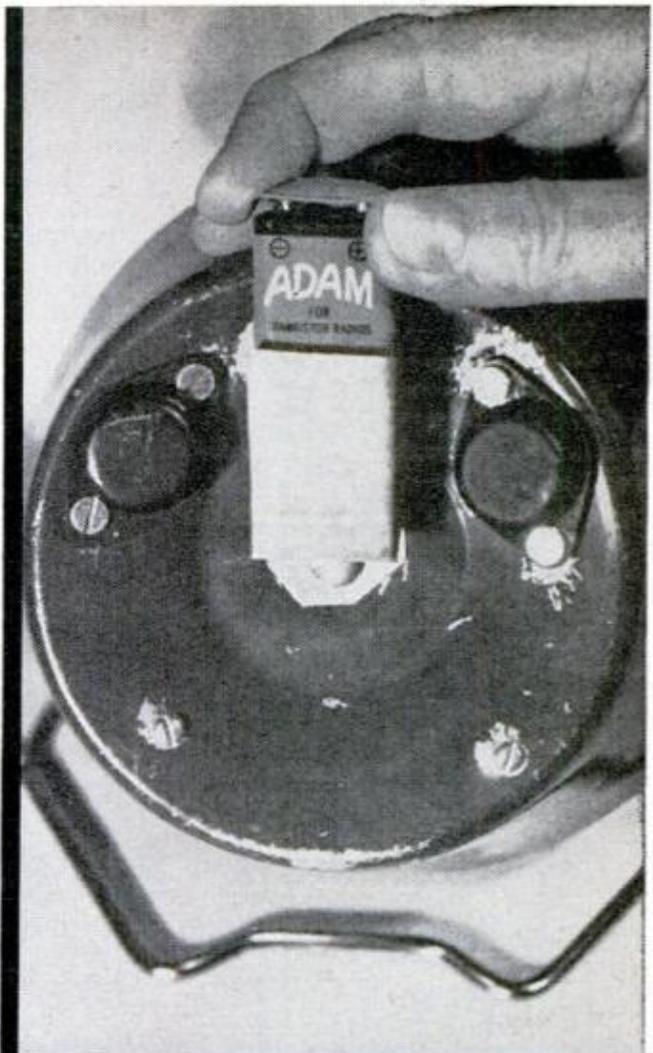
Before starting on the amplifier, remove the speaker from the enclosure and put it aside. Drill holes for the power-transistor leads and mount the transistors on the outside back of the metal enclosure with their leads projecting through the holes into the case. Be sure the leads or the clips that will attach to them do not touch the case.

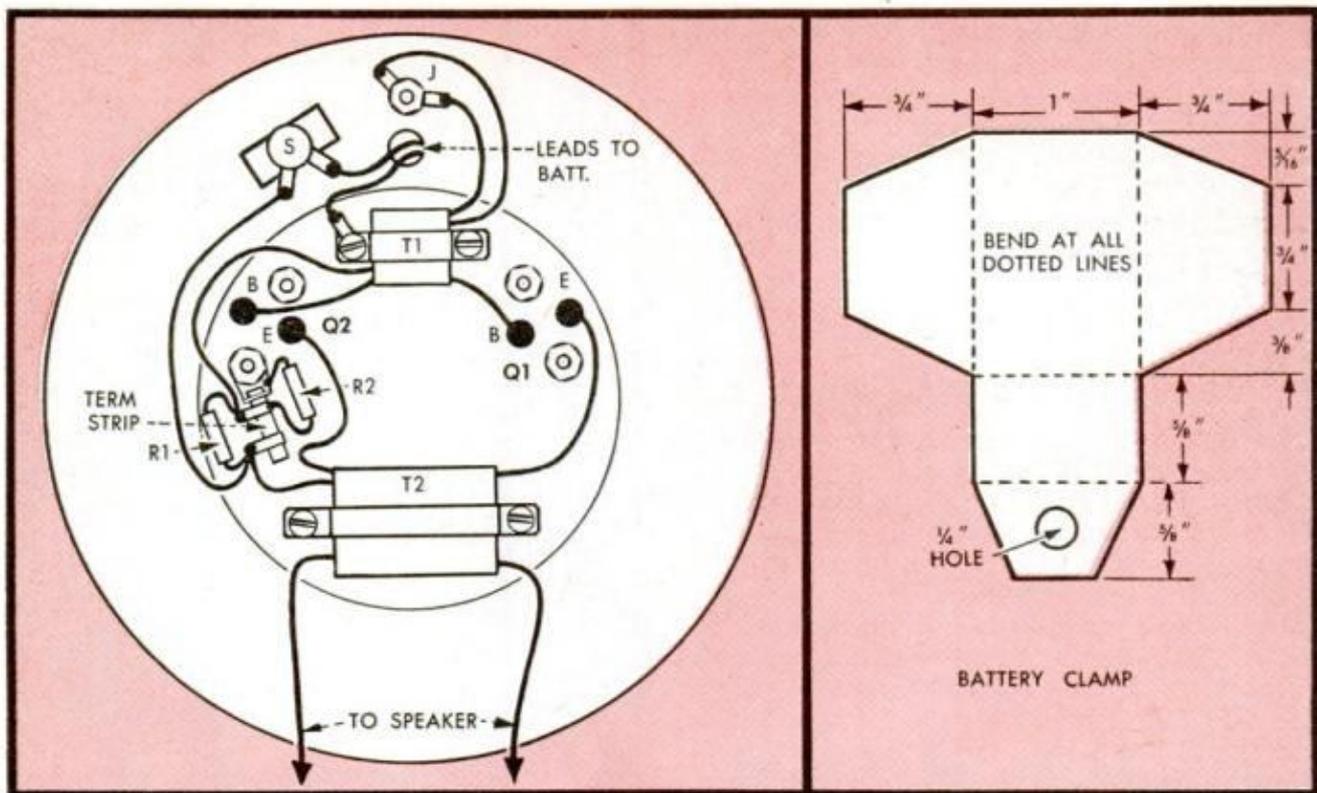
Mount Transformers

Next mount input and output transformers T1 and T2 to the inside rear of the enclosure. Place a ground lug over one of T1's mounting screws and secure the mounting screw with a locking nut.

As strange as it seems, there is no readily available power transistor socket. So to make a connection to the base and emitter leads of each transistor you'll have to use clips obtained from a 7-pin miniature tube socket. Use a wafer-type socket and drill out the center rivet. Then separate the plastic halves of the socket and carefully remove four of the tube

BATTERY for the outboard amplifier (above, right) slips into sheet-metal bracket on rear of amplifier case. Below right: Circuit of the two-transistor booster amplifier is uncomplicated and quick to assemble





USING the pictorial diagram (left) and the schematic on the previous page, you should have little trouble assembling the amplifier. This is an inside view. Transistors and battery clip are mounted outside the case. At right is layout for the battery clip. You'll need a 2 x 2½-inch piece of sheet metal

prong clips. After they are wired into the circuit, push them on over the proper transistor base pins. The transistor collectors are automatically connected when the transistors are fastened down to the metal case—the collectors are connected internally to the transistor cases.

Next mount the toggle switch inside the speaker case with its handle projecting out the top.

Now push the leads from the battery cable through a hole on the case and connect the red lead to one terminal of the toggle switch. Connect the other lead (the black one) to the ground lug on transformer T1's mounting screws. Then following the schematic and pictorial diagram finish wiring the amplifier.

Finally, the Battery Clip

The last bit of construction is mechanical—making the clip that holds the battery for the booster amplifier. It is made from a piece of scrap sheet metal following the pattern shown in the drawing at the top of this page.

The finished clip is attached to the speaker when it is reassembled. It is held in place by the same single screw that holds the speaker case together. If you don't use the specified speaker, bolt the clip to the rear of the unit you do use. Self-tapping screws will hold it securely.

To get the signal out of radio and into the booster amplifier, use the earphone cord that came with your transistor radio. The only change is to remove the earphone and attach in its place the miniature phone plug that comes with the MS-370 jack.

Now use this cord to connect the radio to the booster. Turn on the amplifier and radio, tune in a station and you're in business. ★★★

PARTS LIST

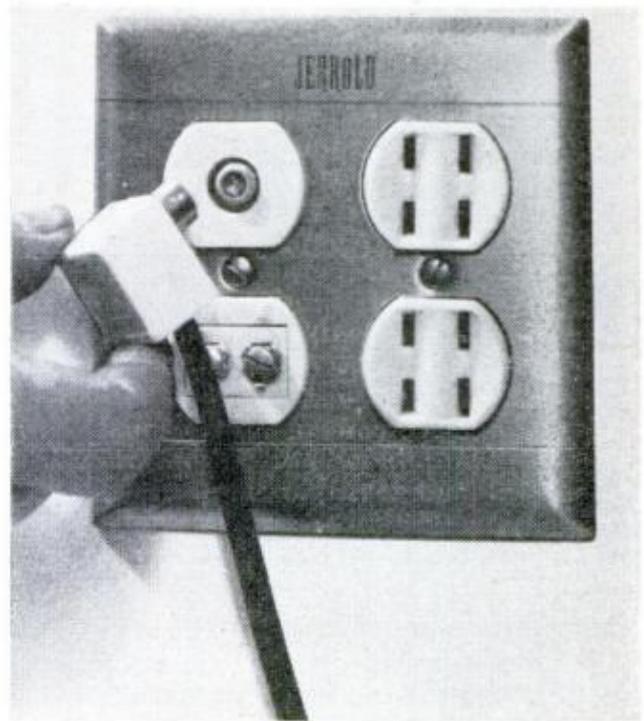
Portable Patio Speaker, Sound Piper Model 81PO67
 Transistor Battery, 9 volts, Eveready No. 216
 Battery Clip and Cable
 Miniature Phone Jack and Plug
 Transistor Output Transformer, Argonne AR-503 (TR2)
 Transistor Output Transformer, Lafayette TR-95 (T1)
 Spst Toggle Switch
 Medium Power p-n-p Transistors, 2N255, 2N301, etc. (Q1, Q2)
 Terminal Strip, 3-lug
 Resistor, Carbon, 56 ohms, ¼ watt
 Resistor, Carbon, 3300 ohms, ¼ watt
 Ground Lug
 Sheet Metal, 2 x 2½ inches
 Tube Socket, 7-pin miniature, wafer type
 Machine Screws, ⅜-inch x 8-32 (6) with matching nuts (7)
 Machine Screws, ¼-inch x 8-40 (2) with matching nuts (3)

What's New in Electronics

SET UP YOUR RECORDER using a Burgess Test Tape. It explains, step by step, how to check frequency response, timing, tape quality, sound level and 10 other important qualities. The test tape is sold in combination with a 1200-foot reel of 1.5-mil tape for \$8. Burgess Battery Company, Freeport, Illinois

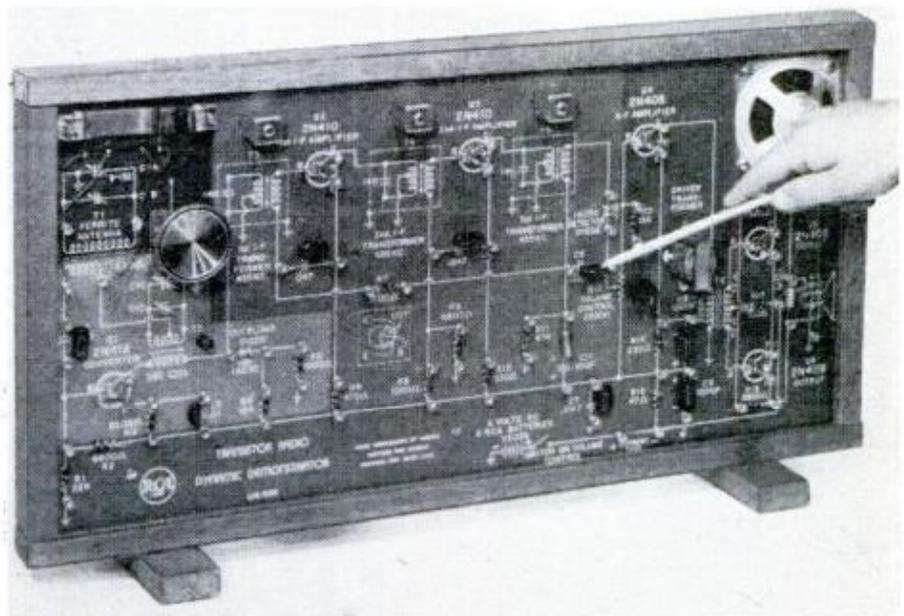


HEADLIGHT LEAVES HANDS FREE while spotting a powerful beam of light on the work area. Uses rechargeable nickel-cadmium cells for up to 10 years of light. Weighs 2½ ounces. Ultra-Beam \$9.95. Recharger \$1.95. Channel-Master, Ellenville, New York.



