

Light Up Your Yard With PM's 'Sequence Santa'

POPULAR MECHANICS

NOV. 1970
50 CENTS

The Skills
They
Don't
Teach in
Driver Ed

How to Get Those Blacked-Out Games On Your TV

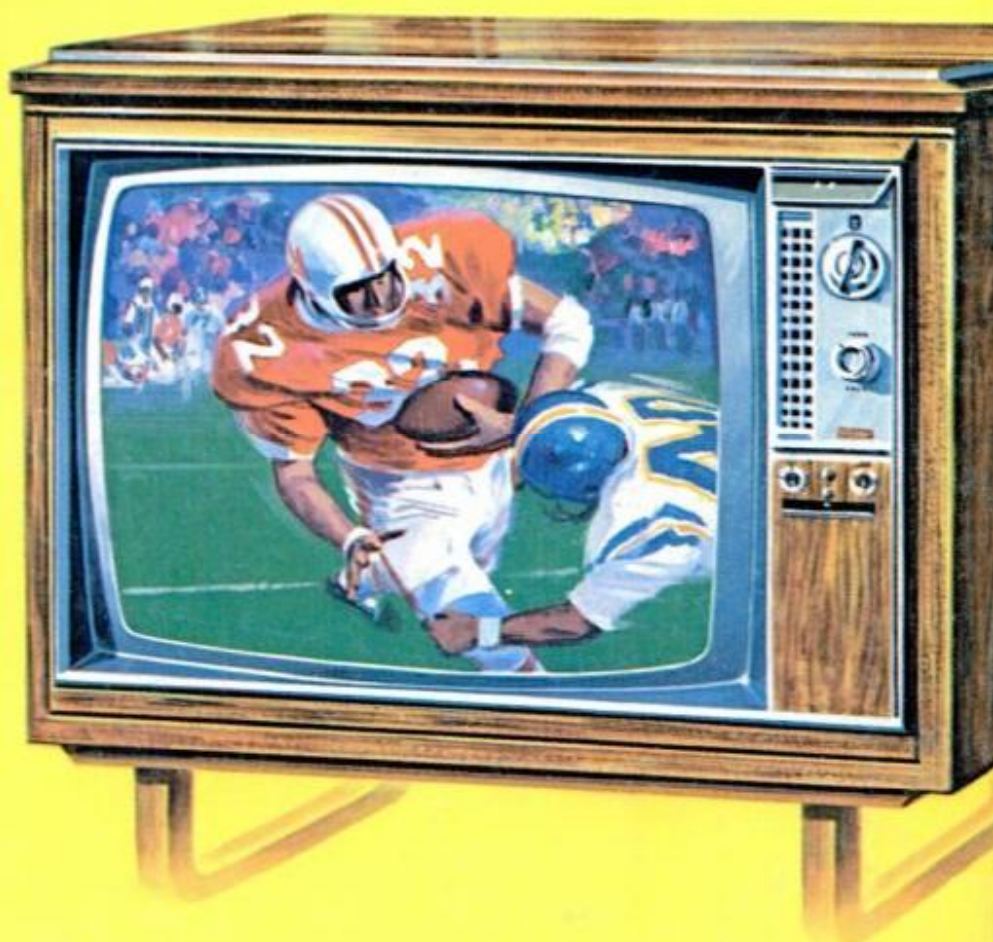
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How Much Carburetor
Do You Need?

Cleaning Up Canada's
'Torrey Canyon'

How the First
Artificial Heart Works

Breaking a Snowmobile
Trail in Our Newest
National Park



Make These for Christmas – or Any Time!

Danish Modern Candleholder

Early American Wall Clock

Rollaway Projection Stand

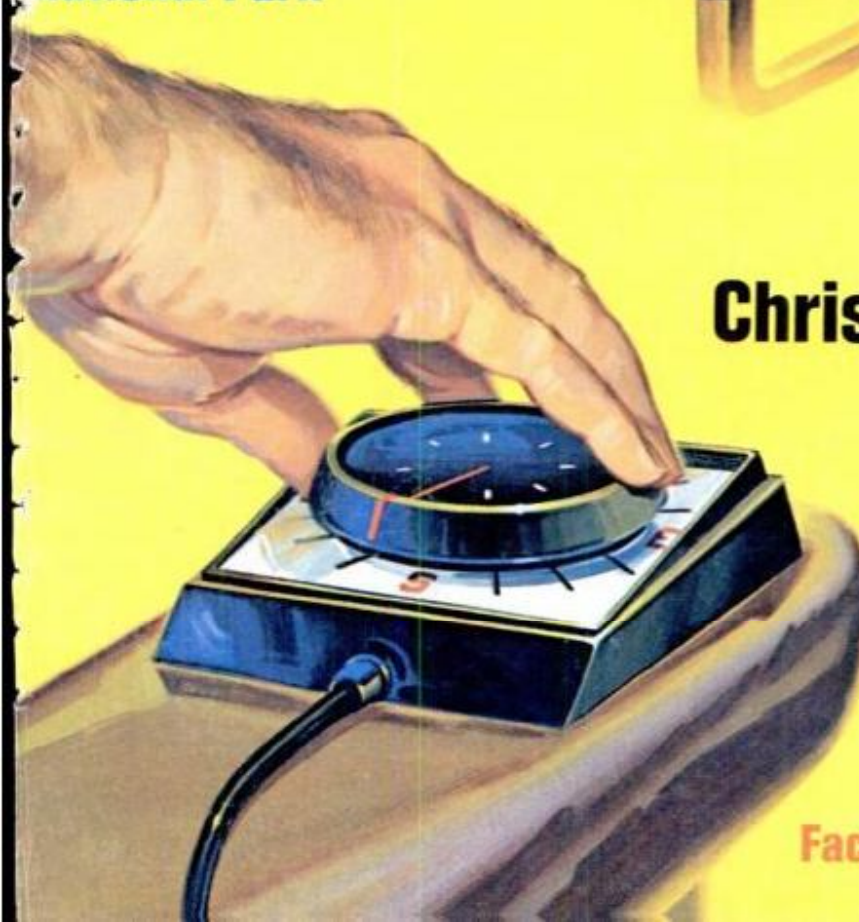
Candlestand Lamp

Handsome Toast Rack

Electronic Checker Game

Emergency Blackout Light

Faceplate Lathe From Odds 'n Ends



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91ZB-L4F-CTKE



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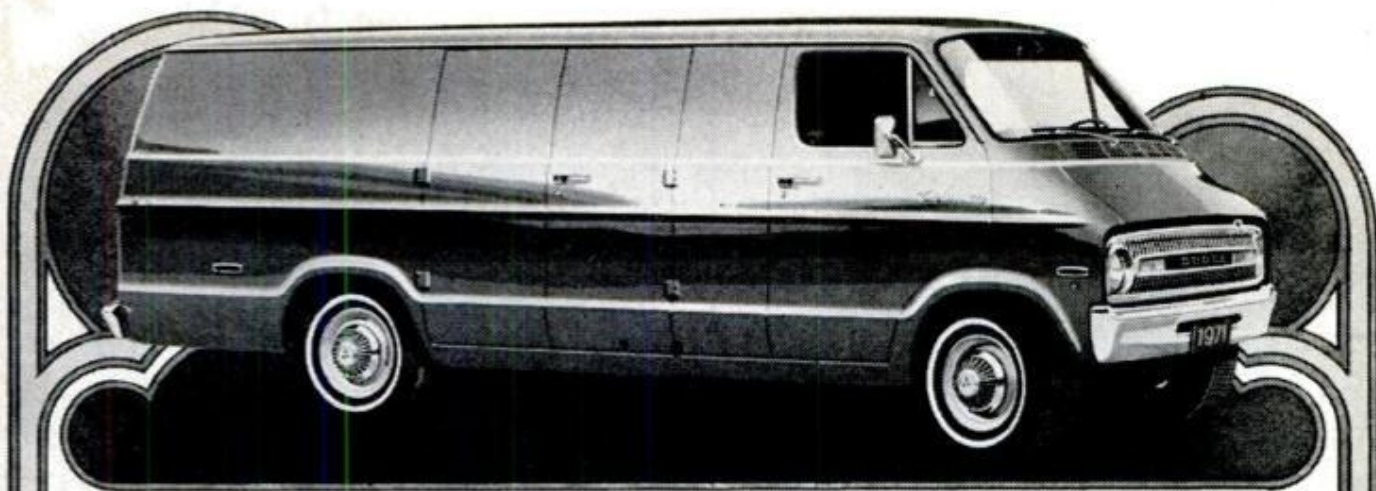
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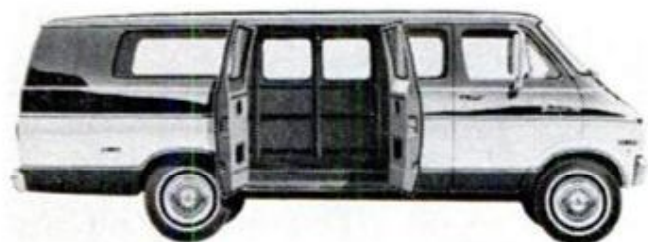
will carry a 12-foot sailboat , plus its mast , a living room-size roll of carpeting , a snooker table , or a full-size alligator , under cover, and still give you all 31 features the other **Dodge Strong Box** models do.

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How to Get Those Blacked-Out Games on Your TV (Tune in channels you've never seen before!)

NEXT MONTH IN POPULAR MECHANICS

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PM Owners Reports: What owners say about Firebird and Camaro.
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All-in-One Music Centers. What you should know about integrated stereo receivers.

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NOVEMBER 1970



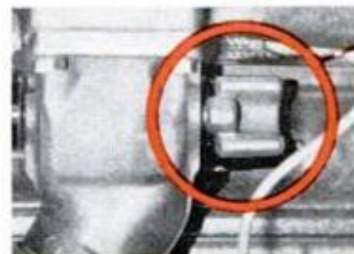
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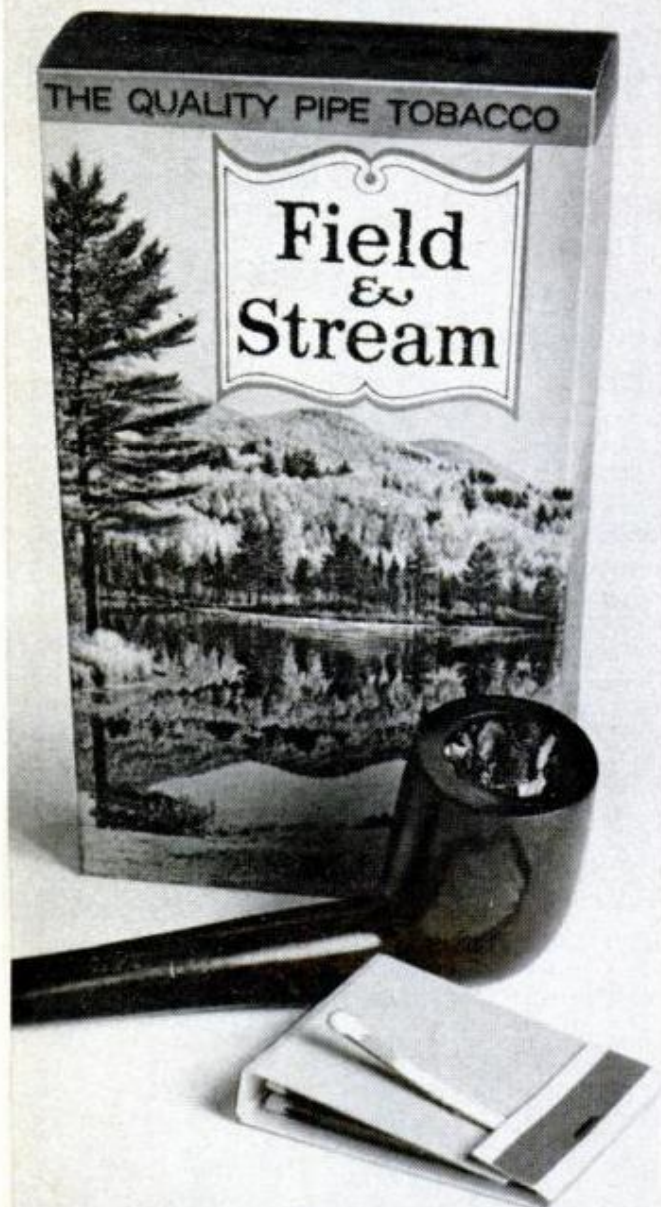
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LETTERS TO THE EDITOR

Too fast in fog

Many thanks—in a grim sort of way—for your report on the New Jersey Turnpike accident (*Too Fast in Fog*, page 84, Sept. *PM*). We got into a huge traffic jam, since all southbound cars had to exit at Philadelphia—and it was the same day as the Army-Navy game in Philadelphia. What a mess! But at least now I know what happened and why it took eight hours for the four-hour trip!

ARLINGTON, VA.

JAMES W. HAM

A tremendous account of a tragic accident! I've driven this New Jersey Turnpike for 10 years, almost every day, and like thousands of others, I know the road. But I do not know fog. No one does—not even the Turnpike Authority. It's the type that appears in patches, there one minute, gone the next. The state troopers fight a losing battle. They know when conditions are right for the fog, and usually reduce the speed limit and light fog-warning signs. But the motorist, after driving for miles under these posted warnings, sometimes gets a false sense of security because he has seen no fog. Then, right around a bend or over a hill, there it is, and he's in it.

One result that grew out of the investigation of the accident was the finding that 13 of the vehicles involved burst into flames. Officials investigating blame faulty gas tanks for the flames. Their construction, composition and placement on or in a vehicle has since been the cause of additional study. Once a tank is ruptured, almost anything can set the gas on fire.

INTERSTATE BUS

ROBERT J. BEARD

DRIVERS ASSN.

EXEC. VICE PRES.

KENSINGTON, MD.

We try harder

Thanks for your fine articles on electronics, especially the construction articles. I have been an avid reader of *PM* for over four years, and every year your magazine has improved.

MADISON, TENN.

RICHARD R. HALL

Aquaplaning salvager

I have been scuba diving here in Canada for several years now. I do a lot of salvage work (mostly for you Americans on holidays) and have been down for everything

(Please turn to page 8)

"Look who's smiling now!"

The department head's job had just been left vacant. When the boys in the office learned I was gunning for it, they gave me their widest grins. One thing they didn't know: I had made up my mind sometime back to take LaSalle training that would prepare me for a better job. My study really paid off. It surprised even me—I was picked for that shiny promotion over everyone's head. Who wouldn't be smiling with a man-sized increase in pay!

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LETTERS

(Continued from page 6)

from wallets to snowmobiles. In July 1967, you printed *Build This Underwater Aquaplane* (page 142). I built one for my scuba salvage work. I can now cover four times the area with the same air, and I've been down 60 feet with no problems.
BELLEVILLE, ONT. WAYNE COCHRANE

Even snorkelers can use it. Anyone who wants a Xerox copy of the article (including plan) can order it for 55 cents from Popular Mechanics, Dept. JL, 224 West 57th St., New York, N.Y. 10019.

Unsafe at any depth?

Some of your readers may be led fatally astray by *Aquanaut Makes Diving Easy* (page 152, Sept. PM). Such statements as ". . . it takes absolutely no experience" and ". . . no hours of costly lessons to learn how to use the equipment . . ." may be dangerously deceiving to the novice.

While it is true that decompression sickness is not a hazard to the Aquanaut diver, he is still exposed to even greater dangers due to the effects of pressure.

If a diver breathing compressed air (Aquanaut included) were to hold his breath on ascent, he might find himself suffering from air embolism, pneumothorax or some other less serious malady. They occur when the lungs are so over-expanded that they rupture. If an air bubble finds its way into the bloodstream, it may lodge in one of the blood vessels (normally in the brain or heart), thus obstructing the flow of blood. This is known as air embolism. If the bubble were to lodge between the chest wall and lungs (pneumothorax) it may cause the lung to collapse and put pressure on the heart. Both conditions may be fatal. It is quite possible to contract either of these within the depth limitations of the Aquanaut.

The volume of air in a diver's lungs would double as he ascended to the surface from 33 feet. If he did not release this air (that is, held his breath), his lungs would almost certainly rupture.

Breath holding may be involuntary, usually the result of lack of understanding of the physics and physiology of diving, or as a result of panic. Training and proper indoctrination give an individual confidence to take intelligent action during times of danger, and panic will not result.

NAVAL AIR STATION J. R. OREILLY
CORPUS CHRISTI, TEX. CAPT., USMC

After reading the first paragraph, I could hardly believe my eyes. ". . . it takes

absolutely no experience," he says. You guys are mechanics, all right.
PHILADELPHIA, PA. EUGENE T. POMPILIO

I am really amazed at your article. I wish diving was that simple. I have used this unit and agree that it is easy to use, but it is extremely dangerous to the person who doesn't know anything about diving.
FULLERTON, CALIF. W. H. WICKETT III

Thanks for pointing out the hazards of diving—even with Evinrude's easy-to-use device. In trying to rouse interest in the sport, our enthusiastic writer probably misled readers when he said "absolutely no experience" is required. Basic knowledge of your underwater limitations is necessary.

PM's outdoors editor adds: "Fifteen years ago I learned to scuba dive by reading two manuals on the subject. In 1965, I took a Navy-sponsored course and found it to be essentially a recapitulation of what my reading and later experience had taught me. A formal course is a great confidence builder, but I'll stand with the author, it is not necessary to safe operation of the Aquanaut. Nor is previous experience. However, I do agree with every reader who expresses concern about any man who bails off the side of a boat with absolutely no knowledge of the killing capabilities of even 10 feet of water."

A spokesman from Evinrude adds: "To the best of our knowledge, we have not had any reports of accidents or fatalities since we began making the Aquanaut."

What a mill!

You say the Rally STX, GMC's new luxury van, has as its largest engine option the "350-cu.-ft. V8" (*On-the-Go Camping*, page 198, Sept. PM).

With an engine this size, the driver must be cramped and the cargo space pretty limited. How many horsepower does this beast turn up?
OMAHA, NEBR. C. R. McALISTER

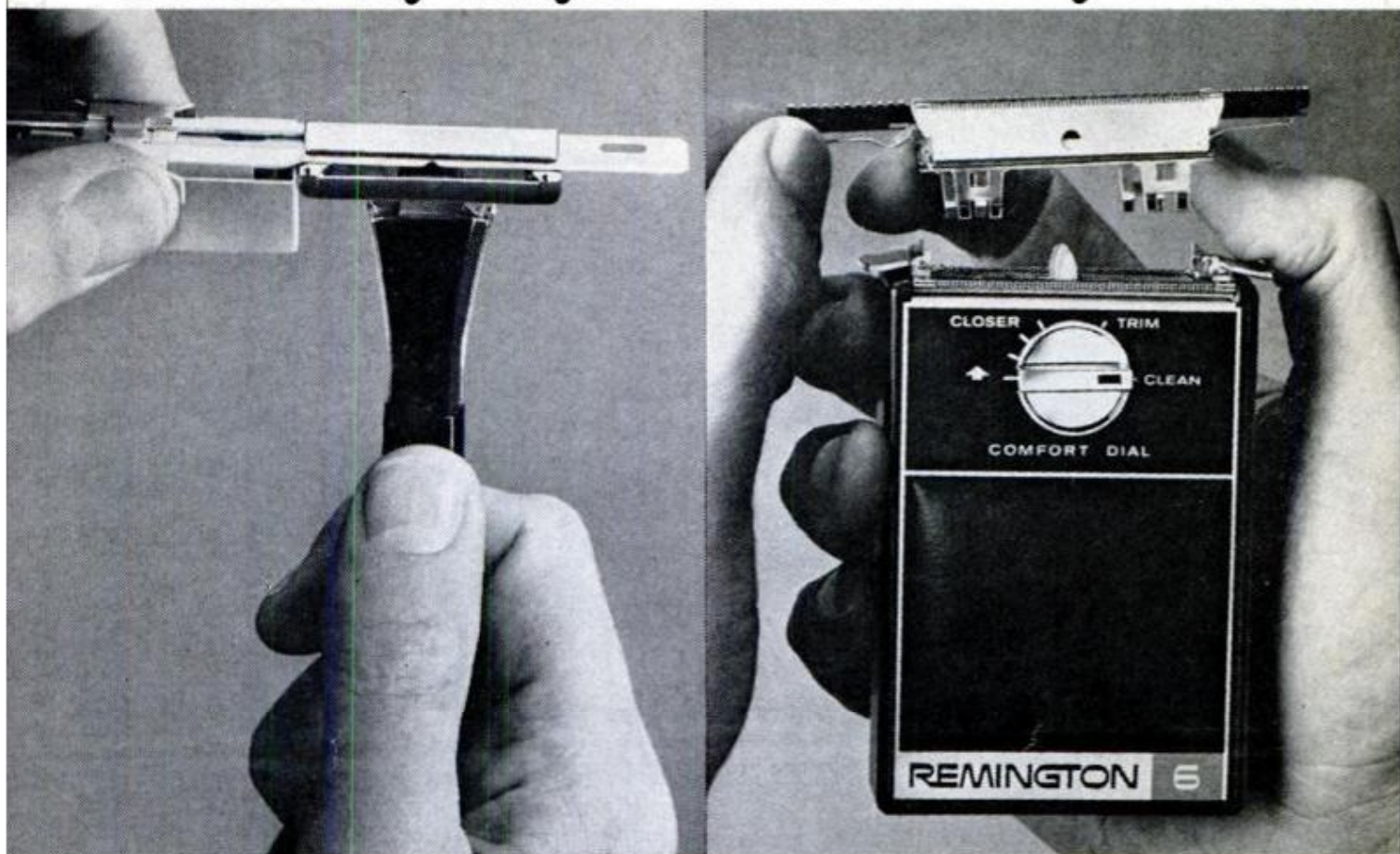
Dunno yet. We'll tell you as soon as we get the first one out of the old Queen Mary.

Where it's at

After reading *How the Gremlin Lost Its Tail* (page 88, Aug. PM), I couldn't help but write to congratulate Mr. Teague on the Gremlin. I'm a 17-year-old who goes for her license in a few days, and I can tell you I'm saving up for a Gremlin. The lost

(Please turn to page 10)

To get a closer shave, you change blades about every 6 days. Or about every 6 months.



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LETTERS

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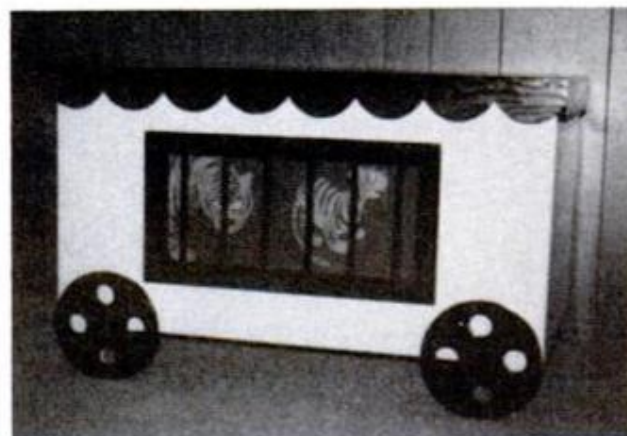
tail is exactly what makes the Grammy so cute. I hope Mr. Teague doesn't plan any major facelifts in the future 'cause in my opinion the present appearance is where it's at.

BROWN'S MILLS, N.J.

JANICE MAHAN

Enjoys the projects

Here are pictures of the *Cradle-Bassinet* (page 138, March '68 PM) and the *Circus-Wagon Toy Box* (page 157,



Feb. '69 PM) that I made from plans in your magazine. I enjoy the projects that you print; keep it up!

St. LOUIS, Mo.

HENRY A. RODDIGER

We will as long as you keep building 'em. For others who'd like to take on these projects: They're one-pagers in our Weekend Projects roundups. Send 20 cents for a Xerox copy of each page, plus 15 cents for mailing (total: 55 cents) to Popular Mechanics, Dept. JL, 224 West 57th St., New York, N.Y. 10019. ★★★

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"Balls of fun" for kids, traffic stoppers for stores, terrific for amateur meteorologists. Create a neighborhood sensation. Great backyard fun. Exciting beach attraction. Amateur meteorologists use to measure cloud heights, wind speed and temperature. Made of heavy duty neoprene. Inflate with vacuum cleaner or auto air hose or locally available helium for high rise.
Stock No. 60.568H (8 Ft. diameter) \$2.00 Ppd.
Stock No. 60.632H (16 Ft. diameter) \$7.00 Ppd.



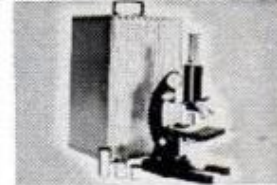
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Red, Green, Blue & White light barrage the eyeballs every 8 seconds with this low-cost mechanical strobe that can run continuously without fear of burning up. Devastating effects over 500 ft. sq. area. Created by rotating color wheel in front of 100W, 120v reflector floodlamp (incl.)—elements seem to flash on & off as colors fluctuate. Store windows, posters, parties become flash, pulsating prods. Convection cooled. Walnut cab.; Brass hdl.; Reg. house current. (9 X 10 X 6 3/4")
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Sturdy, monocular type, 3 coated achromatic parfocal objectives—5X (0.10NA), revolving nose-piece. Automatic focus—10X (0.25 NA), 60X (0.85 NA); triple revolving nosepiece. Automatic focusing stop prevents damage to objectives and slides, fixed 160-mm tube Rack-and-ponion coarse focusing and fine micrometer-type slide adjustments. 3 Huygenian eye-pieces: 5X, 10X, 15X Bakelite stage 4 1/2" x 4-5 1/2"; 2 stage clips accept Edmund graduated mech. stage No. 30,060AH. Substage eqpt.; fixed condenser lens, iris diaphragm, 17.5" diam. plano-concave mirror.
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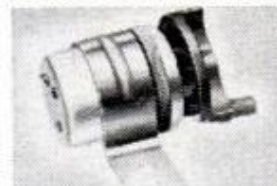
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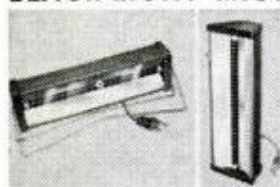


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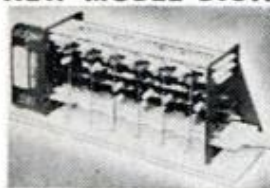
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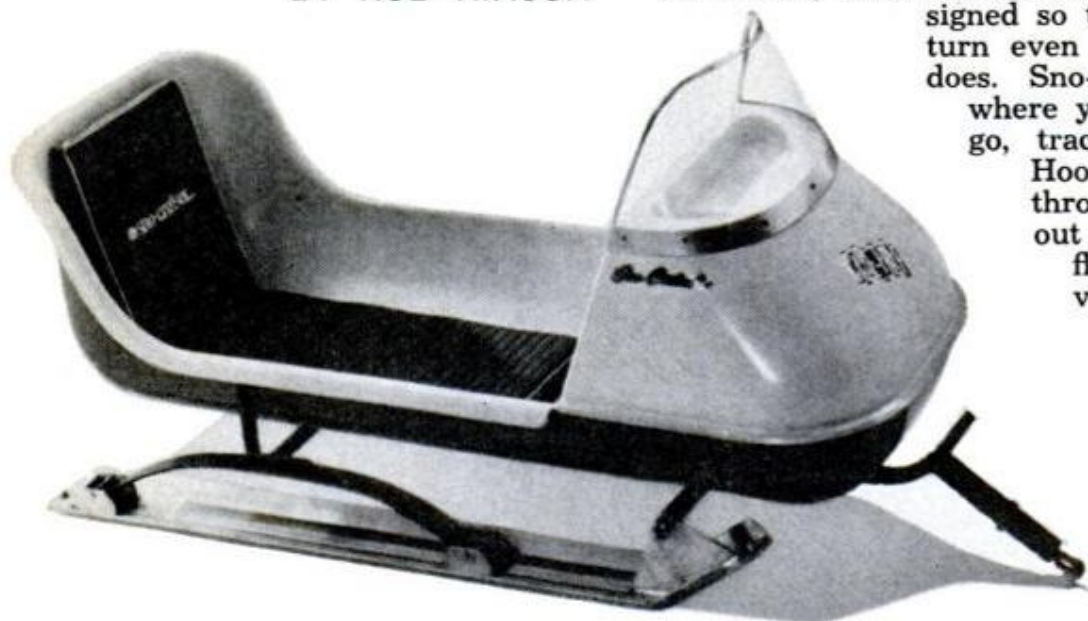
BY ROB KINSON

SNO-CRUISER AND SNO-CRUISER JR. tow sleds carry three and two children, respectively, so the whole family can share the fun of snowmobiling. Color matched to any major-make snowmobile at no extra cost, sleds come assembled with windshield, cushion and spring-loaded hitch designed so the sled won't overturn even if the tow machine

does. Sno-Cruiser goes anywhere your snowmobile will go, tracks within its trail.

Hood design keeps snow thrown by tow's track out of riders' faces. Reflector on back prevents rear-end collisions.

Sno-Cruiser (\$179.95) and Sno-Cruiser Jr. (\$149.95) are fully guaranteed by General Aluminum Products, Box 30, Charlotte, Mich. 48813.



A SURVIVAL PACK called Safe-T-Cell is made to strap to the back of all major-make snowmobiles. First-aid items provided in the waterproof, airtight and shatter-resistant black polypropylene cylinder were determined by statistics of type and frequency of injuries to snowmobilers. Safe-T-Cell weighs two pounds, is 10½ inches long and 4½ inches in diameter. From Relevant Products, Inc., 313 S. Cincinnati, Tulsa, Okla. 74103, it sells for \$13.95. The company also produces survival packs especially suited for cars, campers and boats as well as replacements for each type of pack.

ICE CAT power ice sled is the latest happening in winter fun vehicles. Its 4-cycle, 5-hp Briggs & Stratton engine gives speeds of 40 mph. Made of heavy-gauge sheet metal and a high tensile steel tubular frame with enclosed drive train, the sled features an automatic safety throttle, airplane cable steering linkage, steel-shoed centrifugal clutch and large gas tank. Weighing 125 lbs. and sized to fit in a station wagon, Ice Cat sells for \$399.95. Made by Boscov, Inc., 176 W. Adams, Chicago, Ill. 60603.

YOU CAN ENCLOSE your snowmobile for protection from severe temperatures, wind and driving snow with a Sno-Go-Cab (at right). Made of vinyl-like material that won't freeze, burn or tear, it can be attached quickly without modification. With top up, there's plenty of headroom and natural engine warmth flows back inside cab. When desired, top folds down, leaving big windshield and side curtains up for protection. Guaranteed three years, cab is made by Koehn Manufacturing Inc., Box 862, Watertown, S.D. Price is \$119.95. ★ ★ ★



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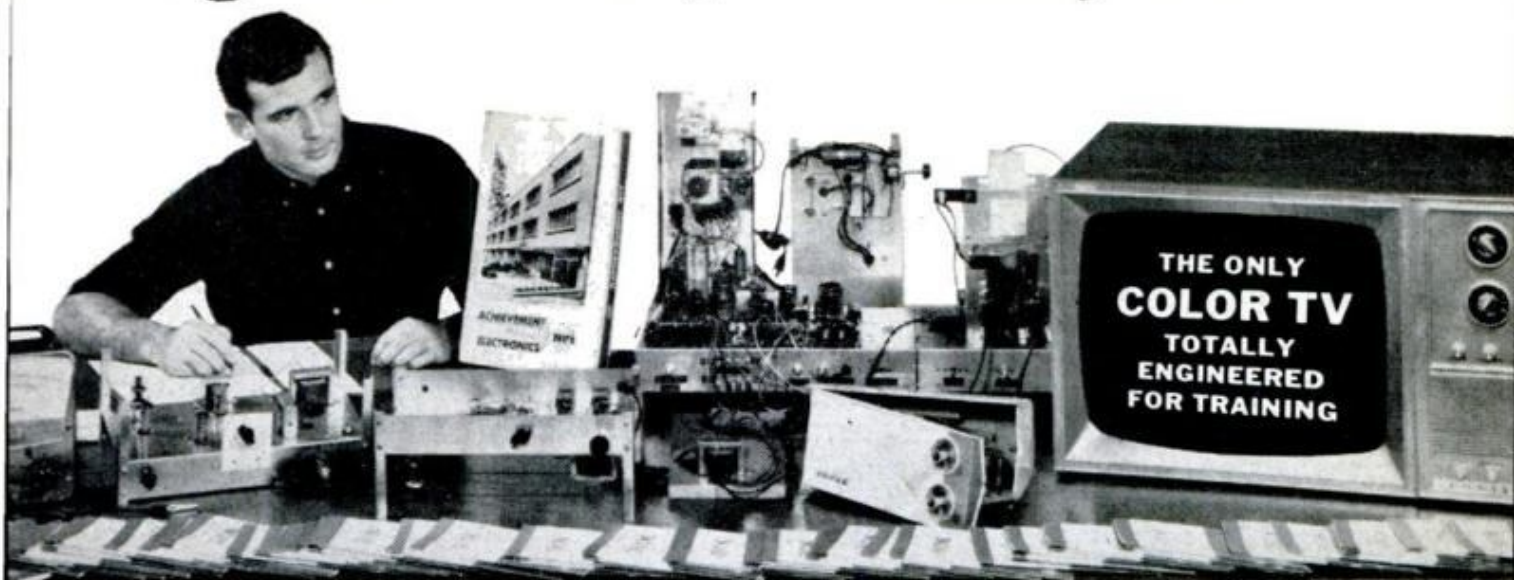


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Burn cases that would have been considered hopeless not long ago are now successfully treated by a new method developed at Stockholm's Karolinska Hospital. The patient lies on an aluminum fiber sheet, which does not stick to wounds and offers little breeding ground for bacteria. The sheet rests on a mattress that's porous to permit the patient to be bathed in a flow of warm, dry air from fans and heaters, and a plastic tent helps to maintain constant atmospheric conditions. The Swedish doctors, who got the idea from reports indicating that burns heal faster in regions with a warm, dry climate, say their method has saved the lives of two men, each with 85 percent of his skin destroyed by fire. Physicians usually consider 80 percent the limit for survival—and that's only for young, robust patients.

Shock waves that travel 6 million mph—the fastest and strongest ever created by man—were recently produced in a Columbia University School of Engineering lab. The waves were generated in a 10-foot-long electromagnetic tube filled with deuterium (a hydrogen isotope) plasma. The plasma, a hot gas, reached temperatures over 10 million°F., according to the Columbia researchers. The driving force behind the shock waves came from a room-sized bank of capacitors that store up to 100,000 volts of electricity and can deliver a current of 2 million amps. The experiment is part of a worldwide effort that may someday lead to the control of the fusion of hydrogen atoms.

No need for an American foot soldier to get lost if he's equipped with the "improved position locator," a device developed by Westinghouse scientists. It consists of a backpack computer, boot antennas and a display and control unit, and weighs 18.5 pounds. Before starting out, the soldier adjusts the system to his gait by walking a measured course and feeds in the coordinates of his starting point. The antennas, mounted inside each boot, count and measure the length of each step by an exchange of electronic signals. The information is fed by wire to the backpack, which also contains a compass device. The backpack computer combines data on distance and direction and computes the results in the form of map coordinates. A Westinghouse spokesman said the locator could prove valuable in forestry work, exploration or in preliminary mapping.

If you're fascinated by man's efforts to probe the secrets of the sea, you will want to read A Pictorial History of Oceanographic Submersibles by James B. Sweeney of the Naval Oceanographic Office. The 320-page book provides a broad look at man's beneath-sea activities. Among its 420 illustrations you'll find just about everything ever to slide under the waves—subs propelled by oars, feet, gunpowder, hand gears, gas engines, steam, electricity and atomic power. Published by Crown Publishers, New York, N.Y., the book costs \$9.95.

High-speed, pulsed water jets are the "bits" in an experimental tunnel-boring system developed by the IIT Research Institute, Chicago. Less than half an inch in diameter, the jets travel at about 4000 feet per second and can even cut through hard rock. It's estimated that a tunnel 20 feet in diameter can be advanced at the rate of 10 feet per hour. Special advantages of system: It generates no dust and has no metal bits to wear out.

Women prefer drugs to alcohol. That conclusion can be drawn from a recent survey of 17 European countries by an international health group. The researchers found that 70 out of every 100 adult addicts were women, but that females totaled only 10 out of 100 when it came to a dependence on alcohol. The survey also revealed a new phenomenon: People are getting hooked on several different drugs at the same time. ★★★

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DETROIT

LISTENING POST

BY ROBERT LUND

HOW SERIOUS IS GM about bringing out a car smaller than Vega? A real micro-mini. GM isn't saying. It never does until it's ready to take the cake out of the oven. But put on your deerstalker and consider some clues:

The company is pulling together a group of its top people—designers, engineers, safety technicians, purchasing agents, production specialists, marketing experts, the whole shebang—to study what a source inside the company describes as “a new concept in automobiles.” No elaboration beyond that.

Why GM's sudden interest in the Wankel rotary engine? GM says it's just tinkering with the Wankel. Don't believe it. The company has an all-out development program in the works aimed at putting a Wankel in a production car by 1975. In terms of pollution output, the Wankel is a bigger polluter than the internal combustion engine. But it's easier and less expensive to clean up than the ICE. GM is said to have three or four different approaches under study that would make the Wankel almost as pure as Ivory soap in terms of emissions.

We'd guess GM is working on a one-seat, two-person car with a wheelbase in the area of 58 to 60 inches and 145 to 150 inches overall. (VW is 159.) When? Say in three to four years. But don't bet the family jewels on it. GM has homeworked cars in the past and then, one minute to midnight, decided not to put them in production. It could happen again.

IF GM BUILDS A SMALLER-THAN-VEGA-CAR, it won't be a three-wheeler. Not if John De Lorean, g.m. of Chevrolet, and Alex Mair, Chevy's chief engineer, have anything to say about it. Listening Post asked the Chevy executives if they think there's a market for still smaller cars—under Vega, Pinto and Gremlin in dimensions—and, if so, what are the chances for a three-wheeler? No dice on the three-wheeler, both officials replied. De Lorean said he's had some personal experience with three-wheeled cars “and it wasn't good.” American-made cars smaller than Vega? De Lorean: “Yes, I'd say there's a market for them.” Mair: “I think there's a good chance we'll see cars smaller than what we know now over the next five or six years. But I'm not predicting GM will make them.”

LATEST ON THE MINI BEING WORKED UP BY OLDS FOR 1973 is that it will not compete head-on against Vega or against a small job coming from Pontiac. The Olds entry will be a much higher priced car than Vega, more of a personal car than a family car and with a heavy emphasis on sportiness.

THERE'S A SPIRIT OF ADVENTURE AT AMC. Back in May we mentioned a new four-wheel-drive system—it delivers a specified amount of power to each wheel—developed by Borg-Warner. The idea could lead to a new category of cars—part passenger car, part utility vehicle, but more of a family automobile than the two-in-one machines around now: Bronco, Blazer, Scout and Jeep. All the auto companies have samples of the system and are experimenting with it, but American Motors has decided to go with the gear and will put it on a '72 Jeep. AMC may be low man in sales, but it tries to be first in other areas.

THOSE FAT C PILLARS THAT BLOSSOMED ON MANY '71S will get thinner next year and the year after. Thickening the C post with sheet metal doesn't add to strength or rigidity of the roof. But the wide pillars do cause visibility problems. They make blind spots for drivers trying to size up traffic via the rear-view mirror. Designers have been told to thin the pillars down pending development of a periscope or other device that'll

(Please turn to page 24)

THE CITY SPARK PLUG THE HIGHWAY SPARK PLUG

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DETROIT LISTENING POST

(Continued from page 22)

bring about a significant improvement in rear visibility.

MID-ENGINE FOR A FOUR-DOOR?

The auto companies have yet to mass-produce a mid-engine in a two-passenger car, so a four-door may seem even more remote. But all the companies have roughed out two-seat, four-passenger, four-door cars with amidships engines. Two of 'em have been built, but they're strange looking monsters in terms of today's long hoods and stub decks, because they come out just the reverse—short hoods with a mile of overhang on the rear. The problem is shrinking the engine down. Engineers believe it can be done, but it'll take a long time—maybe 12 to 15 years.

GREAT PRESS-RELEASE BATTLE

between Chevrolet and Ford to see who could get the most publicity for their respective small jobs when the cars were in incubation hasn't ended now that Vega and Pinto are four-cylindering it around the countryside. Both companies have been looking for—and finding—weaknesses in the other's product. This information used to be passed on to car salesmen to whisper in the ears of showroom shoppers. Now Detroit p.r. men pass the barbs on to reporters, hoping the scribes will put pins in the other guy's doll.

SPEAKING OF FOUR CYLINDERS,

Ford is said to be in a program to develop a new Four to power small cars it envisions for the mid-'70s. The company is using two imported Fours, one from England and another from Germany, in Pinto, but wants something of American design and with more pep.

GOT AN IDEA you'd like to sell to De-

troit? If it figures out to more than \$50 or \$75 at retail, forget it. Some big names among the suppliers say automakers just aren't interested in innovations above these limits, because the car companies can't get enough volume on the add-ons to make them worthwhile. It's not that Detroit lacks interest in new ideas. But with car prices being driven up by increases in production costs and safety gear the government's made mandatory, it's becoming more and more difficult to get motorists to loosen up for expensive accessories. Even the big spenders who buy luxury cars are slow to put out \$200 and up for items other than automatic transmissions and airconditioning.

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Drivin' with Dan

What's the truth about heel-and-toe-downshifting in road racing? Do you shift in corners at Indy? Can production Superbirds and Daytonas hit 200 mph? Dan Gurney answers these and other automotive questions

Q. In the 1967 Rex Mays 300, you and Jim Clark had quite a dice for the lead until the 25th lap, when Jimmy dropped out. Who led the most laps in that duel?—Dan Favor, Oshkosh, Wis.

A. I led the most laps, but in fairness to Jim, he was in a car that never went fast before he drove it and he was unfamiliar in general with his team and car. He passed me as I bobbled and got off the track entering Turn 6. I regained the track and was resuming business when Jim's nitro-burning engine blew right in front of me.

Q. I have read in magazines that heel- and toe-downshifts should be performed by braking with the toe and blipping with the heel, but don't you have to do it the opposite way on an American car, such as a Trans-Am racer?—Bob Martin, Montgomery, Ala.

A. Actually I brake with the ball of my foot (just back of toes) and do the blipping with the side of my foot, not the heel. Usually the pedals on an American car have to be rebuilt and repositioned in order to make this possible. In our Plymouth Barracudas we use a spatula-type gas pedal hinged above the foot on the firewall.

Q. Do you intend to continue the manufacture of your Eagle racing cars after you retire from ac-

tive competition?—Robert Wolf, Pittsburgh, Pa.

A. Yes, by all means I intend to do so.

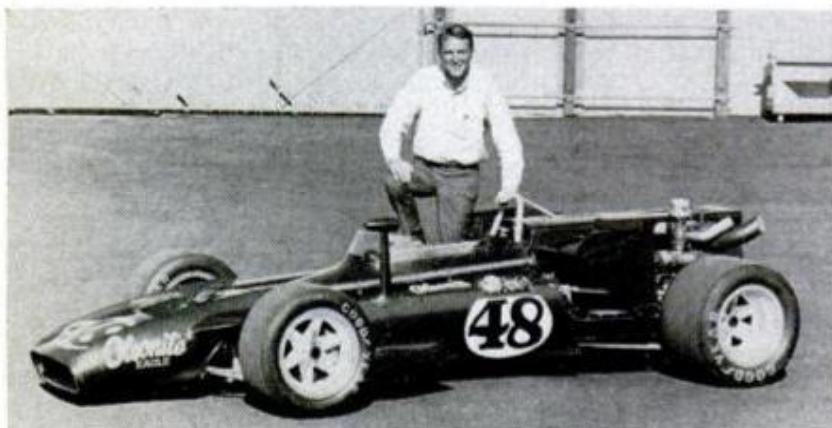
Q. Do you feel it is desirable to sacrifice mid-range torque, used in corners, for top-end horsepower, used on the straightaways, in building a racing engine?—Ken Grohs, West Los Angeles, Calif.

A. As a general rule a peaky or top-end horsepower engine doesn't get the job done as well as one that has good mid-range horsepower with a bit less top. It depends a lot on the track and the car. You can't afford to sacrifice much of either one. Good throttle response and dependability and cooling are most important in races of any length.

Q. I read where Parnelli Jones said he preferred Trans-Am racing to open-cockpit cars because it is safer. I gather you do, too. What's the matter, are you guys chicken?—R. Silman, Humble, Tex.

A. I'm not sure what size helmet you wear, but as you get older you will find that you consider safety more and more often. Which sort of car would you prefer to crash in?

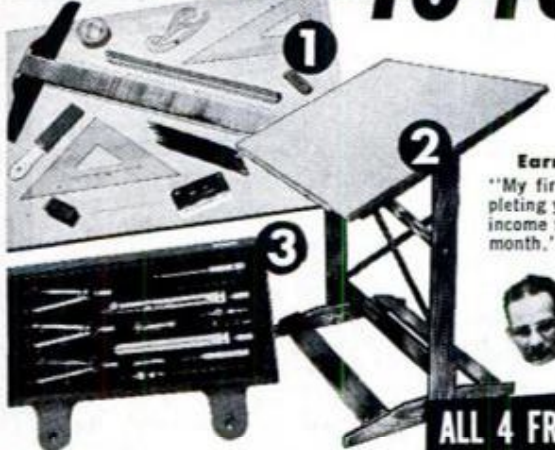
Q. If you could buy a competitive Formula 1 car, (Please turn to page 30)



DAN'S EAGLE, specially modified for the California 500 at Ontario Motor Speedway, shows several aerodynamic changes. Front canard was moved from nosepiece to body behind front wheels. Rear spoiler, a two-step design, allows for more cooling of the turbo-Offy. Running among leaders at start of Sept. 6 race, Dan was forced to retire when tire cut by track debris caused him to spin out in Turn 3, slightly damaging car when it came to rest against the outside wall. Jim McElreath took race at 160.106 mph



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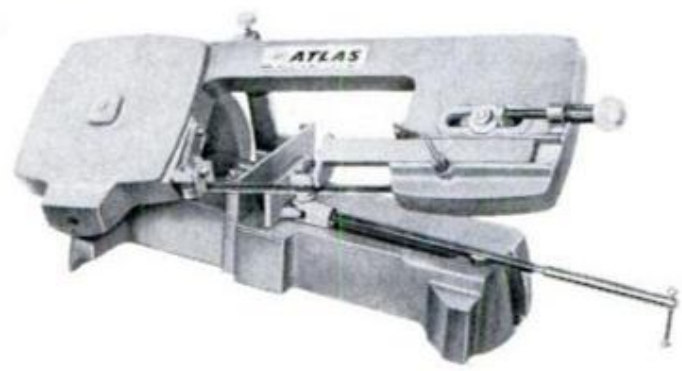
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3/8"	32	40	48	56	64	72
1/2"	24	32	40	48	56	64
5/8"	16	24	32	40	48	56
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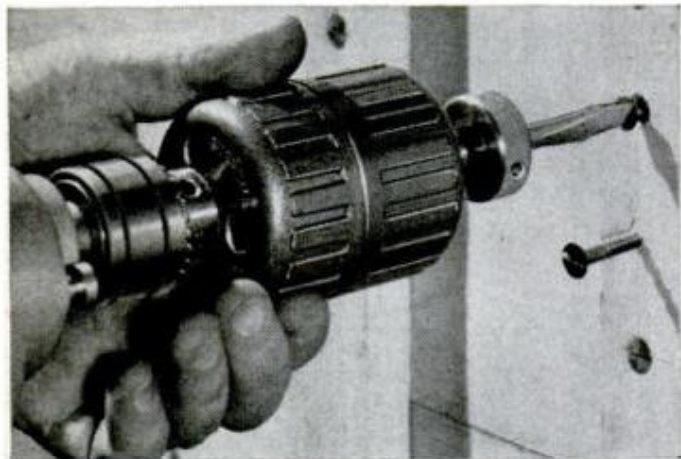
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DRIVIN' WITH DAN

(Continued from page 28)

ready to race, about what would the price be?—
Bill Evans, Orwell, Ohio.

A. Roughly \$50,000.

Q. Why does the new engine for Chevy's mini-car use a belt drive for the overhead cam? Doesn't this present a potential trouble point?—Richard Stiles, Georgetown, Ind.

A. It is less expensive, lighter, quieter and quite troublefree.

Q. Are the bodies of the NASCAR stock cars raced at Daytona fiberglass or plain metal like the street cars?—Don Gleason, Kent, Wash.

A. Plain metal as per street cars.

Q. At Indianapolis, do you have to shift gears on every corner?—Scott Minner, Carmel, Ind.

A. No. You normally stay in one gear and the engine operates in about a 1500-rpm range. Say between 7500 to 9000 rpm—7500 in turns and 9000 at end of long straights.

Q. If I install a transistor ignition on my 1970 Chevy, would I get higher performance? Would my points and plugs last longer?—Louis Zgonic, Chisholm, Mich.

A. I doubt if you would be able to detect any difference in performance if your present ignition is functioning properly.

Q. To settle an argument, could you tell me if the street-legal production Plymouth Superbird and Dodge Daytona are capable of reaching 200 mph?—Al Latino, East Brookfield, Mass.

A. My opinion is no, they cannot. After 150 mph they are going to have to start scratching hard to go faster.

Q. I think Corvettes are great performance cars and cannot understand why they are never in many races, Trans-Am and the like. Can you explain this?—Jeff Van Buren, Rosendale, Wis.

A. The Corvette is not allowed in Trans-Am because it does not meet the requirements of the rules. Corvettes are certainly excellent performance cars. They are raced in

(Please turn to page 32)

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DRIVIN' WITH DAN

(Continued from page 30)

most SCCA amateur race meetings, and often race in the long-distance events such as Sebring, Daytona, Le Mans, Watkins Glen, and so on.

Q. How close have you come to becoming World Champion? Also, I notice you always seem to make a special effort to race in the Belgian Grand Prix. Is this coincidental or do you really try harder?—Dave Bell, Lincoln, Neb.

A. I tied for second in the standings with Sterling Moss in 1961, the year Phil Hill became the first and only American Grand Prix World Champ. Spa is coincidental, although other people said I was pretty good on really fast racetracks.

Q. What do you do on "carburetion day" at Indianapolis and Ontario?—Evelyn Fritz, Orange, Calif.

A. We make the last runs on the cars prior to the race to make final checks on all adjustments. In addition, we also practice our pit stops.

Q. Rumor has it that the McLaren engineers are building three-valve semi-hemi heads for the ZL-1 Chevrolet. If true, would that be anything like your Gurney heads for Fords? Would they be for more horsepower or torque?—Bruce Morris, Kickland Lake, Canada.

A. McLaren engineers have done some work on a special head that was designed by men not employed by McLaren. They are not like our heads. They are looking for more of both horsepower and torque.

Q. What do you think of the Porsche-Audi 914 and 914/6, and do you think it will start a series of mid-engine cars in Detroit?—Arthur Ressio, San Francisco.

A. I have not driven one yet, so I cannot comment. Time will tell. It looks like the way to go for a two-seater. The removeable roof is certainly a nice answer to the age-old open car/closed car dilemma. ★★★

If you have questions on racing, high-performance and everyday driving techniques, send them to "Drivin' with Dan," c/o Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Questions cannot be answered by individual letters. Questions on maintenance and repair should be addressed to the Auto Clinic (see page 36).

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How to buy your first pickup like it was your second.

People usually approach their first pickup with the thought that they're buying a car with a box in the back.

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They discover that passenger-car engines aren't truck engines. And that passenger-car suspensions were never made for 4,000-pound loads.

So the second time they buy a truck, they know better. And choose a pickup for all the right reasons... and wind up with what they should have had all along. A truck.

That's all well and good—if you can stand the \$3,500 lesson.

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They need information. To get second-truck wise before they buy their first truck.

That's just the kind of information we've got.

It begins with our 1971 INTERNATIONAL models. If you're at all familiar with pickups, you'll notice some changes in ours.

A new grill. New hubcaps. A different tailgate treatment. New rocker panel trim. Several new colors to choose from. A few new things. But nothing that can, alone, give you good enough reason to buy one.

That's the job of the information.

Our V-8 engines, for instance. They're truck engines. We didn't pull them out of passenger cars. They are, in fact, the same engines we use in some of our big, gas-engine highway trucks.

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But there's a third point you've probably never considered: the advertised horsepower. It's the horsepower you "buy"... but not the horsepower you get. That's because advertised horsepower figures are theoretical. They represent what the engine should be producing—but because of an engine's inherent traits, never does.

What you do get is the *net* horsepower. An example: Our 193 hp. rated V-8 actually produces 173 hp. A good competitor's 200 hp. rated V-8 gives you 150.

So if you were looking for the "more powerful" of the two—you'd choose the wrong one, based on the advertised figures.

It works that way for most of our V-8's...and for most of our competitors' V-8's. They can promise more—we can deliver more.

Another important consideration concerns suspensions. If you're planning to carry a heavy load—like a big camper—you can't judge the suspension by the way the truck test-rides empty. It will ride differently once it's fully loaded. So to determine the safest, most stable suspension, you have to go at it in a different manner:

A coil spring gives you one point of suspension at each wheel. A leaf spring gives you two.

A standard Chevrolet has coil springs all around... for a total of *four* points of suspension. As standard equipment, a Ford has coils in the front, leaf springs in the rear... *six* points of suspension.* As standard equipment, an INTERNATIONAL 1210 has leaf springs all around... giving you *eight* points of suspension.

So you have a choice of 4, 6 or 8 points of suspension. Or, if you're safety conscious — maybe no choice at all. You need 8.

There are plenty of other things. Like fuel tank location. We're the only manufacturer to put it outside the cab... instead of inside like everyone else. Our pickups are easier to get in and out of... with a doorsill that's up to nine inches lower than the competition. We're the only manufacturer to give you direct-reading gauges as standard equipment. You either pay extra with everyone else — or try to get along without them.

There's even more than that. And the logical place to find out about all of them is at a truck specialist's.

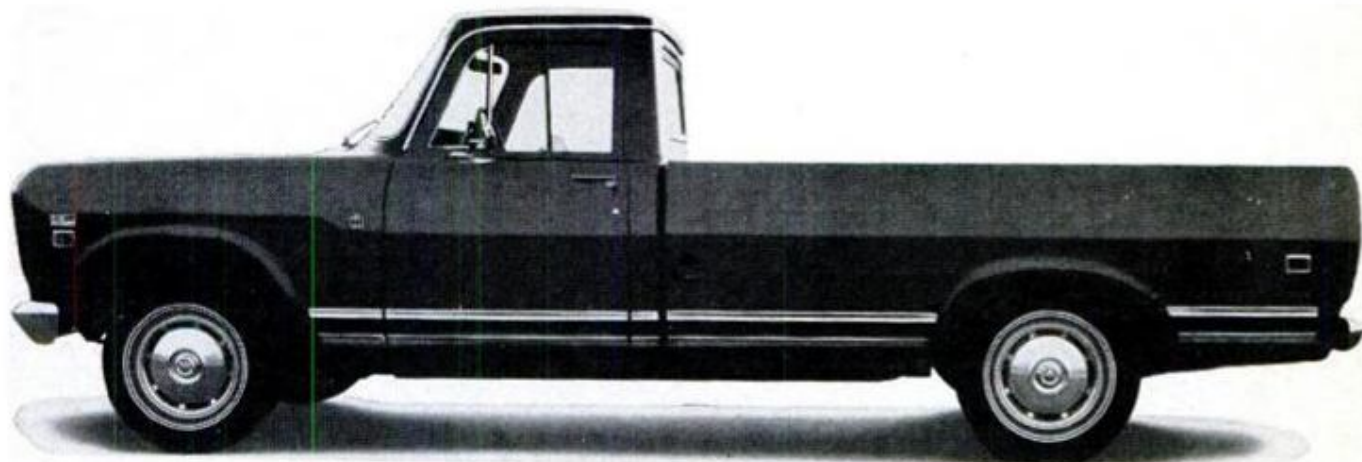
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So that you can buy your first pickup like it was your second.

*Competitive specifications mentioned above pertain to manufacturer's 1970 models and do not reflect any changes in 1971 model lines.



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SOLUTIONS FOR MECHANICAL HEADACHES

AUTOMOBILE CLINIC

BY MORT SCHULTZ

Never empty

My problem is the gasoline gauge of my 1968 Chevrolet Impala. The needle stays past the full mark when it should show near empty, except on a few occasions when it will read normal. What's the remedy?—E. J. Bertonani, Pittsburgh.

One of three things: Clean and tighten the ground connection at the gas tank, replace the float in the tank, or replace the gauge itself.

Swinging rear

My 1967 Plymouth Fury Station wagon has no stability over 35 mph. A recent near-accident prompted me to install heavy duty shocks all around, correct alignment and wheel balance, increase tire pressure and check every part that might have a bearing on the problem. Nothing has helped. What more can I do?—Charles Forman, San Diego.

I sympathize with you and the thousands of other station-wagon owners who have spent a bundle of money trying to correct this problem. There have been many "remedies" offered, some of which you have tried. Here are two more: Install load-leveler shocks in the rear and put on wide oval tires to lay more "footprint" on the road. The best solution, of course, is better engineering.

Ports of call

The brakes of my 1968 Volkswagen tighten up. I've taken the car to a mechanic without success. What do you suggest?—W. J. Daniels, Harrisburg, Pa.

Remove the brake master cylinder and clean out the bypass ports. These ports

cannot relieve pressure if they're dirt clogged. Keep in mind that there are two ports, one for each side of the dual cylinder. The trouble could also stem from a swollen cup that may be blocking the bypass ports, from dirty or defective residual pressure valves, or from an insufficient push-rod clearance.

High-speed shakes

I have a 1970 Pontiac Grand Prix which vibrates at speeds of 55 to 75 mph. My dealer says he can't find anything wrong. Is there an explanation?—Alan C. Wainoris, Hazelcrest, Ill.

High-speed vibration has become a common complaint since the Grand Prix started using belted fiberglass tires as standard equipment. The only advice I can offer is to balance the wheels, front and back. If this doesn't make the condition acceptable, switch tires.

Stop-sign trauma

My 1969 Ford equipped with 390-cu.-in. engine and two-barrel Autolite carburetor feels as though it's going to stall whenever I give it gas after stopping at a stop sign. The dealer reset the accelerator pump to deliver more gas, but this hasn't helped. This is a dangerous situation. Please tell me what to do.—Charles W. Beall, Ames, Iowa.

Ask your dealer to reposition the accelerator pump to its original setting and to look through his file of technical service bulletins, stopping when he comes to No. 112 (4/4/69). This will tell him to replace the accelerator pump elastomer valve with an improved type, and to check the discharge nozzles for dirt and the correct size.

More on Jeep gear

Phil Subry's problem with his Jeep engine (327-cu.-in.) nylon camshaft gear has brought several responses from readers which owners of this vehicle should consider. (See *Auto Clinic*, page 74, May PM).

Larry A. Davenport of Eureka, Calif. and Richard C. Bejtlich of Saugus, Mass., both warn that you shouldn't wait for that gear to break before replacing it. Bejtlich

(Please turn to page 38)

NOW ON YOUR NEWSSTAND

Want clues to hidden ignition troubles caused by faults that aren't in the "book"? Does your engine "diesel"? Need to check your brakes, steering, ball joints, differential, tire wear? Then you'll want PM's all-new 1971 edition of the *Car Repair Annual*, the 128-page dollar-saving guide for Saturday mechanics now at your favorite newsstand for \$1.

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AUTOMOBILE CLINIC

(Continued from page 36)

speaks from experience when he says that when the gear breaks "the engine jumps timing." The pistons ram into the valves and bend the push rods and sometimes even the valves.

Robert C. Ogg of Parks, Ark., suggests that the crankshaft sprocket and chain be replaced, too. In other words, replace the whole assembly. The crankshaft sprocket and camshaft sprocket are connected by a chain. The new camshaft gear bears replacement part No. S378T.

Crack-up

I have a 1965 Chevrolet with six-cylinder engine and standard transmission. Recently, I found oil oozing from the radiator overflow tube onto the driveway. All the oil from the engine had passed into the radiator. What happened? What should I do?—R. J. Rodenbo, Pontiac, Mich.

Friend, you've got trouble. The engine is cracked on the inside. There's no way to seal an internal crack, so I'm afraid your only choice is to replace the block.

Hot to trot

My friend and I both own 1969 Plymouth Fury III's with 318-cu.-in. engines, and we have the same problem. The engine is hard to start for about 30 minutes when it is hot. Flooding seems to be the trouble. We've replaced the needle valve and installed a fuel-line pressure regulator. Now we feel that the fuel line comes too close to the hot engine and should be re-routed. Do you agree?—Charles S. Lehr, Woodbridge, Va.

It's worth the trouble to find out, Charles, but there's an easier way. Just get some asbestos insulation from a hardware store and wrap it around the fuel line. I have another tip for you. Your trouble may also be a leak-down condition in the carburetor. Next time the problem strikes, remove the carburetor air cleaner and see if gas is bleeding into the carb. If it is, overhaul the carburetor.

Lost rpm

My 1967 Volvo model 144S with twin SU-HS carburetors is driving me nuts. It's

set to idle at 700 rpm. After I drive it for awhile in heavy traffic and stop at a light, the engine drops off to 200 rpm from this setting and I have to keep my foot on the gas pedal to keep it going. We've checked everything by instrument and book, including carburetor adjustment, point dwell, timing, sparkplugs, needle valve, seat and floats. Please what now?—William Pawelko, New York.

Got a hunch, Bill, that the trouble is with the car's antismog flapper valves, one of which is positioned beneath each of the carburetors at the intake manifold. These are spring-operated butterflies. If the springs have lost tension, the valves could remain partially closed, which will affect idling.

Service Tips

● **Chevrolet cautions** that the power steering hoses of the 1970 Chevelle and Monte Carlo equipped with V8 engine may be positioned too close to the pump drive belt. There should be a 1-inch clearance between them. Ask your dealer to check this for you as spelled out in the Chevrolet Service News No. 5 (May, 1970).

● **AMC explains** how to remove vinyl roof adhesive droplets and smears from the roof and painted surfaces in its TB 9 (6900 series). The procedure outlined involves removing high spots with a razor blade, rubbing the spot with lacquer thinner until it is dissolved, and lightly polishing the area with a mild rubbing compound.

● **Oldsmobile has issued** a new kit for repairing a steering shaft which has been collapsed, providing it is not bent. Bent shafts must be replaced. The new kit, which carries part No. 7810077, applies to the shaft only. The mast jacket can't be repaired if it is collapsed.

● **Dodge reports** it has found a cure for poor engine idle, stumble, surge or carburetor whistle that may be affecting the performance of your 1970 car or light truck. The trouble is often found to be caused by inadequate compression of the insulated spacer between the base of the carburetor and the intake manifold. The carburetor-to-manifold attaching bolts should be tightened to 100-inch-pounds in three stages: (1) snug; (2) half torque (50 inch-pounds); (3) full torque (100 inch-pounds). ★★★

GOT A PROBLEM WITH YOUR CAR? Ask Mort about it. Send your question to Auto Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of general interest will be published in the column.

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Who Really Won the Clean-Air Car Race?

Speed can't be the only criterion by which a winner is judged in the urgent race for an alternate power source for future vehicles

By **BILL HARTFORD**, Auto Editor/Photos by the Author



UNIVERSITY OF TORONTO hybrid at start

IT DIDN'T MATTER in what order the cars crossed the finish line. What did matter was the score they achieved in the six-day race from MIT to Caltech at the end of August. The race was a follow-up of the first electric-car race (*Across the USA With MIT's Electric Car*, page 52J, Nov. '68 PM).

Instead of two cars, the entries this year numbered over 50. The cars didn't have to be electric. There were in fact five battery-powered cars, three hybrids (electric with an engine burning liquid or gaseous fuels to generate electricity), one turbine car, several steam entries (which did not prove competitive) and the remainder internal combustion (i-c) modi-

fied to burn unconventional fuels and equipped with exhaust-treatment devices.

Score was based on a car's emissions, performance and elapsed time. Performance took into account thermal efficiency of the powerplant, noise levels and other factors important at a time when environmental considerations must take precedence over speed, comfort and chrome.

Winner in the electric class was Cornell's homemade vehicle. In the hybrid class, honors were shared by Worcester Poly's converted Gremlin and the University of Toronto's hand-made machine, which was, even as the competition admits, "the grooviest car running." In the internal-combustion category, Worcester's LPG entry tied with Stanford's alcohol-burning vehicle. Turbine winner was the MIT entry.

All the students we talked to, even those who didn't get to the starting line, displayed enthusiasm, excitement and extraordinary knowledge of automobile propulsion and pollution problems. Space and electronics have been the glamour fields of late, but these kids are stressing the need to come back down to earth and get cracking on cleaner cars. In the end, we'll be the winners of 1970s Clean-Air Car Race. ★★★



WAYNE STATE STUDENTS start in i-c Capri—overall winner

COMPLEX INSTRUMENTATION of MIT turbine; all electric, Boston U.; VW converted to electric, Iona College



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When our new merchandise man was offered an exclusive on these indestructible nylons socks, he called the manufacturer a liar.

"Can't be done!" he said. "If the socks are as strong and durable as you claim, they've got to be so stiff underfoot, they'll be unwearable!"

"Kitten-soft," said the manufacturer.

"Then they won't wash satisfactorily."

"Always come out like new," barked the manufacturer. "Permanent colors, lasting texture and shape."

"Or you'll weasel the guarantee," added our man, doubtingly.

"Unconditional!" snapped the manufacturer.

"What's the catch?"

"No catch, no secret!" said the manufacturer happily. "8-ply yarn of DuPont nylon—instead of the usual 4. Woven so closely, they make ordinary socks look like they're three-quarters air, by comparison! Styled by one of the world's great sock designers—for perfect proportion and fit. This yarn is guaranteed to wear forever, in normal use. That "normal use" simply means regular ordinary wear—don't burn holes in them deliberately, or try to cut them with a scissors or razor."

We still had to be shown. So we got samples. And we wore them. And wore them. And machine washed them. And Laundromatted them. And tortured them. Like wearing one pair for a week

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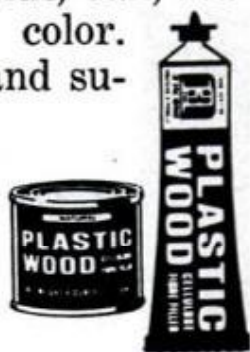
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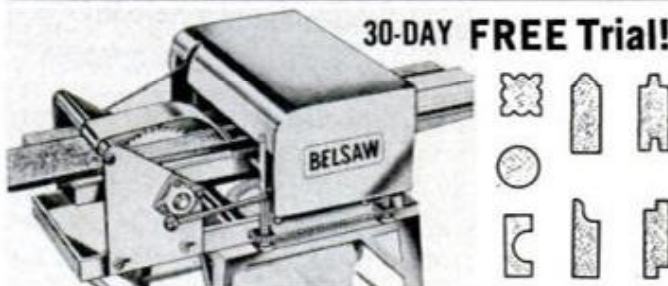
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- Architecture
- Arch. Drawing & Design
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- Carpenter-BUILDER
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- Heating & Air Conditioning with Drawing
- House Planning, Int. Design
- Plumbing
- Plumbing & Heating
- Reading Arch. Blueprints
- Refrigeration

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- Commercial Cartooning

- Interior Decorating
- Sign Painting & Design
- Sketching & Painting

AUTOMOTIVE

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- Auto Mechanic-Techn.
- Diesel-Gas-Motor Vehicle Engines
- Auto. Electrical Techn.
- Engine Tune-Up
- Transmission Specialist

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- Business Administration
- Business Law
- Industrial Psychology
- Inventory Control
- Managing a Small Store
- Personnel-Labor Rel'n's
- Purchasing Agent
- Retail Business Mgmt.
- Traffic Management

BUSINESS: SALES

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- Real Estate Sales
- Sales & Sales Mgmt.

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- Chemical Engineering
- Chem. Lab Technician
- General Chemistry
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- Highway Eng. Tech.
- Sewer Plant Operator
- Surveying & Mapping
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- Calculus
- Economics

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- Fortran Programming
- Programming for Digital Computers
- Programming the 360
- Programming the 1401

DRAFTING

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- Architectural Drafting
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- Drafting Technology
- Electrical and Electronic
- Mechanical
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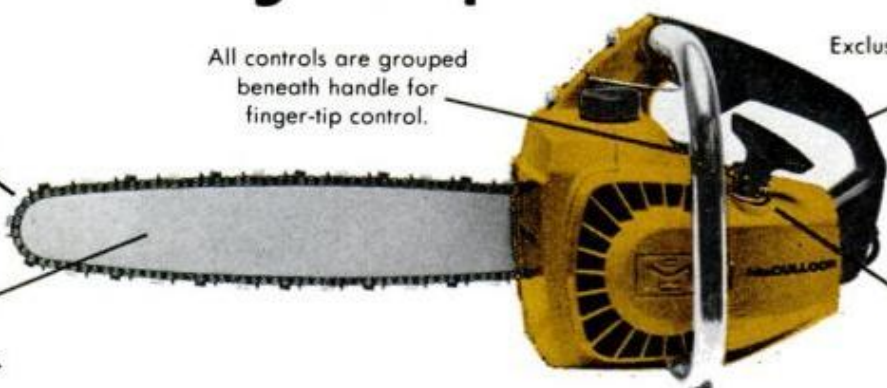
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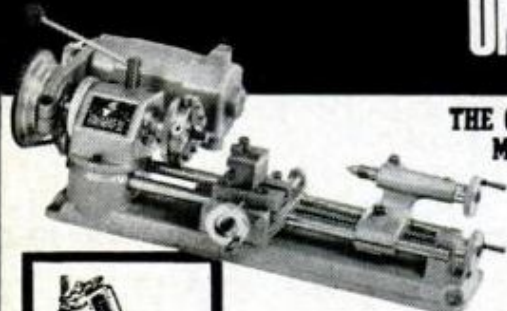
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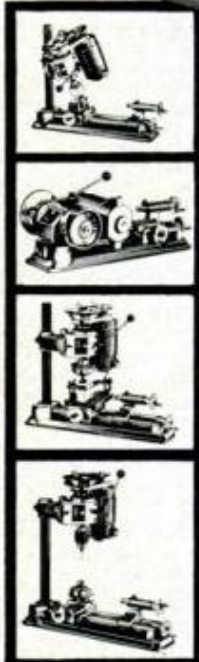
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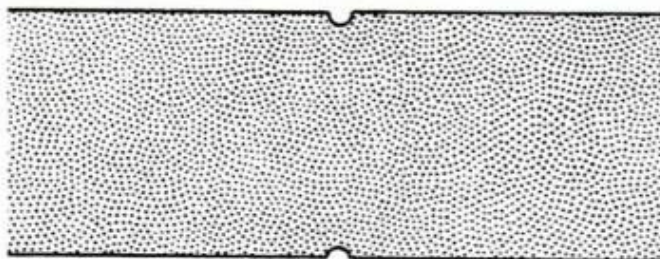
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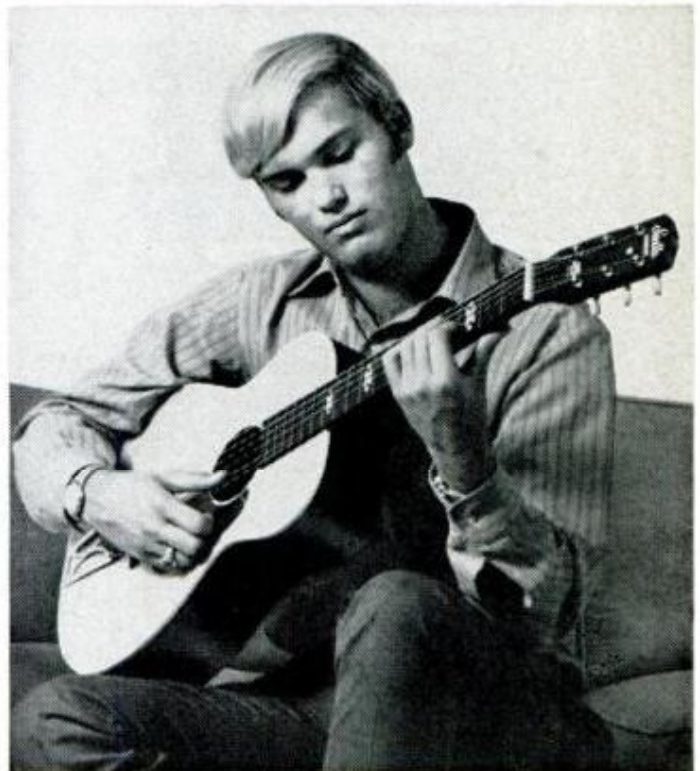
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Roll-up sails on Chrysler boats

The Buccaneer (above), Chrysler's new 18-foot day sailer, has jib-furling gear that enables a skipper to reduce total sail area by a third simply by pulling on the furling line. The sail rolls around the headstay. Sail area on the 15-foot Man O' War (left) can be reduced by rolling the sail around the mast (bottom photo). Chrysler has 43 powerboats and 4 sailboats for 1971.



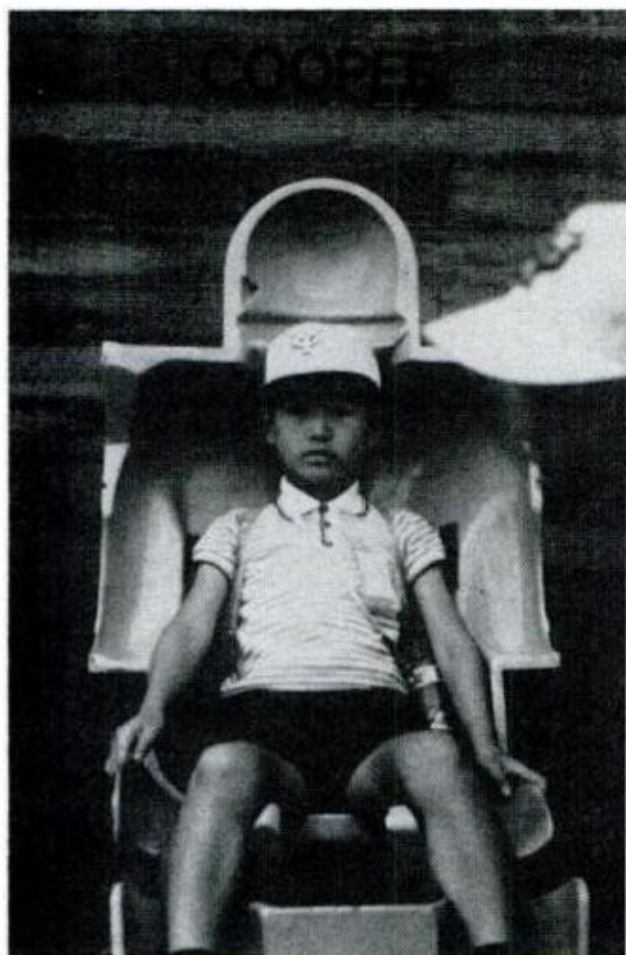
Racing prototype is powered by a two-stroke engine

The prototype of a high-performance formula racing car, powered by a three-cylinder, 475-cc Suzuki two-stroke engine, is undergoing development by U.S. Suzuki Motors, Santa Fe Springs, Calif. The car, which weighs 667 pounds, will do 134 mph. There are no plans at present to put the car into production.



Skyservant is a workhorse

Designed to be a "packhorse with wings" in the air and easy to service on the ground (no ladders are needed to get in and out or to overhaul the engines), the Dornier Sky Servant is taking on many flying jobs around the world. The STOL craft is used as an ambulance, industrial transport and short-haul passenger transport—to name a few of its jobs. Powered by two 380-hp Lycoming engines, the plane can take off after a run of 560 feet, attain a maximum 175 knots and carry 12 passengers with luggage or 3000 pounds of cargo.



It'll take a little growing

Looking slightly apprehensive, a Japanese boy tries for size a U.S. astronaut's fiberglass couch in the U.S. Pavilion at Expo 70 in Osaka. Couches of six Mercury astronauts (Cooper's is shown) were part of the space display. The photo is by PM editor Robert Crossley (See *They Said I Was Crazy to Drive in Japan*, page 126, Oct. PM).

NOVEMBER 1970

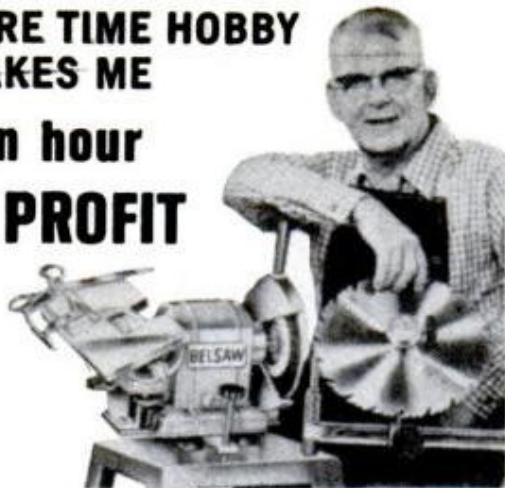


Citroen shows new GS

The new Citroën GS, which comes in the Comfort and deluxe Club models, has front-wheel drive and an air-cooled, four-cylinder, horizontally opposed overhead cam engine. Top speed is about 92 mph. Citroën has not yet made plans to sell the car in America.

49

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Von Schrader Upholstery Deterger. Gives deep-level cleaning to fabric upholstery and synthetics.