ULTRA-TAPE OUTLETS combine TV and FM antenna outlets with wall a.c. sockets in a single neat wall-mounted fixture. Two types of connectors are made—one is for 300-ohm twin-leads; the other for 75-ohm coax. Jerrold Electronics Corp., Philadelphia, Pa.

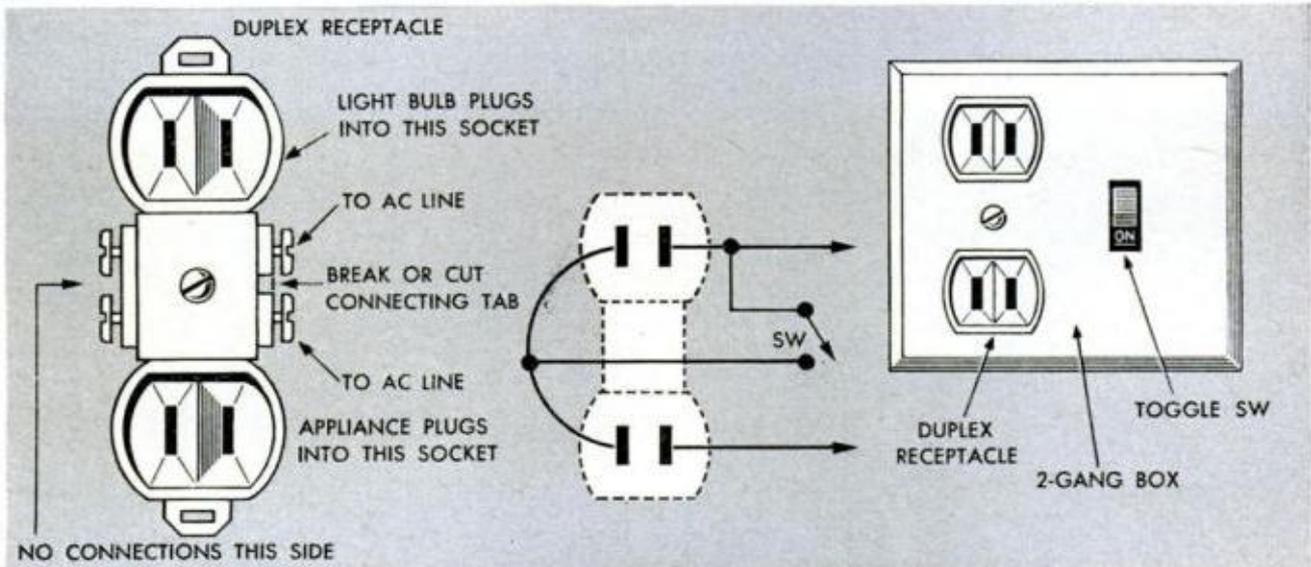
GIANT-SIZE TRANSISTOR radio, 12 inches by 24 inches, is perfect as a classroom demonstrator. It's a complete working 6-transistor superhet that can be used to teach the operation of transistor radio circuits as well as techniques of troubleshooting. Sold for \$39.95 from RCA, Electron Tube Division, Harrison, New Jersey.



Electronic

KINKS

USE BRASS EYELETS when you have to connect several wires to a single stud and hold them in place with a nut. Wrap the bare end of the wire around the eyelet and compress with eyelet pliers. Then slip the eyelet connector over the stud. You can now add or remove several connectors with ease.—Robert Micals

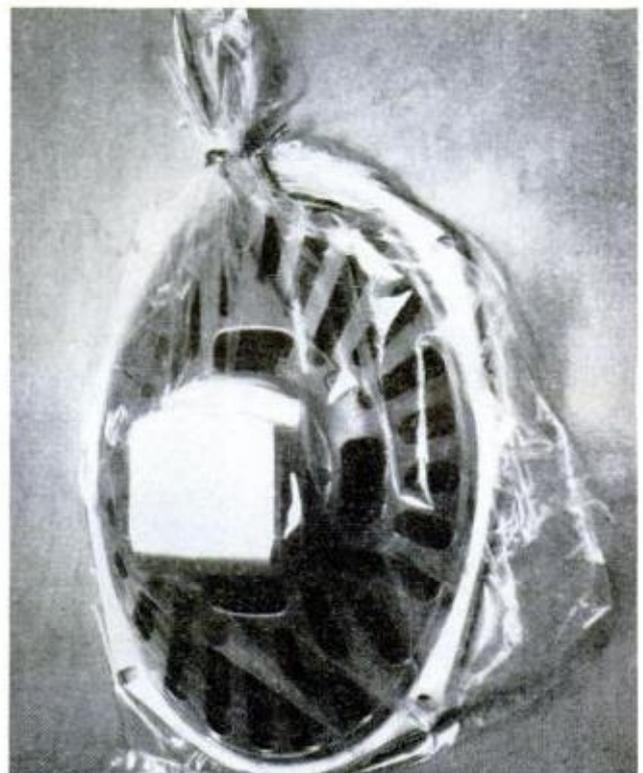
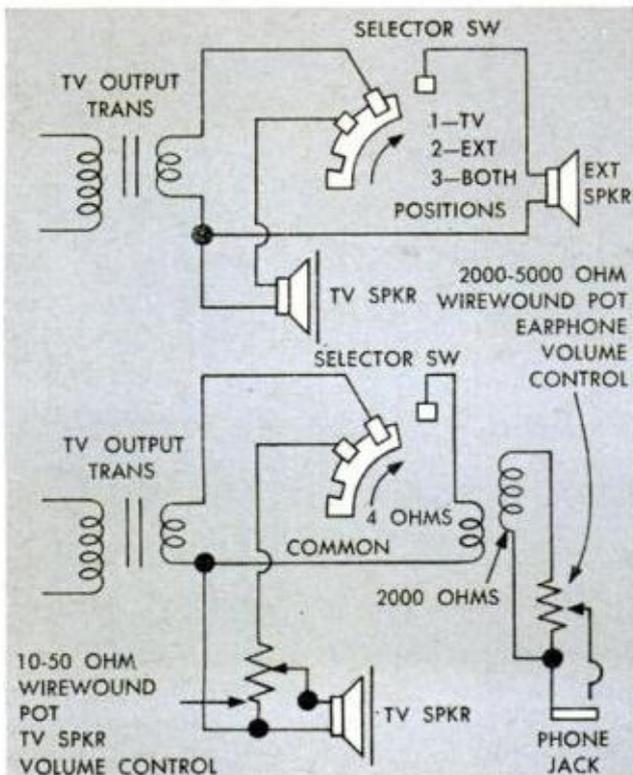


VOLTAGE-CONTROL AN A.C. OUTLET by breaking one of the tabs connecting the two sockets of a duplex receptacle and placing the two outlets in series as shown. Now plug a light bulb into one outlet and a

soldering iron into the other. Since the voltage to the iron is reduced, the heat it produces is also reduced. Use a bulb with a wattage rating that produces the desired level of heat.—M. L. Snedeker

MAKE A SWITCHABLE EXTENSION SPEAKER for your TV from a rear-speaker kit intended for an auto radio. Connect the speaker as shown, and you can use the TV speaker alone, the extension speaker alone, or both at the same time. Mount the extension speaker in a bookcase or on a plywood panel.—Jack Darr

PROTECT LOUDSPEAKERS against damage while they sit on the bench by wrapping them up in plastic bags. This keeps dirt, dust, bits of solder, etc., from getting into the voice coil and causing trouble when you re-install the speaker. The thin plastic has no perceptible effect on the sound.—E. Cohn



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2 See flicker-free slow motion. Switch to "slow motion" by merely flipping a switch so that *any* 8mm film becomes a smooth-action slow-motion movie. Adds more fun

to sport, scenic, and comedy scenes. You can also vary the running speed for both slow-motion and normal screening.

3 Watch your film thread itself 100% automatically. Your film winds right up and onto the take-up reel with-



Twin ducts aim jets of cooling air at film to permit brilliant "still" projection.

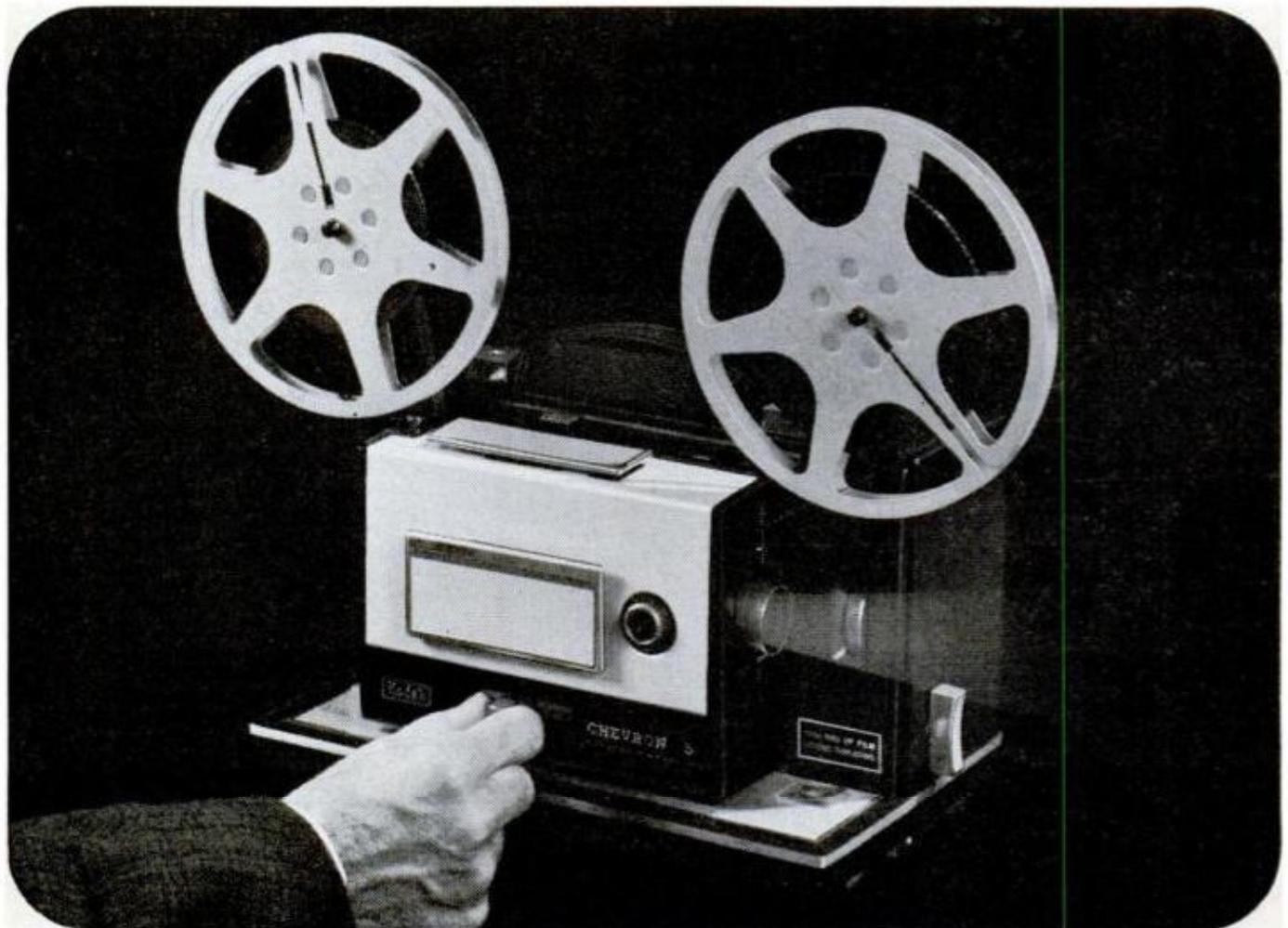
out stopping. Plug in a room light, and the projector will turn it off automatically as your show starts. Then, at the end, the room light comes back on automatically.