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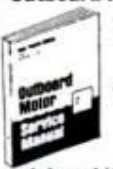
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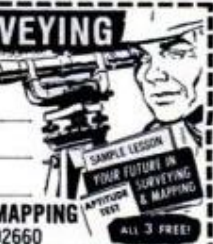
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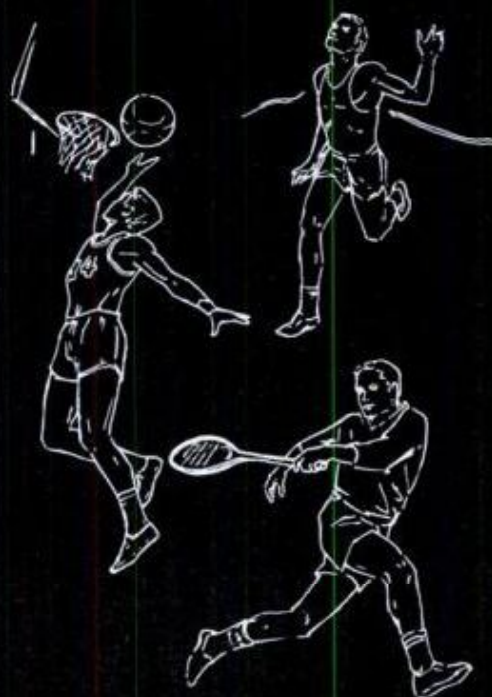
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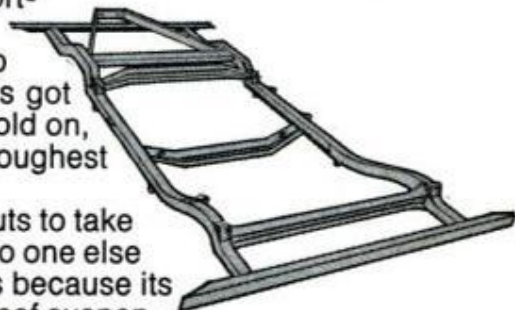
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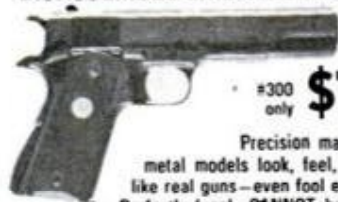
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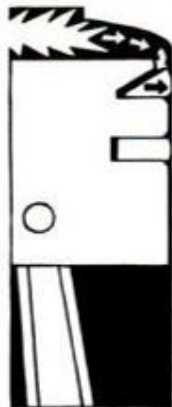
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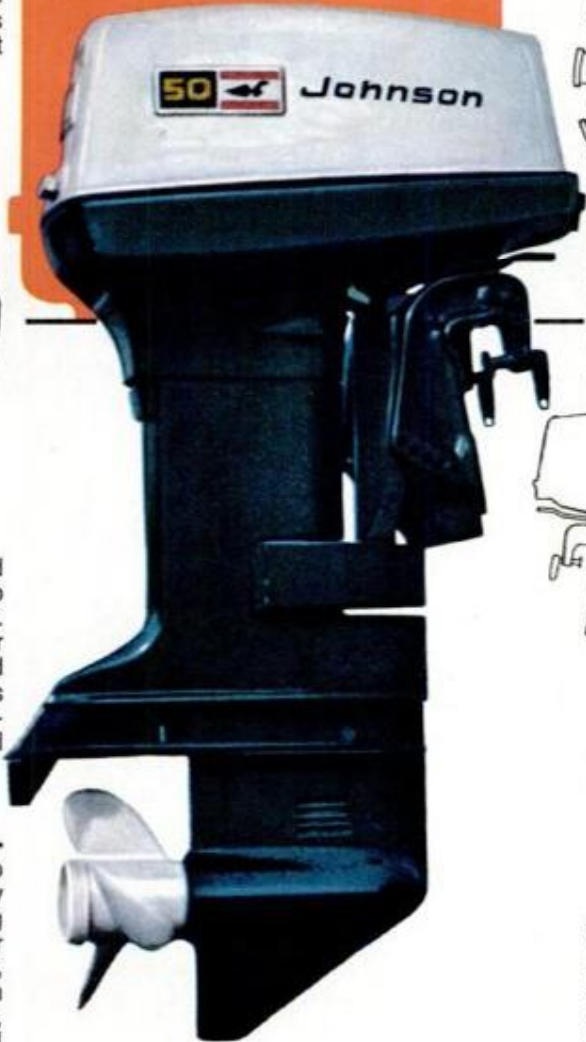


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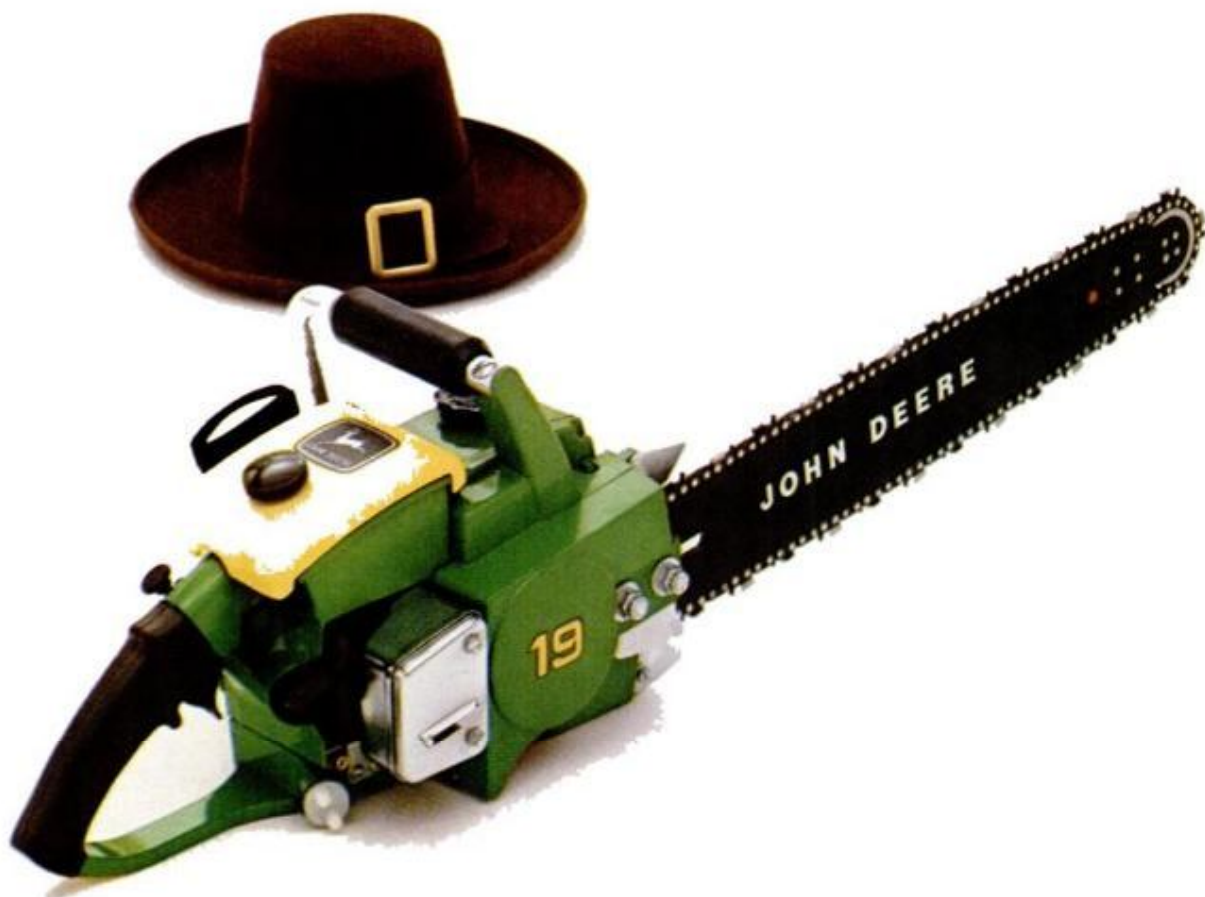
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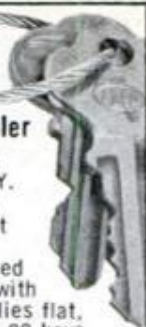
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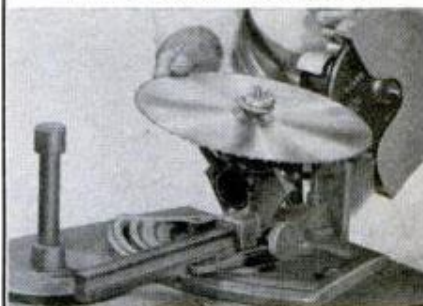
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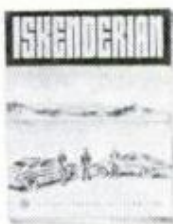
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ON-THE-GO

CAMPING

BY WADE MITCHELL

NEW ATV TIRES MAY REVOLUTIONIZE OFF-ROAD TRAVEL. B.F. Goodrich tires trade-named High-Flex are designed to operate at a pressure of just two pounds per square inch. These soft tires literally float the ATV over mud, marsh, sand or rocks with equal ease. Because of the low-pressure design, the flabby tires roll right over broken glass, cactus and spikes without damage. The High Flex is 12 inches wide and 20 inches in diameter—about as broad as it is long. Made through a unique new molding process and wearing a new flat-tread surface, this special tire can be used on the front wheels of most offroad ATVs. B.F. Goodrich tire dealers will have prices and information.

CAMPERS COMPLAIN OF CLIP-JOINT TACTICS at some large private and franchised campgrounds. They charge that advertised rates sometimes cover only the basic per-vehicle fee for a night-camping space and that operators then add from 50 cents to \$1 per person extra. Some parks have charged \$1 per night for each pet, and dump-station fees range from about 50 cents to as high as \$2.50 per tankful. Groceries are sold in some campground stores at 50 to 100 percent above local supermarket prices. Complaints we have received from campers also say that an advertised price of \$2.50 per night sometimes ends up at \$6.50 or \$7.00 per night for a family of five. While this is still less expensive than stays at motels, it is considerably higher than those "free" parks which coach dealers talk about.

REAR-ENTRY DOORS FOR COACHES COMING? That's the rumor. Campground designers have complained that side-door models cramp their style. Back-in spaces with rear patio areas would be less expensive to build, and campers could be provided with more privacy. Truck campers already have rear doors, but most trailers have side doors. One trailer manufacturer has even suggested that the front frame could be altered to provide for a *front-wall* entry door. The advantages include more safety in traffic-congested areas, more convenient entry closer to towing vehicle, and the possibility of a Pullman-type passageway from tow car to trailer which could snap into position. Rumor, perhaps, but it shows that trailer designers are breaking out of traditional molds.

CHEVROLET AND OPEN ROAD ANNOUNCE NEW MOTOR HOME and a new van conversion. Geared to the sluggish economy the new models will sell from \$5995 to about \$10,500. Length of models will range from 18 feet to about 24 feet. Open Road has built a new factory in Warren, Ohio, near Chevrolet Truck's Lordstown truck facility. This may be the first open collusion between a coachmaker and one of the truck giants. The move is sure to spark similar plans at Ford and at Dodge Div., both of whom are strong in the motor-home and van-chassis field.

IS YOUR HOLDING TANK TOO SMALL? Replace it with one of the jumbo-sized Cylolac tanks now available in capacities up to 70 gallons. These supertough new tanks feature leakproof drain outlets, molded pockets for mounting brackets and built-in drain angles that assure rapid evacuation of tank when properly installed. Many older coaches still suffer from 10 and 15-gallon holding tanks. For about the price of one weekend trip, any coach owner can buy one of the new Borg-Warner units and enjoy the modern range of two to five more days' use. Most trailer dealers stock and sell such tanks.

ARE INSURANCE COMPANIES LOSING \$5 MILLION A YEAR ON RVs? That's the rumor. Possible causes, if true, as suggested by one claims adjuster for a national underwriter: Coach repair costs have skyrocketed and the scarcity of trained help has driven up labor rates to between \$6 and \$8 per hour. There are no standards in the coach repair business. ★★



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HOMEOWNERS' CLINIC

BY W. CLYDE LAMMEY

Wobbly casters

I have a chest (not old) in which the casters are loose and wobbly—two of them drop out when the piece is lifted. Apparently holes for the caster sleeves are too large for any adhesive to hold them in place. Is there any other way of securing the sleeves?—H.R., Md.

It's hard to suggest what to do without knowing why the sleeves are loose and by how much. Small wedges pared to a thickness that would give the sleeves a tight fit when driven home in glue would be effective, but the problem is to determine just the right thickness to give a tight fit without splitting the post or leg into which they are driven.

Perhaps it would be better to bore out the existing holes to take a length of hardwood dowel having a diameter greater than the hole required to take the sleeve. Tap the dowel into place with glue in the hole and, when the glue is dry, bore a hole to take the sleeve in a moderately tight fit. Before driving each dowel, flatten one side slightly to permit escape of entrapped air and also allow the glue to work up alongside the dowel and anchor it securely.

On buying a house

Can you tell me what to look for before I buy a house in a suburb: defects to spot, what may require repair or replacement, how to judge value and so on?—F.N., Okla.

Lengthy articles have been written on this subject (See *How to Buy a Good Old House*, page 139, Sept. '69 PM), but I have space for just a few pointers. "Value" is based on so many variables that I wouldn't venture a guess at long range. Before you look at the house, take a turn about the neighborhood and judge for yourself whether you like what you see. Then walk around the structure, noting condition of the paint, brickwork and stonework, if any, and pay special attention to the condition of the chimney and roof. Major repair or replacement here will cost money.

Inside, watch for cracks in plaster, unstable floors, open joints in woodwork, a sagging ceiling, wrinkles in papered walls (indicating plaster cracks underneath), sticking doors and window sashes. Note

space for closets, beds and dressers, decorative possibilities of living areas and whether your furnishings will fit adequately. Check location and number of electrical outlets in all rooms, take a long look into the attic with a flashlight for evidence of leaks, condensation (which could mean wet or rotted roof deck and rafters), and note the vent areas, usually at the gable ends or near the ridge.

In the basement, look along walls for cracks and water marks which could mean flooding or excessive seepage. Open the service box (electrical) and note its rating. Check furnace or boiler inside and out; you can't see much, but you might catch a defect. Ask the seller for location of drains, tiling around footings and similar information. Locate stakes determining the lot lines.

Chalking tiled floor

A fine whitish powdery dust is appearing at the joints of the asphalt tiled floor in my basement. Wipe it and it reappears. Is there any remedy and if so, what?—A.G., Minn.

This dust is caused by alkaline salts in the concrete, activated in the presence of moisture. There is no easy cure for the condition, which is more or less common where tiles are laid over relatively new concrete. The dust causes no special harm as a rule; you simply "wait it out," for in time it generally disappears entirely as the materials stabilize. In the meantime, keep the dust wiped up.

Condensation remedy

You and others make much talk about condensation but you never give the specific cure. Let's have the "specific" for a change. Come now, just what is it?—C.N., Ky.

There isn't any. What's "specific" for one instance isn't always so in another. The cause is built-in in nearly all new homes because they are more "airtight" than older structures. This is an oversimplification, but still it is basically the cause of troubles from excessive condensate as stated. Moisture trapped in newer homes cannot normally escape through walls and ceilings in sufficient amounts to prevent condensate from forming on surfaces having a lower temperature such as window panes, often doors and even walls. The only remedy is to reduce the moisture content of the air in the rooms. Some homeowners do this with an automatic dehumidifier, which is reported to give satisfactory results. ★★★



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CAMBRIDGE, MASS—New instrumentation needed for air and water pollution analysis in the next decade will be recommended in a report to industries prepared by Arthur D. Little, Inc., 25 Acorn Park, Cambridge. The study, to be completed this month, will suggest devices for measuring the equivalent of oxygen demand in waste water; automatic particulate monitors employing tape sampling and particle counting; and instruments for sensing sulphur dioxide, hydrocarbons and carbon monoxide in ambient air. Among areas of application for pollution analysis equipment included in the study will be air quality, automobile, diesel and aircraft exhaust, stack-gas, water quality and waste water.

LOS ANGELES, CALIF.—The nation's first urban people mover will be developed as a ground-transportation system to replace the automobile, the Department of Transportation's Urban Mass Transit Administration announced. The administration and the Los Angeles Dept. of Airports have been working with interested firms on a cost-sharing basis to build a passenger-carrying, tracked, air-cushion vehicle line to run over a 16.3-mile course between Los Angeles International Airport and the San Fernando Valley. Scheduled for completion by late 1972, the system will run along the San Diego Freeway on guideways elevated 20 to 60 feet above the road. A rail in the center of the guideway will provide electricity for the vehicles' linear-induction motors. The project is expected to cost \$50 million, excluding the vehicles.

NEW YORK—The Glass Container Manufacturers Institute, 330 Madison Ave., New York, has begun an industry-wide program to buy back used bottles from consumers, grind them into crushed glass and use them to make new containers. The Institute believes it could use reclaimed glass for 30 percent or more of its raw material. Paying a penny a pound, the GCMi plans to open a network of redemption centers in 25 states.

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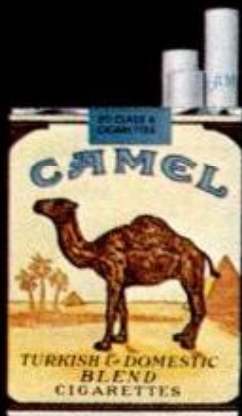
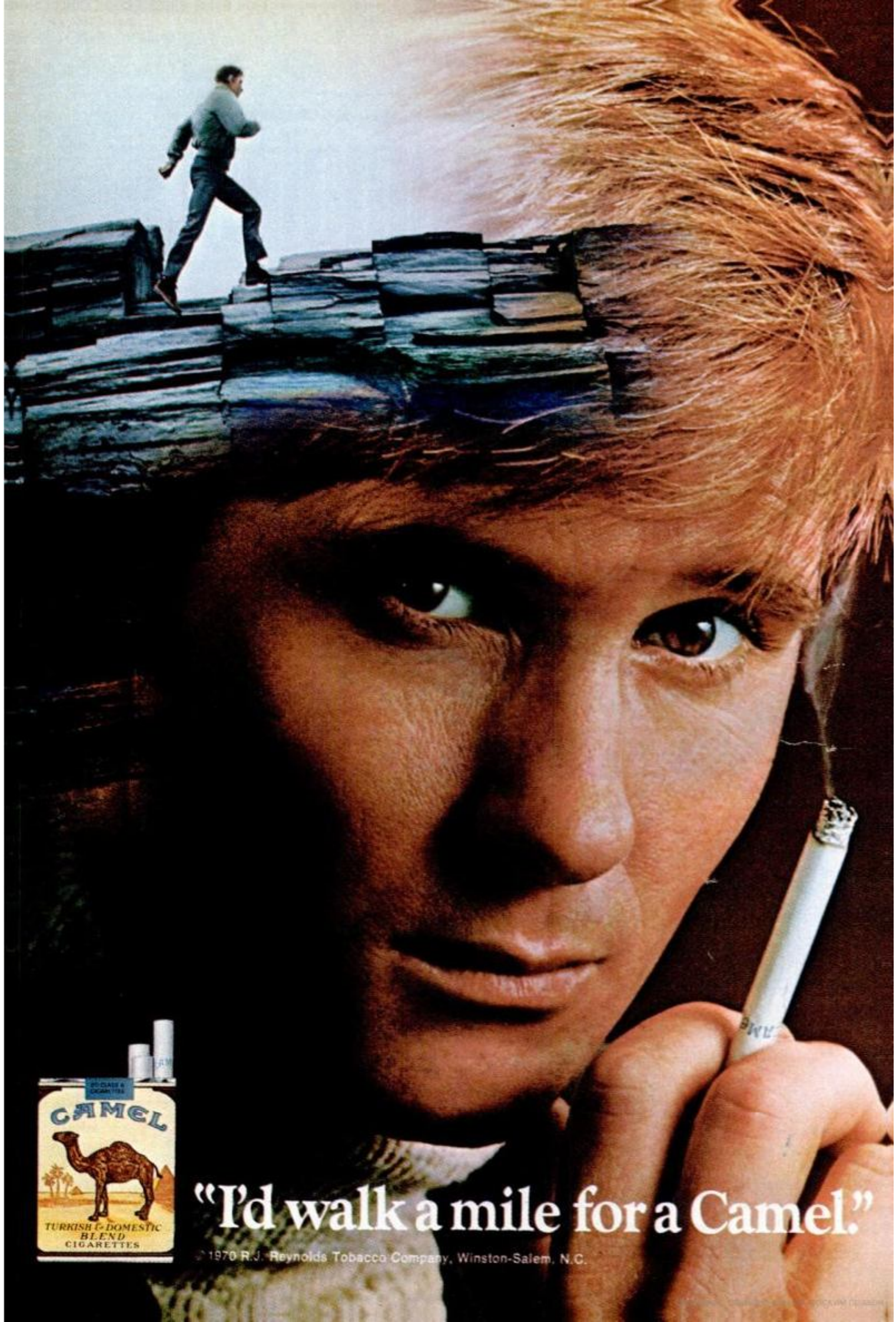
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PM goes to a skid school and finds out that both the prevention and control of slides should be a part of driver training instruction.

By MICHAEL LAMM, West Coast Auto Editor/Photos by Kerry L. Cartier

SUDDENLY I FOUND MYSELF sitting in the middle of a car whose front end was standing still and whose rear end was going around it in a large circle.

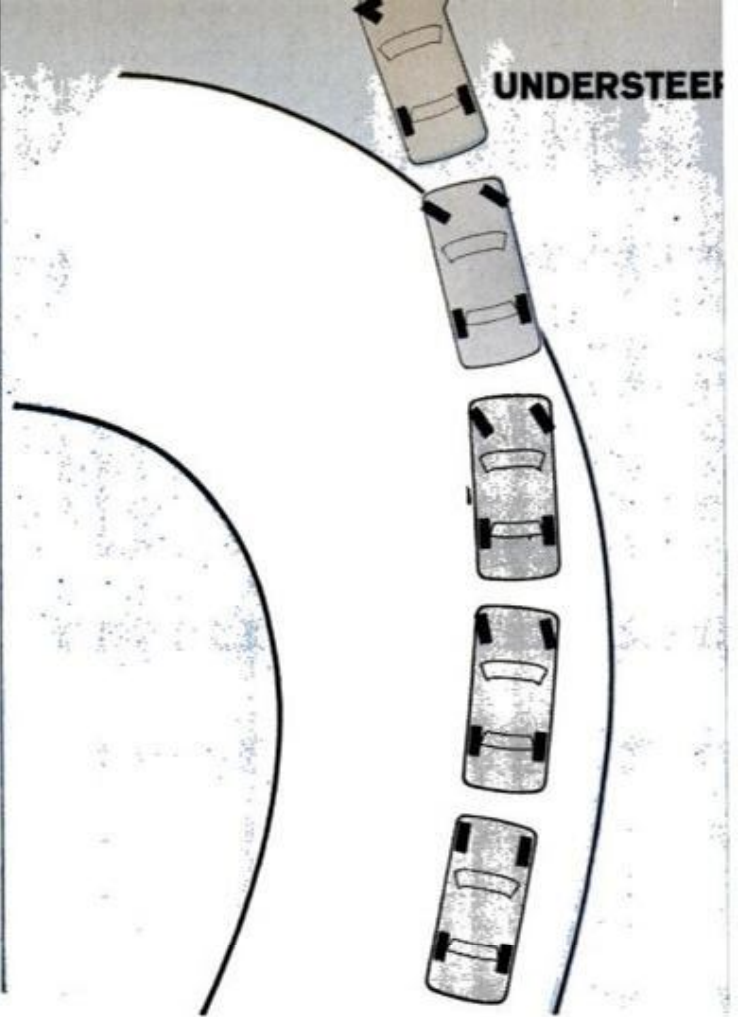
Beside me sat Bruce Campbell, my instructor, who just moments before had told me in the classroom about typical reactions students have to their first spin-outs. Some throw up their hands. One girl did this and covered her eyes. Other students grab the edge of their seat with both hands. A few seesaw the steering wheel, trying somehow to regain control. But the commonest reaction is simply to freeze—to hold tight to the wheel and wait for the car to stop spinning, hoping all this time that it doesn't capsize.

That was my reaction. I froze. The panorama outside the windshield slid by as if in Cinemascope. Eventually the car's tracks became visible as we passed 180°—the shudder marks of our rear tires as they scribed their dotted circle on the wet asphalt. These tracks got fuller and finally, with a jolt, we stopped. The car was still upright. I thought to myself, "Well I'll be damned."

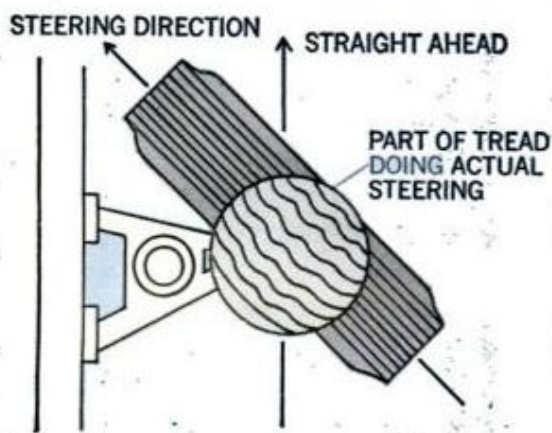
That was my first spin-out. Two things impressed me immediately: 1) how quickly the car went out of control, and 2) the feeling of utter helplessness once



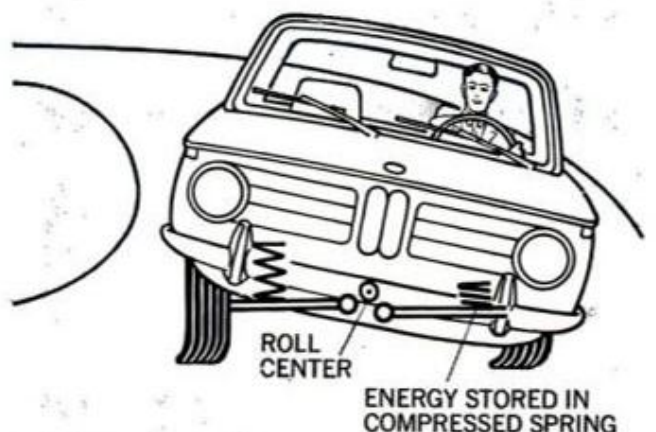
A CAR THAT OVERSTEERS is one whose rear wheels in a turn lose their grip before the front ones. The rear end tries to come around the front. The car steers too much. Think of the rear scribing a circle or "O" around the front. If a car understeers it means the front tires lose their grip first. The car tends to plow straight ahead rather than follow the line of curve. The car does not steer enough. Think of "un-steer," the condition when a car won't steer. Generally, rear-engine



cars oversteer and front-engine cars understeer, but that is not always the case, weight distribution not being the only factor in determining understeer-oversteer characteristics. Other factors are suspension geometry, relative tire size and pressure, and how power or braking is being applied to the front or rear tires. U.S. cars are designed to understeer somewhat. Some cars have practically neutral steering characteristics—usually until they lose adhesion and characteristics change abruptly



ONLY FOUR PATCHES OF RUBBER are between car and road. When turning, even slowly, the tread leads the way. It distorts and the tires also slip sideways. Sideslip is minimal unless tire loses its grip and skidding occurs. Locking of brakes loses all steering control since sliding tires can't steer. Factors that affect traction include car speed, turn angle, tire tread, pressure, pavement and suspension



LEAN OR BODY ROLL in a corner depends on stiffness or softness of suspension. Soft suspension doesn't necessarily mean less ability to get through a corner fast, but does mean slower response—longer time for car to reach a stable lean after steering wheel is turned. Driver must anticipate loss of traction, can't wait to feel it. On the other hand, quick response is necessary with stiff suspension

it did. I had always thought that after a car begins to spin, my natural driving instincts would tell me how to steer out of it. Not quite. I was soon to learn that once a spin starts, you simply have to wait it out. The trick is to learn how to *prevent* or *avoid* spinning. Which is what skid school is all about.

The course I attended is given by the School of Slide Control, a division of Opposite Lock Enterprises, the brain-child of Bruce Campbell, my instructor. Among other things, it's an extension course of the University of Nevada in Reno. Facilities are at the old Stead AFB site outside town.

Bruce, who's all of 23 but wise beyond his years, has been a race driver in Australia and England (Formula II and III). He's taken formal training in race driving. The School of Slide Control, though, isn't intended primarily for budding racers, although many do take the course and surely profit. But the skid school's main function is to teach a driver—any driver—how to prevent and control an emergency slide or skid. And as I learned all too soon, even a driver who thinks he's fairly skillful hasn't any idea of what skids are all about: how they start, how to forestall them, or how to keep control.

The course is set up so it can be completed in one day. It consists of six hours of instruction—one in the classroom and five behind the wheel. Both portions are broken down further into four sections: 1) understeer and oversteer, 2) loss of control, 3) regaining control, 4) slides and slide correction.

First, the instructor—either Bruce or Frank Zimmerman, his assistant—lectures briefly on understeer and oversteer: what the terms mean technically and from the practical standpoint. Then they and their students go out onto the skid pan and experience understeer and oversteer in the school's several cars.

The School of Slide Control runs three basic makes—VW Beetle, BMW 1600 and swing-axle Corvair (1960-64). Students alternate between these makes to get the various feels. The VWs over-



CORVAIR is one car at the school. Car is set up to understeer turning right, oversteer turning left



VOLKSWAGEN oversteers and reacts very quickly. All cars run on bald tires, pavement is wetted down



BMW 1600 has basically neutral steering characteristics, but weight is added in trunk to change that

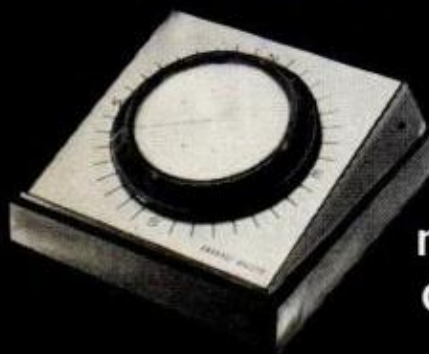
steer and react superquickly. The Corvairs are set up to oversteer when turning left and to understeer when turning right. The Corvairs react slowly and forgivingly. The BMWs have basically neutral steering characteristics, but these can be (and are) changed by adding weight to the trunk.

The school has a 180 by 240-foot skid
[\(Please turn to page 210\)](#)

BEFORE

FUZZY, SNOWY IMAGE above is all you normally get if you attempt to watch Channel 8 from New Haven, Conn., on a TV set in the New York area 40 to 60 miles away. The picture on the opposite page shows how

How to Get Those Blacked-

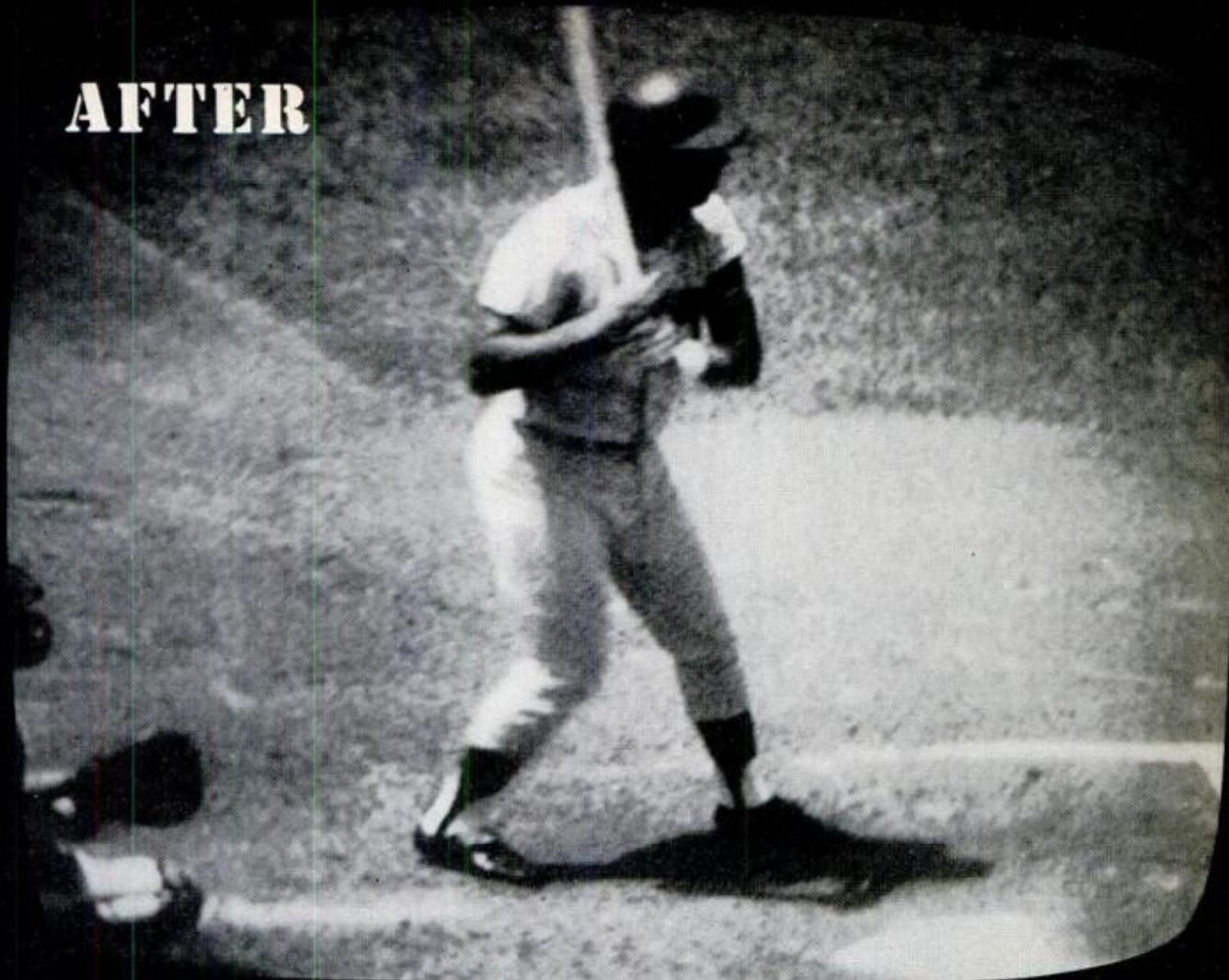


Installing a booster or rotor on your antenna can add miles of distance to your reception—often enough to get you channels never seen before. Here's what these aids can do and how to choose the best for your needs.

IF YOU LIVED near New York City and tried to get Channel 8 on your TV set, the picture would look like the one above—impossible to watch. That's because Channel 8 is broadcast from New Haven, Conn., 60 miles to the northeast and normally way out of reach for residents of New York and southern Connecticut. But add a rotor to beam the antenna in the right direction and a booster to amplify the weak signal, and almost magically the picture comes in clear and sharp—just the way you see it at the top of the opposite page in an actual test conducted by PM editors.