4 Show a full half-hour movie. A 400-foot take-up reel lets you project half-hour showings.

Take a reel of your favorite movie film to your Kodak dealer and run it off on this new KODAK CHEVRON 8 Projector, Model 10. See how much more entertainment you can get out of every scene.

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6 Put on an automatic slide show. Set the timer for slide-changing intervals of 5, 10, or 20 seconds; sit with your guests and enjoy your slide show as it plays by itself.

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and fine-tune the focus. You can stand at the screen and point out special features of your slides as you operate the projector by remote control.

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Push buttons, grouped on rear console, put control of show at your fingertips.

adjust lamp brilliance "high" or "low," run off slides in 1-to-80 order, "forward" or "reverse," or jump to any number in between by pushing the "select" button and spinning the tray.

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projectors you can own!



The KODAK CAROUSEL Projector

Game-Bird Savers

(Continued from page 161)

simple affairs that can be assembled in a few minutes, largely from materials immediately at hand. The cornstalk station is an example. Gather sufficient stalks to make a large shock. Stand them at an angle around a small tree and wire the tops tightly to the tree trunk as illustrated. Spread the stalks apart to form an opening on the leeward side of prevailing winds and storms. Form a hopper for ear corn from woven-wire fencing. Such a feeder provides food and even shelter for pheasant, prairie grouse and others. Another quickie feeder especially suited to pheasant in some localities is the ear-corn "string" at the bottom of page 161. A length of fairly heavy wire is forced through the cob of each ear of corn and tensioned between two shrubs with loops of wire and a spring. Three to five ears of corn can be strung in this fashion.

For Bobwhite and Valley Quail

The self-feeder shown and fully detailed on page 160 is especially suited to bobwhite, valley quail, even seed-eating, non-migrant songbirds. As dimensioned, it's about minimum size but can be made larger and the legs can be extended from the length given to 30 or even 36 in. to keep the feeder above deep snows. Use outdoor plywood and solid stock combined and when finished, stain the exposed parts with a gray shingle stain to give a weathered appearance. The feeder should be placed where it is not easily overturned by wind (or livestock). In some cases it may be advisable to anchor the four legs with stakes driven into the ground.

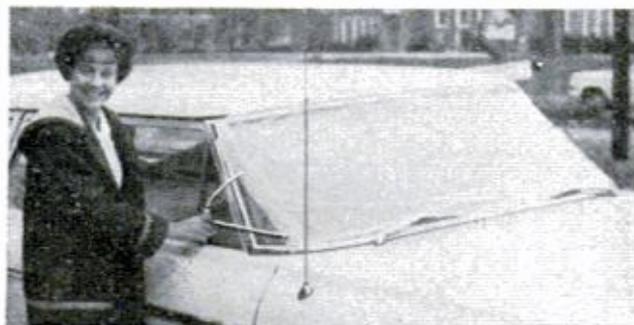
Although both are hardy and resourceful birds, the native prairie grouse—also called prairie chicken—and the "immigrant" chukar partridge often suffer greatly from lack of food when severe winter storms sweep their ranges in the plains states. A feeding station built of twigs can help these birds survive the severest winters. To make it, cut forked "posts" from small saplings and drive into the ground, spacing 3½ to 5 ft. each way over-all and standing to a height of about 15 to 18 in. Lay poles in the forks and cover with a sheet of heavy plastic. Then pile on trimmings from shrubs and small trees to make it appear as a natural brush pile with the opening on the leeward side of the prevailing winds and storms. Scatter a good supply of small grains such as wheat, oats or barley inside the enclosure and sprinkle a few grains outside to attract the birds. They will soon locate the feeder and once association overcomes

their wariness you will have regular patronage.

Wild turkeys are increasing their range due largely to protective and propagation measures of various clubs and state conservationists. Normally, in the southern turkey ranges particularly, the birds can make it through the average winter without any outside help. But there are seasons when a line of feeders in the mountain ranges of the wild turkey could mean the difference between few or no birds the following spring and a normal or increasing turkey population. One feeder for turkeys which seems to meet most of the requirements is shown on page 159. Turkeys are extremely wary birds and it will likely be some time before they finally visit your feeders. Once feeders are placed don't move them. Any of the small grains are acceptable as food, also hazelnuts and even small acorns, if they can be gathered in sufficient quantity.

For recommended feed grains and other foods contact your state department of conservation. They also may have special recommendations for winter feeding of game birds in your locality, may even have available late surveys of bird populations and where they are to be found. This information should be helpful in carrying out your feeding program. ★★

Quick Cover for Windshield



Ice and snow are kept from sticking to the windshield of a parked car with a new plastic cover. Loops of cord on the cover stretch over small clips installed in the vents to hold the plastic sheet in place. Ribs in the cover ends hold it flat.

The Jiffy cover is sold for \$2.95 by New Products Distributors, 117 Moore St., Danville, Ill.

Diamond Dust for Pens

Diamond dust sprinkled on the ballpoint of a pen makes for smoother writing, according to the Parker Pen Company.

The new "T-Ball Jotter" ballpen has a textured tungsten carbide point designed for better grip on paper. Diamond dust is added for increased durability.

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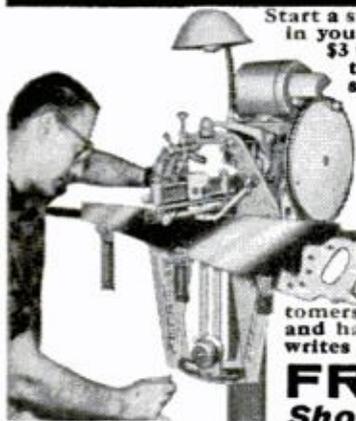
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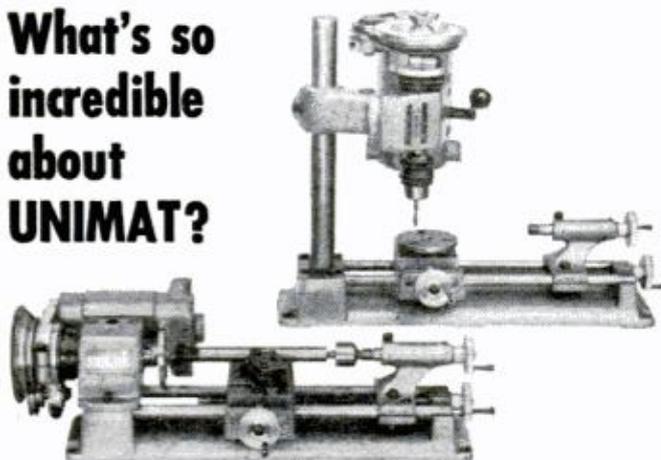
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Arc Welding Basics

(Continued from page 147)

if you're left-handed). Tilt the rod slightly toward the direction the weld is to be laid. This enables you to see the molten weld pool or puddle as you work, and observing this puddle is an all-important step in learning to weld.

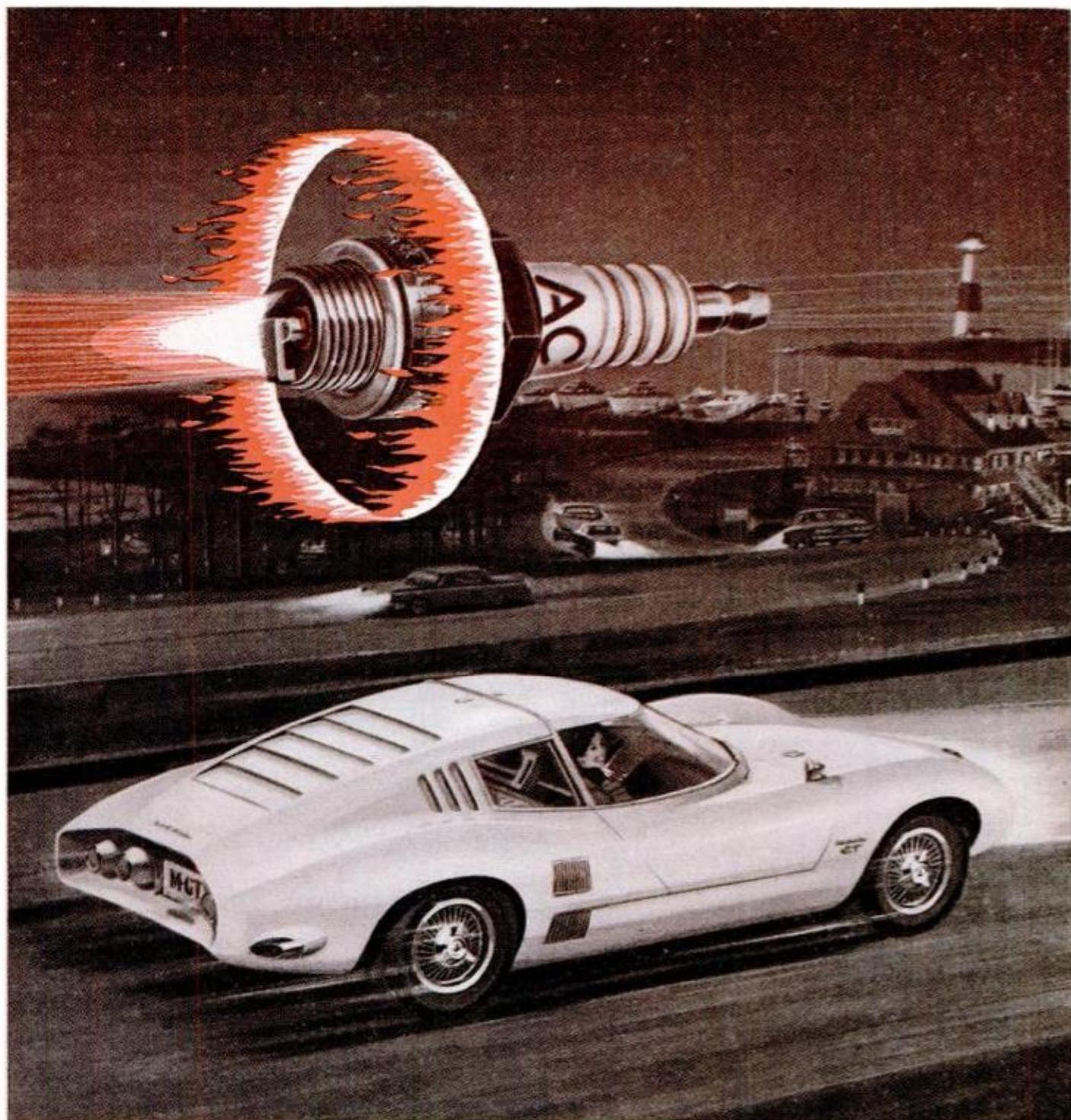
Now, again strike an arc—only this time continue to maintain it while slowly moving the rod in a path from left to right for a distance of about 4 in. Be sure to feed the rod downward to maintain the crackling sound of a correct arc length. Then stop welding and, after allowing the weld to cool for a few seconds, chip away the slag covering with a cold chisel tilted away from you. Keep your hood down to guard against hot flying particles—unless you normally wear glasses which will serve the same purpose. After removing the slag, wire brush the weld bead until it is bright and clean so that you can inspect the results and find out just what, if anything, you are doing wrong. A good weld should have very slight uniform ripples on the surface that are curved to the radius of the weld puddle. Most beginners tend to travel too fast and hold too long an arc.