Such dramatic pulling in of far-off TV stations is possible in many parts of

AFTER



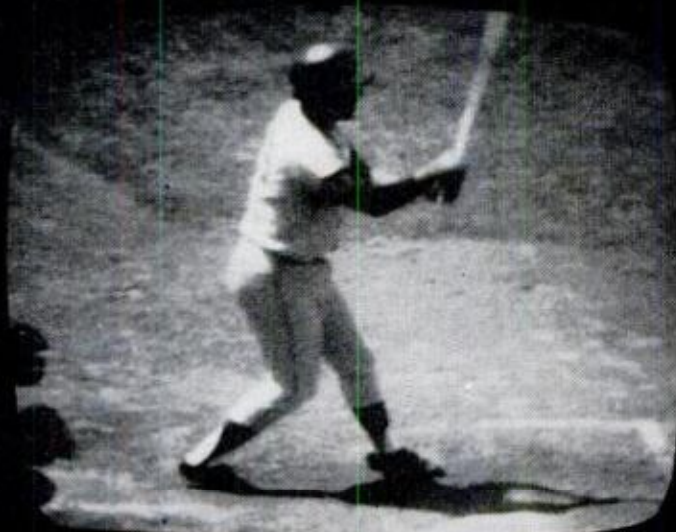
the same Mets baseball game appeared on Channel 8 after an antenna rotor and booster were installed, producing a clear image. Such aids improve local reception as well as helping to bring in distant stations

Out Games on Your TV

By LEN BUCKWALTER

Tech Art by John Lind

Photos by Robert D. Borst



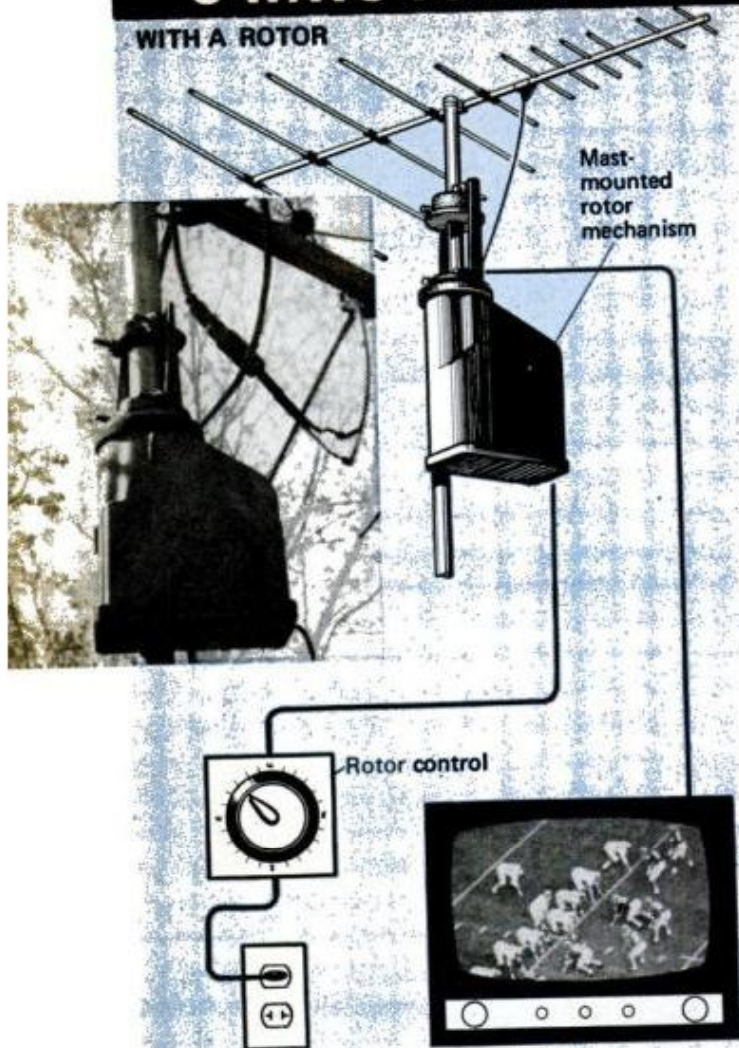
SAME METS GAME on local New York Channel 9 looked like this. Image is actually not quite as sharp as that seen on New Haven's far more distant Channel 8 with the help of an antenna rotor and booster



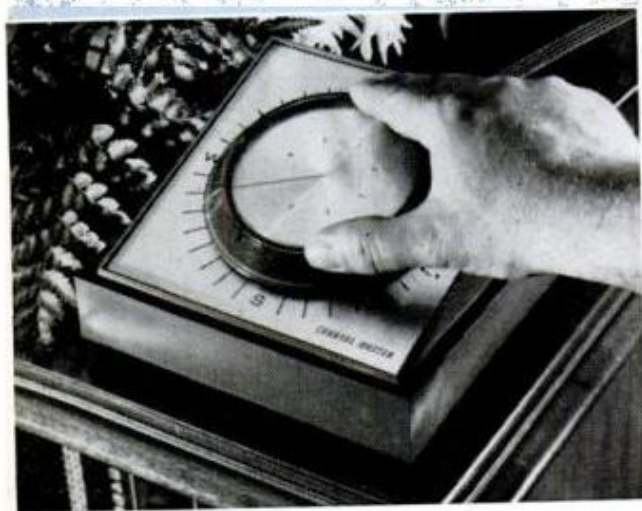
THIS IS HOW GAME APPEARED on Channel 8 with antenna properly oriented but no booster attached. A fair picture, it proves an antenna rotor often is more helpful on distant stations than a booster

3 WAYS TO IMPROVE TV RECEPTION WITH YOUR

WITH A ROTOR

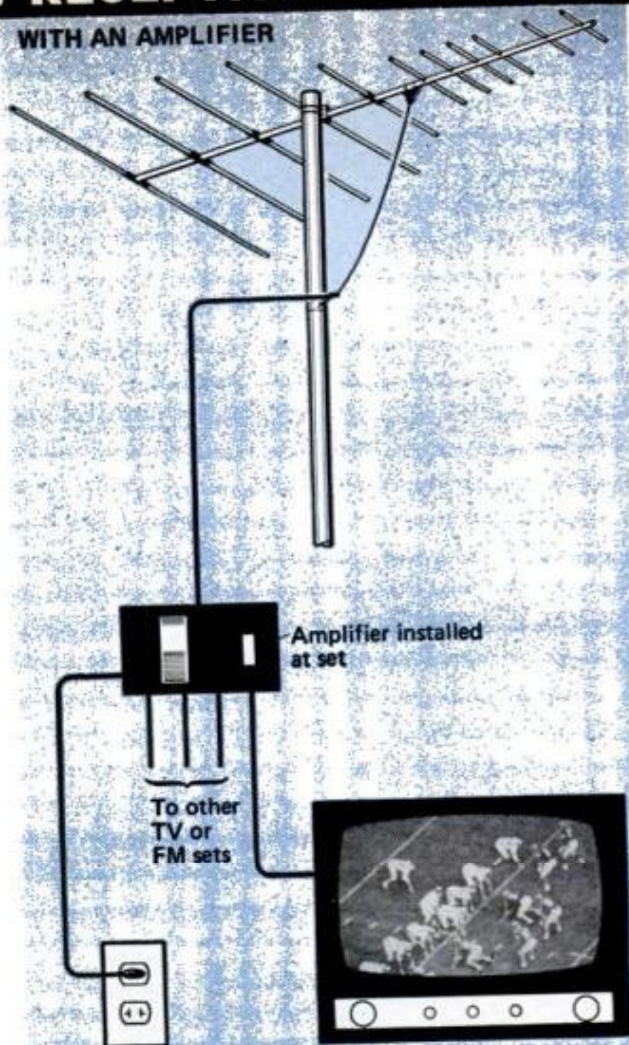


ANTENNA ROTOR is biggest single aid you can install for bringing in far-flung TV stations. Remotely controlled by knob at the set, it turns antenna for best reception in any direction. Control below is an automatic type that stops the antenna at any preset heading

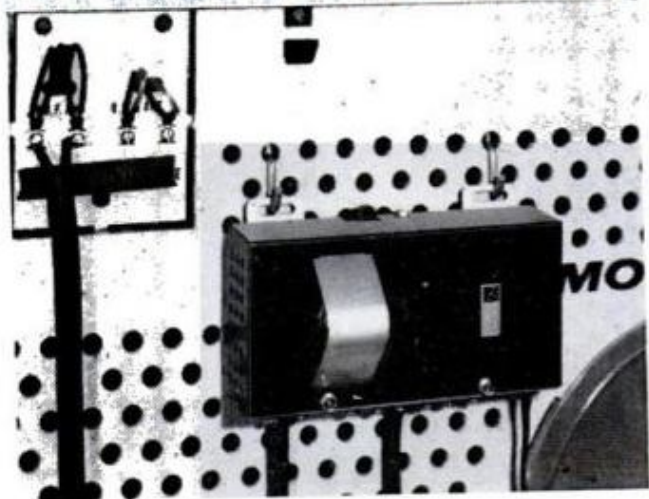


the country where a program you want to watch is not carried on your local channel, but may be seen on a network channel from a nearby city. For example, when the Jets or Giants are

WITH AN AMPLIFIER



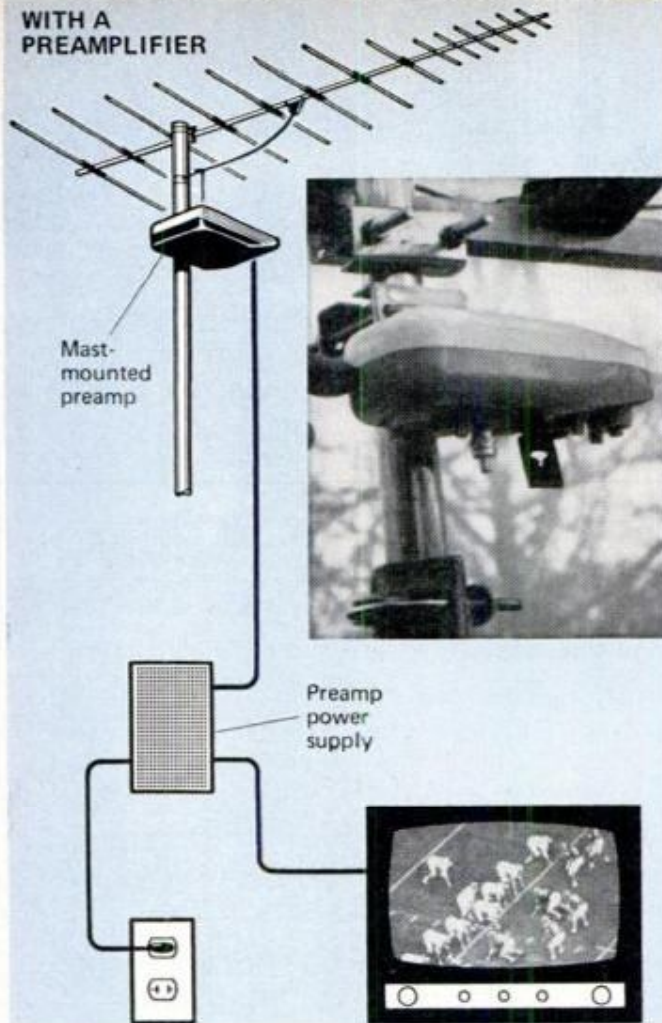
INDOOR AMPLIFIER plugs into a wall outlet and has connections for up to four TV sets. It can be mounted on back of set, as below, or in any other handy location. Antenna lead-in is wired to the input terminals and sets to be fed connect to a row of output terminals



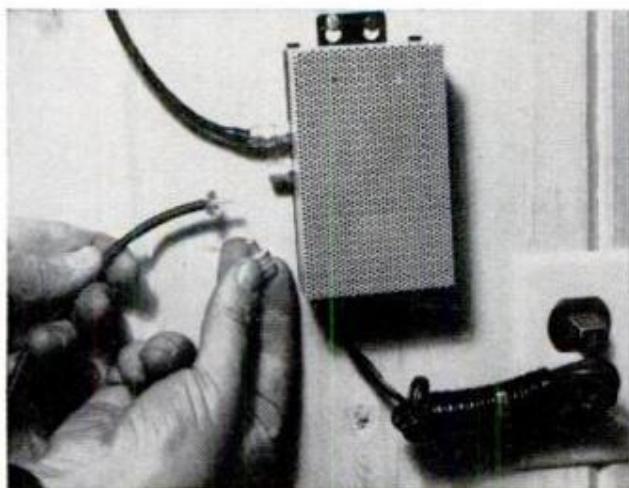
blacked out in New York, they frequently can be tuned in on Channel 8 in New Haven or Channel 3 in Hartford. Bars and motels, using high-powered signal-grabbing equipment,

EXISTING ANTENNA

WITH A
PREAMPLIFIER

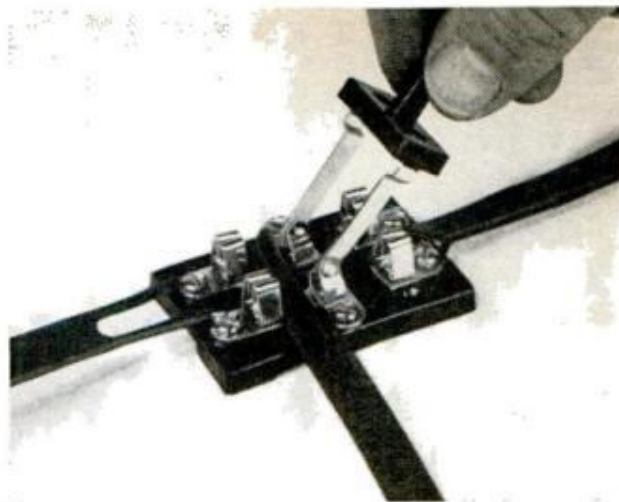


OUTDOOR AMPLIFIER, usually called a preamplifier, attaches to mast near antenna. It amplifies the signal before it enters the lead-in to offset a loss between antenna and set. Separate power supply, shown below, requires a.c. current, can be mounted near any convenient wall outlet

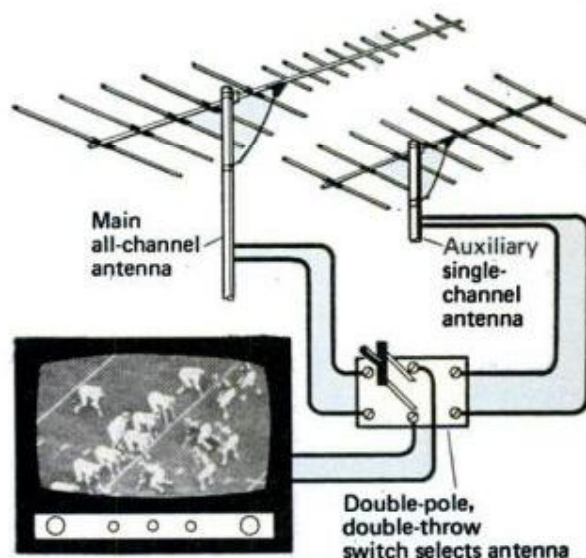


do a brisk business luring in customers to watch such games when home screens are blank. You may be able to cash in on the same opportunities by installing similar devices.

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ADDING HIGH-POWERED YAGI ANTENNA, designed to receive only one channel, may let you pull in distant TV station not otherwise obtainable. Switching arrangement shown here, using an ordinary double-pole, double-throw knife switch, allows you to select either it or your regular antenna as desired. For three or more antennas, you need rotary switch



Major sports events, like football, are usually blacked out in a 50-mile radius around the home city. If you live within 50 or 60 miles of surrounding cities, there's a good chance you can latch onto a network broadcast from a different direction. Broadcasting companies have literally hundreds of network affiliates spotted around the nation, many in relatively small cities. Viewers in the Chicago area, for instance, have as many as half a dozen possible alternate stations to watch in neighboring Milwaukee and Madison, Wis.; South Bend, Ind.; Kalamazoo, Mich., Peoria, Rockford and Champaign, Ill. Suburban Atlanta residents might tune in sur-

(Please turn to page 220)

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The Most Remarkable People

By ERIC A. WALKER, President Emeritus
The Pennsylvania State University

THIS GRADUATION CEREMONY marks the completion of an important phase of your life. It is an occasion in which all who know you can share in your sense of pride and accomplishment. But no one has more pride in your accomplishment than the older generation. But I am not going to tell that older generation how bright you are. Nor am I going to say we have made a mess of things and you—the younger ones—are the hope of mankind. I would like to reverse that process. For if you will look over into the bleachers to your left or right, I will reintroduce you to representatives of some of the most remarkable people ever to walk the earth. People you might want to thank on this graduation day. These are people you already know—your parents and grandparents. And, if you will bear with me for five minutes, I think you will agree that a remarkable people they are indeed. Let me tell you about them.

Not long ago an educator from Northwestern University by the name of Bergen Evans, a radio performer known to your parents, got together some facts about these two generations—your parents and grandparents. I'd like to share some of these facts with you.

These—your parents and grandparents—are the people who within just five decades (1919-1969) have by their work increased your life expectancy by approximately 50 percent—who while cutting the working day by a third, have more than doubled per capita output.

These are the people who have given you a healthier world than they found. And because of this you no longer have to fear epidemics of flu, typhus, diphtheria, smallpox, scarlet fever, measles or mumps that they knew in their youth. And the dreaded polio is no longer a medical factor, while TB is almost unheard of.

Let me remind you that these remarkable people lived through history's greatest depression. Many of these people know what it is to be poor, what it is to be hungry and cold. And because of this, they determined that it would not happen to you, that you would have a better life, you would have food to eat, milk to drink, vitamins to nourish you, a warm home, better schools and greater opportunities to succeed than they had.

Because they gave you the best, you are the tallest, healthiest, brightest, and probably best-looking generation to inhabit the land.

And because they were materialistic, you will work fewer hours, learn more, have more leisure time, travel to more distant places, and have more of a chance to follow your life's ambition.

These are also the people who fought man's grisliest war. They are the people who defeated the tyranny of Hitler, and who when it was all over, had the compassion to spend billions of dollars to help their former

enemies rebuild their homelands. And these are the people who had the sense to begin the United Nations.

It was representatives of these two generations who, through the highest court of the land, fought racial discrimination at every turn to begin a new era in civil rights.

They built thousands of high schools, trained and hired tens of thousands of better teachers, and at the same time made higher education a very real possibility for millions of youngsters—where once it was only the dream of a wealthy few.

And they made a start—although a late one—in healing the scars of the earth and in fighting pollution and the destruction of our natural environment. They set into motion new laws giving conservation new meaning, and setting aside land for you and your children to enjoy for generations to come.

They also hold the dubious record for paying taxes—although you will probably exceed them in this.

While they have done all these things, they have had some failures. They have not yet found an alternative for war, nor for racial hatred. Perhaps you, the members of this graduating class, will perfect the social mechanisms by which all men may follow their ambitions without the threat of force—so that the earth will no longer need police to enforce the laws, nor armies to prevent some men from trespassing against others. But they—those generations—made more progress by the sweat of their brows than in any previous era, and don't you forget it. And, if your generation can make as much progress in as many areas as these two generations have, you should be able to solve a good many of the world's remaining ills.

It is my hope, and I know the hope of these two generations, that you find the answers to many of these problems that plague mankind.

But it won't be easy. And you won't do it by negative thoughts, nor by tearing down or belittling. You may and can do it by hard work, humility, hope, and faith in mankind. Try it.

We took out a perfectly good PM article so we could run these words by Dr. Eric A. Walker, who retired this past summer as president of Penn State. We're printing them because they make sense and needed to be said. May we add the generation he was talking about also harnessed the atom and achieved Man's first journey to the moon.



Editor

How to Get Close To the Dam Fish

If you're not allowed near the turbines or if the fish lie beyond your normal casting range, try this technique for 'motor casting' to the big ones.

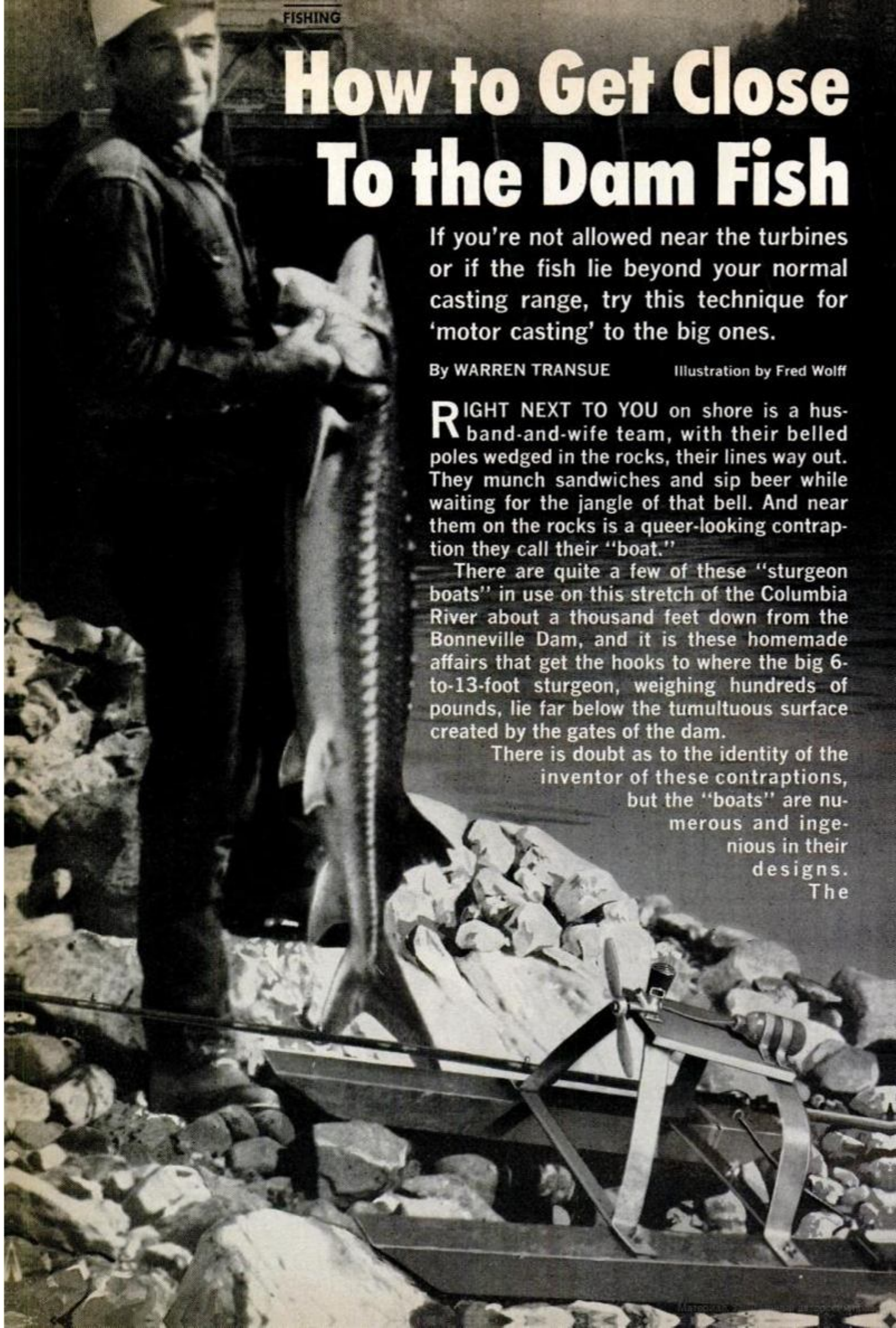
By WARREN TRANSUE

Illustration by Fred Wolff

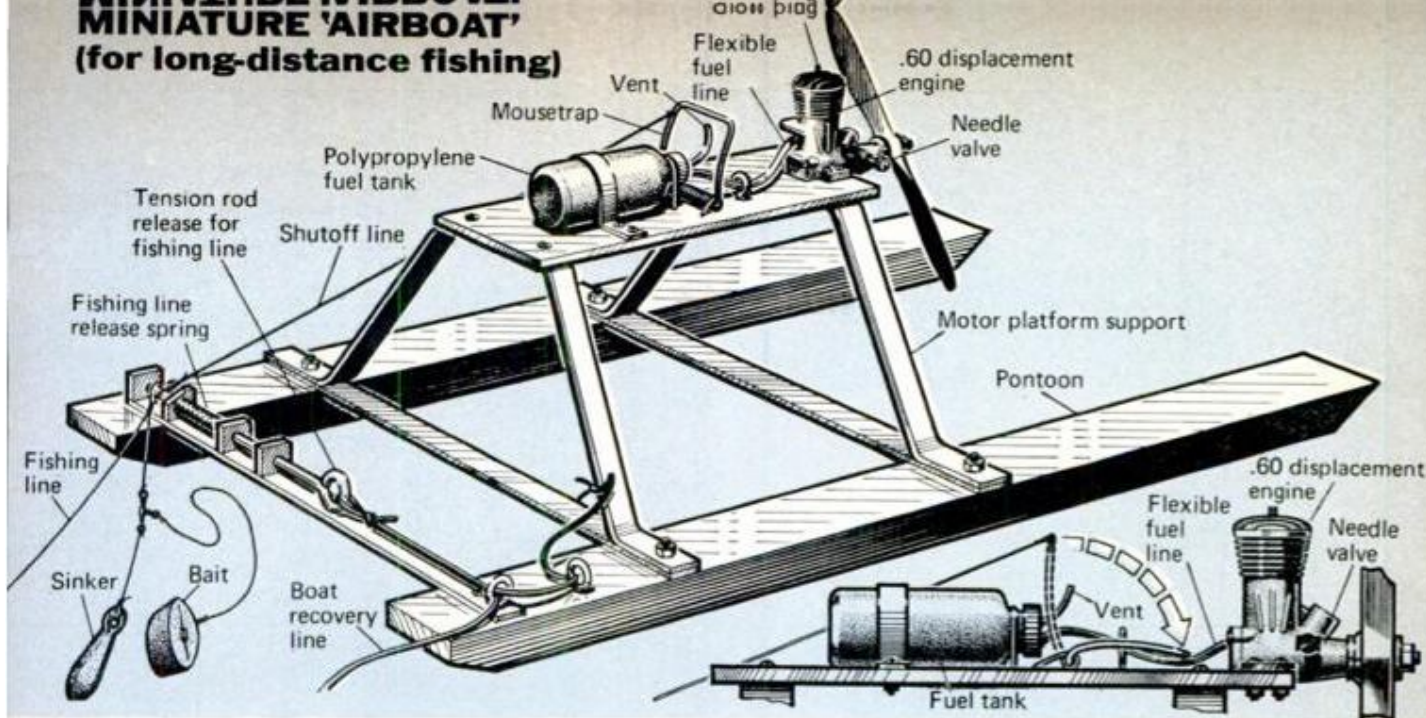
RIGHT NEXT TO YOU on shore is a husband-and-wife team, with their belled poles wedged in the rocks, their lines way out. They munch sandwiches and sip beer while waiting for the jangle of that bell. And near them on the rocks is a queer-looking contraption they call their "boat."

There are quite a few of these "sturgeon boats" in use on this stretch of the Columbia River about a thousand feet down from the Bonneville Dam, and it is these homemade affairs that get the hooks to where the big 6- to-13-foot sturgeon, weighing hundreds of pounds, lie far below the tumultuous surface created by the gates of the dam.

There is doubt as to the identity of the inventor of these contraptions, but the "boats" are numerous and ingenious in their designs. The



MINIATURE 'AIRBOAT' (for long-distance fishing)



structure comprises two homemade pontoons, each 3 to 4 feet long, made of waterproofed balsa (about 3 by 6 inches) or of galvanized metal cut to size, soldered, waterproofed and painted.

Metal brackets are center-mounted on these pontoons; they are about a foot in height and support a platform that measures from 12 to 18 inches square. On this platform is mounted a propeller-type model airplane motor—usually in the .60-cu.-in.-displacement range (approximately equivalent to 1½ hp)—with connecting polypropylene gas tank for the special nitromethane fuel necessary for optimum engine performance. “Boats” are varied in main components, but most use a mousetrap for the shutoff switch, and the shutoff operates simultaneously with a hook-and-sinker drop-off.

Confusing? Not really. But the question arises: How are the two main operations performed—the engine cutoff with simultaneous drop-off, and the return of the boat to shore?

Well, there is always one line attached securely from a pole and reel to the “boat,” sometimes two poles, with each pole needing an operator to wind in once the hook is released and the power off. This main line is attached to a release spring which, when given a strong jerk from shore, drops the hook and line, at the same time releasing a



TWO FISHING LINES can be hooked up to the little airboat and taken out to midstream or up to the foot of the dam. Once the boat's on target, a sharp jerk on connecting line shuts off fuel supply to model-airplane motor and drops lines to bottom. Boat is then reeled in, clear of fishing area. Below: A wife waits for a launch signal from her husband





CATAMARAN DESIGN enables boat to ride well over rough water, carry considerable weight behind motor



BELLS are attached to the fishing rods to signal bites for busy anglers tending many rods at once



cocked mousetrap spring that snaps onto the flexible fuel line, "squeezes" the supply, and kills the motor.

Then the boat is reeled in. Once ashore, the "wait is on"; after the poles are wedged securely between rocks or in pipes set for the purpose, a little bell is hung near the top of the bent pole to set up a fuss in case of a strike.

Quite often, even with a higher powered motor, if too many gates of the dam are open the little boats are swamped. Then they have to be reeled in, dried out, and subjected to a severe workout in order to get the wet motor started again. Occasionally a boat is lost in the turbulent water, but skilled operators have virtually overcome this problem. There is unanimous agreement among owners that the boats are highly effective and were a real inspiration on the part of their originator for reaching these gigantic fish.

Sturgeon are among those rare creatures whose species have undergone very little change over millions of years. Because of their size they are opponents to be reckoned with, and here is a word of caution about fishing for them at Bonneville: Fishing is forbidden within 300 yards of the dam, and there is a guard on duty. Any sturgeon between three and six feet long can be considered a legal catch, whereas one under 36 inches must be returned to the water to grow to maturity, and one over six feet has reached egg-production age and must also be returned.

Anyone wishing to see these prehistoric monster fish can view them in a special display tank at the hatchery on the Oregon side of Bonneville Dam. But leave your "boat" home. ★ ★ ★

TOO BIG TO KEEP! G. A. Dorsey examines his catch briefly before returning it to the Columbia River in compliance with regulations designed to preserve the sturgeon population. Fishermen can keep fish measuring between 3 and 6 feet in length. His catch was 7 feet 3 inches long and 50 inches in girth



Warm-air helmet

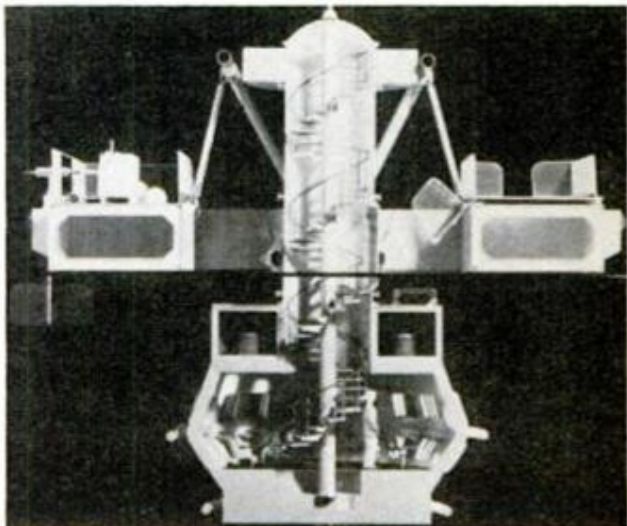
Claiming that man is risking more than 60 different illnesses by breathing in cold winter air, Dr. Jean-Philippe Crouzet of Paris has invented a transparent warm-air helmet that prevents all that. One model (above, left) is warmed by body heat. Another employs a heating lamp and fan. Tiny perforations let out used air and allow fresh air in.



Hands-free telephone

Only a dial and buttons protrude from the stainless-steel front of this new hands-free telephone being tested by the N.Y. Telephone Co. Sending and receiving equipment is concealed behind a metal plate. The phone is designed to be nearly vandal-proof.

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Underwater stairway

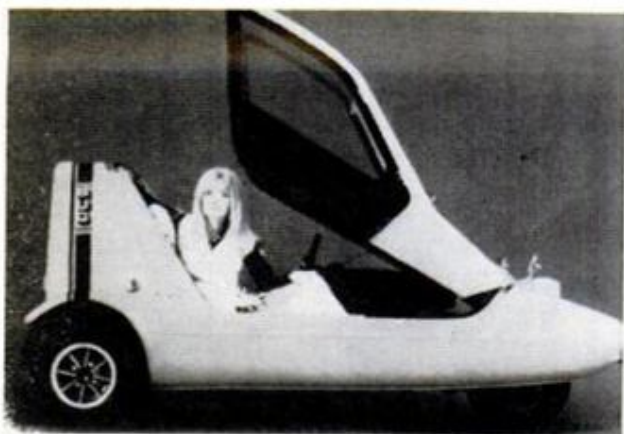
A Japanese underwater observation station (shown here in model form) will have a stairway that enables observers to descend to the underwater viewing room. An engine will move the platform from place to place.

109



On the level, anywhere

Steel arms can extend the six wheels of a new off-road vehicle to match the unevenness of rough terrain. The 11-foot-long, 20-mph machine is built by James M. Bird Co., Tulsa.



Three-wheeled Bug

An upward-opening canopy, fiberglass body and 73 mpg fuel-consumption rate are features of the 70-mph "Bond Bug," recently introduced by the Reliant Motor Group.

NASA to test space shuttle

Artist's conception (right) shows how NASA plans to air-launch a manned model of a space shuttle craft for tests.



Leverage for gardeners

An "automatic spade" now sold in England works on the principle of a lever. Pulling back the handle lifts the blade and earth.



Soviet launching pad

The main service towers are still horizontal while the crew's entry tower is upright in this photo of the Russians' Soyuz-9 launch pad in the Baikonor rocket center.





Smashing job

"It was a bit heartbreaking at first, but now it's just a day's work," says the chief smasher at the Wedgwood pottery works. His sole job is to break pieces of china and pottery that don't meet the firm's standards so they won't be sold.



Plane-looking car

A three-wheeled car developed by Highway Aircraft Corp. cruises at 70 mph, can reach 110 to 120 mph. Cruising, it gets 40 mpg.



Coal-burning steam car

The engine from a steamboat now powers Briton John Harding's coal-burning car. His mileage? Forty miles to the hundredweight!

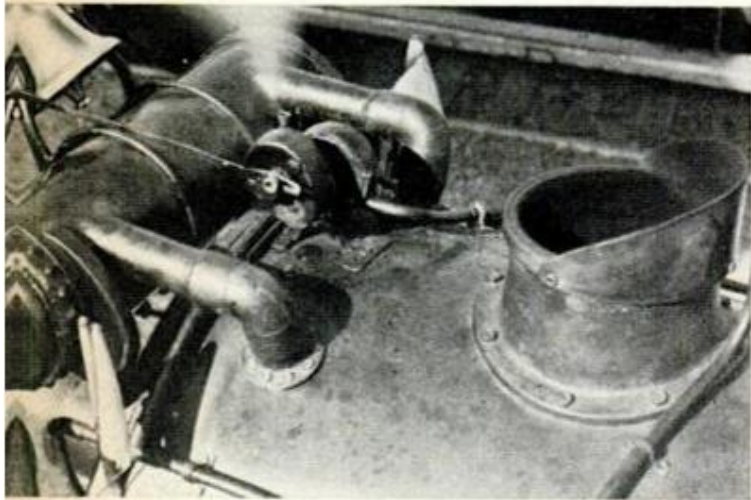
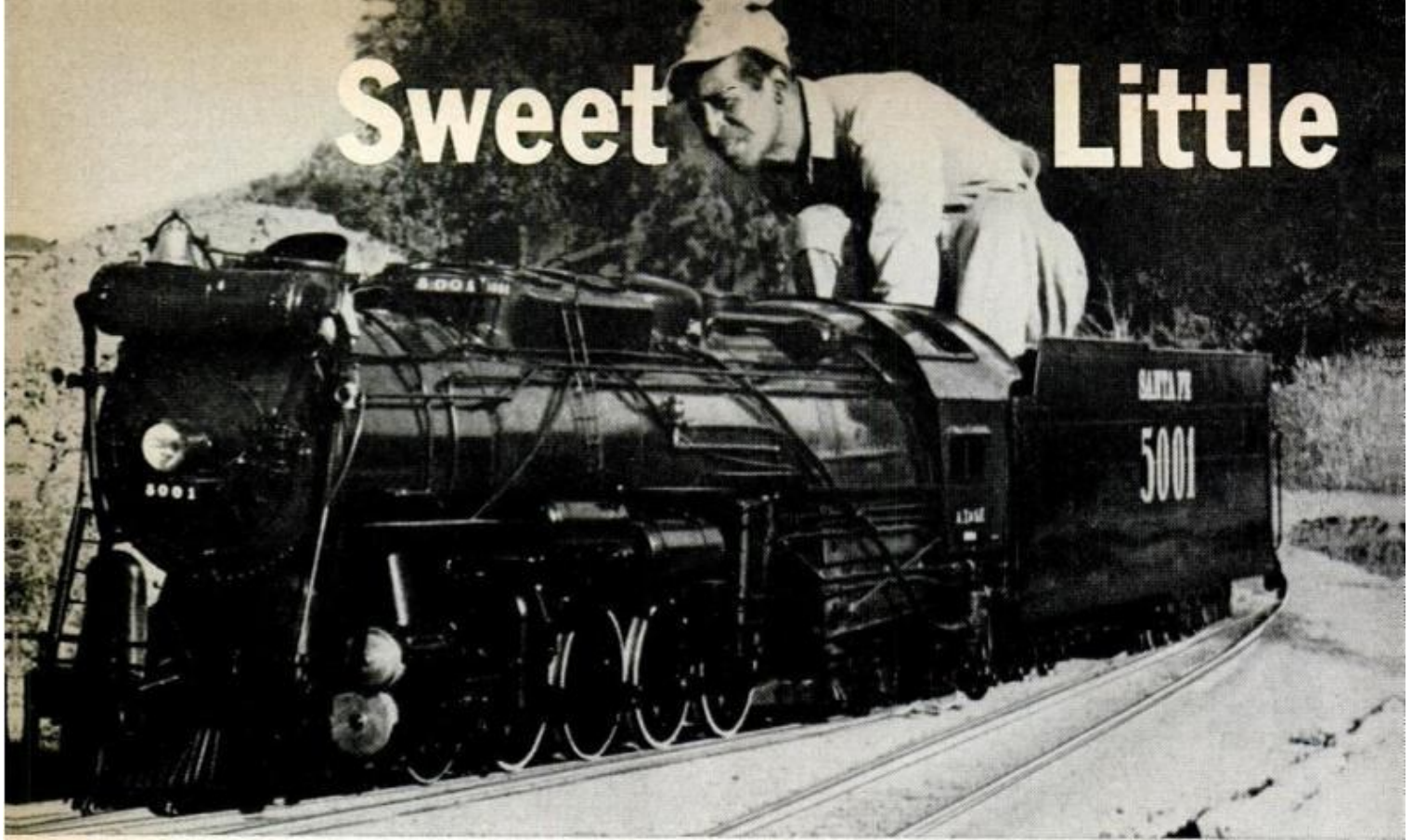


Unlawful assembly

Using actual photographs of various facial features, inventor Jacques Penry shows how he assembles a composite face with his new Photo-Fit criminal-identification system. Choices include 169 foreheads, 81 pairs of eyes, 70 noses, 86 mouths and 64 chins.



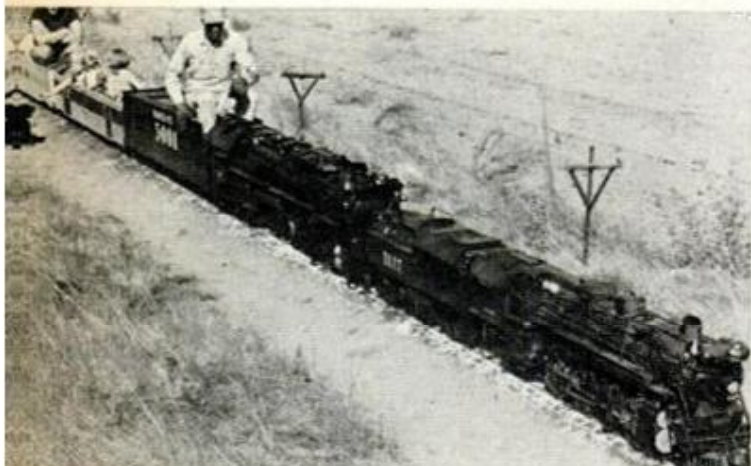
Sweet Little



TINY TURBINE, using steam for power, drives a warning bell when Mann's locomotive is in operation



FROM ENGINEER'S SEAT aboard tender, Mann can see this array of tiny pressure and steam gauges



DOUBLE HEADING, Mann uses both locomotives to pull extra long trainload of youngsters and adults



ROLLING PAST original locomotive parked on siding, Mann high-balls 5001 and "Spike" rides the tender

POPULAR MECHANICS

Santa Fe

By FRANK TAYLOR

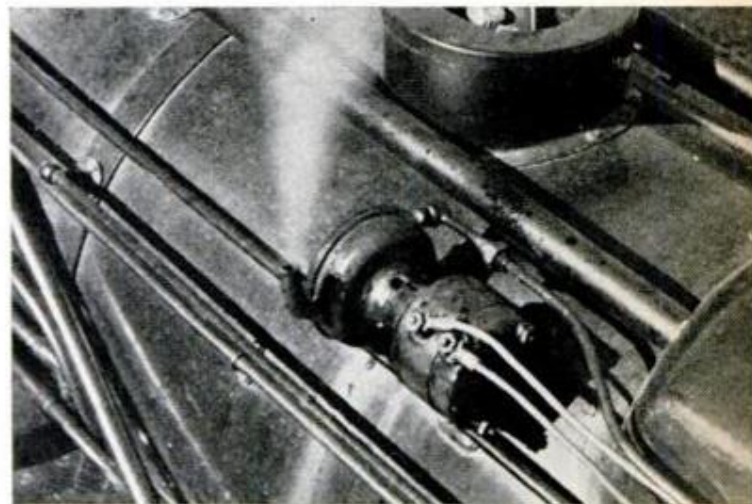
A RETIRED AEROSPACE ENGINEER who believes that "a half-done job is no job at all," Frank Mann completed a $\frac{1}{25}$ -scale locomotive in 27 weeks from plans he drew. He made all parts on his lathe, made most of the switches and laid all the track in his back yard in Pacoima, Calif. He prizes a switch given him by the late Walt Disney, a fellow member of the Los Angeles Live Steamer Club. A former fighter pilot, Mann now plans to build a four-place, prop-driven delta-wing plane.