It's Easy to Judge Welds

Compare your welds with the welds in the photochart on page 148, and decide what correction you should strive for. Repeat this check for each weld bead you lay until you have developed enough skill to make a good weld every time. It's also helpful to practice laying poor beads, so you can observe the weld puddle and thus recognize how a wrong condition looks during the welding process.

Lay your practice welds about 1-in. apart. If the scrap you're using is small, it may become hot enough, after a number of welds, to alter the conditions. This could be very confusing to a beginner, since proportionally less current is needed to weld steel as it heats up. So, alternate your practice welds on several pieces of scrap, if they're small.

We don't recommend that you cram the six hours of practice into one session. You'll learn faster working an hour at a time, spreading it out over a week or two. Meanwhile, the plans presented here are only for eager beavers—or for beginners with access to an experienced helper. The four projects are simple enough for the novice, but he'll do a better job on them if he saves the plans until he's learned all about joint welding, in our February issue. We'll cover butt and fillet, multiple-pass and lap, edge and corner welding. ★★★



(The Chevrolet Monza GT: 92" wheelbase, 165" overall, engine displacement 145 cu. in., 6-cylinder engine featuring dual carburetors, developing 102 SAE BHP at 4400 RPM)

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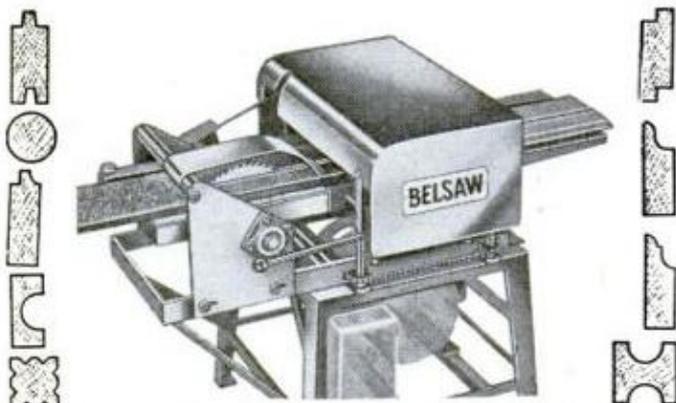
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Hot Tips for Cold Starts

(Continued from page 182)

plugs back, you may find that the shortened gaps permit the weak spark to jump them and start the cold engine.

At any temperature below zero there's danger of your crankcase oil setting and becoming solid as lard. This can add up to enough friction to make it impossible for the starter to turn the engine over. Not too many years ago, it was common practice to pour kerosene or diesel oil into crankcases to thin the engine oil. This would almost certainly damage modern engines that require extreme-pressure lubricant.

Fortunately, it's never necessary, with today's motor oils. Extreme-pressure capability is now available in a wide range of oils, of both the regular weight-graded (5W, 10W, 20W, 30, 40 and 50) and newer multi-graded types (5W-20, 10W-30 and 20W-40). The difference between the types was explained in a special article (*Exploding Myths About Oil Changes*) in the November issue. But a few points pertinent to cold starting bear repeating now:

If quick starts at low temperatures were your only consideration, the thinnest oil you could buy—5W—would be your choice. But once you're on your way your main concern is what happens to that oil at *high engine* temperatures—temperatures that vary little from summer to winter. At 210° F., 5W oil gets extremely thin—so low in viscosity, in fact, that car manufacturers warn you not to drive faster than 60 m.p.h. with it in your crankcase—and even that speed can be risky. The newer 5W-20 multi-grade oil, however, has a viscous polymer solution added to prevent such thinning out. Your choice between the two types (as a winter oil in very cold climates) has to be a compromise: for short, low-speed winter drives, 5W is okay. But change your oil before you head for the open road and speeds upward from 50—even at the risk of a few hard starts en route. See the chart on page 182 for other recommendations.

Gadgets Galore

Whatever oil you choose, there are devices to keep it from thickening, or to thaw it once it has thickened. These are called engine heaters; plug them into an electric outlet overnight. Then you get the kind of hot start you'd expect in July.

One of the most popular types is the dipstick warmer, shown on page 182, but there are others. One is a 650-watt water-jacket heater which is immersed through the head into the block coolant. It fits most engines and sells for about \$7. For engines that this regular size *won't* fit, you can

buy a special model for about \$8.50.

There's also an 850-watt external-tank heater which connects between the lower water jacket and the car's heater hose. This type has a siphon percolator that circulates heated water throughout the system. It fits all liquid-cooled engines, is thermostatically controlled and sells for about \$10. There is also a 1500-watt model that sells for about \$14 and warms up an engine in less than an hour.

Some types of dipstick warmers and other engine heaters are equipped with a cigar-lighter adapter. When away from an outlet, the device is plugged into the car's cigar lighter. Prolonged use will, of course, run the battery down.

In the absence of an engine heater, there is a makeshift method you can use. This is a photoflood lamp in a reflector placed beneath the car near the crankcase. This is too expensive, though, for any but emergency use; these lamps throw off a lot of heat, but have a limited life, ranging from 4 to 6 hours. Far longer-lasting is an infrared heat bulb. But don't dangle even an ordinary light bulb under the hood. It's of dubious value and you could bake the plastic-insulated wiring.

For Your Battery: Pro and Con

To keep a battery from freezing, there are several types of plug-in heaters on the market. Better still is a trickle charger, like the one shown on page 177. Hooked up overnight, it will keep the battery at maximum charge, which is a more effective means of preventing freezing than mere warming. The more expensive types can be connected to either 6- or 12-volt batteries and have automatic shut-offs to prevent over-charging. And remember: if you invest in a trickle charger, you won't need a booster battery—unless you want one for the road. Forget about chemical additives; they're of no proven value in keeping a battery warm and charged. But combining a trickle charger with either a crankcase immersion heater or a coolant heater is as effective as building a heated garage around the family bus.

The final cause of cold weather no-start can be the driver himself—the type who insists on flooding his engine although all mechanical parts may be operating.

When you go to start an engine in cold weather, depress the accelerator to the floor once or twice to prime the carburetor. Then, holding the accelerator halfway to the floor, turn on the ignition and hit the starter for about 15 seconds. If the car doesn't start, release the starter. After a minute or two, try again. Should you flood the engine, keep the accelerator *against* the floor on the next trip. ★★

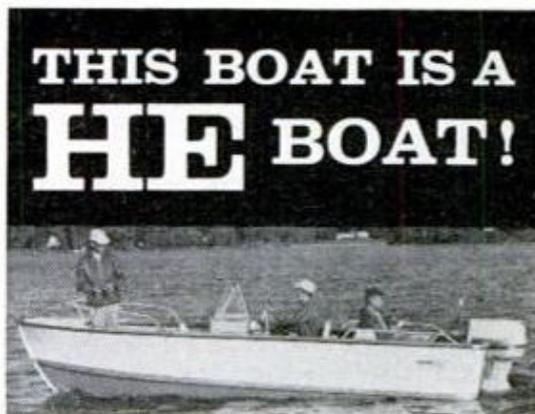


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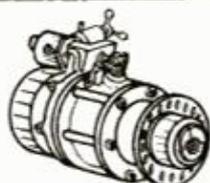
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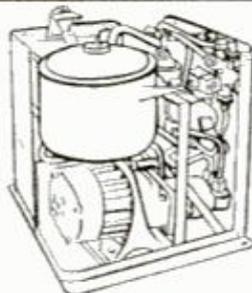
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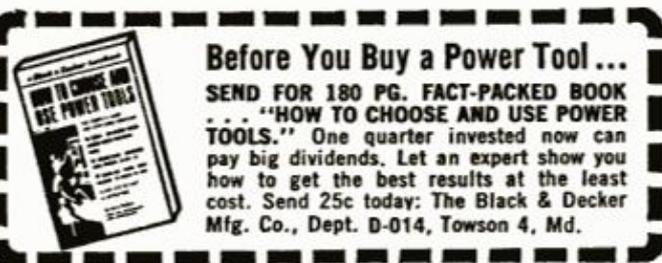
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Camping at 30 Below

(Continued from page 132)

but I couldn't have had a warmer sleep.

Since he must carry everything on his back, a second major consideration of the winter camper is weight. Snowshoeing on rough terrain can be arduous. It took us two hours to cover 100 yards on one difficult uphill stretch. There are times when an extra candy bar seems to weigh five pounds. The perfect weight for a pack is the lightest you can get away with and still carry everything you might need. The Sierra Club winter mountaineers have it down to 21 pounds per man, but this is Spartan living.

On my first trip I carried 60 pounds out of pure ignorance. A lot of my equipment was useless. I have since cut that weight almost in half with careful check lists.

Practical Rules of Thumb

Figure the number of days you'll be out, decide exactly what you'll eat for each meal, then figure on the possibility of being lost for three days and add emergency rations. Take only what can be cooked in a folding mess kit to eliminate extra pans. I carry freeze-dried foods to eliminate cans, dried fruits and candy bars containing fruits and nuts. A folding saw is lighter than an axe and is more efficient. I carry a surplus Navy knife that is heavy enough for chopping evergreen boughs, so there's no need for an air mattress. What to carry is an individual matter, but with a little experience you can learn to follow the maxim of the U.S. Mountain Troops—"when in doubt, leave it out."

In areas where clubs or state recreation departments maintain a network of lean-tos it is not necessary to carry a tent. But for comfort above the timberline a tent becomes a necessity. The ideal tent for snow is an A-frame of light, but tight, Egyptian cotton that does not require guy lines. It should lie small enough so that a one-burner stove will warm it, and be built low so that winds won't tear it down.

Dishpan Feet

Choice of snowshoes depends on what you intend to do in the hills. The long "Alaskan" shoe is excellent for long treks, but cumbersome for bushwhacking and impossible for uphill climbing. The "bearpaw" is good for heavy brush and climbing, but it's like walking on two dishpans when trekking. The choice of the Adirondack Mountain Club is the "modified bearpaw"; it's a compromise between the two and an excellent all-around snowshoe.