WATER TANK, like everything on the road, is built to scale. Tender holds 40 gallons of water



SAND BINS are duplicates of the real thing. Sand is dropped in front of drive wheels when starting



ELECTRIC GENERATOR, driven by steam turbine, supplies electricity for train's running lights, cars



TURNTABLE is working model of the real thing and switches the heavy locomotives from track to track



REPAIR WORK is done in garage shop where Mann made all parts on lathe from new and scrap stock



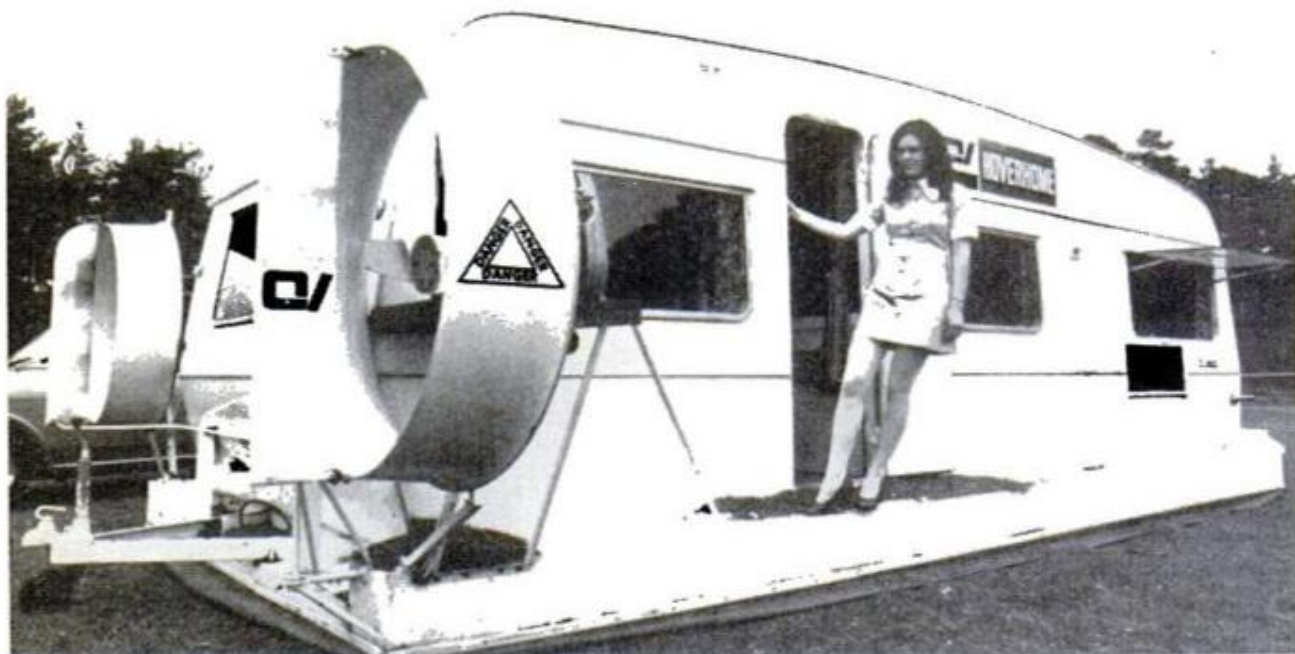
'Ray gun' at checkout counter

A Los Angeles supermarket employs a Buck Rogers kind of "ray gun" at the checkout counter to read the price stamped on an item, ring it up on the cash register—and also keep a constant inventory of merchandise.



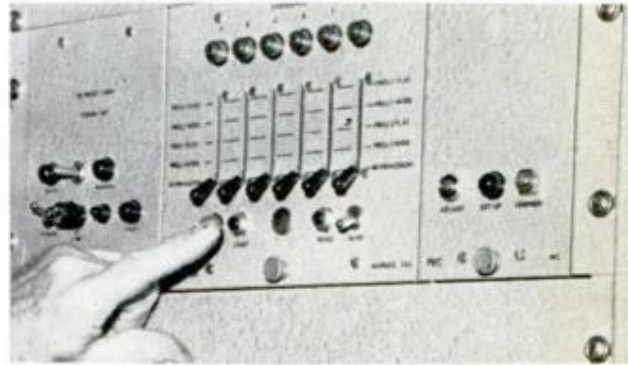
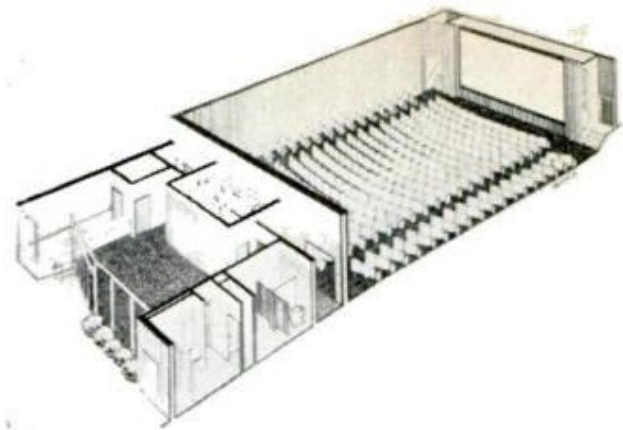
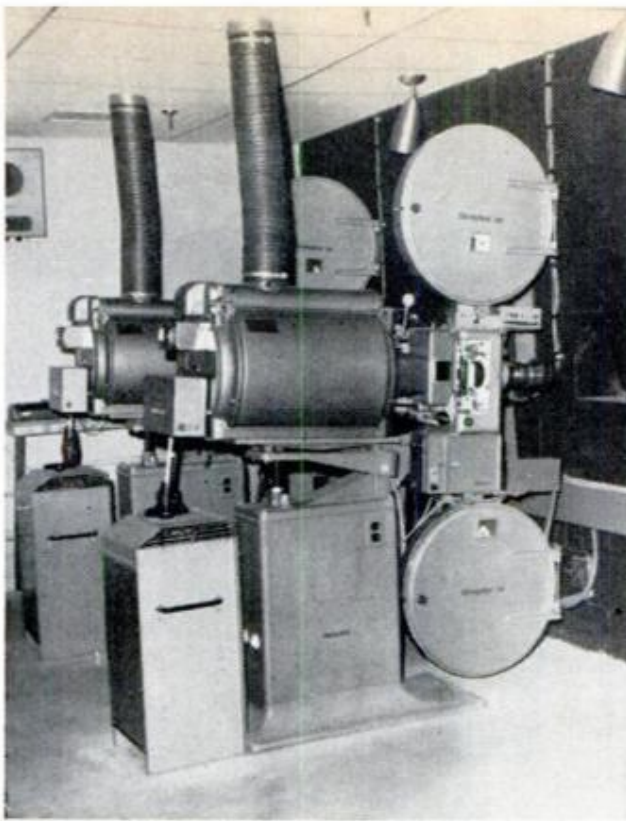
Moon cycle

Trying out a minibike to see if a space-suited astronaut can operate a two-wheeler on the moon, a crewman at the Manned Spacecraft Center rides under one-sixth-gravity conditions aboard a KC-135 aircraft.



Air-cushion travel trailer

Adapting a vacationer's travel trailer to a hovercraft "chassis," a British manufacturer has come up with the Hoverhome. The amphibious vehicle provides a home or field office—complete with kitchen and beds—for five adults. There's a separate control room (left) for operator. Maker is Caravans International Ltd., Saffron Walden, Essex, England.



New mini-theaters are operated by pushbutton

The projection room of a new type movie theater remains as empty of people as the one shown above (left), even when the house lights dim, the background music stops, the curtain opens and a movie appears on the screen. The secret is an electronic control system that enables the theater owner to program up to two complete movies—including intermission—with preset position switches (lower right-hand photo) and simply push a button to get the show going. Typical of the new automated "Jerry Lewis Cinema" mini-theaters is that shown in the drawing (upper right). These mini-theaters, with seating capacities that range from 200 to 350 persons, are now under construction in Maine, Connecticut, New Jersey, Florida, New York, Indiana, California, Pennsylvania and Louisiana. They're designed to be operated by two persons—and that includes the popcorn stand!



Great Britain returns home

Rusty and barnacled after lying 33 years off the Falkland Islands, the SS *Great Britain* has been brought back to England. The 127-year-old ship, which will be restored, is the first large ship built of iron and first ocean-going vessel to be propeller-driven.

NOVEMBER 1970



A bell-ringer is too big

When a main London thoroughfare was shut down for repairs, traffic was diverted through a low underpass. Fearing trucks might get stuck in the tunnel, engineers rigged a row of bells at each entrance. If a truck rings a bell, it's too high to get through.

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Defusing Canada's Sunken Time Bomb

By JOHN F. PEARSON and JOSEPH ALBINO

THOUGH THE VOYAGE from Venezuela to Canada had been uneventful, there was cause for concern aboard the *Arrow* as she entered Nova Scotia's Chedabucto Bay on the morning of Feb. 4, 1970.

For one thing, a dangerous shoal called Cerberus Rock lay ahead. For another, several of the *Arrow's* main navigational aids were out of whack. The radar wasn't functioning properly, the echo sounder was disabled, and the gyro compass had a 3° error.

The 530-foot, 11,379-ton tanker rode low in the water, burdened with a cargo of 108,224 barrels of fuel oil for delivery at Port Hawkesbury. To get there, the ship had to sail across the broad bay and into the Strait of Canso.

Chedabucto Bay lies 150 miles north of Halifax, Nova Scotia's main port. Though it remains open all winter, the bay is no picnic for mariners when the temperature drops. Storms with gale-force winds are not uncommon.

The *Arrow* was lucky. There was no

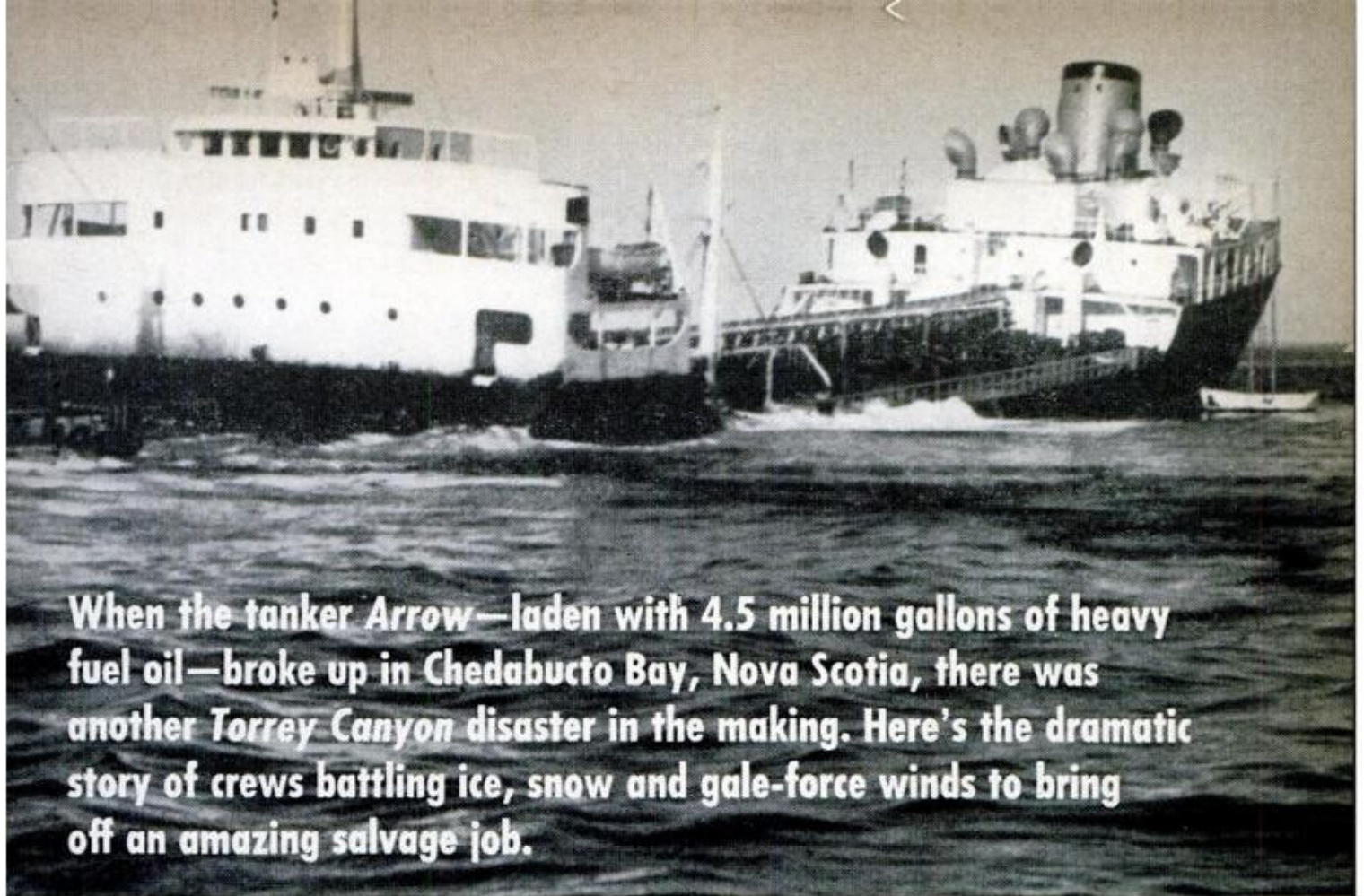
storm on Feb. 4. But the sky was overcast and there were patches of mist. The sea was running northerly and the wind was strong enough to chop the tops of six-foot waves.

The captain, the third mate, the helmsman and an able seaman were on the bridge, all keeping their eyes peeled for the Cerberus Rock buoy.

Shortly after 9:00 a.m. the captain ordered a reduction in speed. At full speed, the ship's screw made 95 revolu-

ICE FORMS ON MASK of Royal Canadian Navy diver as he surfaces. Weather plagued men and machinery





When the tanker *Arrow*—laden with 4.5 million gallons of heavy fuel oil—broke up in Chedabucto Bay, Nova Scotia, there was another *Torrey Canyon* disaster in the making. Here's the dramatic story of crews battling ice, snow and gale-force winds to bring off an amazing salvage job.

tions a minute. The skipper wanted 80.

At 9:25 he ordered speed cut again—to 60 revs.

Soon after that order was given—and while the men on the bridge still strained to spot the buoy—the *Arrow* ramméd Cerberus Rock.

The ship shuddered and groaned as her bow rode up on the shoal and came to rest. The force of the crash was so great that the vessel cracked amidships. The sailing days of the *Arrow* had come to an abrupt end—a fate that, following an investigation, would be attributed to the skipper's negligence. A government commission would accuse him of improper navigation “in failing to maintain his plotted course into Chedabucto Bay and in failing to check his ship's position in relation to that plotted course for over an hour while proceeding at virtually full speed through waters unfamiliar to him.”

The waters of Chedabucto Bay may have been unfamiliar to the *Arrow*'s Greek skipper before the accident; after it, they looked most unfamiliar to local fishermen and shore residents.

The bay was streaked with oil slicks three and four miles long, marred by dark patches in tidal pools. Molasses-thick gunk turned beaches black.

Shortly after the accident, it was evident that the 108,224 barrels (over 4.5 million U.S. gallons) of Bunker C oil the *Arrow* had carried could deal a crippling blow to Chedabucto Bay's fishing industry, create environmental problems for villages and foul beaches so that sports fishermen and tourists would shun the area for years to come. Nova Scotians remembered what the breakup of the *Torrey Canyon* had done to the English coast in 1967.

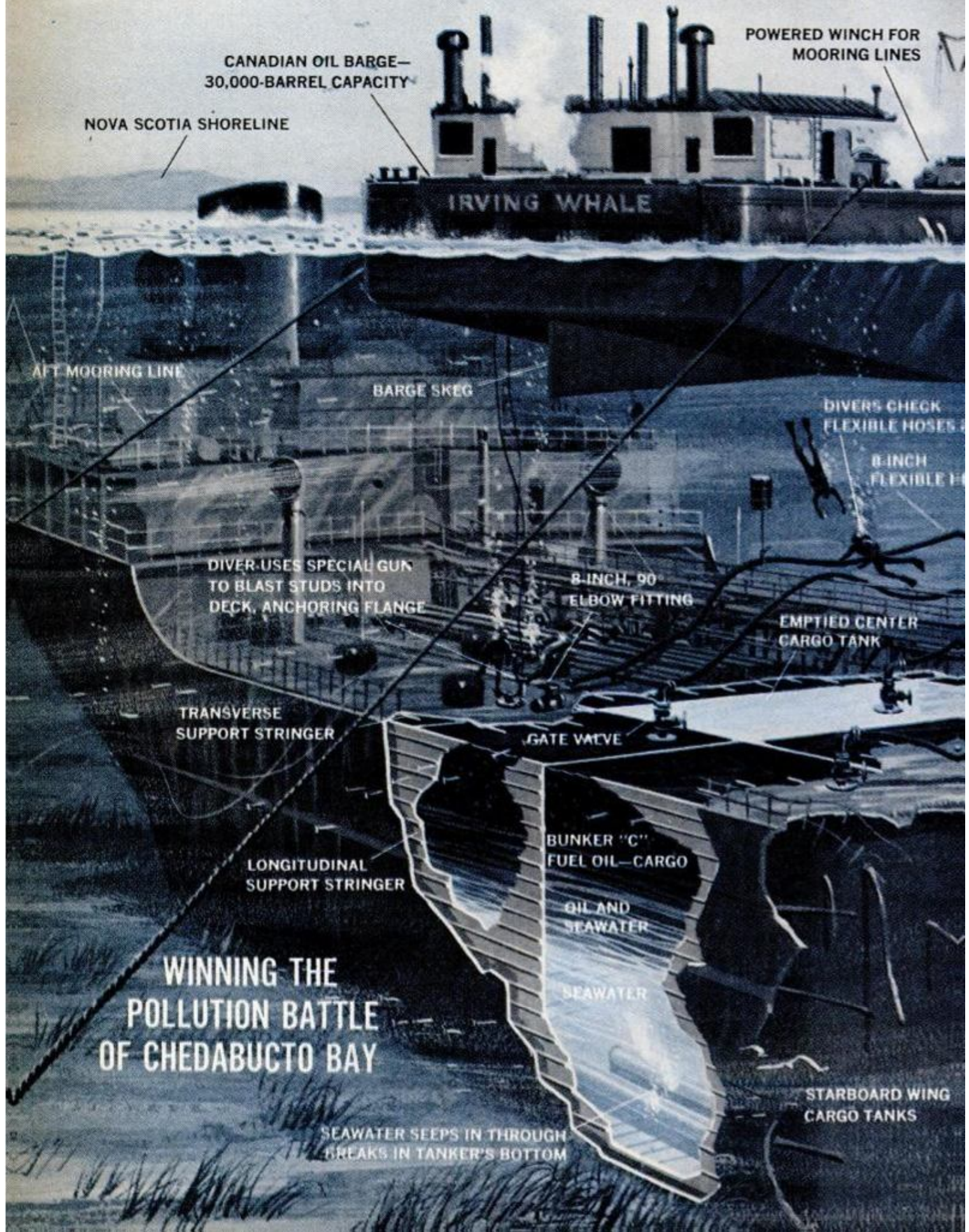
As it was later learned, some 65,000 barrels of oil had leaked from the ship, mostly during the first few days after the grounding. Most of it came from the severely damaged bow section.

The ship was still grounded on the rock and in one piece on Sunday, Feb. 8, when tugs attempted to pull her free. The strain proved too great. The *Arrow*'s longitudinal bulkheads gave way and she split in two. The bow belched

(Text continues on page 120)

IT TRULY WAS A BATTLE. For over two months, salvage crews worked under incredibly severe conditions. They worked in subfreezing temperatures, in sleet, snow, ice storms and mists. High winds

hampered them, gales and rough seas drove them ashore. Royal Canadian Navy divers had to endure the bone-chilling effects of 29° F. water. But finally the job—a "first" in oil-salvage operations—got

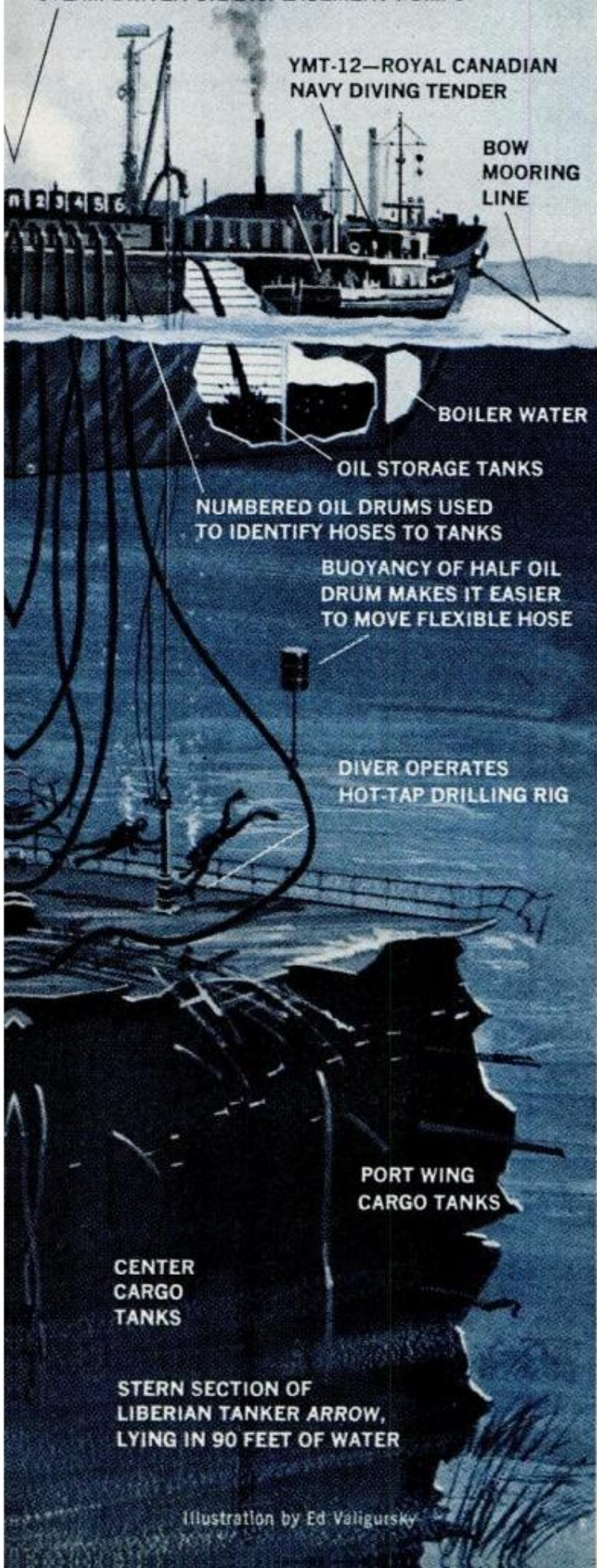


WINNING THE POLLUTION BATTLE OF CHEDABUCTO BAY

SEAWATER SEEPS IN THROUGH BREAKS IN TANKER'S BOTTOM

done. Over 36,000 barrels of heavy fuel oil was recovered from the *Arrow's* stern section, saving the Chedabucto Bay area from further pollution, fouled beaches and possible fish kills.

STEAM-DRIVEN OIL DISPLACEMENT PUMPS



YMT-12—ROYAL CANADIAN NAVY DIVING TENDER

BOW MOORING LINE

BOILER WATER

OIL STORAGE TANKS

NUMBERED OIL DRUMS USED TO IDENTIFY HOSES TO TANKS

BUOYANCY OF HALF OIL DRUM MAKES IT EASIER TO MOVE FLEXIBLE HOSE

DIVER OPERATES HOT-TAP DRILLING RIG

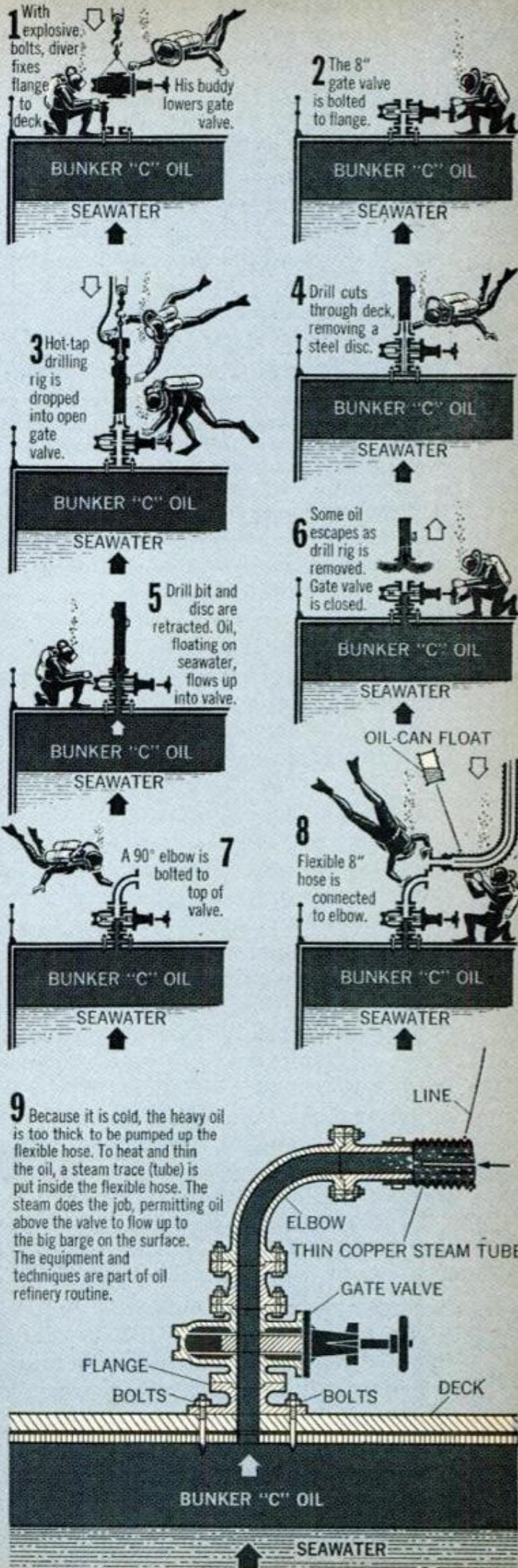
PORT WING CARGO TANKS

CENTER CARGO TANKS

STERN SECTION OF LIBERIAN TANKER ARROW, LYING IN 90 FEET OF WATER

Illustration by Ed Valigursky

Down on the Arrow's Back



oil and settled in relatively shallow water. The stern section sank in an upright position in about 90 feet. Later, divers reported that the stern, which still contained an estimated 40,000 barrels, had suffered little damage and was resting on a firm gravel bottom.

Imperial Oil, Ltd., the Canadian company that owned the cargo, had gone on an oil-spill alert soon after the accident. (Though Imperial owned the oil, the ship was operated by a firm owned by Aristotle Onassis and registered under

Thousands of tankers sunk during World War II are a threat to the oceans, say experts. They're starting to break up, causing phantom oil slicks, as reported in *Sunken Time Bombs Full of Oil* (Nov. '67 PM).

the Liberian flag.) But when the enormity of the problem became apparent, the Canadian government created a task force to spearhead the cleanup.

Dr. P. D. McTaggart-Cowan, executive director of the Science Council of Canada, was named task force chief. A headquarters was set up in a motel.

Dr. McTaggart-Cowan and his assistants—Capt. Mike Martin of the Canadian Navy and Dr. Harry Sheffer, vice chairman of the Defense Research Board of Canada—recruited help from many quarters. Canadian soldiers and sailors, oil company workers, fishermen and scientists were soon doing their bit in the battle of Chedabucto Bay.

Various types of booms—plastic, wood and metal—were used in attempts to contain oil slicks. Tons of straw and peat moss were dumped on beaches to sop up oil. And various types of mechanical devices were tested for scooping up oil in shallow waters.

Dr. McTaggart-Cowan ruled out the use of dispersants and detergents because he believed they would do more harm to marine life than would the oil.

The task force leaders had to "feel" their way as they went along because the problems they faced were unique. Unlike oil spills off Florida, California, England and France, this was the first to occur in an area where conditions

resembled those of the Arctic. Sub-freezing weather, for example, thickened the oil to a paste, making it impossible to pump by the usual methods.

While the cleanup continued, slowly and laboriously, the task force tried to figure out what to do with the sunken stern. The danger was that it would break up in a storm and foul the bay with another 40,000 barrels of oil. The stern was a sunken time bomb that had to be defused. But how?

The answer finally was provided by Capt. Sven A. Madsen a senior marine advisor with Esso International, New York City, who was appointed salvage master by the task force leaders after he had produced a plan of attack. At 53 Madsen had held a master's ticket for 25 years and had some 15 salvage jobs under his belt.

He proposed that the tanks in the stern be tapped through the deck by using a method common in oil refineries, but never before, so far as was known, used underwater. After certain refinements were incorporated and trial runs made, the system was tested in early March. It worked perfectly.

As illustrated on pages 118 and 119, divers attached flanges and gate valves to the deck over each tank to be tapped, drilled through the open valves and cut holes in the deck. Flexible hoses, connected to pumps on a surface barge, were then hooked to the valves. The sludgy oil was heated and thinned by forcing steam down to it through copper tubing inside the flexible hose. And then the oil could be pumped.

Storms plagued the operation. "Though we worked 24 hours a day, seven days a week, we were lucky to get one good day out of three," says Capt. Madsen.

But they completed the pumping by April 11 recovering 36,924 barrels of oil and oil-water emulsion. The stern section no longer was a pollution threat.

And though there still was work to be done, thanks to the efforts of the task force, the battle of Chedabucto Bay was on the way to being won. ★★★

Questions About the Oceans

Ever wonder where the greatest depth is found, how high the tallest wave is, or where the Gulf Stream comes from?

THE MOST POPULAR EXHIBIT at the 17th International Science Fair in Dallas was a Teletype machine. It owed its success to the fact that it was hooked up with the National Oceanographic Data Center in Washington, D.C., and that students and teachers were free to use it to ask any oceanographic questions that occurred to them.

Those questions and answers given by the NODC data bank later became the basis for a book, *Questions About the Oceans*, published by the U.S. Naval Oceanographic Office and available from the Government Printing Office at 55 cents a copy. Material in this article was adapted from that book.

What is the ocean's greatest depth? Where is it?

According to latest records, the greatest depth of 37,782 feet was discovered in 1962 by the British survey ship *Cook* in the Mindanao Trench near the Philippines. This spot is now known as the Cook Deep. As long ago as 1927, depths in excess of 35,000 feet were reported in this area.

What is the pressure at the deepest part of the ocean?

Close to 14,000 pounds per square inch, almost 1000 times atmospheric pressure on the Earth's surface, is found in the deepest parts of the ocean. Even at 3000 feet there is a pressure of 8100 pounds, sufficient to squeeze a block of wood to half its volume.

How high is the highest wave?

An American tanker, the *USS Ramapo*, spotted the highest wave that has been measured with any degree of certainty. In 1933, while steaming from Manila to San Diego, she reported a wave 112 feet high. It was produced by winds of 60-68 knots operating over a sweep of several thousand miles.

Most ocean waves are less than 12 feet high. Waves more than 25 feet are rare and those exceed-

HIGHEST WAVE ever measured—112 feet—was reported by an American oil tanker crossing the Pacific



ing 50 feet develop only during very severe storms.

What causes tides?

Gravitational forces of the moon, the sun and other celestial bodies. The moon, being nearest, has the greatest effect. The sun exerts a pull less than half that of the moon.

High tides are generated on the sides of the Earth nearest to and farthest from the moon. At times of new moon and full moon, the sun's attraction reinforces that of the moon, producing higher (spring) tides. Halfway between new and full moon, solar attraction does not coincide with lunar attraction and therefore the difference between high and low tides is less. These lesser tides are called neap tides.

How deep has a skin diver gone?

The greatest depth for a diver without a pressure suit was reached in December, 1962, when Hannes Keller, a Swiss mathematician, and Peter Small, a British journalist, went down to 1000 feet in an open diving bell off Catalina Island. At that depth, Keller swam outside for three minutes. He breathed a secret mixture of gases, based on his own computations of what the human system requires. Unfortunately, Small and another diver died during this attempt.

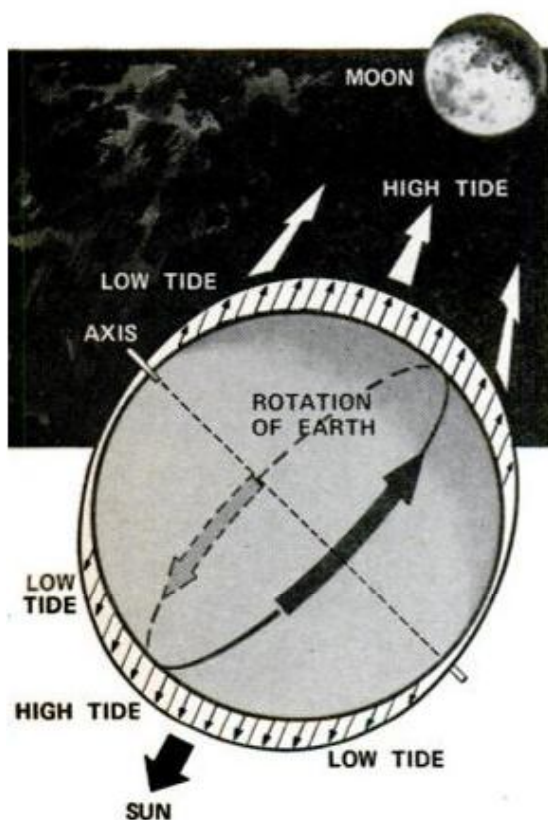
What is the "bends" and how do divers become afflicted with it?

High pressure at depth causes nitrogen to dissolve in a diver's blood. If he ascends too rapidly, bubbles will form in the blood and collect in his joints and bone marrow, causing the extremely painful condition known as the bends. It is not ordinarily fatal unless bubbles collect in the spinal cord or brain, but the pain will continue unless the diver is put under pressure and decompressed gradually. If the condition goes untreated there will be bone damage.

After a long dive, a diver is returned to normal pressure gradually so that nitrogen in the blood may be released through the lungs, avoiding the bends.

How many species of fish are there?

Estimates range from 15,000 to 40,000 species; however, 25,000 appears to be the most often quoted figure. This discrepancy exists because fish species are sometimes named more than once due to inadequate descriptions, variation within a species and geographical distribution. In some species, the male has been described as belonging to one species and the female to another because of a difference in body form or color pattern. Other fish have been named more than once because the young look different from the adults. Most scientists agree that not all



TIDES ARE CAUSED by the gravitational forces exerted by the moon, the sun and other celestial bodies

fish have yet been named; the estimate of 25,000 allows for this unknown.

Is there any danger of overfishing?

Overfishing is already a problem for some species. Stocks have been depleted in heavily fished areas such as the continental shelves of Europe, particularly the North Sea. Cessation of fishing during two world wars proved that a decrease in fishing could increase the number of large specimens.

The U.S. Bureau of Commercial Fisheries has listed the following species as being seriously depleted: Pacific sardine, Atlantic salmon, Atlantic sturgeon, blue whale, fin whale, Atlantic shad, sperm whale, humpback whale, oyster and sea otter. But depletion is not caused entirely by overfishing; disease, predators, and pollution take their toll.

What types of organisms, other than sharks, are potentially dangerous to swimmers?

The most dangerous animal is probably the barracuda. It is feared even more than the shark by West Indian divers. Its usual length is only four to six feet, but it is aggressive, fast and armed with a combination of long canines and small teeth capable of cutting as cleanly as a knife.

Although no authentic record of deliberate attacks on man exists, the killer whale is potentially more dangerous than either shark or barracuda. This 15 to 20-foot carnivore hunts in packs, attacking seals, walruses and even baleen whales.

The moray eel, which is as long as 10 feet, lurks in holes in coral reefs and may inflict severe lacerations on a diver who pokes his hand into its hiding place. Or it may grasp the diver in its bulldoglike grip until he drowns.

The octopus is probably overrated as a villain because of its evil appearance; nevertheless, its bite is poisonous. The giant squid has been known to pull a man beneath the water to his death. The Portuguese man-of-war has tentacles up to 50 feet long with stinging cells that are painful to a swimmer brushing against them.

There is a large group of animals dangerous to swimmers who step on them. These include the sting ray, stonefish, zebra fish and toadfish.

Has a sea gull, albatross or other sea bird ever flown across the ocean?

Like other coastal birds, sea gulls don't normally cross oceans. But there are birds that spend their lives over the ocean, returning to land only to nest. Kittiwakes banded by scientists in the Barents Sea area were recovered in Newfoundland four months later. Puffins, fulmars and petrels are known to

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SEA GULLS are coastal birds. But superflyers like the tern and albatross go in for transoceanic hops

cross the Atlantic from Europe to North America.

By far the most impressive travelers are the Arctic tern and the albatross. The tern, the size of a small sea gull, regularly migrates from its breeding grounds in the Arctic to the Antarctic. Banding records indicate that albatrosses fly around the world.

What would happen if all the ice on Earth should melt?

This possibility is extremely remote. However, if it should, the time span would be measured in thousands of years and the increased weight of the water would probably cause the ocean basins to sink and the land masses to rise. The sea level all over the world could rise as much as 500 or 600 feet. The Antarctic ice cap alone covers 6 million square miles and, if melted, would yield about 6.5 million cubic miles of water, enough to feed the Mississippi for more than 50,000 years. A rise of even 100 feet would flood most of the U.S. Atlantic seaboard.

On the basis of evidence gathered from all over the world, Dr. Rhodes Fairbridge of Columbia University concludes that some 6000 years ago the oceans rose about 14 meters (46 feet) within a few centuries, flooding almost all the areas where man had begun to found civilizations. He believes this to be the same Great Flood described in the Bible and in Buddhist writings.

What is the source of the Gulf Stream?

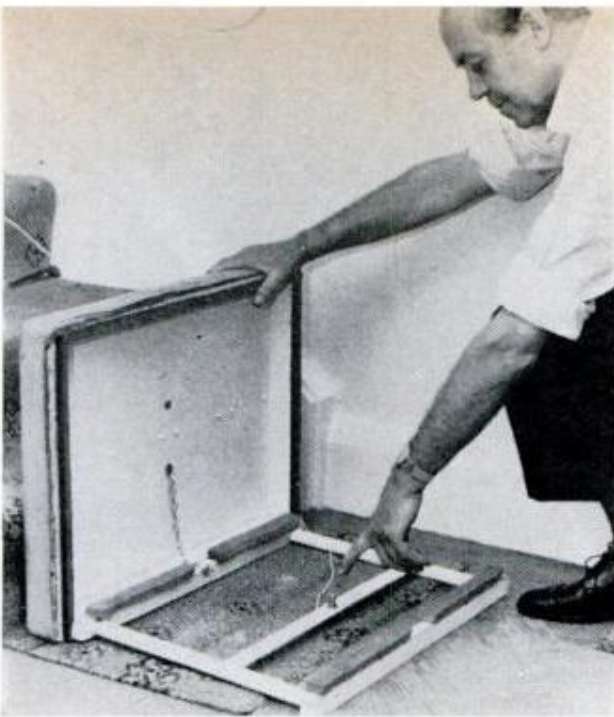
It received its name because of the misconception that its source was the Gulf of Mexico. It is now known that the Gulf contributes very little to the flow of the Gulf Stream. The North and the South Equatorial Currents join to flow through the passages between the Windward Islands into the Caribbean Sea. The resultant current, flowing through the Yucatan Channel, has only one outlet between Florida and Cuba. Off the southern coast of Florida, other currents from the northern coast of Puerto Rico and eastward from the Bahamas add to the flow.