Scourge of the winter camper is frost-

(Please turn to page 212)

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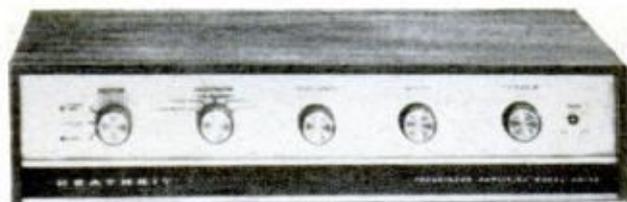
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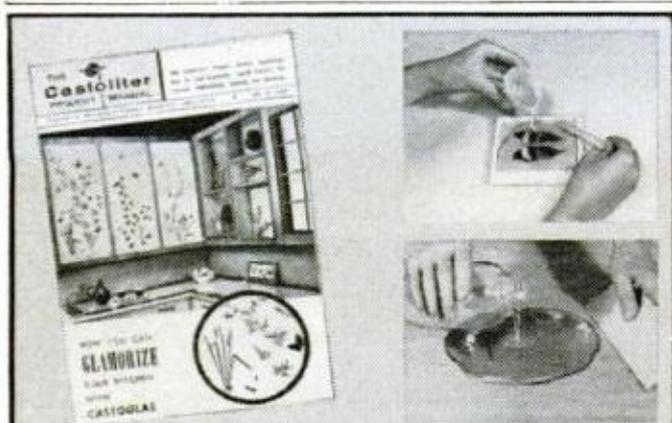
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Camping at 30 Below

(Continued from page 210)

bite. This can be brought on by inadequate clothing, pressures that inhibit blood circulation such as tight boots, wet clothing and severe wind. You can actually freeze your lungs by shouting in extreme cold. A face mask should be worn if the wind is strong, and take care not to get wet. Try not to breathe through your mouth even when you're short of breath. Nature gave you a nose to pre-heat and filter the air going into delicate lung tissues.

Hiking in Underwear

On one trip last year the temperature went up suddenly and it began to rain. The leader of the small party made us remove all our clothing down to the underwear, and stuff everything in plastic bags. We hiked along in the drizzle, a strange sight, but when the rain stopped the temperature plummeted, and we gratefully got back into dry clothes. We got back to camp without mishap.

Exactly why people go camping in the winter is difficult to pin down.

"I never thought much about it," a veteran camper told me. "I just like getting out into the mountains."

There is a crackling pristine beauty to the woods in the winter that is entirely different from summer. It is a thing hard to evaluate, like the whisper of snowshoes over new snow.

I spent five hours on one hike that was an agony of exhaustion. At the end of the ascent you could only collapse in the snow and question your sanity for attempting it. But the trip down was a wild, exhilarating romp on a pillow-soft chute. Back at camp with a cup of hot tea, I felt that I'd spent a wonderful day.

And that, I suppose, is why anyone wants to go camping in the winter. ★★★

Thunderstorm Analyzed

Downdrafts, the destructive villains of thunderstorms, are now better understood because two University of Chicago scientists fed storm data into an electronic computer for a year and a half.

Dr. Horace R. Byers and P. M. Das say that thunderstorms originate with an updraft that forms a thunderhead. Cloud droplets condense in this updraft and some fall through to form accumulations of raindrops in the lower part of the cloud. Their weight drags the cloud down. As it moves downward, it gathers speed and becomes colder than the air around it, striking the earth as a violent burst of wind and rain.

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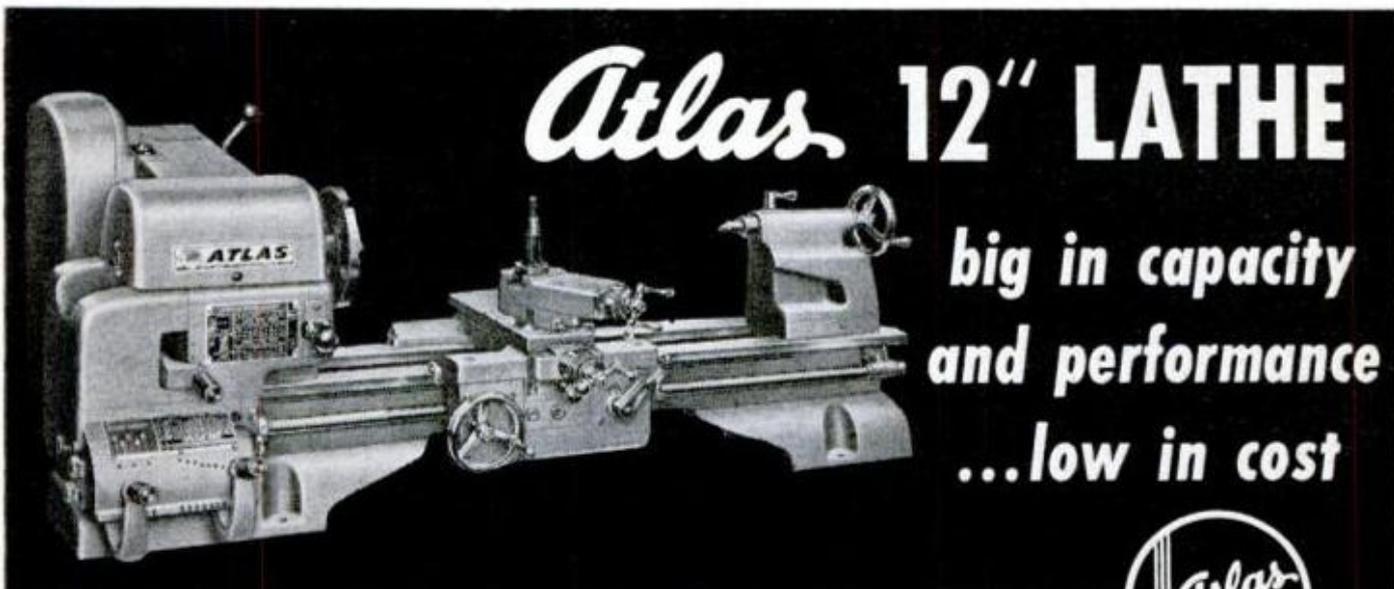
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Track Testing the Hot "400s"

(Continued from page 90)

shifted automatically from passing gear to drive at 75."

For a general evaluation, here's the way Hanks looks at all five cars:

"They all performed well, as they should with such big engines. They all had safety belts, which I insist upon, anyway. One thing that surprised me was their sticking quality in all the turns, with original equipment rubber. And another surprise was how close the cars were in all the competitive runs. You can't go wrong with any one of them. An owner's personal taste, the way the car fits and feels from behind the wheel, the styling he wants, would be the determining factors in his purchase decision.

"A thoughtless driver hasn't any business driving one of these cars; he can get into a lot of trouble."

Detroit's Other Speed Options

These are not the only high-performance cars that Detroit is offering this year. The Mercury Marauder, for instance, can be powered with the same 427-cu.-in.-engine used by the Ford. Buick's 425-cu.-in.-engine, standard on its big and heavy Riviera, is available for the Electra and Wildcat, together with twin four-throat carburetors, high output cams and other goodies. Similarly, the 413-cu.-in. Imperial engine is a performance option in the Chrysler 300 series.

Now that Detroit is definitely in the speed shop business it is offering more and more performance extras. Except for Pontiac, every car that *PM* tested can be made even hotter than our test cars, with additional factory equipment.

Chevrolet has a performance pack that increases the output of its 409-cu.-in. engine to an advertised 425 hp. The pack includes two four-barrel carbs, special camshafts, mechanical valve lifters and a full traction differential. (Mechanical lifters are necessary for peak performance; hydraulic lifters load up with oil and "float" at high r.p.m. reducing the valve action.) Chevrolet also offers a four-speed stick and tachometer in place of an automatic transmission for an extra option costing \$37.65.

PM's test Ford had a full competition mill with 11.5 to 1 compression, three dual carbs, mechanical lifters and special cams. It is still a pleasant street automobile when the throttle is adjusted for a high idle, to smooth out the roughness of the wild cam. Ford offers nothing greater in the form of power, but the factory does offer one more performance option: a

"lightweight" package. Performance goes up because the weight goes down.

The pack includes fiberglass doors, fenders, deck lid and hood; aluminum bumpers and brackets, flywheel housing and transmission case, and a special lightweight frame. Four-ply tires and heavy duty brakes are thrown in, but there's no radio, heater, undercoating or insulation; the car is lighter without them.

Dodge and Plymouth Four-Throaters

The 426-cu.-in. engine in both the Dodge and Plymouth tested by *PM* had a single four-throat carburetor, hydraulic lifters, moderate cam action and a compression ratio of 10.3 to 1. It is rated at 365 hp. Two optional extra performance engines are available. One is rated at 415 horsepower and lists for \$165 extra, the other delivers 425 horsepower. It is listed at \$233, including stick shift.

Dodge and Plymouth also offer an aluminum "front end" package including hood, fenders and bumper, which reduces front end weight by 150 lbs. In the *PM* tests, both the Dodge and Plymouth were powered by the same engine, yet Plymouth was more than two miles per hour faster in the quarter mile trap. This is an indication of the difference that light weight can make. The *PM* Plymouth weighed some 300 pounds less than the *PM* Dodge.

The big luxurious Pontiac that *PM* tested gave surprising performance, considering its curb weight of 4125 lbs. Its 421-cu.-in. engine, rated at 350 hp., has a compression ratio of 10.75 to 1, and is equipped with three two-barrel carburetors and hydraulic valve lifters. It was timed in the quarter-mile drag at 90.45 m.p.h., only three miles per hour slower than the Ford with its competition engine. No average owner is apt to test this automobile to its maximum.

Fact is, with any of these cars, the average owner may well chicken out long before the engine does. ★ ★ ★

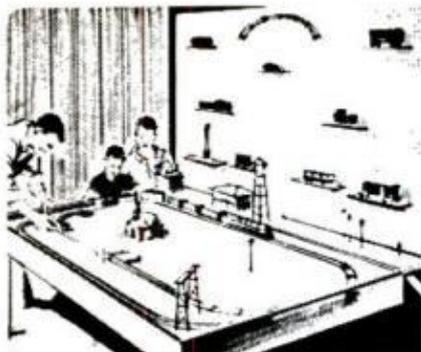
Water Supply from Dew

People in arid lands may soon enjoy a water supply from man-made "kiss-tanks."

Scientists at the U.N. Conference on the Application of Science and Technology for the Benefit of Less Developed Areas have suggested the use of small metal containers with refrigerating units which could condense water from fog.

Natural "kiss-tanks" are small pools of water condensed from dew drops which gather in the hollows of hard rock surfaces. The term "kiss-tank" describes the way the water is drunk.

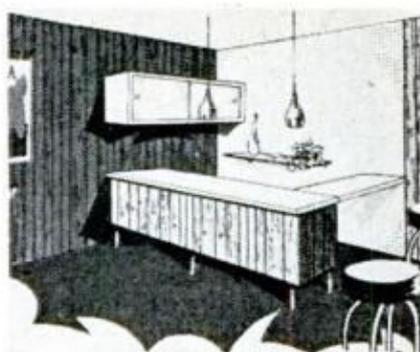
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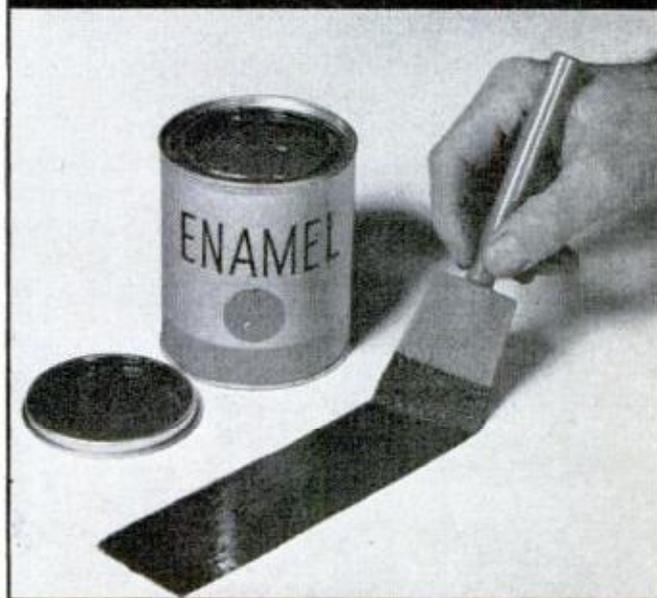
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Anti-Missile Missile

(Continued from page 125)

realistic decoys, now arrive in droves.