What are seamounts? How are they created?

Seamounts are relatively isolated features rising from the deep sea floor. To qualify as a seamount, a rise must be at least 1100 yards above the surrounding topography. At least 1400 seamounts have been discovered in the Pacific Ocean, but this may be only a small percentage of the number eventually found. Their distribution in linear chains lends credence to the theory that they are caused by fissure eruptions. There is also speculation that seamounts were volcanoes that once extended above the ocean surface and later sank because of their weight. ★★★

IF ALL THE ICE on the Earth were to melt, the worldwide sea level could rise several hundred feet





Mat calls for help

Designed for use in a home where an elderly person lives alone, a wood mat fitted with a pressure switch will sound an alarm and flash a "help" sign in a window if the person falls down the stairs onto the mat. A spring in the mat keeps the switch from tripping in normal use, says the inventor.



Something's missing

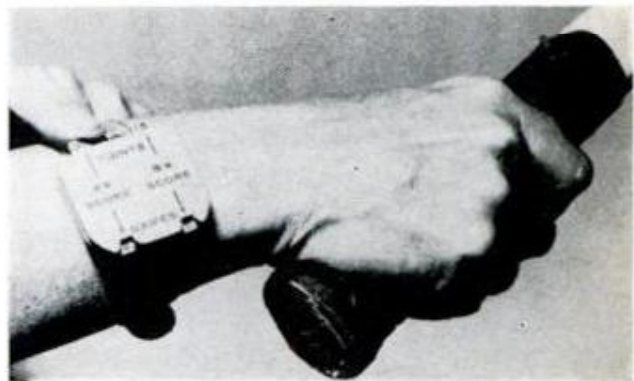
A German auto dealer demonstrates the hydropneumatic suspension system of Citroën cars by driving with a rear wheel off.

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Patch of frog ahead

Frogs are such a traffic hazard in some areas of Switzerland that signs like this warn motorists of a "frog crossing." The Swiss are also trying another solution to the frog problem: They've built tunnels for them under some of their highways.



How to know what the score is

Tennis scores won't be forgotten in the heat of the contest when players wear the new Tennismaster score-keeper on their wrists.



Tread gauge

A European tiremaker has brought out a gauge to measure depth of tire tread in millimeters. (Here, 2-mm tread is dangerous.)

Sitzen Sie Ski?

By FRANK A.
TINKER



Easy for beginners and fun for the experts, the 'sitz ski' or skibob is sitting 'em down from coast to coast

WITH THE FIRST GOOD SNOW of the year, after some 25 years absence from the slopes, this *PM* correspondent tackled the formidable Payday run at Utah's Park City. Foolhardy? All the practice necessary was picked up along the first gentle ski trails and by the time we hit the main pitch I was more secure on the slats than ever before. Twisting down the course required common sense rather than elaborate skill, yet the swift descent was as exhilarating as ever. I arrived at the lodge leg-weary but ready to pile on the lift and ride the fine mountain powder again.

Ride?!

Exactly. Although I was skiing, my

FOR BEST SLALOM CONTROL keep knees close to seat. Toughest ski trails are negotiable with skibobs



OLYMPIC ski champion Jean Claude Killy studies jump of a skibob expert before sampling the excitement of skibobbing for himself (see lead photo opposite)—and in an unconventional Killy manner! Enthusiasts are urging that skibobbing be recognized as a competitive sport so it can be made a winter event in the 1976 Olympics

equipment included not only short foot skis but a low bikelike sled called a skibob. By lowering my center of gravity and creating a stable tripod of feet and center ski, this compact device permits even a mediocre skier such as myself to ride safely down slopes that might be awkward or suicidal to try on standard equipment. As a result, the skibob is a boon to a host of Americans who spend too much of their winter indoors. It's gaining belated recognition on the best snow in the country, from Vermont to the Sierras, and deserves a try by anyone who enjoyed skiing the back-yard hill as a youngster.

Just where or when the skibob originated is worth anyone's guess. However, one John C. Stevens of Hartford, Conn., received American patent number 473434 in 1892 for his Ice Velocipede! Thereafter, various contraptions have been seen on the hills, most of them homemade, bulky and awkward.

However, with the surge in skiing provided by the installation of lifts all over the country, it was inevitable that this sensible idea be refined along with the rest of the sliding sport. Europeans, to whom snow sports are an obsession, were the first to come up with an operable skibob which they call *sitz ski* or "sit ski." In 1951 a low-slung, compact skibob made by Georg Gfaeller of Bavaria caught the eye of promoters and sportsmen in the Alps. A little later the abbreviated foot skis were added by Willy Brenter.

Once established with new and light-

(Please turn to page 214)



TEAM OF SKIBOBBERS sails down a mountainside in Utah. Note that turns are easily made even in a light powdery snow and that skibobbers are heading into sections where only experienced skiers go

CARRYING A SKIBOB is done either with a special carrying arm mounted on the device or with it looped over the shoulder as this skibobber is doing. Never attach skibob to any part of the ski lift!



The Pump That Works Like a Heart

'Much of heart surgery is pure mechanics,' says Dr. Domingo Liotta. His new artificial heart points the way to a permanent mechanical heart that will succeed where transplants have failed.

By ARTHUR S. FREESE

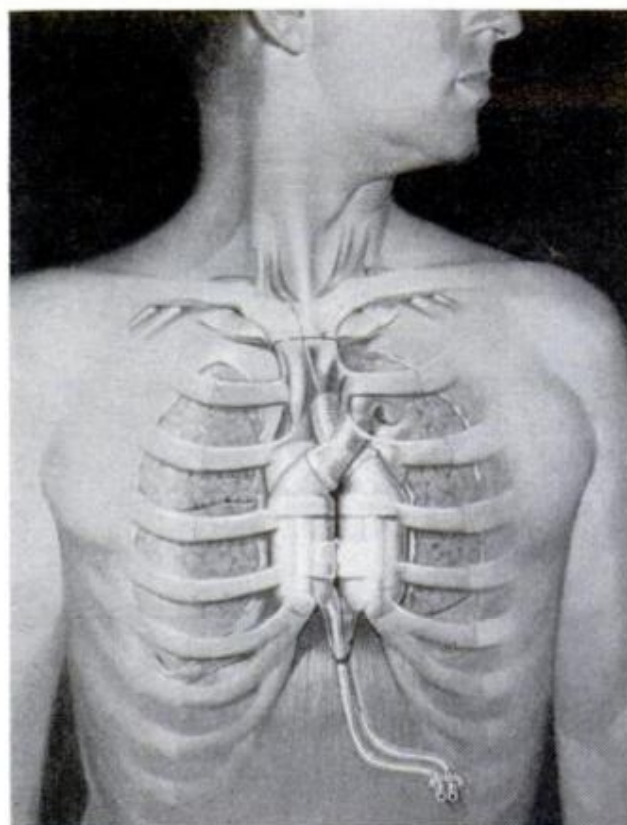
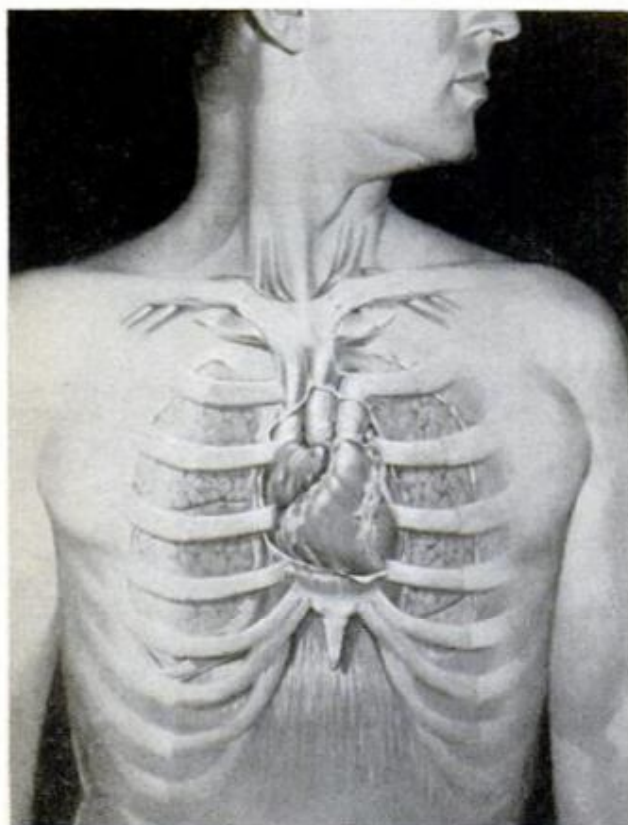
"THE HEART is only a pump," says Dr. Denton A. Cooley, the world-famous heart surgeon who was first to implant a mechanical heart in a human being. "The heart is one of the simpler visceral organs. Most other organs serve a dual or a triple or even a quadruple purpose—but the heart is only a pump."

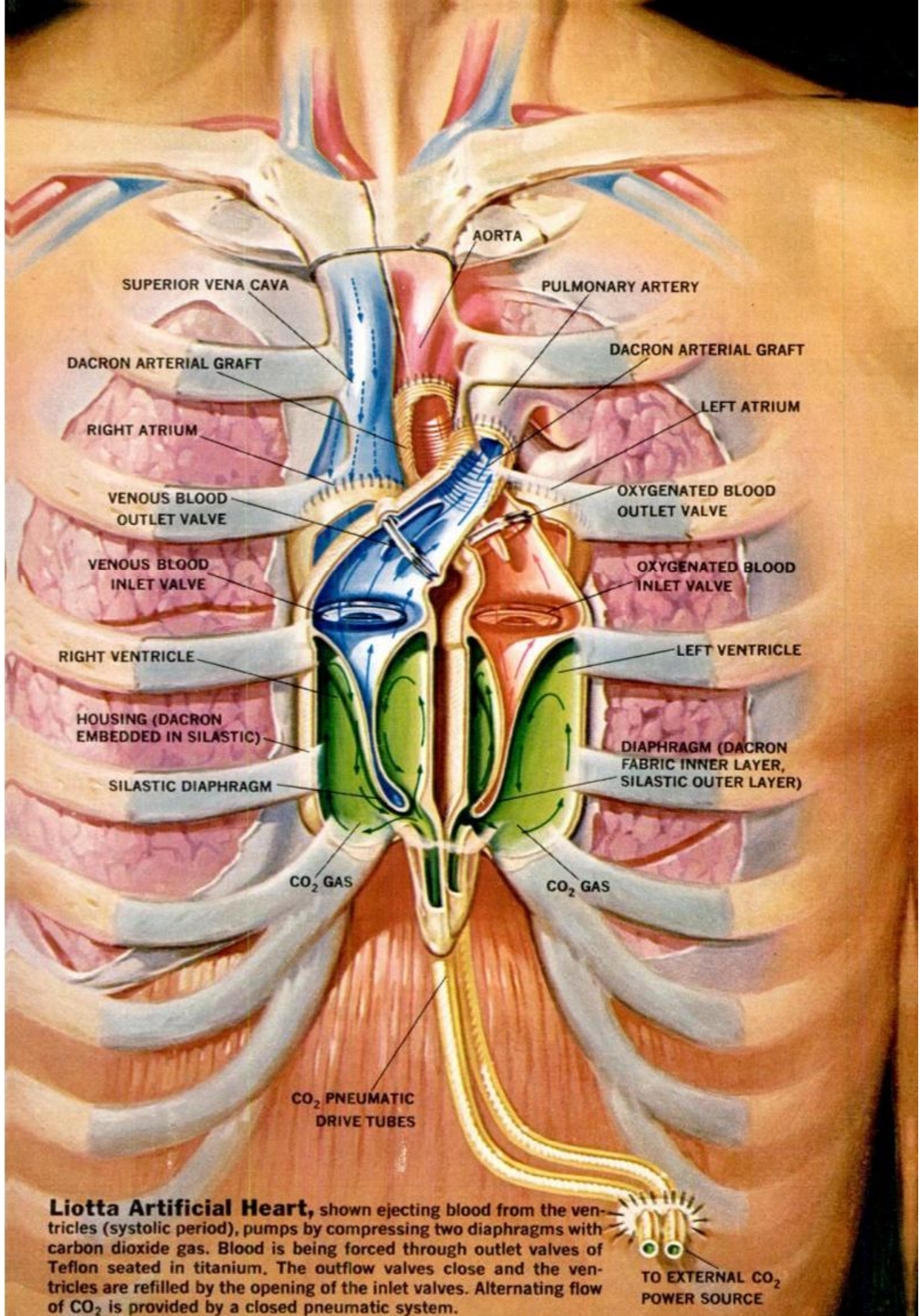
Dr. Domingo Liotta, the heart surgeon who earlier designed, with Dr. Michael DeBakey, the mechanical heart Cooley implanted (and built the *latest* version shown on these pages) made the same comparison when I interviewed the two specialists at the Texas Medical Center in Houston:

"The heart is a pump, and the entire circulatory system follows the laws of hydraulics. The heart valves work in a mechanical way and a pressure gradient opens and closes them."

Earlier, Dr. Michael DeBakey, the world-renowned open-heart surgeon

DACRON AND SILASTIC HEART (below, right) is the same size and is positioned like human heart (left)





Liotta Artificial Heart, shown ejecting blood from the ventricles (systolic period), pumps by compressing two diaphragms with carbon dioxide gas. Blood is being forced through outlet valves of Teflon seated in titanium. The outflow valves close and the ventricles are refilled by the opening of the inlet valves. Alternating flow of CO₂ is provided by a closed pneumatic system.

of Baylor College of Medicine, told me:

"While the heart is only a pump, it is a magnificent pump, with its built-in energy source and its built-in control mechanisms."

At the National Heart and Lung Institute (NHLI), Bethesda, Md., Dr. Frank Hastings, chief of its Artificial Heart Program and an open-heart surgeon involved in artificial heart development since its beginning about 15 years ago, also made a mechanical comparison:

"Surgeons are mechanically oriented physicians; they treat disease mechanically."

Your life may one day depend on highly skilled medical "mechanics" and engineers. More than half of us past the age of 40 will probably die of heart disease unless we can get a replacement for the defective human

pump on which we depend.

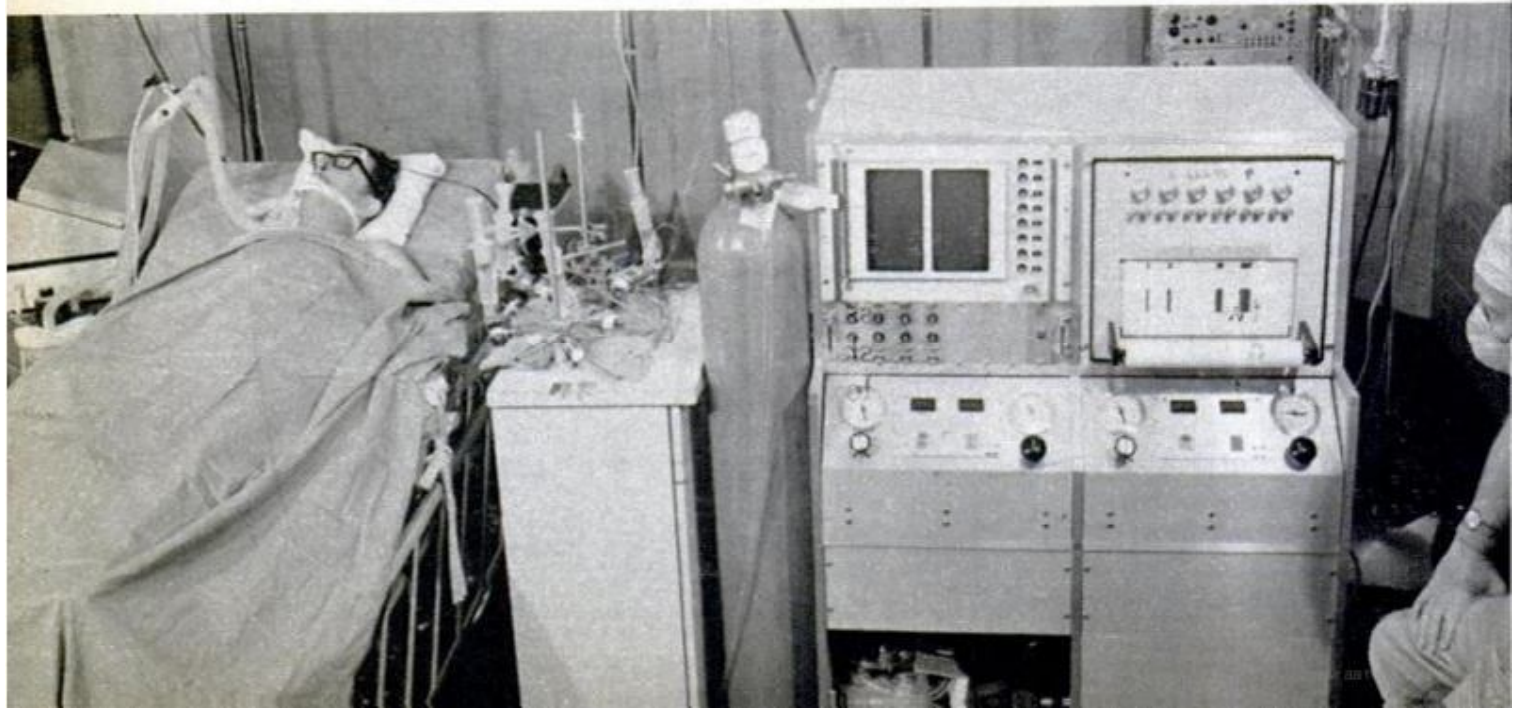
When Dr. Christiaan Barnard performed the world's first heart transplant in Capetown, South Africa, in December, 1967, the number of transplant operations that followed all over the world seemed to indicate that the only remaining problem would be sufficient donors. The number of transplants performed each month rose to a high of 26 in November, 1968. But failures also rose—virtually all from either "rejection" (the body's natural defense reaction needed to eliminate foreign proteins whether invading bacteria or someone else's heart) or infection due to oversuppression of the body's immune defense reaction. And Dr. Barnard's most famous patient, Dr. Philip Blaiberg, died after 19 months.

These failures soon discouraged both patients and physicians. Heart transplants dropped abruptly to an average of only a half-dozen a month for the next half year and, ever since, to some one or two a month. By Jan. 1, 1970, only 22 heart transplant patients still lived out of a worldwide total of 150 such operations. Only 13 had lasted more than a year. Another limiting factor is the availability of a maximum of 22,000 possible American donors a year—only about 1/10 the number of needed heart replacements.

On April 4, 1969, Dr. Denton Cooley replaced a dying man's heart with an



MONITORING CONSOLE (below) used after artificial implant is later reduced to compact pump unit (above)



artificial one developed by Dr. Liotta, who had worked on it while on Dr. DeBakey's staff. The patient, Haskell Karp, lived on it for 64 hours but died 30 hours after it was replaced with a natural transplant.

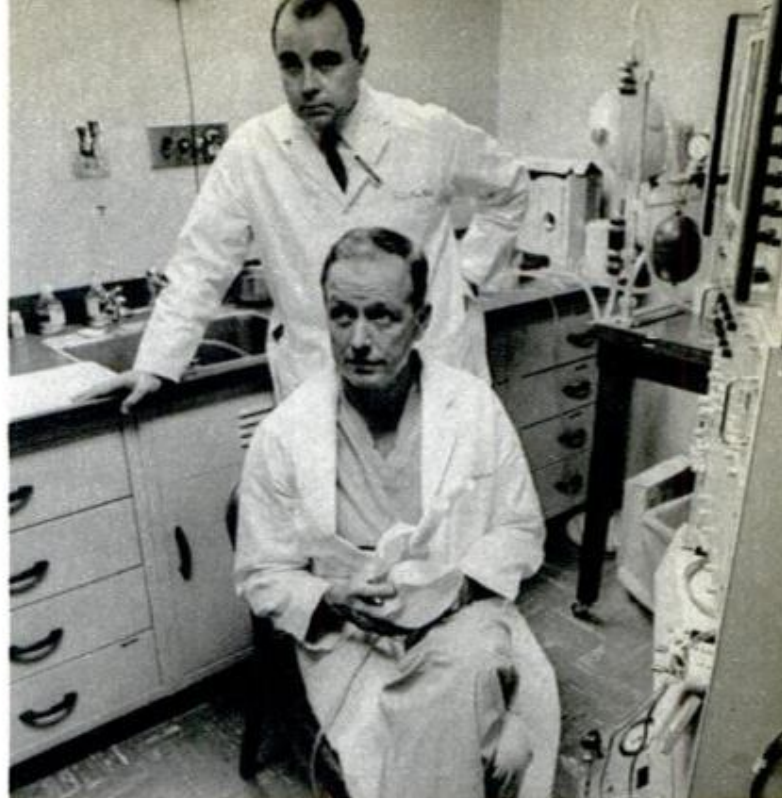
The operation started a storm of controversy, but the Liotta heart clearly indicated a new avenue of hope. Research teams are at work all over the world trying to build a self-contained, permanently implantable artificial heart. None has kept a laboratory animal alive more than 48 hours. The Liotta heart is not yet self-contained; it depends on an outside power source. But its valves—the most critical component—have been vastly improved and a compact bedside power unit developed to replace the original 3 by 5-foot machine. Short of being self-contained, the Liotta heart shown on page 129 is now the leading contender in the race to develop a permanent artificial heart.

To fully appreciate the engineering genius required to design a replacement for your heart, it's necessary to know how the original "pump" functions. This vital organ in the center of your chest is a pear-shaped hollow muscular structure weighing some 12 ounces and about the size of your fist, some 5 inches long and 3½ inches wide.

Your heart is actually a four-chambered pressure pump with two "atria" and two "ventricles." The upper two chambers, the atria, are smaller and thinner-walled than the two lower, the ventricles. The blood enters the atria, from the veins, then moves down into the ventricles and out through the arteries to the farthest places in your body.

In the narrow opening between the atria and the ventricles are valves formed of two or three leaves of tissue so designed that they're slammed shut noisily by the pressure of the blood during ventricular contraction—what doctors call "the first heart sound." This contraction forces the blood into the two connecting arteries, the pul-

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DR. DOMINGO LIOTTA and Dr. Denton Cooley (seated) with artificial heart at Texas Heart Institute

monary (to the lungs) and the aortic (the main one to the rest of the body). These also have valves to prevent the blood from flowing back and their shutting produces the "second heart sound." These sounds can be heard—either by placing your ear over the heart or with a stethoscope—to make a sound like "lub-dub."

This closing of the heart valves produces the thumping you sometimes hear in bed when all is quiet and you suddenly notice your heart banging away. It's the first heart sound that you hear and feel as "the" heartbeat.

But make no mistake—this heart of yours is no fragile or delicate organ! Its muscle is different from any other in your body because it must do more work over a lifetime than any other. It must contract or "beat" some 70 to 80 times a minute, nearly doubling that during violent exercise, but dropping to about 55 during sleep. In all, it will beat some 3 billion times during a 70-year life span. Each beat drives little more than two ounces of blood into your arteries but this adds up to some 250 million quarts during the

(Please turn to page 201)

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Cruising the Cascades

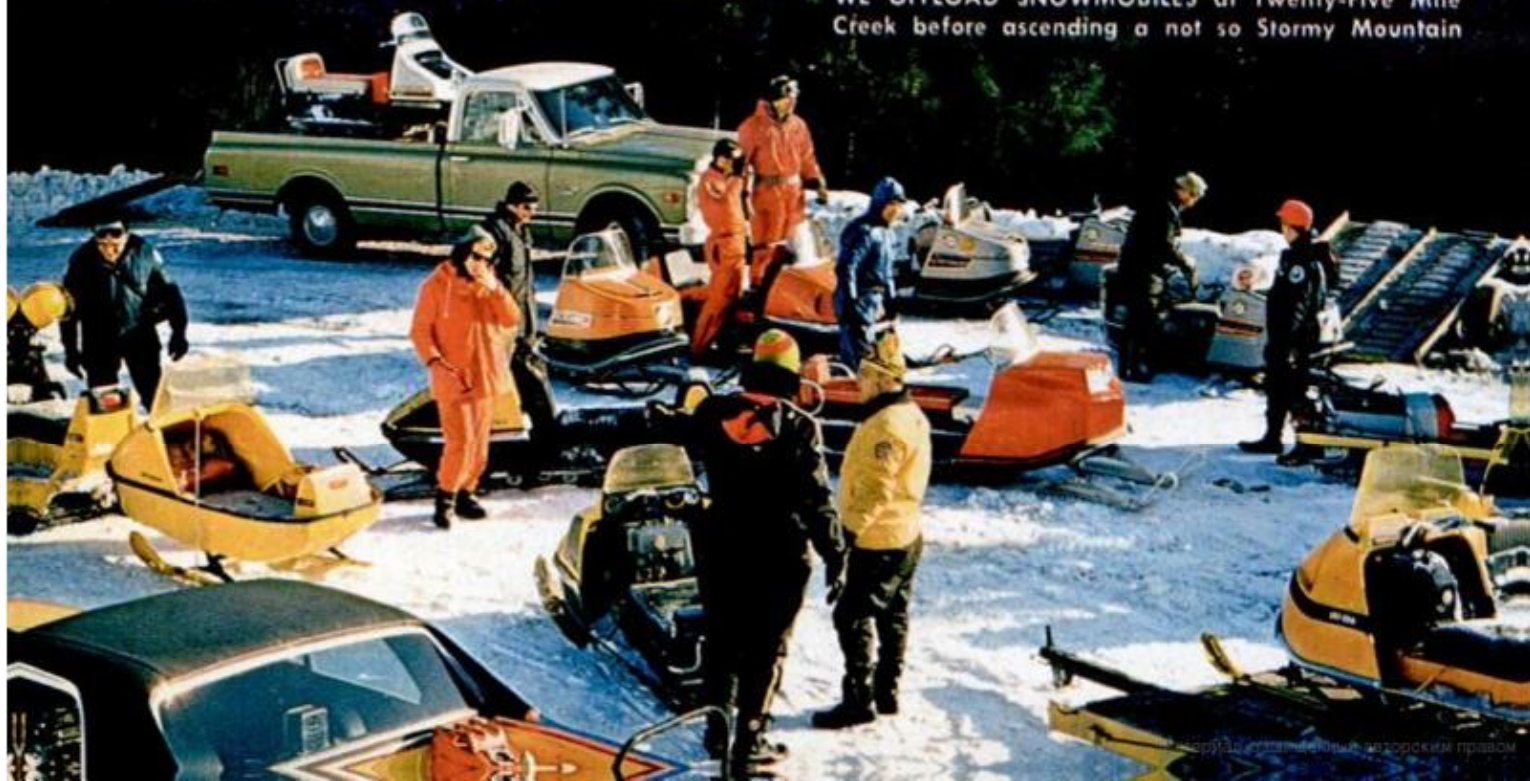
PM takes the first snowmobile safari into our newest National Park

EACH TURN IS BREATHTAKING. Pass under snow-laden trees, cross a clearing, swing round a curve and look over a valley 15 miles long and 3000 feet below you. Easy now, watch the snow slide. Throw your weight to the mountain side of your machine. What a drop-off! Nothing between you and the valley floor but a few treetops above the snow. Look, a golden eagle! Steady, watch the trail ahead. Coming up you see a snow lane barely *(Text continues on page 134)*

By GEORGE W. REIGER,
Outdoors Editor



WE OFFLOAD SNOWMOBILES at Twenty-Five Mile Creek before ascending a not so Stormy Mountain

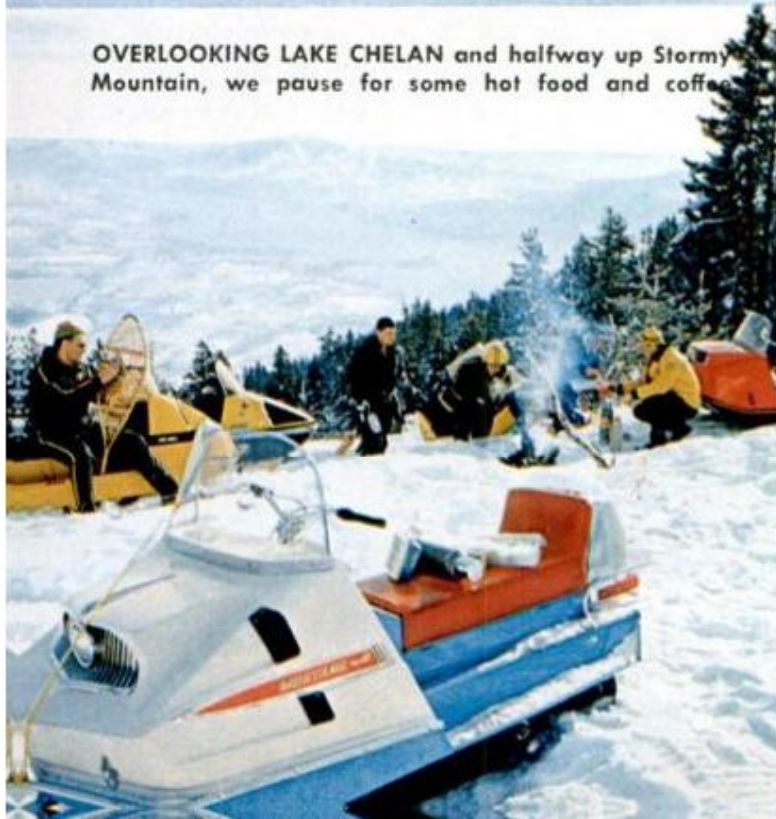




MOUNTAIN CLIMBING with a snowmobile isn't all up-hill! We found frequent switchbacks and downgrades where we (and the machines) could take a breather or race one another in breathless downhill runs **WE STOP** by a one-room log schoolhouse (above right) after a history-making portage of our snowmobiles up the entire 55-mile length of Lake Chelan (right)



OVERLOOKING LAKE CHELAN and halfway up Stormy Mountain, we pause for some hot food and coffee



WHENEVER WE CAME to a gap in the trail, we chivalrously let Ski-Doo test driver, Dave Galle, go first





SPEEDWAY AND SISTER SHIP, *Lady of the Lake*, offer only access to east end of North Cascades National Park. A call ahead assured special assistance would be waiting in Stehekin to help offload our snowmobiles



WE PAUSE to take in icy beauty of the Stehekin River. Persuade a park ranger to make his rounds with you and he'll help you keep to regulation trails

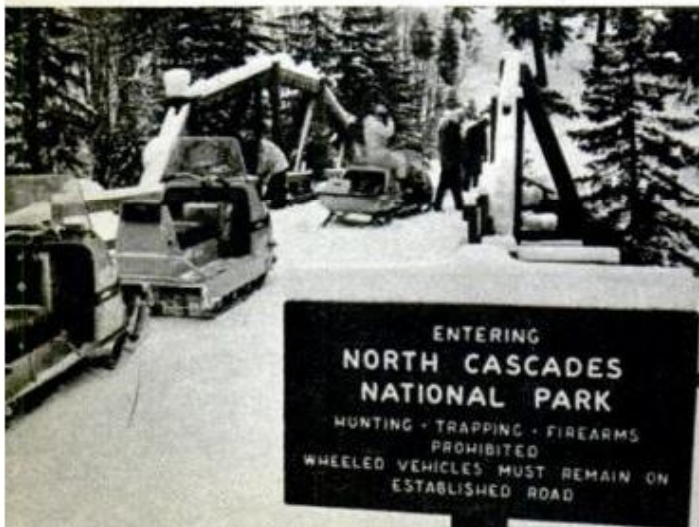
brushing under limbs that are 10 feet above a hiker's head in summertime. Roar, swoosh—into a stand of Douglas fir taller than most city buildings!

After your first season of snowmobiling, you'll wonder how you could've spent any winter hours indoors watching rerun TV movies when you had all outdoors to explore. Suntanned and fit, you'll even feel like a pioneer if you snowmobile a region still new to the sport. If you want recommendations, start making plans for a trip to Washington State.

Snowmobiling in the Pacific Northwest is just getting under way as major winter recreation, and while folks there may be curious about strangers packing their own machines, they couldn't be more helpful.

Once on the trails, nothing compares with the climbs and vistas of the Cascades range. The vertical nature of

AT TWENTY-FIVE-MILE CREEK, Chelan Snowmobile Club member, Hank Davis, slides ramp into place converting pickup truck to trailer for two snowmobiles





PORTAGING SNOWMOBILES by car and truck from one snowy trail to another can in itself be fun, particularly when you have such gorgeous vistas as those offered by the road along south shore of Lake Chelan

these mountains will leave you awe-struck and exhilarated when, after 45 minutes of climbing and switchbacks, your caravan breaks through to a view of a lake 55 miles long and some of the tallest peaks in North America.

If you want adventure, mountain climbing itself can't offer moments more hazardous than those you'll encounter while hugging snowy cliffs and following a drifted-over trail with sheer drops of several hundred feet practically at your elbow. And watch out for avalanches!

During our week's stay in the Cascades, we used Campbell's Lodge in Chelan as our base camp. This community, an active ranching and farming center the year round, offers your best hope for hot meals and spare spark-plugs after a long haul in neighboring mountains.

Before going uplake we tested our-

AUTHOR LEADS WAY PAST SLIDE where rocky lumps of ice and snow-covered holes make the going rough. New routes should be scouted ahead of main party

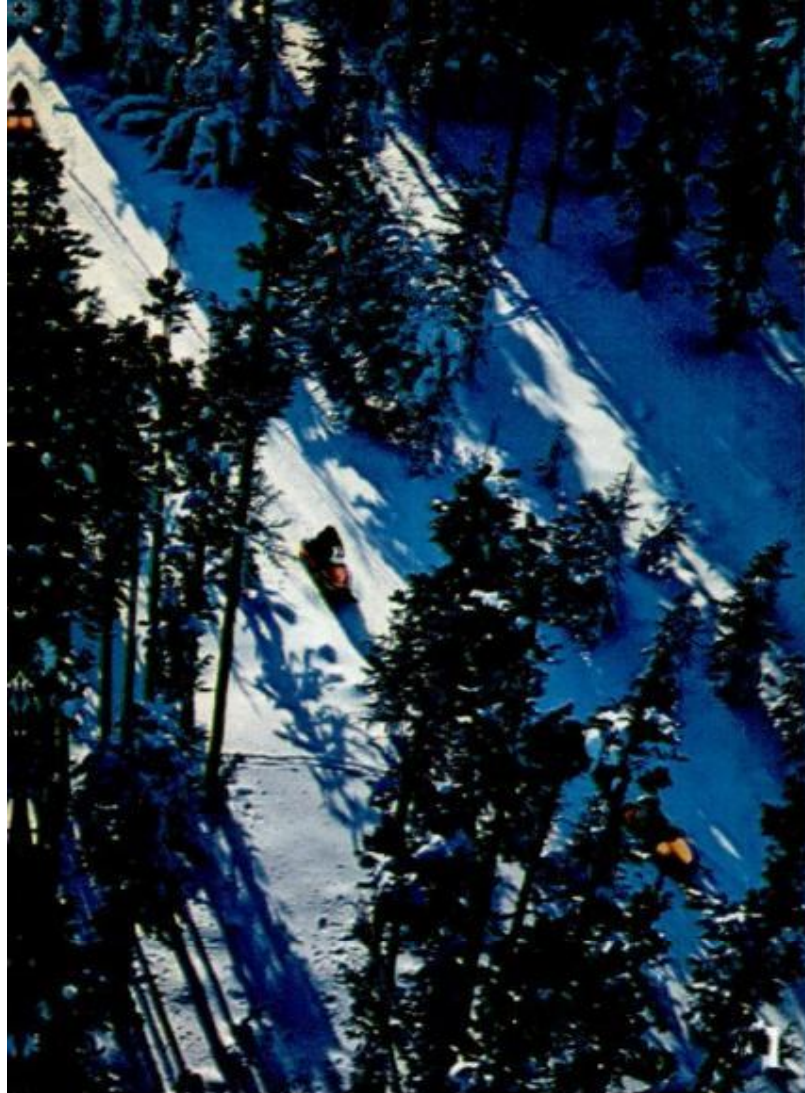


selves and our machines on trails around Stormy Mountain in the Wenatchee National Forest about half-way along the western shore of Lake Chelan. This peak, at the heart of extensive plans for a bustling ski resort programmed to handle ultimately more than 20,000 skiers a day, is well worth a trip while its solitude can still be shared by a small group of snowmobile enthusiasts.

Our primary objective, however, was America's newest National Park at the head of Lake Chelan. The only way to get there was via the *Speedway* or *Lady of the Lake* which make Monday, Wednesday and Friday runs throughout the winter. Though there was already a snowmobile in Stehekin, we quickly discovered these machines are hardly the *Speedway's* usual cargo! Yet the captain was game and by 9:00 a.m. Wednesday morning, with snowmobiles

IF WINDFALL LIES FLUSH on the ground, it's easier to pile snow against both sides and run your machine over than try to cut or move the fallen timber







FOGGY SNOW greets our history-making caravan as it crosses the boundary between the Loke Chelan Recreation Area and North Cascades National Park. From here on we're opening virgin snowmobile territory

1. **DOWNHILL RUN** through tall timber is exhilarating way to round out day of snowmobiling on Stormy Mountain

2. **WE HOVER** over Chelan snowmobilers riding along Slide Ridge on their way back to the trucks at 25-Mile Creek

3. **WITH MOUNTAINS ABOVE** and river below, this North Cascades trail surrounds us with incomparable beauty

4. **ROGER HAMILTON** has ample head-room beneath windfall as Dave Galle hitches ride in Ski-Doo "ski-boose"

5. **PHOTOGRAPHY HELICOPTER** flew to peak of Stormy Mountain where we had unrivaled view of Cascades range

squatting on foredecks, cabin roof and afterdeck, we were on our way.

The boat ride was, perhaps, even more eventful than actual entry into the National Park. We saw deer, goats, coyotes and eagles against scenery reminiscent of Norway's fjords. As we approached Stehekin, however, snow fell and continued with few pauses for three days. And though we relished the trails and runs through the river's gorge, we equally enjoyed the evening rewards of warmth, shelter and good hot food.

If you plan to stay in Stehekin several days, you can either camp out at Purple Point or Company Creek where park personnel will help you locate

(Please turn to page 214)



WATCHING A GOOD MAN WORK! Park Ranger Dave Burkhardt is admired by (from left) Dave Galle, Roger Hamilton, the author, Barney Slaughenhaupt, Tom Courtney while cutting fallen timber with practiced strokes

FIVE STEPS TO A TROUBLEFREE COOLING SYSTEM

Here's a strictly preventive-maintenance job that's aimed at doing the right things to avoid overheating, leaks, corrosion and other problems

By MORT SCHULTZ

IT DOESN'T MATTER whether you service your cooling system in the fall or the spring—as long as you do it at least every two years.