Decoys belong to a new class of weapons called penetration aids. Sometimes they are complex little electronic packages that generate a signal which, when it appears on the anti-missile radar, reads out exactly like a nuclear warhead. More often they are simpler.

Some decoys are merely thin metal triangles that, when spinning through space, have the same effective size—or radar cross section—as a bathtub-sized warhead. Others are simply sheets of cardboard covered with metal foil.

The most common decoys are toy balloons sprayed with a metallic coating and containing a trace of gas. Collapsed, hundreds can be packed in the decoy chambers just behind the warhead of, say, Titan I. (One reason for developing the new Titan II was to double the decoy capacity). When ejected into the vacuum of space, the gas expands, inflating the decoys to three-foot metalloid balls.

In space, balloons plummet toward Earth just as fast as heavy warheads. A Nike-Zeus radar would see perhaps hundreds of objects racing toward it at 15,000 m.p.h. Any one could be the warhead. And no single anti-missile blast could knock out more than a few of these widely scattered flying objects.

Fingering the Target

How does the anti-missile missile know which target to go after? The first country to come up with a reliable solution will upset the strategic balance in its favor. Nike-Zeus can tell *sometimes*. Nike-X will be able to tell more often and more reliably. Both rely on something called "atmospheric filtering."

When warheads and decoys plunge into the earth's atmosphere, heavy warheads slow a little; lightweight decoys slow down faster. The decoys that don't burn up completely turn red hot. Warheads get hot too, but not as hot as decoys, thanks to protective materials. Both "re-entry signatures" can be detected by ground-based infrared sensors.

Right now, scientists with the Advanced Research Projects Agency's Project Defender are busy all over the world watching re-entering test warheads and nose cones on sensitive instruments, in order to measure and study the characteristic re-entry signals they produce. Nike-X computers will be programmed to detect all possible aspects of each re-entry "signature" for a wide variety of warheads. Some change trajectory due to the slowing

effect of atmosphere; some heat up in special ways; the nature of ionized gas plasma that wraps around an object re-entering at high speed takes on special characteristics with different shapes.

The computers will also memorize the signatures of dozens of types of decoys. Fast as light, the computer will match the signatures that a Nike-X radar spots in the sky against its memory file. In a split second it will sort warheads from decoys and take defensive action.

The farther through the atmosphere the object travels, the more information it yields. For sure discrimination, Nike-X should be able to watch the speeding cluster of warheads, decoys and missile debris for several seconds before it gets too frighteningly close.

Zeus was designed to intercept warheads 200 miles from their intended target, at altitudes of 50 to 100 miles. The system has to make its target discrimination decision early—too early to be reliable.

Zeus Fools Decoys

In at least one test, however, Nike-Zeus successfully intercepted an ICBM nose cone accompanied by several simple decoys. At White Sands, N.M., the missile has more than once intercepted fast Nike-Hercules anti-aircraft missiles. On Roi-Namur Island, more than 2000 miles southwest of Honolulu, launchers send up small Speedball missiles that streak into the atmosphere and then blast downward to simulate an attacking ICBM warhead, while Nike-Zeus complexes on nearby Kwajalein practice picking them out of the Pacific sky.

Bigger tests begin nearly 5000 miles away at Vandenberg Air Force Base, Calif. Atlas and Titan ICBMs are directed to an impact area near Kwajalein, providing valuable opportunities for anti-missile developers to collect genuine intercept data. The Army has announced five successful intercepts of Atlas and three of Titan warheads. The goal is to make Nike-X at least ten times more effective than Zeus in all respects.

Zeus uses four radars to perform four jobs: Acquisition, discrimination, target tracking and missile tracking. Nike-X will do all four jobs with a single radar. It will not be the usual huge dish, but a flat plane. It won't move. It will be aimed electronically. The plane actually is an array of several hundred small stationary antennas, or elements.

At one instant the radar beam may be wide for spotting a small object in a vast expanse of sky. The next instant, the beam can be narrow for close tracking that

(Please turn to page 218)

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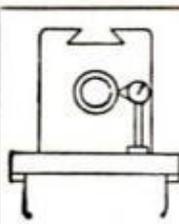


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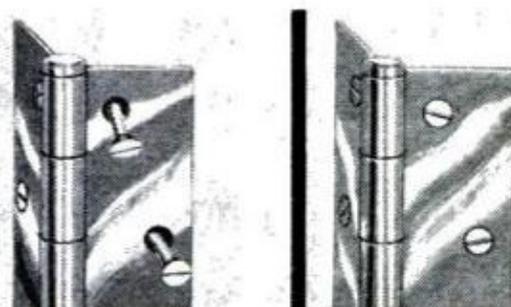
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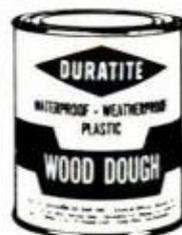
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Anti-Missile Missile

(Continued from page 216)

object. One second, the beam may point East and the next second, West. Switching from one function to another is so rapid that the effect is equal to four simultaneously operating radars.

Nike-X's multifunction array radar (MAR) is not easily saturated by a mass attack. And with no huge rotating dishes, most of the system can be hidden underground in hardened pads.

Although it will work faster, Nike-X must still allow incoming objects to plunge through the atmosphere for a couple of seconds to sort the warheads from decoys. Still it will make intercepts at a safe altitude. One reason: a much faster anti-missile missile called Sprint.

Sprint's speed makes up for the seconds used up to identify decoys. Sprint will intercept at 40 miles altitude in just over five seconds. Sprint will be smaller and cheaper than the 48-foot, 450,000-lb.-thrust Nike-Zeus.

So much for our side. What do the Russians have?

Pentagon officials believe the missile installation at Leningrad works about the same as Nike-Zeus. Reports indicate it is designed to intercept medium and intermediate range missiles, launched from 350 to 1200 miles away.

Zeus Tops Red Missile

The Russian missile killer probably has destroyed mock warheads, or at least flashed a light near enough to show that a nuclear-tipped weapon could have destroyed the invader—something Zeus has done many times. The Pentagon believes that so far the Soviets have intercepted only medium and intermediate range missiles. Zeus has "killed" warheads from Atlas and Titan ICBMs fired from 5000 miles away.

The Russian system, which we call AM-1, consists of 30 missiles and their launchers. The AM-1 radar and computers, according to Defense officials, can spot, track and intercept up to five incoming objects at a time—to old Nike-Zeus' nine.

Details of the missile used in the Soviet system remain a mystery. The Reds probably use an improved Guideline anti-aircraft missile, a modification of the weapon that brought down Francis Gary Powers' U-2. The latest known Guideline can climb only about 15 miles. It is probably the business end of a two-stage missile, the booster being an obsolete medium-range ballistic missile called Shyster.

Shyster is fueled with alcohol and liquid oxygen. The Russians have developed re-

liable techniques for fueling a liquid propellant missile and keeping the tanks constantly topped off. We have devoted our effort to perfecting fast-reacting solid propellant missiles.

If the Soviet anti-missile system is inferior to Nike-Zeus, why did they deploy it? U.S. officials believe the AM-1 at Leningrad is largely a propaganda maneuver—to reassure satellite countries and impress neutral nations. The Pentagon also believes that AM-1 is a test system for developing a mobile missile defense to accompany armies in the field.

Who, then, is really winning the anti-missile missile race?

The Defense Department, and many outside scientists, say neither side is winning. Many experts think there will never be a successful anti-missile missile.

Part of their reasoning involves a large dish-type radar on Roi-Namur Island near the Speedball launching site. It is called TRADEX for target resolution and discrimination experiments.

When nose cones plunge toward Kwajalein, Nike-Zeus isn't the only radar that watches them carefully. So does TRADEX. It has learned much that will help Nike-X developers sort warheads from decoys.

Two-Sided Coin

But it has learned even more that is helping the Air Force redesign its warheads and decoys so they cannot be distinguished. As Defense Secretary McNamara points out: "Missile defense and missile penetration aids are but opposite sides of the same coin." Offensive weapons will probably always be a step or two ahead of the defense.

Why then are we pouring some \$450 million per year into an anti-missile missile program that probably can't do an effective job? Says the Pentagon's research chief, Dr. Harold Brown: "I don't feel comfortable that an antiballistic missile can be developed. . . . But the consequences, if achieved, are so important that they fully justify the very large effort that already has taken place on Nike-Zeus and the further development effort which will take place on the Nike-X system." ★★

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Imagination Is the Product

(Continued from page 120)

Another problem: Make a paper structure without glue or metal fasteners that will support a brick. *Aha*, thinks the student, *I'll simply make an accordion fold, which will do the job nicely*. Then Ray adds a second requirement: The structure must always support *one* brick, but always collapse under *two* bricks. If you think this is easy, try it. The problem teaches the student that most design problems have limiting factors.

Critique Is a Thrill

Ray says his biggest thrill each year is the final critique, when the students display and discuss everything they've turned out during the course.

"Inevitably, at that point I can see that the course has, at least to some extent, succeeded. It gives me a feeling of accomplishment—not my accomplishment, but the accomplishment of the students.

"A student once told me that the biggest thrill of his life was to look over everything he'd done, and suddenly realize that it was unique, that no one had ever done any work exactly like it before.

"It was one of the biggest thrills of my

life, too."

None of the problems that Ray Pearson gives his students results in functional objects. Yet a glance at those objects suggests countless applications. Who can look at the soda-straw structures without visualizing Christmas decorations; or at some of the off-center lathe work without seeing graceful, free-form candlesticks?

Anyone can try similar experiments in sculpturing with wood. Here are a few ideas and techniques—but no projects. Ray is vehement on one point:

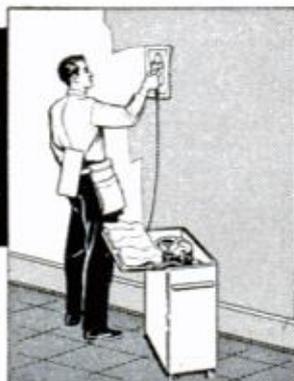
"Don't imitate. Use your imagination."

Table Saw

Clamp a strip of wood to the table at an angle to the blade—any angle—to serve as a temporary fence. Start with the blade low, and slide a block of wood along the fence in a scraping cut across the blade. Raise the blade a bit on succeeding cuts. In this way you can make any elliptical cut, or cut any segment of a half-circle. By making scraping and overlapping cuts on various faces, you'll sculpture the wood into surprisingly unique effects.

You can develop other novel patterns by making numerous cuts in a length of dowel. A short section of clothes rod is excellent for experimenting. Across one end of the dowel draw index lines in a pat-

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tern. Feed the dowel through the blade in successive cuts, turning it after each cut so that the next index line matches a guide line on the miter gauge. Also try raising or lowering the blade on certain indexed cuts.

Drill Press

Pattern drilling can produce striking effects. At periodic points in the pattern, from one side or the other, drill all the way through the board or block; at other points drill only partially through. The overlapping result of such pattern drilling may surprise you.

You can also cut a hole down through the center of a square block (a two-by-two, for example), without drilling into either end. The secret, of course, is to drill pattern holes along each face, making sure that the holes on one face overlap those on another. The core is carved right out of the block by the drill.

Lathe

There's a world of fun—and graceful curves—in off-center lathe turning. Center a block of wood in the lathe and turn a deep pattern into it—any pattern. Then remove the block and recenter it. This can be done in several ways: You can simply recenter one end at a slightly different point; you can recenter both ends at different points; or you can cut two new parallel faces at an angle in the original faces, then recenter the block on these faces. Now turn another pattern on top of the first one. The result usually is an odd but graceful shape.

Bandsaw

Here you can really let your imagination go. Start from one end of a block and cut almost to the other end. Make successive cuts until you have, in effect, a series of thin slats bound together at one end. Now turn the block to an adjacent face and make similar cuts from *either* end. This will produce a bundle of long thin strips, all connected at one end, or half at one end and half at the other. Spring them apart into any pattern that pleases you, and hold them there with bits of dowel or small blocks of wood.

Another technique: Cut a thin slat along each face of a block, almost to the opposite end. Now notch some or all of the faces a short distance in from the end at which you started, peeling back the slats to cut the notches. Bow the slats outward into graceful curves, and insert the ends into the notches. The result is an oddly beautiful shape, with each slat assuming a slightly different curve, depending upon its thickness.

And now—try inventing some tricks of your own. That's the whole purpose of this article. ★★★

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Servicing the '64s

(Continued from page 95)

is the use of a thin, stamped steel insert to protect the aluminum housing.

Crevice corrosion usually attacks gasketed joints or areas covered by hose clamps. Aluminum normally protects itself with a tough oxide coating on the surface. But if oxygen can't get into a tightly sealed area, the protective film doesn't form and the bare metal is gradually eaten away. Engine designers have found this out the hard way and are still learning how to avoid such headaches.

That Clog-Prone Smog Valve

One year ago, in *Popular Mechanics'* January issue roundup of 1963 service requirements, positive crankcase ventilation was cited as a major obstacle in the path to the service-free car. That prediction turned out to be painfully true. Ford's simplified system, used on 6-cyl. engines, had to be scuttled completely. The idea looked good on paper. Air sweeping through the crankcase carried blowby fumes through a tube to the air cleaner. Since this additional air entered above the carburetor, the fuel/air ratio was not disturbed and the usual ventilation control valve was unnecessary. What engineers apparently failed to anticipate was severe clogging of the air cleaner. Ford quietly dropped the arrangement during the 1963 model run and has switched to the conventional design, complete with ventilation valve, for 1964.

Ford's desire to get rid of the ventilation valve was understandable. Regular cleaning is necessary to prevent the valve from sticking or clogging. When this happens, the carburetor idle mixture is disrupted, resulting in rough idling or stalling. Should the system become blocked, pressure builds up inside the crankcase. Unburned particles of fuel escape to the atmosphere, creating smog that the device was intended to reduce.

This situation will get worse before it gets better. Most cars equipped with positive crankcase ventilation are less than one year old. Piston rings are still tight enough to prevent excessive blowby. When the rings become worn and partially burned fuel pours into the crankcase like steam from a bubbling tea kettle, the ventilation valve will become the No. 1 trouble-maker on the automobile.

Extended Lube Revisited

When this whole service-free kick started, one of the biggest question marks was extended chassis lubrication. Would ball joints run 30,000 miles or more with-

out regular lubrication and still remain tight and free of squeaks? Could the average housewife still turn the steering wheel without overworking her deodorant after sealed joints in the steering linkage had gone through summer heat, slush-and-salt baths and grease-thickening cold?

Although the first U. S. cars without lubrication fittings are now three years old, nobody is sure how well the idea is working out in practice.

One company that supplies its salesmen with approximately 500 lube-free 1962 and 1963 Ford Fairlanes reports that some cars have reached 45,000 miles, and there has been no significant trouble with the sealed joints. High-mileage cars had the joints repacked as scheduled at 30,000 miles.

On the other hand, there's no doubt that many cars on the road have been converted from the 30,000-mile cycle to regular visits to the lube rack, but who knows how many? To find out, the National Lubricating Grease Institute surveyed manufacturers of grease fittings. These companies reported that replacement sales had increased 12-15 percent in 1963 over comparable periods in 1962. One respondent frankly admitted, however, that he didn't know how much of this gain was due to changeovers from sealed joints and how much could be attributed to the greater number of vehicles on the highways.

Squeaky Doubts

When sealed joints are equipped with grease fittings and switched to a periodic lubrication schedule, it's usually because squeaks or excessive looseness have developed. One defective seal that lets water seep into the joint can cause a car owner to lose confidence in the whole arrangement. When a ball joint starts to squeak, it needs lubrication. Looseness, however, is another matter. Even before sealed joints, the needless replacement of ball joints because of *apparent* looseness was a common practice. Thousands of perfectly serviceable ball joints are discarded *simply because servicemen don't know the correct procedure for checking them.*

In the most common front-suspension setup, with the coil spring or torsion bar attached to the lower control arm, the lower ball joint is the one that carries the weight of the car. This forces the ball into the socket. The upper joint merely adds stability. If the car is hoisted with a bumper jack, its weight no longer forces the ball into the socket. Under this condition, a certain amount of play is normal. Too often, mechanics feeling this looseness assume that the joint is worn. In states requiring safety inspections, even new cars have been rejected for this reason.

According to the AMA's Inspection Handbook, the correct way to check ball joints is as follows:

If the spring is mounted on top of the lower control arm, or the torsion bar is attached to the lower arm, support the vehicle at the arm. There should be no perceptible vertical play in the upper ball joint. Maximum vertical play in the lower ball joint is specified by each manufacturer and varies from zero to .200 in. When the wheel is grasped at top and bottom and rocked back and forth, maximum movement at the tire sidewall should not be more than .250 or 1/4 in.

Upper Lower Joint Play

On cars which have the spring mounted on top of the upper control arm, the vehicle should be lifted by the front cross-member or side rails. There should be no noticeable play in the lower ball joint. Vertical play in the upper ball joint is the same as that specified above.

The ball joint situation points up what is probably the greatest weakness in the automobile industry today—a lack of trained mechanics. Automobile manufacturers haven't talked about the big hidden reason behind the whole service-free development. In complication and sheer numbers, today's cars are outstripping the ability of mechanics to service them.

There are, today, about 750,000 men who call themselves mechanics. They range from the skilled artisan to the hopeless incompetent who can't install a spark plug without cross-threading it.

Estimates vary widely as to the number of additional mechanics needed. Some industry spokesmen put 800,000 as the minimum total necessary. Ford's former national service director, Carl Doman, disagrees. All that is necessary, Doman says, is to increase the skill and productivity of the mechanics we now have.

They Don't Like Grease Pits

This is no easy task. Oldtimers are retiring. Bright young men are turning to electronics, space flight and other pursuits where the pay is higher and apprenticeship isn't served in a grease pit. Yet, the skilled auto mechanic who takes the time and trouble to master such complex mechanisms as automatic transmissions and electric control devices can pick his spot.

Perhaps the shortage of men who love and understand fine machinery is what prompted a leading engineer to remark that the ultimate goal of his company was to develop a car that required no more routine maintenance than a refrigerator. Despite much genuine progress, that day is still a long way off. ★ ★ ★

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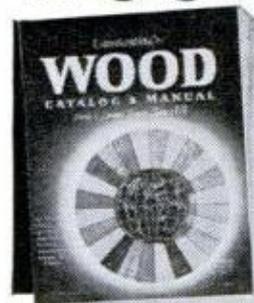
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Testing '64's Cool Compacts

(Continued from page 109)

you to an indicated 58 miles per hour.

Entry is commendable on this sedan. Doors are high and floor sills are flat at the edges. The hump is unobtrusive.

Among the car's strong points are its roomy body and truly excellent vision. It's like riding in a wide open solarium, yet there's little "baking" from the lack of protective overhang. There's a good deal of seat room in the rear.

Pontiac Tempest, 6-cylinder, four-door sedan, automatic transmission, manual steering and brakes.

The Tempest, even this bottom-of-its-line model, has a distinctly plush feel. It's exactly the same as the Chevelle in body structure and frame, but has delicate differences in action.

Manual steering is precise and, unlike the Studebaker's, the recirculating ball gear starts working as soon as you move the wheel. Around right-angle turns on this high-crowned road, the car stays just where you put it.

It's a pity the stylists weren't willing to use a lower, down-sloped hood line.

Tempest's riding qualities betray the longer wheelbase. Action is more rhythmic, less delicate and cushion floating than Valiant. There seems to be more feel of action between the body and frame, in the rubber-mount area compared to the Chevelle which, theoretically, has the same system. The Tempest, however, is lighter. Its mounts absorb a lot of shake, but could, I feel, benefit from retuning.

Engine response is good. The new automatic transmission has a kickdown, but it's less harsh than Falcon's two-speed planetary or the three-speed planetaries of Studebaker and Rambler. Tempest's flip-the-switch system takes you up to 65 before upshifting torque converter blades again. There's no engine vibration and power flow is silky.

Tempest, of all the group, is most similar to the Valiant in the feel of body excitement and body roll. Cornering roll isn't extreme, but it starts freely and quickly. You feel more lean than is present, yet there's no sense of lack of control.

Seating is a good compromise for most people, but rear kneeroom isn't quite what you'd expect in a car this size. Wheelbase is equivalent to "big" Chevrolts of five or six years ago. Tempest now feels big, husky, but not bulky.

The stability and control sense, in spite of slightly softer suspension, is excellent. It corners without any of the walkout or cambering nonsense you got on the old Tempest. Body float is minimal at 80,

although a bump betrays just a little too much shock absorber freeness.

Rambler American 440 4-door sedan—six-cylinder, 125-hp., power steering and brakes, air conditioning.

This test Rambler has everything on board. The heavy air-conditioning compressor, which looks like one of the biggest ones in the business, plus the power steering unit up front, make the car feel as heavy as if it had a V8. It also has a steering wheel that sticks way out from the panel, closer to the driver than you would like for good control.

Rambler was best of the group for over-the-hood-vision. The hood slopes down and inward so you see the road sooner.

The car has individual front seats with reclining backs—unusual in a 4-door sedan and rather nice. It permits split adjustment of the front seat, for long legs or short.

Along with Valiant, Rambler boasts the shortest wheelbase, 106 inches. This year's ride is a little choppier, perhaps because of the weight of the front end which keeps it outbalanced. But the body feels solid.

There is little evidence of the excitation from small bumps that you get in the Studebaker, but the short wheelbase pitch is noticeable, due to that higher than average weight up front, from the air-conditioning gear. The car probably would ride better with back seat passengers.

Of all the three unit bodies, Rambler's is the most solid. The best steering cars of the lot were the Rambler, the Valiant and the Chevelle, with the Tempest coming in fourth because of slowness of response. You can almost think Rambler around.

Those speedometer figures are slanted and look like spooky Halloween shadows in white on black; they are hard to read. There is a fuel gauge and a temperature gauge and the rest are idiot lights.

Studebaker and Chevelle tie for the best instrument panels, with Valiant coming in third, then Tempest, Falcon and Rambler.

Rambler's suspension is a little loose, but not quite as soft as the Pontiac's. It yaws a bit, but its tread is narrower, and its wheelbase shorter. I am sure the Tempest, with its big iron 326-V8 would yaw and plow the same way if the wheel were snapped back and forth abruptly, in the way we handled Rambler's. The power steering response is not quite as fast as on the Valiant and the Chevelle. But the car's controllability is good on bumpy, cambered roads, such as this one.

High speed at 90-indicated is stable. As the car creeps up to 95, you get mostly wind noise, some engine fan noise, and a lot of wind draw coming through. But there's no feeling of float, no wind wander

(Please turn to page 226)

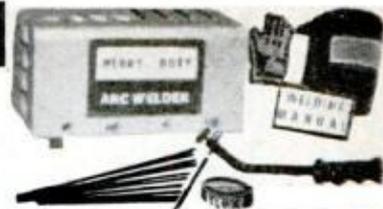
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Testing '64's Cool Compacts

(Continued from page 224)

or yawing, no slopping up and down. It's a very civilized car in action.

Valiant Signet 2-door hardtop, automatic transmission.