This frequency (infrequency, really) is required because the corrosion (rust) inhibitor contained in all popular brands of ethylene glycol coolant loses potency after two years. Once inhibitor is exhausted, corrosion builds up and starts to plug cooling-system passages, causing overheating.

Although rust-clogging of a cooling system is fairly common, you can avoid it by periodic cleaning. Thus, when antifreeze is drained, the cooling system should be flushed to clear out particles and assure that no old coolant remains to contaminate new antifreeze.

Keep in mind that simply draining the radiator will not get rid of old coolant. The engine must also be drained.

When draining and flushing are done, the condition of key parts, such as hoses and thermostat, should be checked. The cleanest antifreeze in the cleanest system isn't going to do you any good if you can't get the coolant to where it's needed. Here's the sequence:

1. *Pressure test the system.* A cool-

ing-system pressure tester costing about \$15 will uncover leaks in the system and test performance of the radiator cap.

There are two kinds of pressure testers. The most common type attaches to the radiator. Make two separate tests—one for cooling-system leaks and one to check the radiator cap.

To check for leaks, connect the tester to the radiator filler neck (engine off) and pump it up until the dial reads the pressure stamped on the radiator cap. Wait about 10 minutes. If the pressure drops (the dial reading will fall), there's a leak.

Most common places where leaks occur are at engine-to-heater core hoses, engine-to-radiator hoses, thermostat housing, and at radiator tank-core seams.

Ideally, this test should be conducted with the engine both at cold and at operating temperatures. Some leaks will occur under one condition and not under the other. For example, a leak at the engine-block plug with the engine cold may stop when temperature causes this metal part to expand.

To check condition of the radiator cap with the radiator-attaching pres-



RUBBER SEAL on radiator cap should be inspected, and any dirt under it cleaned out with clean paper

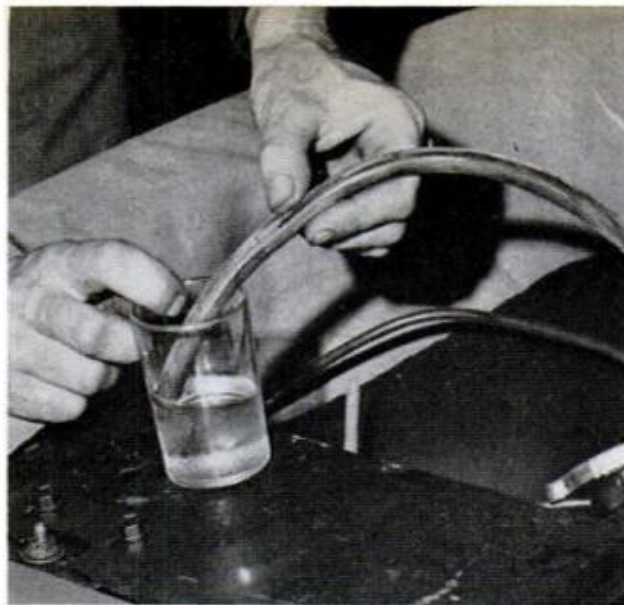
sure tester, wash cap in clean water and attach it to the tester. Pump up pressure until the dial reads the p.s.i. at which the cap is rated (see imprint on cap). The dial should maintain this reading. If it doesn't, remove the cap from the tester. Place a clean piece of paper beneath the seal, press down on the valve, and pull the paper out. Do this all around the circumference of the seal to dislodge any dirt that may keep the cap from seating properly.

Test the cap again. If it still is faulty, replace it.

With the other type of pressure tester, which attaches to the engine, you can test the entire cooling system, including the cap, at one clip. It connects to a small threaded adapter that's inserted into the engine in place of the temperature-sending unit.

With the tester hooked up, the radiator overflow tube is disconnected from the side of the radiator and its end inserted into a container of water. The tester is then pumped up until bubbles appear in the water. If the reading on the tester's dial is above or below 10 to 16 p.s.i. when bubbling ceases, the cap is at fault. If pressure drops from specified limits for your cooling system, check for leaks.

2. *Check hoses and clamps.* Make replacements, if needed, when the cooling system is drained for cleaning and



RADIATOR OVERFLOW TUBE is placed in water when using pressure tester that attaches to the engine

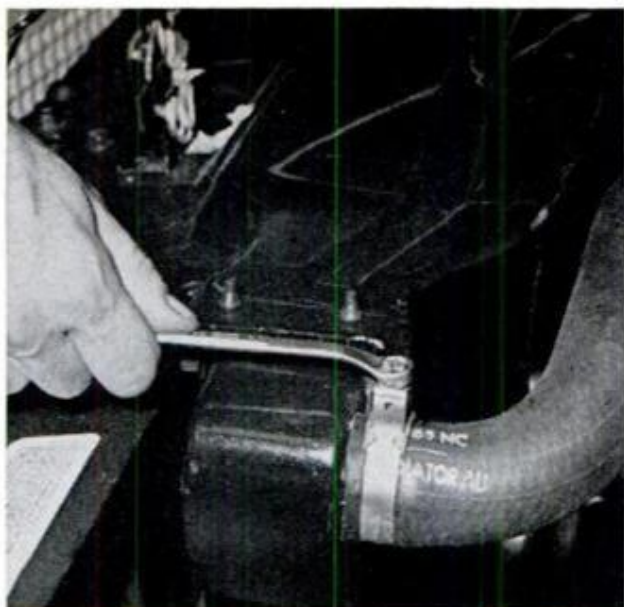
flushing. You've got to drain the system to replace a hose.

Be sure to examine every hose that has some connection to the cooling system, including upper and lower radiator hoses, small bypass hose from the water pump to the block (if your engine has one) and heater hoses. If they're mushy when squeezed, replace them. If tiny cracks appear in a hose when it's squeezed, be safe and replace that hose.

Some mechanics replace the lower radiator hose at the two-year maintenance service whether it shows wear or not. This hose has a spring in it to prevent the hose from collapsing during high-speed operation. If the spring loses tension, that hose will collapse and present you with a tough-to-pinpoint overheating condition.

When you replace a hose, clean off the connection with a wire brush and coat the entire connection area with a water-resistant sealing compound. With the new hose in place, position the clamp (make sure the one you use is in good shape) no closer than $\frac{1}{8}$ inch from the end of the hose. Tighten the clamp.

3. *Check and adjust drive belts.* If a drive belt is too loose, the water pump won't be able to deliver the amount of coolant needed by the engine to dissipate heat. If it's too tight, the strain



ATTACH HOSE CLAMPS at least $\frac{1}{8}$ inch from the end. Clean connections before replacing and tightening

placed on the pump can cause premature failure of bearings.

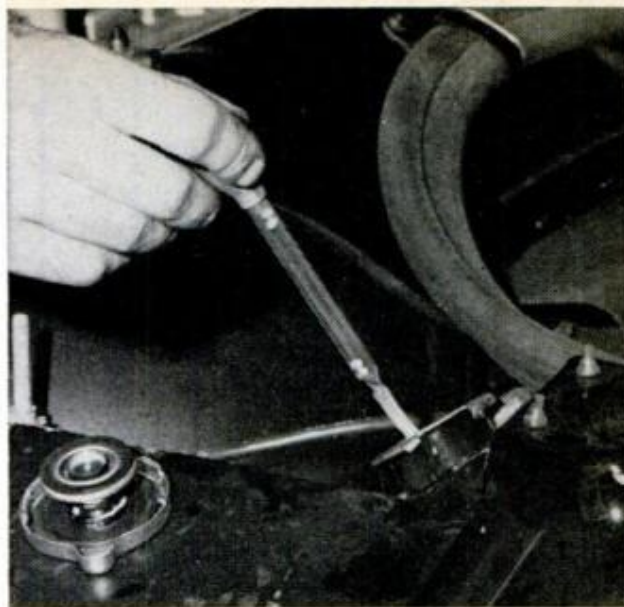
Check the inner circumference of drive belts to spot signs that the belt is beginning to fail. Look for cracks and glazed areas. Check for proper tension with a drive-belt tension gauge. It costs about \$8. Most gauges can be left in place while you make the adjustment—the pointer will change position as the belt is tightened or loosened. When the pointer swings to the correct specification, lock up the adjustment and remove the gauge.

4. *Check thermostat.* You don't have to remove a thermostat from its housing to check operation if you have a thermostat calibrated to at least 200° F.

Start with a cool engine. Insert the thermometer into the filler neck and start the motor. The coolant should heat up quickly to the rating of the thermostat. This rating varies from car to car, so check specs. However, in today's cars the rating is around 195°.

The thermostat should open at this temperature, which should maintain itself. If the temperature soars past the specified rating, the thermostat is bad. If the temperature never reaches the rating, the thermostat is bad. If you want another check to make sure the thermostat is working, squeeze the top radiator hose when the thermometer hits the specified rating. In most cars,

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COOLANT HYDROMETER of this type measures coolant specific gravity by number of balls that float

you'll be able to feel the coolant surging.

5. *Drain coolant, flush system, add coolant.* Open the drain cock at the bottom of the radiator and remove the threaded drain plug(s) from the engine. Six-cylinder engines have one engine-block drain plug—eight cylinders normally have two, one in each bank. Be sure to open (turn on) the heater, too, so that full drainage can take place.

When old coolant has finished draining, flush the cooling system. Close the radiator cock and replace the drain plug(s) back into the engine tightly. Fill the system with plain water.

Start the motor and allow the engine to run until it reaches normal operating temperature, but occasionally increase acceleration. You don't have to push the pedal to the floor—just gradually increase rpm, hold it at a good speed for a few seconds and release. Acceleration permits more forceful circulation that will help to dislodge rust and scale.

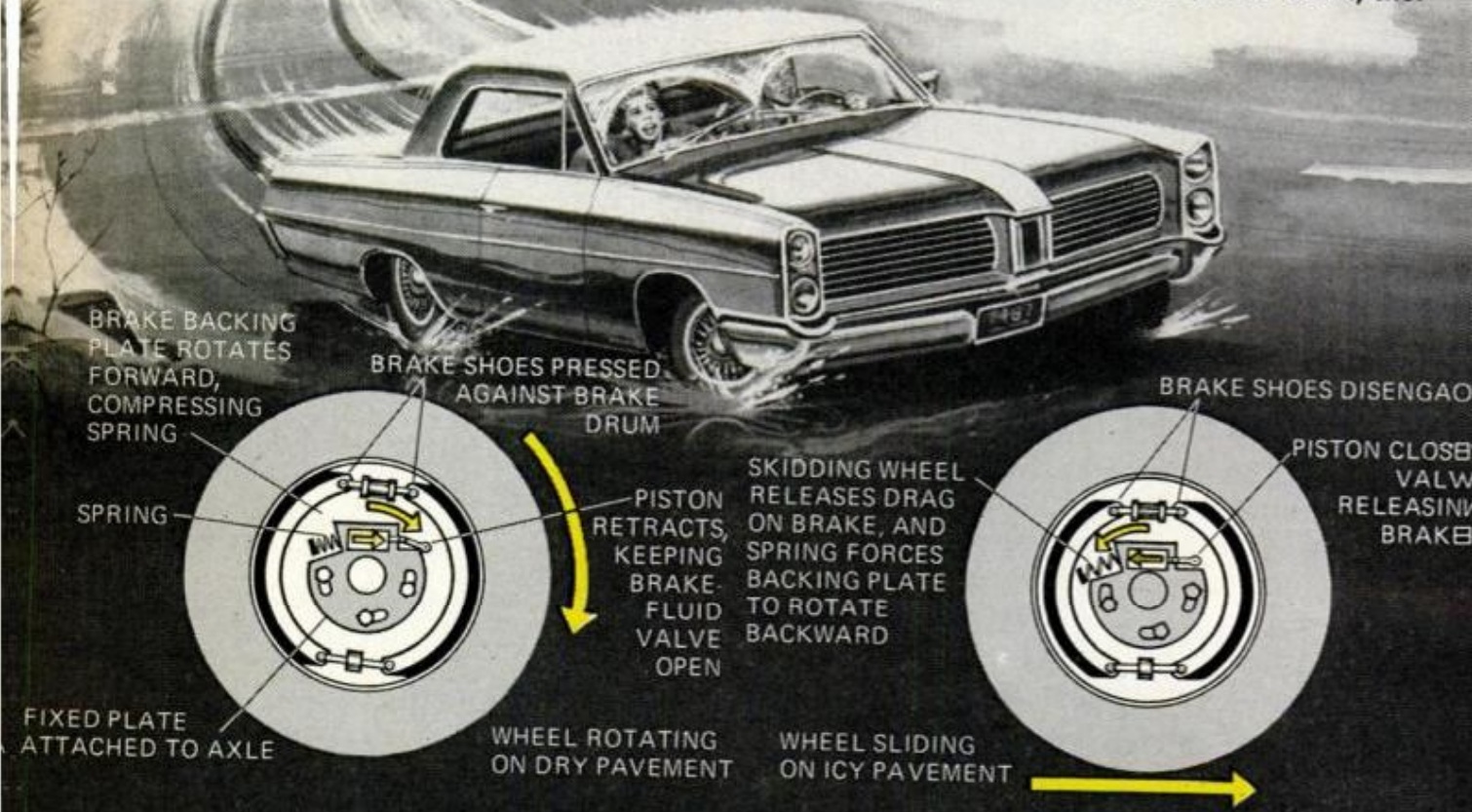
When engine temperature reaches normal range, drain the system. If the water comes out colorless, the system is clean. If it doesn't, repeat the flushing procedure. To be safe, allow the engine to cool before adding water or run the engine as water is added.

Add a good quality ethylene glycol antifreeze about 50/50 with water and relax. ★★★

Just patented

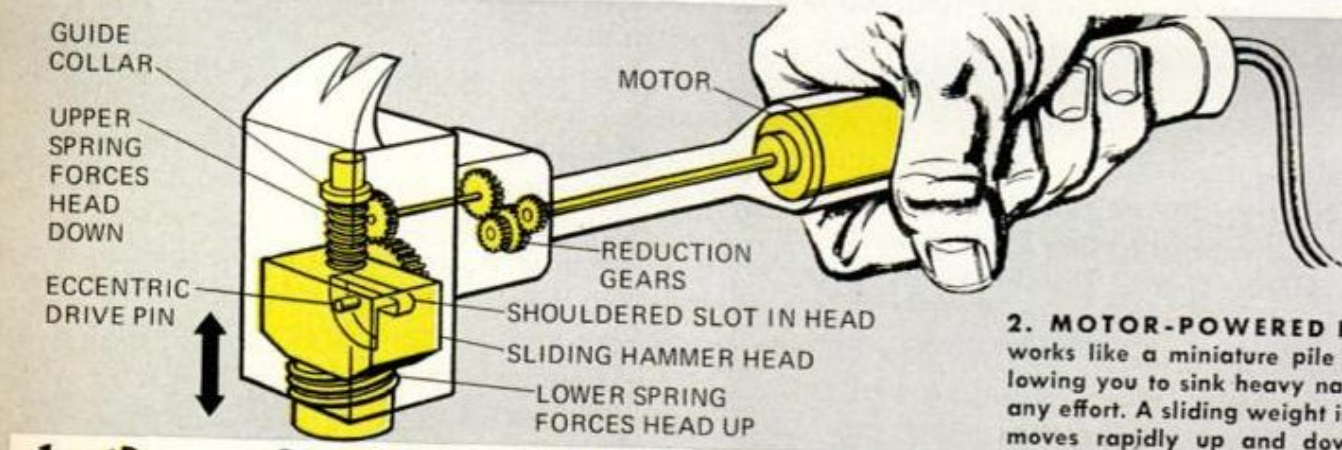
PM'S PICK OF THE NEW INVENTIONS

Prepared in cooperation with Roger S. Shashoua, Director, International Inventors Assn., Inc.

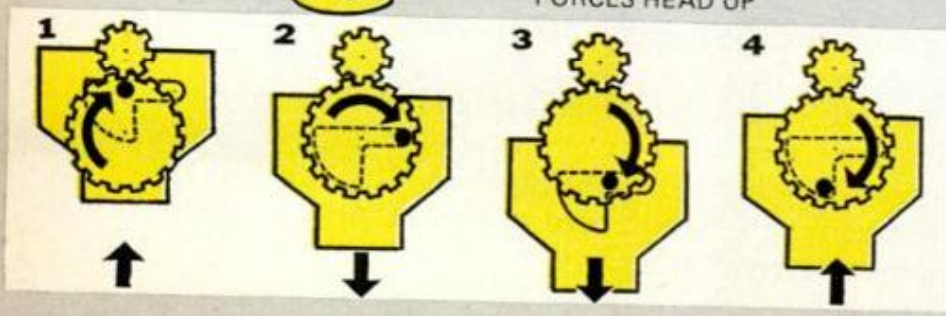


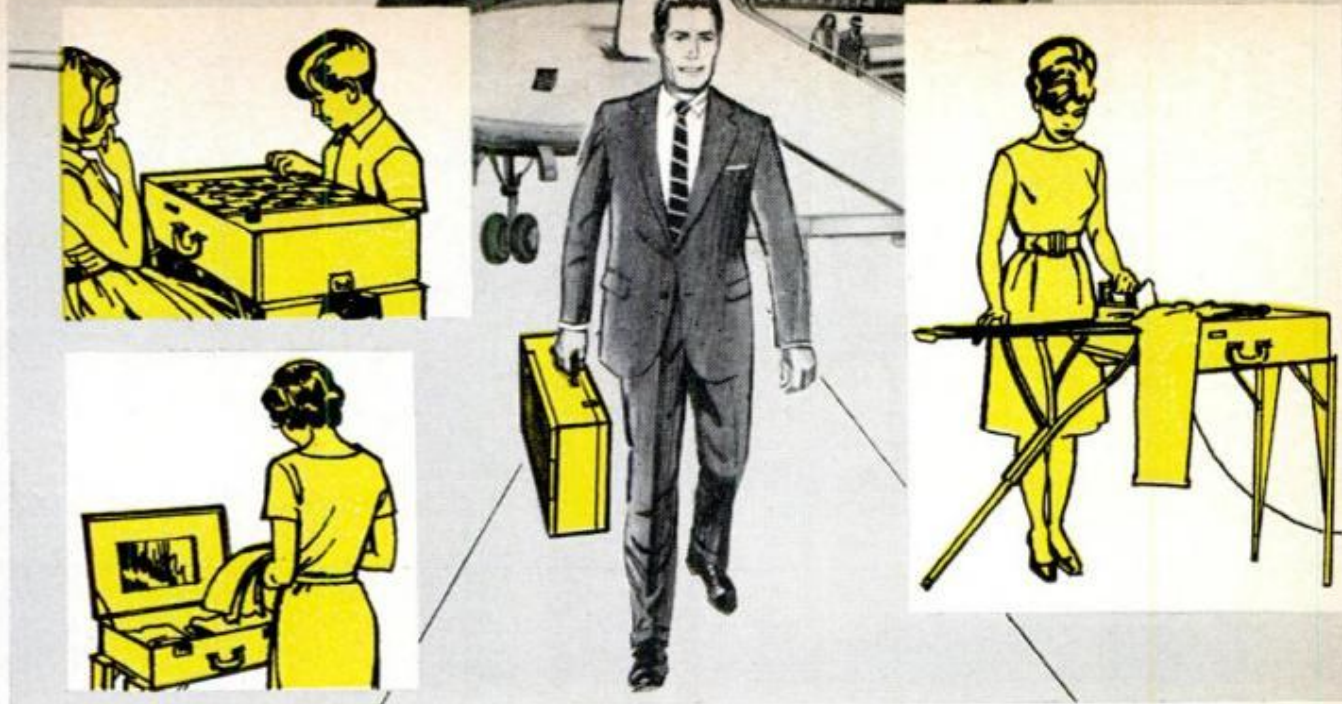
1. SELF-RELEASING BRAKES keep you from going into a dangerous skid with this ingenious invention. If your wheels start to slide on snow or ice, the brake shoes automatically retract, allowing you to regain control. As soon as the tires start to grip again, the brakes go back on to slow you down. The brake

backing plate is rotated forward against a spring by drag on the brake shoes as long as the wheel keeps turning. When the wheel slips, the drag is reduced and the spring forces the backing plate backward. This closes a valve, temporarily shutting off the brake fluid and releasing the brakes



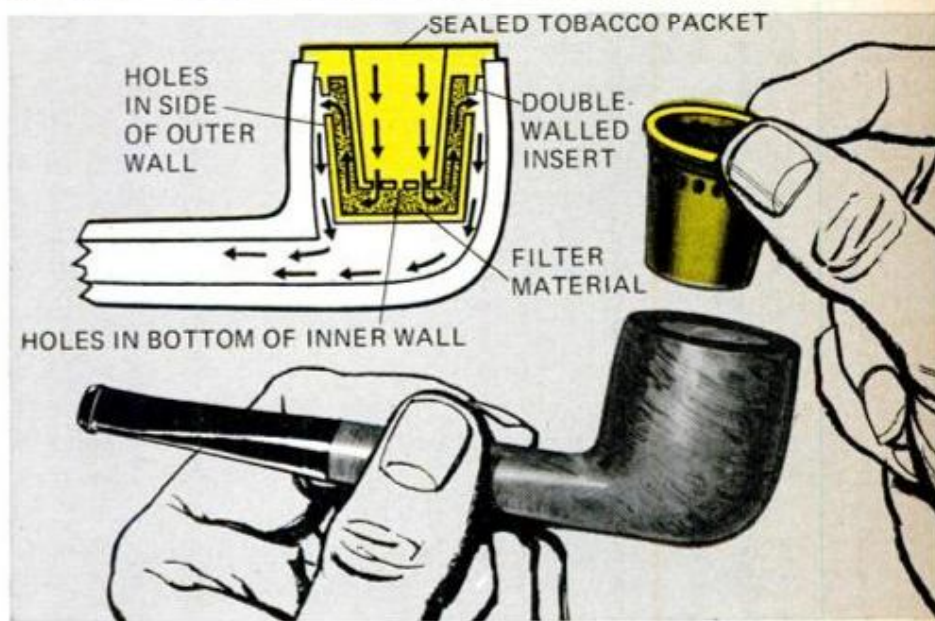
2. MOTOR-POWERED HAMMER works like a miniature pile driver, allowing you to sink heavy nails without any effort. A sliding weight in the head moves rapidly up and down, driven by an eccentric crank pin through reduction gears in the handle. The crank pin engages a shouldered slot in the weight in such a way that power is applied only on the downstroke. At the bottom of the downstroke, the pin slips off the shoulder and the weight springs back up, ready for the next stroke. This minimizes recoil and makes the hammer easy to hold.





3. CONVERTIBLE SUITCASE has fold-out legs that turn it into an all-purpose table for travelers and campers. With the legs extended, it can be used as a desk, snack bar, game table or bedside night stand. An additional panel swings out to form an ironing

board or long picnic table. With the lid raised, a mirror on the inside allows the suitcase to serve as a dressing table. The legs also enable the suitcase to be packed and unpacked at waist level, making its contents easy to reach without bending over



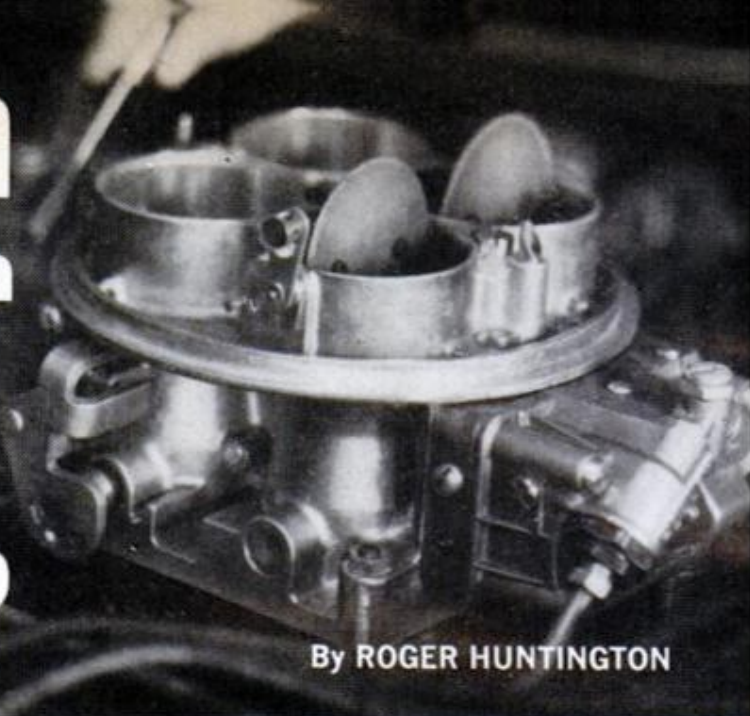
4. DISPOSABLE TOBACCO PACKETS eliminate the mess of loading and cleaning a pipe every time you want a smoke. You just slip a packet into the pipe bowl, peel off the seal on top and you're ready to light up. At the end of the smoke, you discard the used container, ashes and all, and insert a fresh one. The double-walled packets have a built-in filter for cleaner smoking and are designed to be sold in a variety of tobacco types to suit different smokers' tastes

5. NOVEL LEMON SQUEEZER at left works something like a hypodermic syringe. It consists of a plastic barrel with a nozzle on the end and a metal plunger that slides inside. You load a slice of lemon into the barrel, press the plunger and out comes a stream of juice without pits or rind. The lemon wedges itself into the plunger as it's squeezed so it's easily removed when the plunger is withdrawn

Inventors of the items shown on these pages are as follows: 1. Harold J. Von Keszycki, 5220 Collier Place, Woodland Hills, Calif. (No. 3,490,566); 2. Richard K. Willis, Route 28, Inlet, N. Y. (No. 3,376,940); 3. Harry A. Bell, Box 106, Hamilton, Mont. (No. 3,326,337); 4. Lib-

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How Much Carburetor Do You Need?



By ROGER HUNTINGTON

Before you go out and get a 'smaller' carburetor for better economy, or a 'bigger' one for hotter performance, you'd better know just how those multi-barrel designs work.

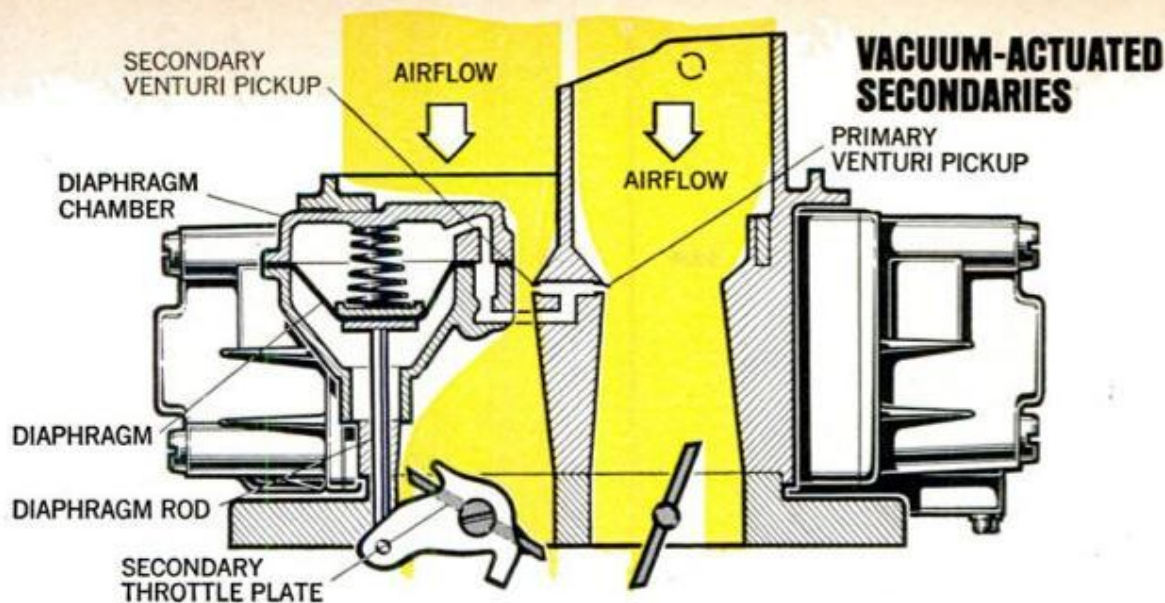
MORE AND BIGGER carburetors have been a favorite hop-up trick since the earliest days of hot rodding—and that was 50 years ago with Model T Fords. The carburetor throats, or venturis, are one of the tightest restrictions for the air to pass through in getting to the cylinders. Obviously the easiest way to reduce the restriction, and let the cylinders get a bigger gulp of fuel-air mixture on the suction stroke, is just to use bigger venturis and more of 'em. Nothing to it.

The hooker here is that you can very easily get *too much carburetion*. The big venturis really only help you at high engine speeds, when there's a lot of air being sucked into the engine. They hurt you at lower speeds. Here the velocity of air going through the venturi throats is slow and sluggish. There isn't enough suction and whipping action to break up and atomize the gasoline that's dribbling out of the fuel nozzle. The liquid fuel settles out and puddles in the manifold, so you can't get equal amounts to each of the cylinders through the twisty passages. Some cylinders run rich, others lean. Power and torque drop off. The engine burns more gas to develop a given power. Throttle response is sluggish. The engine coughs and stumbles when you punch the loud pedal at low speeds.

Here our engine would be happier with smaller venturis—big venturis for the top end and small ones for low speeds and cruising, when airflow is light. It's a vicious compromise.

The modern four-barrel automotive carburetor is a clever attempt to get around this. Here we have small primary venturis in front to feed the fuel efficiently at low speeds and when cruising on the highway. The big rear barrels are closed off at this time. You're running on one tiny two-barrel carb. Then when you want full power for passing or quick getaway, punch the gas pedal and you've got instant "big carburetion"!

There's a special secret to the wide-range flexibility of a modern four-barrel carburetor. You may not realize it, but all four barrels *don't open wide* when you punch the gas at any speed. If they did you'd get the same old stumbling and hesitation that comes with too much carburetion. The answer is a separate air-valve butterfly in the rear barrels programmed to open gradually as engine speed builds up and the engine can *use* the extra airflow. Generally this valve will start to open around 1500 rpm (when the regular throttles are wide open) and will reach full open between 3000 and 4000 rpm. At intermediate speeds you're getting just a partial flow through the



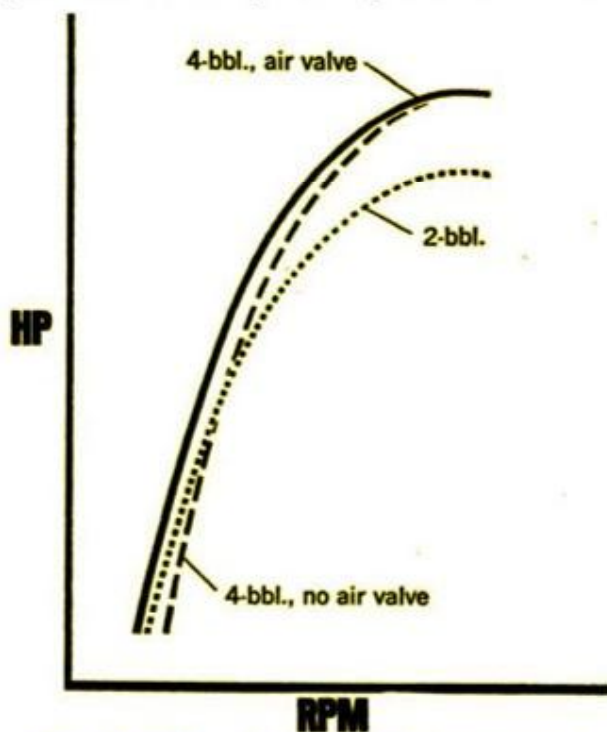
SECONDARY THROTTLE ACTUATION in Holley four-barrel is by means of vacuum diaphragm that senses flow vacuum in primary venturis. Front barrels, in effect, suck rear barrels open as engine needs extra air

rear barrels to maintain good fuel metering in the front barrels.

There are two ways to work the air valves. One is by a vacuum diaphragm that senses the airflow vacuum in the front venturis. Airflow through the front barrels literally sucks the rear barrels open. Holley carbs work this way. The more common (and cheaper) method is to pivot the air-valve plate on an offset shaft, so it will tilt open by itself under air pressure. The rate of opening is controlled by a spring tension on the shaft, which can be easily adjusted with a screwdriver like late Carter and Rochester carbs.

These air-valve secondary systems on modern four-barrel carbs make all the difference in overall performance, smoothness and flexibility. In the old days a two-barrel would actually develop more torque than a four-barrel up to 2000 or 2500 rpm because the engine was overfed with all four barrels wide open. And it invariably had quicker throttle response, better fuel economy and a smoother feel at low and medium cruising speeds.

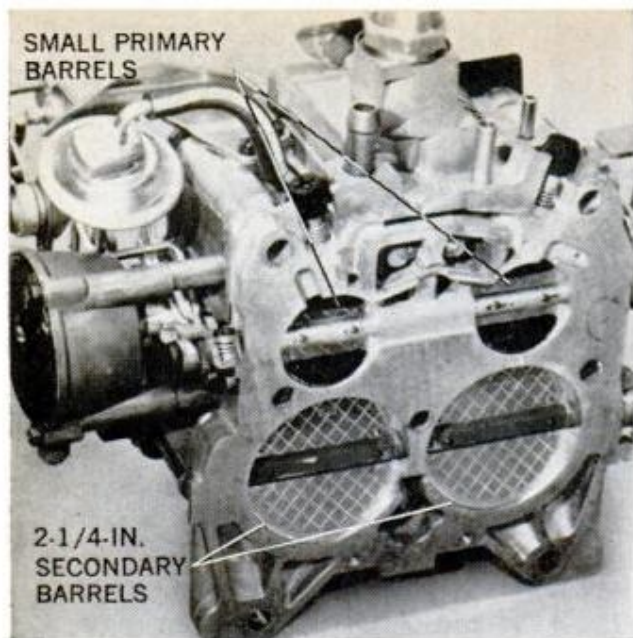
The air valve has changed all that. A modern air-valve four-barrel will outpull a typical two-barrel from idle speed on up. With as good or better throttle response and smoothness. There's a very good chance you'll get slightly better gas mileage, too. Fuel economy at cruising speeds depends a lot on how *small* you can make the venturis to keep the air velocity up when the airflow into the



FOUR-BARREL has higher peak horsepower; at lower speeds may give less power unless it has air-valve design for secondary venturis

engine is low. Most modern four-barrel carbs have considerably smaller primary venturis than a two-barrel that would be used on a similar engine. The result is usually a quarter to a half mpg better economy in normal driving.

The logical extreme of small primary venturis and big secondaries would be a design like the late GM Quadrajets carb (and more recently the large Autolite four-barrel and the Carter Thermo-Quad, both used on a number of 1971 models). They feature very small primary

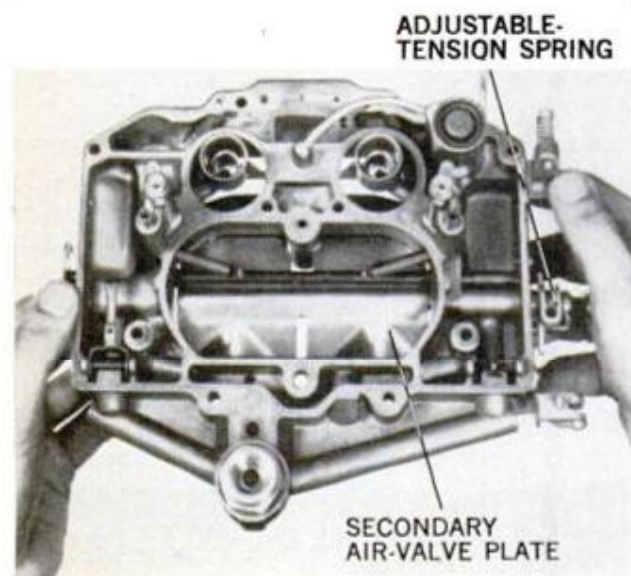


GM QUADRAJET four-barrel, used on most large GM engines, has very small primary barrels for economical cruising and low exhaust emissions. Large 2¼-inch secondary barrels provide air for full power

venturis for cruising and huge 2¼-inch secondary barrels to feed a tremendous volume of air for ultimate top-end power on engines of all sizes. Great idea. These carbs give excellent fuel economy when cruising and also low exhaust emissions because they can be run leaner without surging. The latter is mainly why Ford and Chrysler have gone to the design.

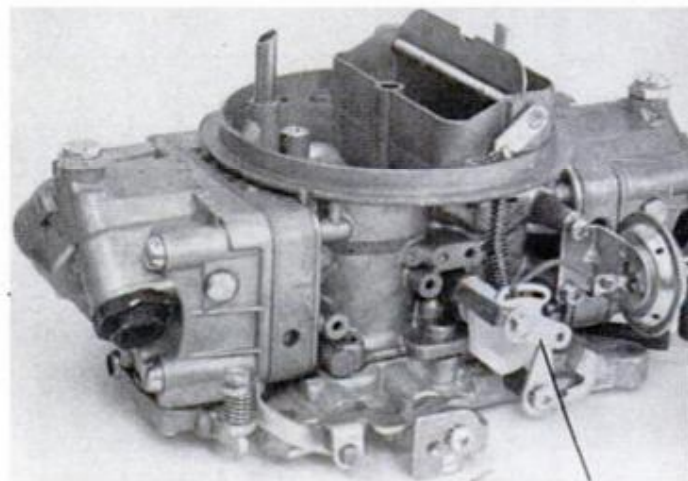
The important fact remains that a four-barrel carburetor does not need to mean less gas mileage. It will usually give *more* mileage—if driven the same as a

CARTER THERMO-QUAD is quite similar in operation to the GM Quadrajets, with its small front barrels and large rear barrels. Secondary valve plate on this carb will tilt open as the pressure increases



two-barrel; in other words, if you don't punch into the throttle hard. When you continually use the extra power of the four-barrel you use more gas. Fuel consumption is a close function of power output level with any engine or any carburetor. The four-barrel has good economy potential, depending how you drive.