This car has a nice, easy ride rhythm, yet is quick and responsive. There's little buzz or hum from the engine. It's precise; you hold it on the line easily. On bad washboard there's a certain rubbery shake but it's a tighter-feeling car than the hardtop Chevelle.

The transmission upshifts in low at full throttle at 30 and takes you right up to 65 before it upshifts out of intermediate.

You get a big car feeling. Even the Falcon with its broad, flat hood, doesn't feel bigger. Valiant has a smooth hood that tapers down and provides good road vision. The corner posts, however, are fairly thick. The rear view mirror is excellent, better than the other five; it gives a good view back, low along the road.

The transmission control buttons are perhaps a little bit far in, though not too bad. The wheel might be an inch farther away for better steering.

The ride is good for a short car; it's much better than Falcon's used to be. The gap has been closed by the Falcon's notable improvement, but the Valiant's ride is about as good as you can get on a true compact today. With its slow rate of up-and-down movement, there's almost no pitching in the way this car's suspension operates. The synchronization between front and rear spring action is excellent. The car rises and falls instead of rocking, bobbing or pitching.

You can kick the Valiant down and it will take you up to about 66 m.p.h. flat out. Or you can push in the "2" button at half throttle at 45 and get it rolling nicely.

This transmission is darn near perfect.

The car rolls in cornering, but it seems under control, with less tendency for the rear end to hop off the pavement than the Falcon, even the improved '64 Falcon.

The only real noise in the Valiant is the low-gear acceleration whine in the automatic transmission. ★★★

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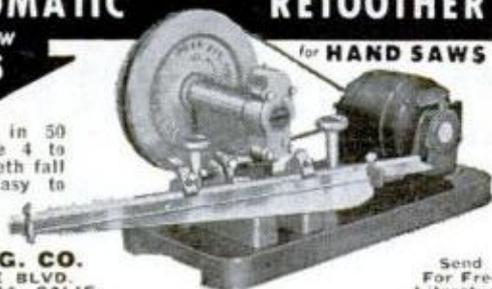
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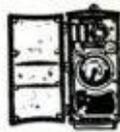


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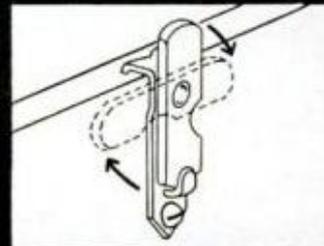
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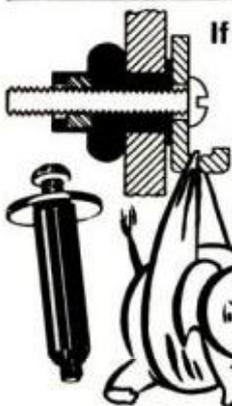
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Pressure-Vessel and Tank
Print Reading
Sheet Metal Layout for Air Conditioning
Structural Drafting

ELECTRICAL

Electric Motor Repairman
Electrical Appliance Servicing
Electrical Contractor
Electrical Engineering (Power option or Electronic option)
Electrical Engineering Tech.
Electrical Instrument Tech.
Electrical Power-Plant Engineering (Steam option or Hydro option)
Industrial Electrical Tech.
Industrial Telemetering
Power Line Design and Construction
Practical Electrician
Practical Lineman
Reading Electrical Blueprints

ENGINEERING (Professional)

Chemical
Civil
Electrical
Mechanical
Industrial Management for Engineers

ENGLISH AND WRITING

Better Business Writing
Introductory Technical Writing
Modern Letter Writing
Practical English
Short Story Writing

HIGH SCHOOL

High School Business
High School College Prep. (Arts)
High School College Prep. (Engineering & Science)
High School General
High School Mathematics
High School Secretarial
High School Vocational

LANGUAGES

(Edited by Berlitz)
French

German
Italian
Spanish

LEADERSHIP

Basic Supervision
Industrial Foremanship
Industrial Supervision
Personnel-Labor Relations
Supervision

MATHEMATICS

Advanced Mathematics
Mathematics and Mechanics for Engineering
Mathematics and Physics for Engineering
Modern Elementary Statistics
Value Analysis

MECHANICAL

Industrial Engineering
Industrial Instrumentation
Machine Design
Mechanical Engineering
Quality Control
Safety Engineering
Technology
Tool Design

PETROLEUM

Natural Gas Production & Transmission
Oil Field Technology
Petroleum Production
Petroleum Production Engineering
Petroleum Refinery Oper.

PLASTICS

Plastics Technician

PLUMBING, HEATING, AIR CONDITIONING

Air Conditioning
Air Conditioning Main.
Domestic Heating with Oil & Gas
Domestic Refrigeration
Gas Fitting
Heating
Heating & Air Conditioning with Drawing
Plumbing
Plumbing & Heating
Plumbing & Heating Contractor
Plumbing & Heating Estimator
Practical Plumbing
Refrigeration

Refrigeration & Air Conditioning
Steam Fitting

PULP AND PAPER

Paper Machine Operator
Paper Making
Pulp Making
Pulp & Paper Engineering
Pulp & Paper Making

RAILROAD

Car Equipment Fundamentals
Motive Power Fundamentals
Railroad Administration
SALESMANSHIP
Creative Salesmanship
Real Estate Salesmanship
Sales Management
Salesmanship
Salesmanship & Sales Management

SECRETARIAL

Clerk-Typist
Commercial
Professional Secretary
Shorthand
Stenographic
Typewriting

SHOP PRACTICE

Foundry Practice
Industrial Metallurgy
Machine Shop Inspection
Machine Shop Practice
Machine Shop Practice & Toolmaking
Metallurgical Engineering
Technology
Patternmaking
Practical Millwrighting
Reading Shop Blueprints
Rigging
Tool Engineering Techn'gy
Toolmaking
Welding Engineering
Technology
Welding Processes

STEAM AND DIESEL POWER

Boiler Inspector
Industrial Building Engineer
Power Plant Engineering
Stationary Diesel Engines
Stationary Fireman
Stationary Steam Engineering

TEXTILES

Carding
Carding and Spinning
Cotton Manufacturing

Dyeing & Finishing

Loom Fixing
Spinning
Textile Designing
Textile Engineering Technology
Textile Mill Supervisor
Warping and Weaving
Wool Manufacturing

TRAFFIC

Motor Traffic Management
Railway Rate Clerk
Traffic Management

TV-RADIO-ELECTRONICS

Communications Techn'gy
Electronic Fundamentals
Electronic Fundamentals (Programed)
Electronic Fundamentals with Electr. Equip. Tr'n'g
Electronic Instrumentation & Servo Fundamentals
Electronic Principles for Automation
Electronics and Applied Calculus
Electronics Technician
First Class Radiotelephone License
Fundamentals of Electronic Computers
General Electronics
General Electronics with Electronic Equip. Tr'n'g
Hi-Fi Stereo and Sound Systems Servicing
Industrial Electronics
Industrial Electronics Engineering
Industrial Electronics Engineering Technician
Practical Radio-TV Eng'g
Practical Telephony
Principles of Radio-Electronic Telemetry
Principles of Semiconductor-Transistor Circuits
Radio Servicing with Radio Equipment Training
Radio & TV Servicing with Radio Equip. Tr'n'g
Second Class Radiotelephone License
Sound Systems Specialist
Telephony, Electronics and Radio Communications
TV Receiver Servicing
TV Technician

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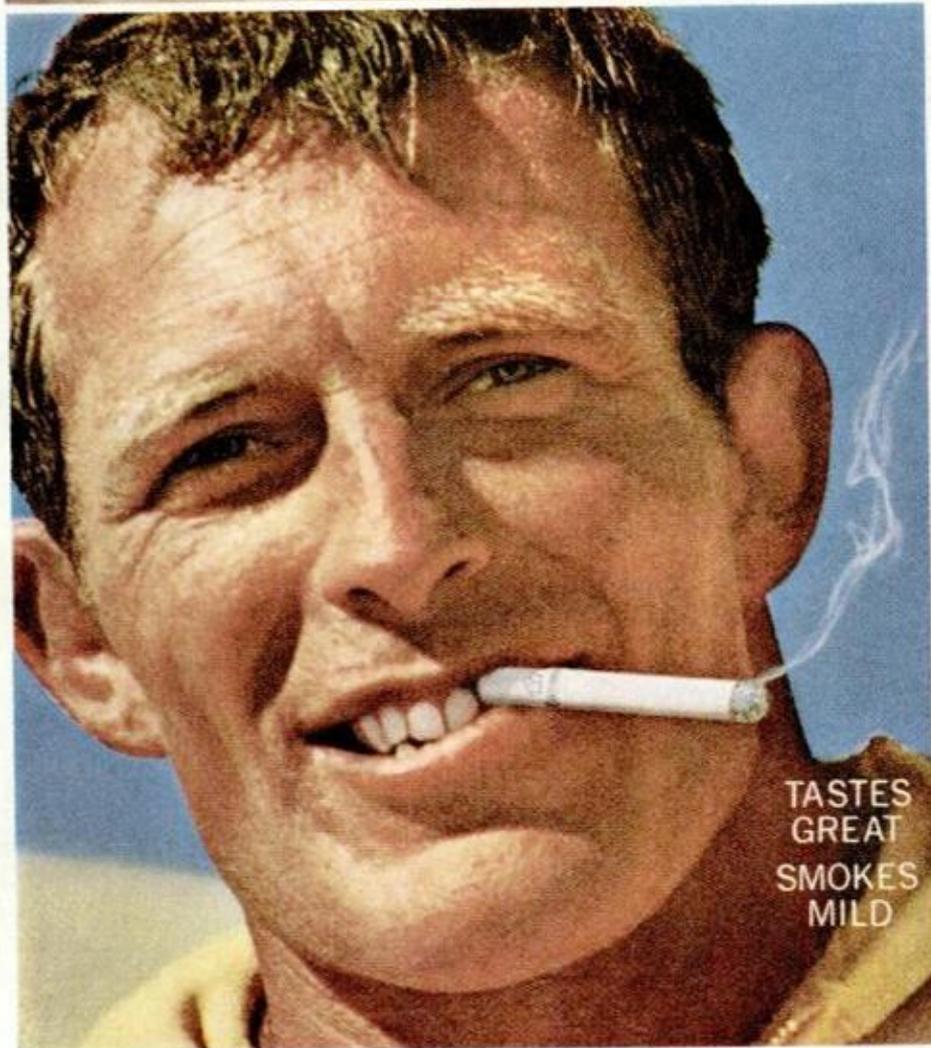
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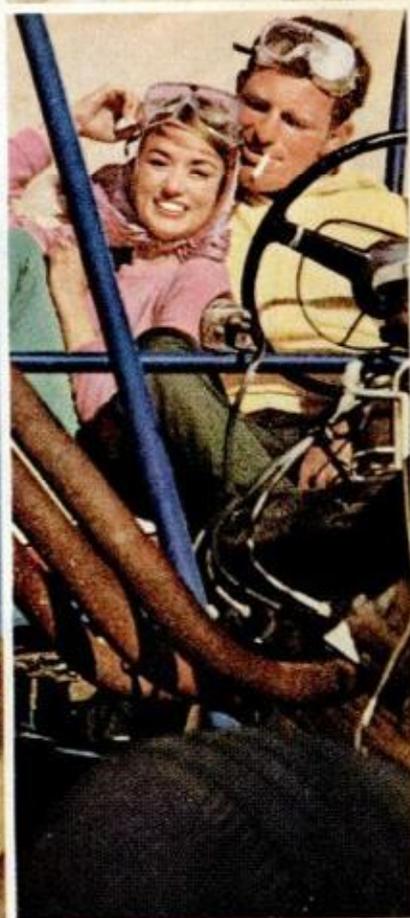
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