As we go up in carburetion from a single four-barrel we run right into the "law of diminishing returns." Each increase in venturi area brings a proportionally smaller power boost than the previous one. You might jump 10 percent in hp when going from a two to a four-barrel, but adding a second four-barrel wouldn't pick up another 10 percent. It



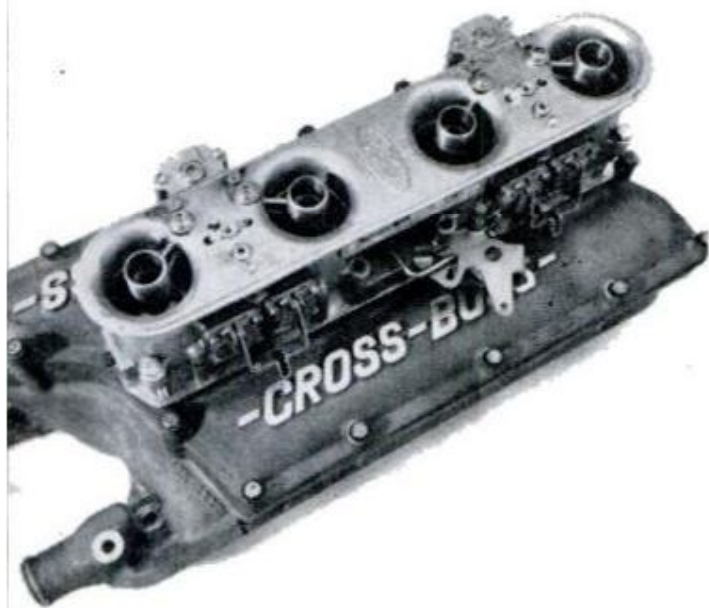
PROGRESSIVE MECHANICAL LINKAGE

HOLLEY FOUR-BARREL has a progressive mechanical linkage to operate rear barrels. Double accelerator pumps squirt in a large volume of gas when throttle is punched. Good off line and when speed shifting

would be more like 3 to 5 percent. If you could somehow add a *third* four-barrel, the hp boost would be only 1 or 2 percent, or less. Adding two, three or four two-barrel carbs to an engine the result's the same. You quickly reach a practical limit.

For these reasons, Detroit carmakers are gradually settling on one large air-valve four-barrel as the ideal for high-performance street engines. There are only a few exceptions today: Chrysler still uses two quads with "progressive" throttle linkage on the 426 Hemi, to cruise on just the rear carb. Its unique triple two-barrel carburetion system for the 440 and 340-cu.-in. performance engines is more flexible. The end carbs are

opened by vacuum diaphragms that sense venturi vacuum in the center carb—actually the same principle as the secondary air-valve operation on some four-barrels. There is no direct throttle linkage to the two end carbs. The center carb gradually sucks them open as the engine requires the extra air. The system works beautifully to combine good power, fuel economy, low exhaust emission and low-speed response on the street. There's a good power boost over a single four-barrel, too, since the carb venturis are closer to the cylinders they feed, which gives more even fuel-air mixture distribution than with one four-barrel setting in the middle of the engine.



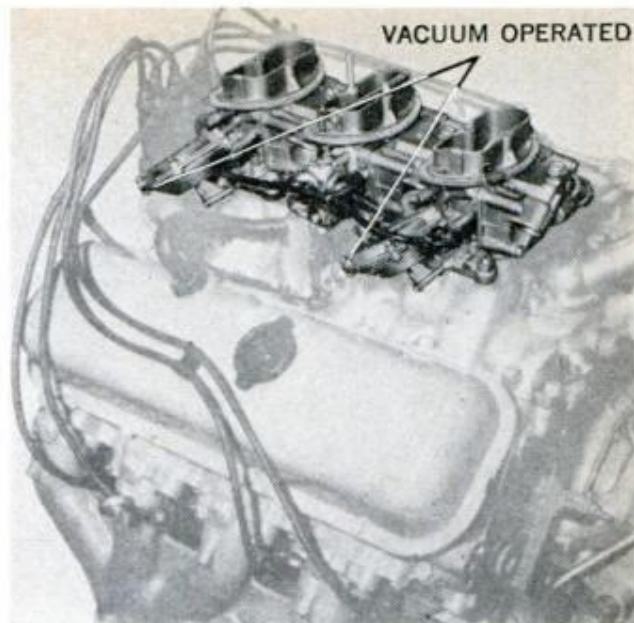
RACING FOUR-BARREL from Ford-Autolite has four barrels in line for more even fuel mix. In carb shown, mounted on Cross-Boss ram manifold, huge 2¼-inch throttle bores flow 1400 c.f.m. air at full power

Here's how these various carburetion system might measure up on peak horsepower and fuel economy (easy and hard driving), assuming the same engine and no other changes. Assume the base engine develops 300 hp with a two-barrel carb:

	HP	MPG EASY	MPG HARD
2-barrel	300	15	13
4-barrel (Quadrajets type)	330	15+	12
Triple 2-barrel, vacuum	340	15	11
Triple 2-barrel, progressive	340	14	11
Two 4-barrel, progressive	345	12	9

You can see how the law of diminishing returns works when carburetion is added. You can pay a big price in fuel economy and low-speed performance for a small boost in top-end power.

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TRIPLE TWO-BARREL CARBURETOR developed by Chevrolet for its '67 Corvette and used by other manufacturers as well. Carb in center is actuated by a foot throttle; the other two are vacuum-operated

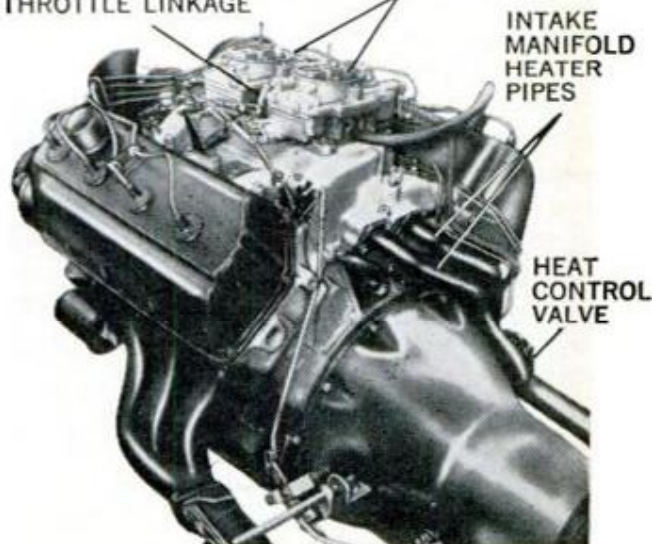
How much carburetion do you need for your car?

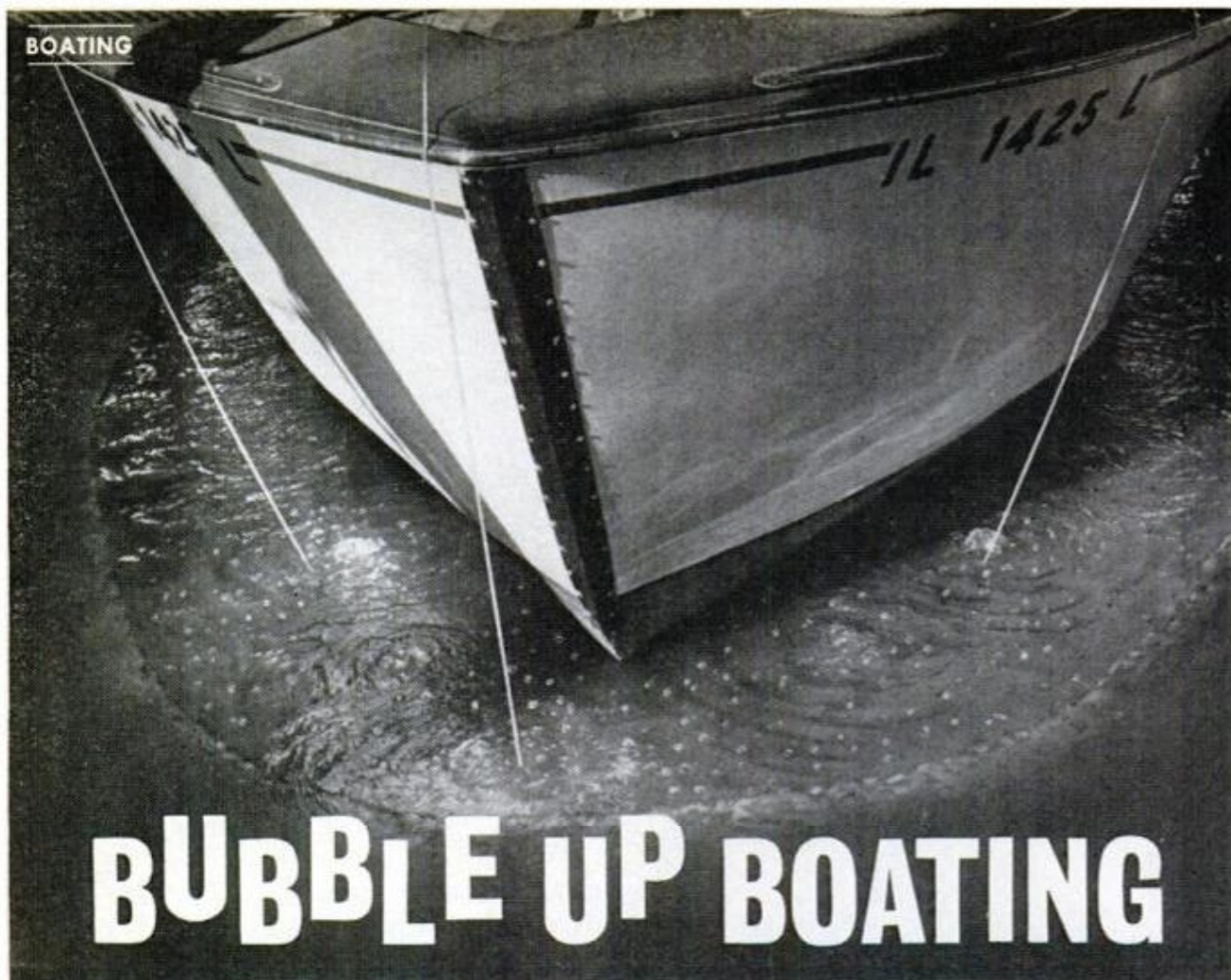
We still feel the single four-barrel is a good compromise for everyday street driving with the average "performance" car. If you have a stock V8 with a two-barrel you can switch to a four-barrel for \$100 to \$150, using all factory parts or an aluminum manifold, replacement carb and special throttle linkage from the hot-rod industry. The factory switch would be cheaper (all companies have good

(Please turn to page 226)

DODGE, PLYMOUTH 426 Street Hemi uses two Carter four-barrel carbs in line with progressive or staged throttle linkage, cruises on rear carb only. Heat from exhaust manifold warms intake to vaporize fuel

STAGED CARBURETOR DUAL FOUR-BARRELS THROTTLE LINKAGE





BUBBLE UP BOATING

Why pay more for dry storage during winter months when for just \$150 you can make your own portable wet-storage system?

By **RAYMOND A. PALMER**

Technical Illustration by Fred Wolff

EACH YEAR when winter winds begin to blow and temperature falls, wet-storage advocates gain new adherents.

Formerly, the last week of October and the first days of November were busy with cruisers being hauled from the water and rolled onto storage platforms. The violent movement of a boat on a cradle as it's pulled from the water and racked onto the storage skids causes more damage than an entire season of cruising! Hulls suffer from drying out and seams may need recaulking. Winter covers must be put in place to protect from snow and ice. This means continual checking, adjustment and retying of tarpaulin all winter long. Add to this the ever-present possibility of theft or vandalism and you wonder whether a boat is worth having at all!

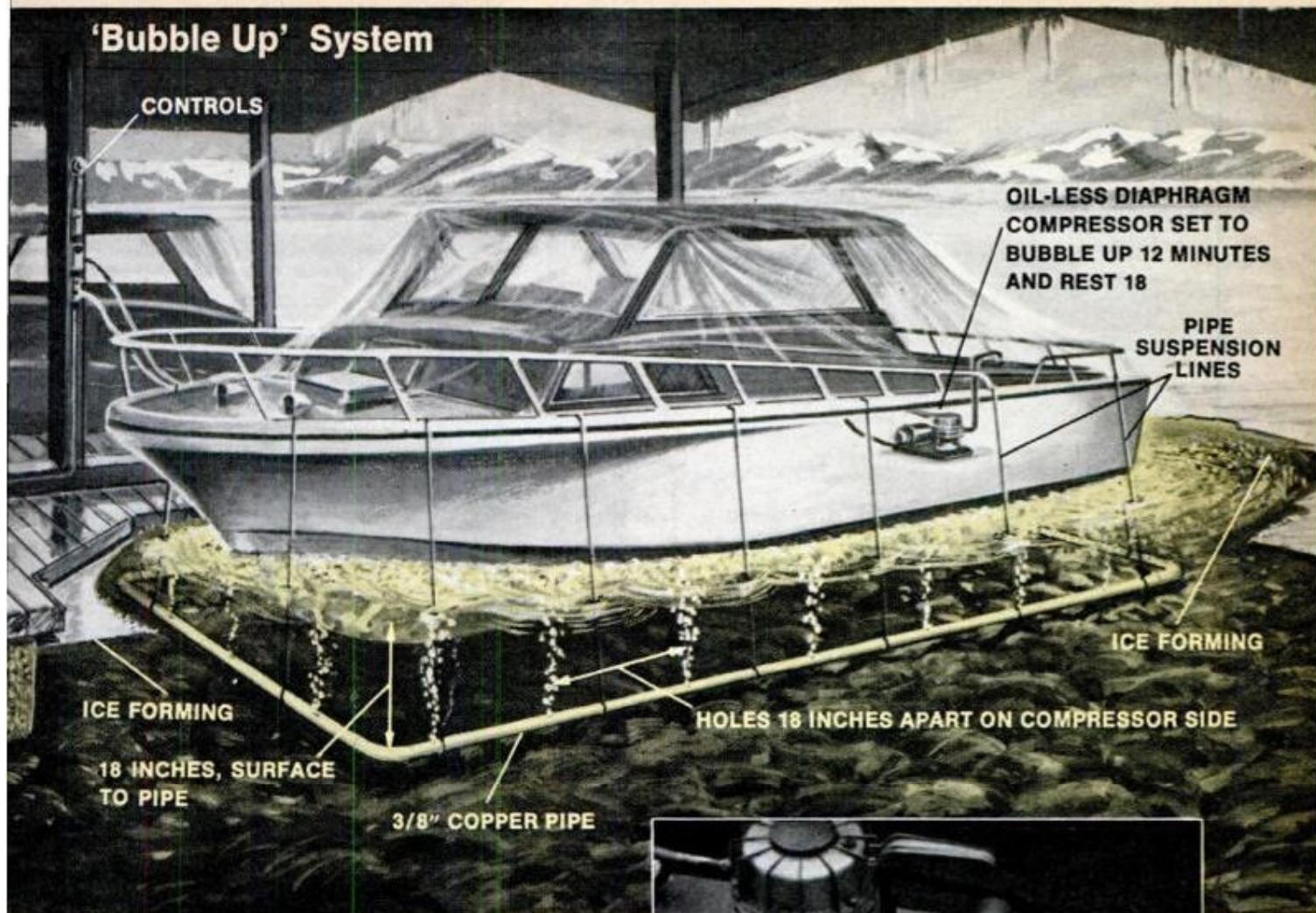
Four years ago we decided to join the wet-storage gang. We had a good floating dock with an all-weather roof which covered the boat and the surrounding walk.

There was plenty of electric power dockside to heat the craft when winter work was needed. We did tie a thin sheet of plastic over our hard top to keep it clean and protect the paint. We did not remove the batteries since they could easily be checked and recharged aboard. Besides, battery power was needed to run the automatic bilge pump protecting us if we took on any water during the winter. Perhaps, the advantage that appealed most was the privilege of going aboard without having to set up ladders and untie covers.

Our next step was to acquire a bubbler. We could purchase the complete package with all the controls or we could assemble our own. We chose the latter but didn't start from scratch since some of our neighbors had experimented with their own designs. We used their experience and what we had read about winter storage and began our own project.

We started with ½-inch plastic water

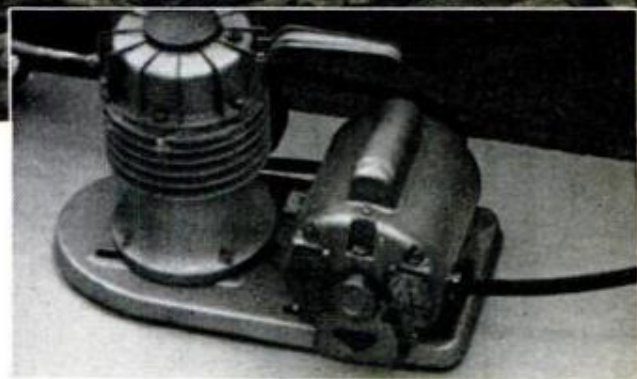
'Bubble Up' System



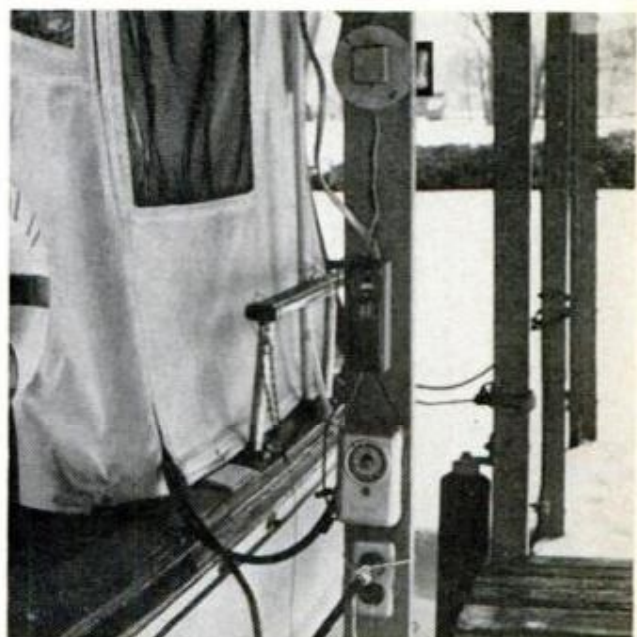
pipe. This was cheap, easy to cut and with all the standard fittings available we had no trouble assembling the shape needed to encircle our 28-foot cruiser. Unfortunately, plastic pipe is not a good choice. The pipe is so light it was necessary to attach weights to hold it under water and since it's delivered in coils we were never able to straighten it enough to follow the contour of the hull. In addition, the $\frac{1}{2}$ -inch size was much too large. Our compressor labored three minutes to clear the lines of water before bubbles appeared.

We next tried $\frac{3}{8}$ -inch hardwall copper pipe. This eliminated two drawbacks of plastic. Copper pipe sank to the depth it was set for and because of its smaller diameter the compressor was able to clear all water from the lines in less than a minute. We used copper right-angle sweat fittings at the corners and compression fittings in front and at two places on the

CONTROLS FOR DEICER SYSTEM are attached to dock post. They comprise (top to bottom) a small fuse box, Honeywell remote bulb-temperature control, Paragon percentage timer with 30-minute dial and power outlet for compressor located aboard boat
NOVEMBER 1970



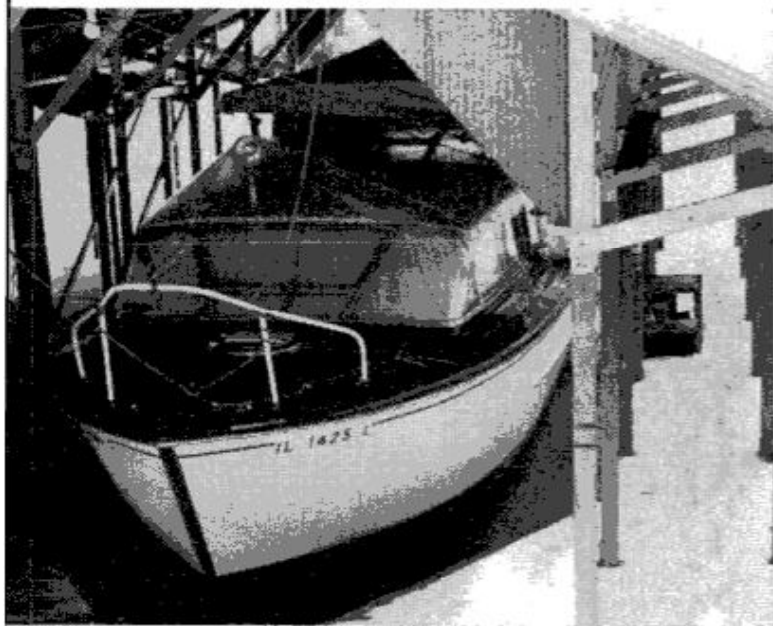
OIL-LESS DIAPHRAGM COMPRESSOR (above) must have air hose wrapped with tape to avoid freezing



sides so that the assembly could be taken apart for summer storage.

Drilling air holes in the copper tubing was difficult. We tried unsuccessfully to tighten a $\frac{1}{64}$ -inch bit in our electric drill. Finally a friend suggested using a pin vise. This solved the problem but we broke the first two bits (75 cents each) before we discovered our mistake. If the small drills are inserted in the pin vise so only $\frac{1}{16}$ inch protrudes, chance of breakage is almost eliminated. We then drilled holes which were spaced every 18 inches on the compressor side and 12 inches on the other side so that both lines would receive approximately the same pressure.

The system was run with a piston com-



AUTHOR'S BOAT floats clear and comfortable during midwinter freeze with bubbled water round the hull

pressor but after the first extreme cold weather we changed to an oil-less diaphragm compressor. The oil had congealed in the piston-type and hard starting had blown fuses. The diaphragm compressor is rated at 2.5 cubic feet per minute with 35 pounds pressure per square inch. This is sufficient to clear 75 feet of $\frac{3}{8}$ -inch pipe in about one minute and produce big bubbles all around the hull.

We used plastic-covered bell wire fastened at intervals of 5 feet around the boat to hold the tubing suspended 18 inches under the water and 6 to 9 inches from the side of the boat. The tubing's depth depends on local weather conditions and ice thickness in your harbor. Winters in Missouri are mild compared to those in Minnesota, so adjustment of the timer and

bubbler depth will vary with your area.

Electrical hook-up is simple. At the top of a post we installed a small 10-amp fuse box and ran a wire to the Honeywell remote bulb temperature control. The bulb had a liquid-filled wire long enough to attach the bulb to the dock one inch above the water surface. (*Ed. note:* Boaters in coastal areas will find tides and saltwater corrosion special problems that may best be dealt with by using a commercial ice preventive device such as Ice-Away made by Anchormatic, 8100 Paseo, Kansas City, Mo. 64131.) We set the control at 27° and a temperature drop to that level or below would turn on the system. This control was then connected to a Paragon percentage timer with a 30-minute dial. The timer was set to operate 7 minutes out of 30 during November and December, and advance to 12 minutes in the colder months of January and February.

Amateur engineers must learn the hard way. The first hard freeze and our harbor neighbor phoned, "You're frozen in tight." What a heart breaker! The air hose was frozen at the waterline. Careful use of a blowtorch soon melted the line and we then wound 8 feet of heat tape around the air hose. We further reinforced the hose with refrigeration tape.

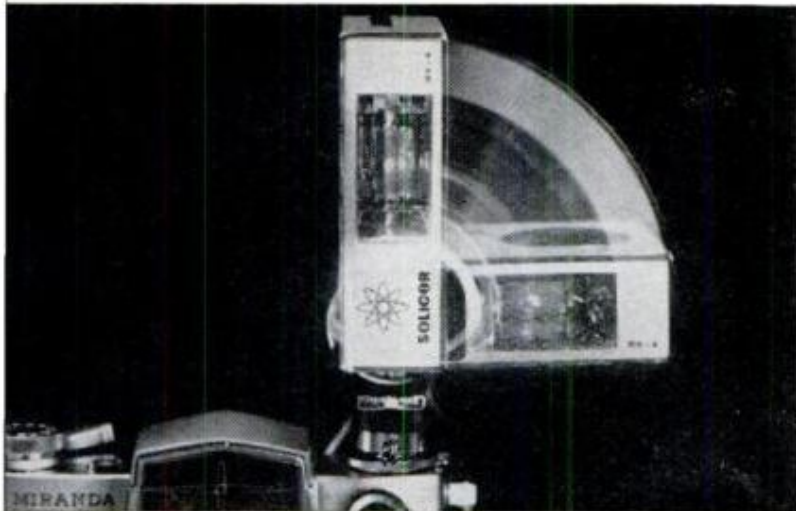
Then for the remainder of the winter we bubbled. The ice around the boat was often 12 inches thick but the *Alice L* floated in clear water.

In assembling your own deicing device, keep these thoughts in mind:

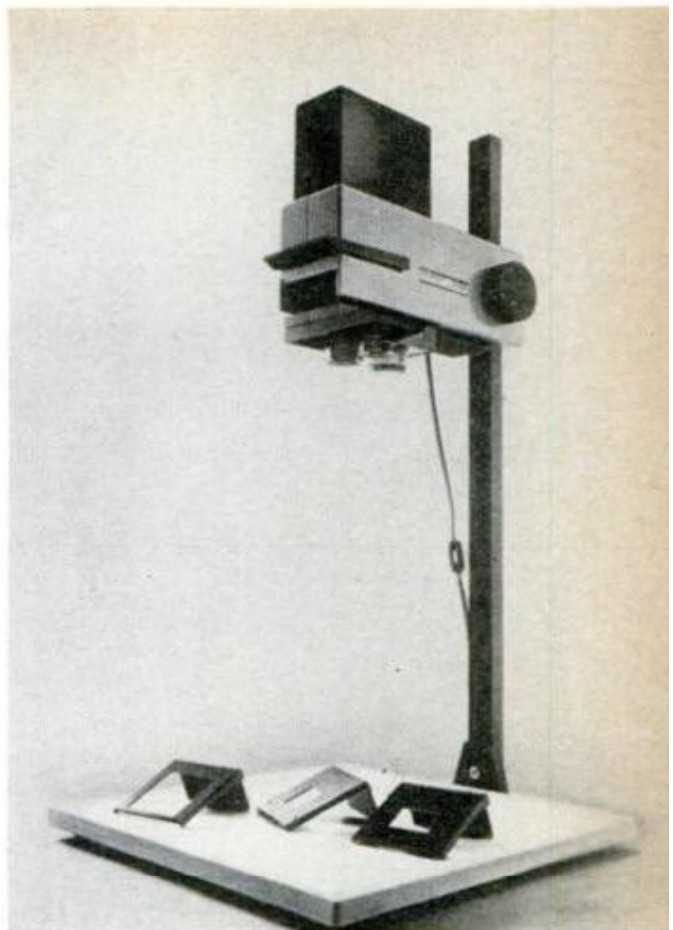
- Use the smallest pipe which can be drilled and still be stiff enough to hold contour around the hull.
- An oilless diaphragm compressor is a must since a piston-type will be difficult to start in cold weather.
- Use a heat tape to protect your lines. Condensation from the compressor can freeze up the air hose at the waterline.
- Avoid poor materials for the air lines. Some bubblers are put together with garden hose. While this is functional in mild weather, in extreme cold the compressor will spend so much of its running cycle clearing water from the lines, little time will be left over for bubbling. Plastic water pipe has the additional handicap of needing weights to keep it submerged.
- We experienced some difficulty with standard motors and found high-torque

(Please turn to page 228)

New in Photography



LOW-COST STROBE FLASH operates on two ordinary penlight batteries or from an a.c. outlet. It swivels for use in either a vertical or horizontal position and has a guide number of 28 with ASA 25 film. Flash duration is 1/2000th of a second and recycling time 4 to 6 seconds on batteries, 8 to 10 seconds on a.c. Price of the Soligor MK-4 is \$19.95. Allied Impex, 168 Glen Cove Rd., Carle Place, N. Y.



HANDY ENLARGER for beginning dark-room hobbyists is this inexpensive Durst J66. Priced at about \$75, it has three interchangeable negative carriers for 35-mm, 2 1/4 x 2 1/4 and 126 film. Two lenses of 50 and 75 mm are arranged side by side in a sliding mount so either can be shifted quickly to change magnification. Enlarger disassembles for storage. Ehrenreich Photo-Optical Ind., 623 Stewart Ave., Garden City, N.Y.



NEW CARTRIDGE-LOADING movie projectors have been added to those announced in PM last month (see [New Magic for Home Movies, page 152](#) Oct. '70 PM). Above is Kodak's latest entry, the M110, capable of taking big 400-foot reels in plastic cartridges. You just drop one in a slot and the film threads automatically through the projector and then back into the cartridge when it's finished. The projector also accepts the smaller 50 and 100-foot cartridges like the earlier M105 and M109 models. Price is \$214.50 with zoom lens; \$194.50 without. Similar self-threading, automatic-rewind cartridge projector from Bell & Howell (right) takes four cartridge sizes: 50, 100, 200 and 400 feet. Three models range from about \$160 to \$220. Both Kodak and B&H projectors take Super-8 or regular 8-mm film.

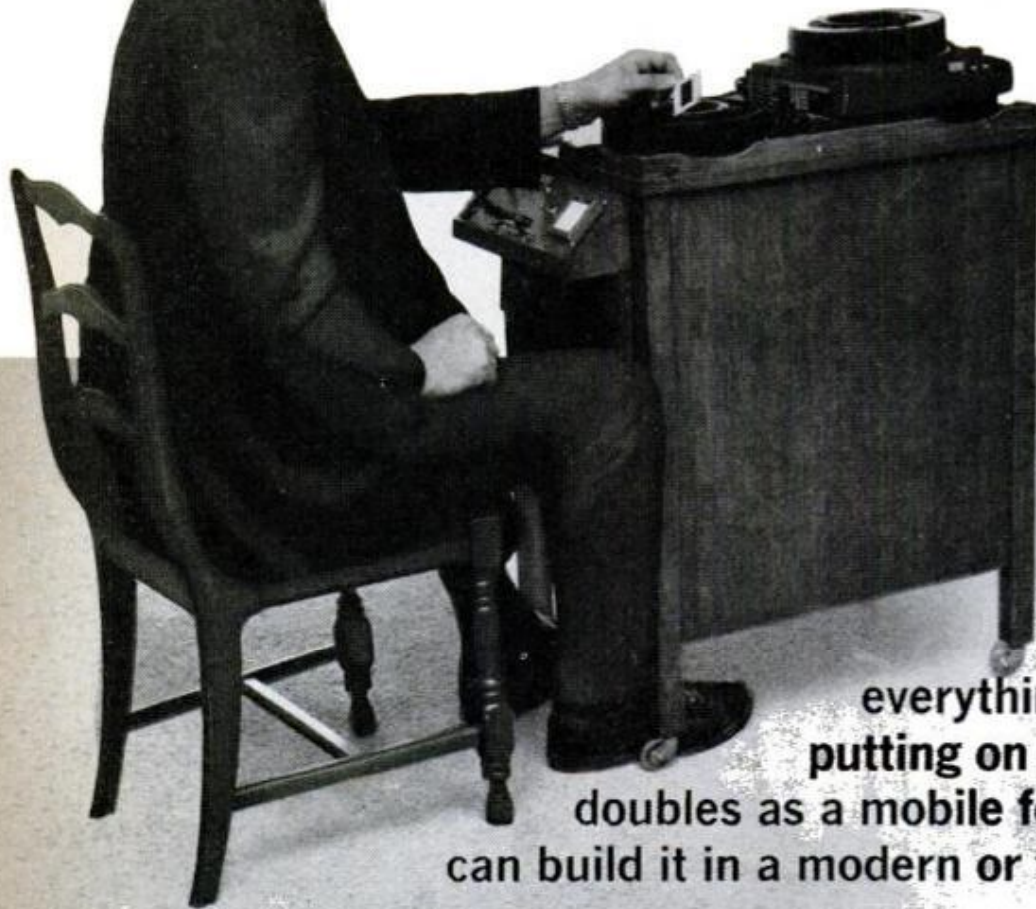
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Rollaway Projection Stand for Slides or Movies

By HOWARD R. CLARK



This wheeled cart stores everything you need for putting on shows and also doubles as a mobile food server. You can build it in a modern or traditional style

SETTING UP for a slide or movie show can be a bothersome chore if you have to drag the projector out of a closetful of clutter, find a table to put it on, then go searching for those stray film reels or slide trays. This mobile projection stand solves the problem by keeping everything at your fingertips. You just roll it out, set the projector on top, and you're ready to start the show.

The wheeled cart is roomy enough to store both a slide and movie projector, plenty of trays or reels, extra editing equipment and even a tape recorder for adding sound to your presentations. The top surface puts the projector at a height of about 32 inches—a convenient working level that lets you operate it comfortably from a sitting position.

The slickest feature of all is a built-in, slope-front control panel that slides out like a drawer from one end. The panel contains three switched power outlets and

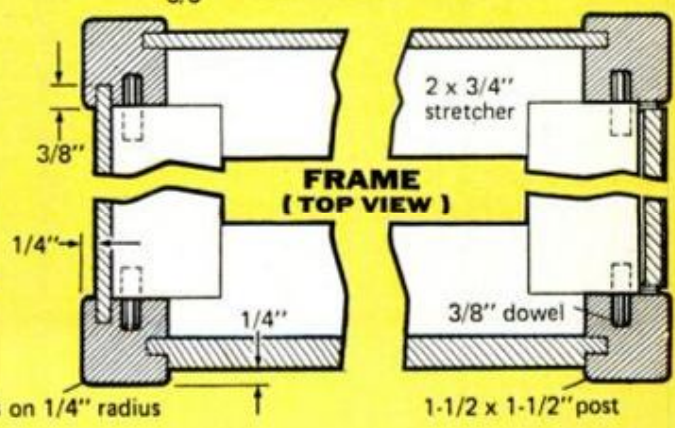
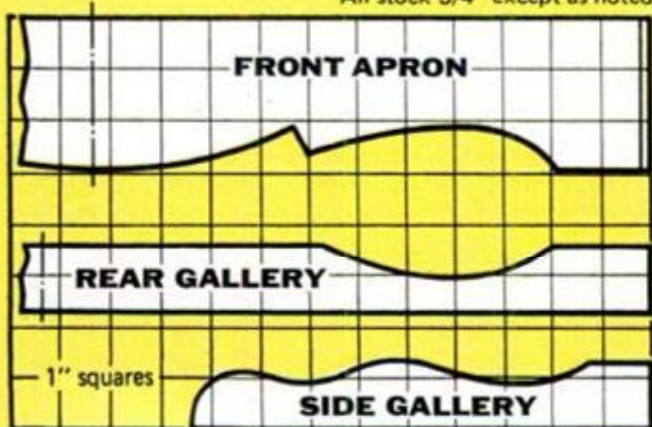
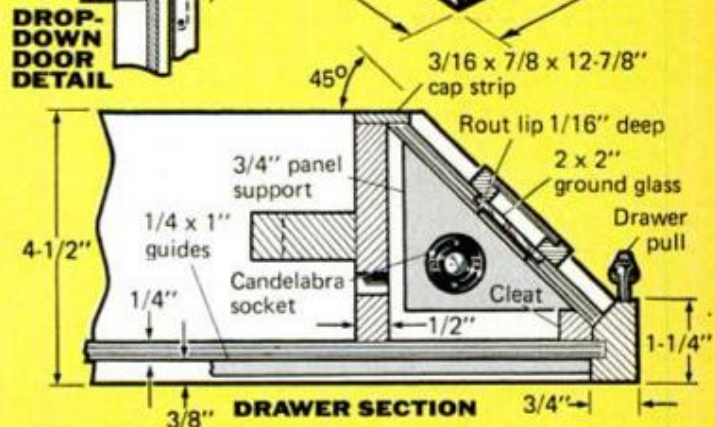
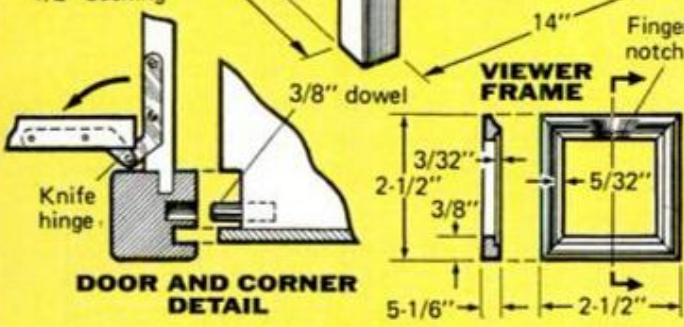
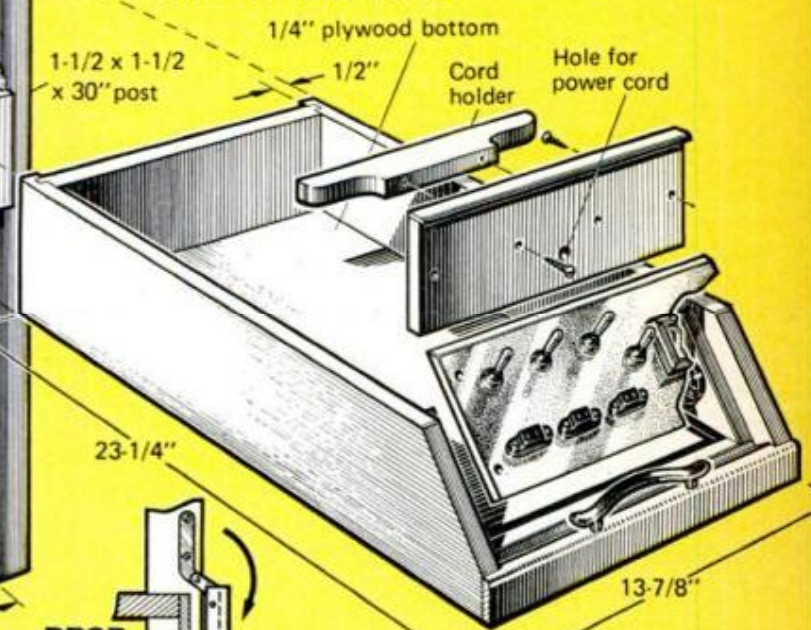
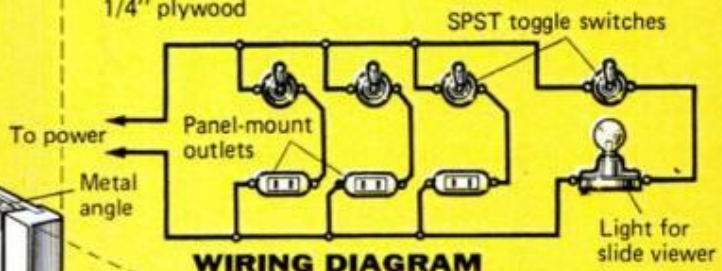
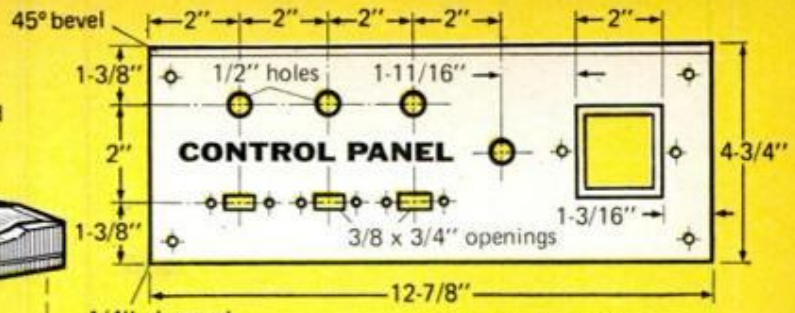
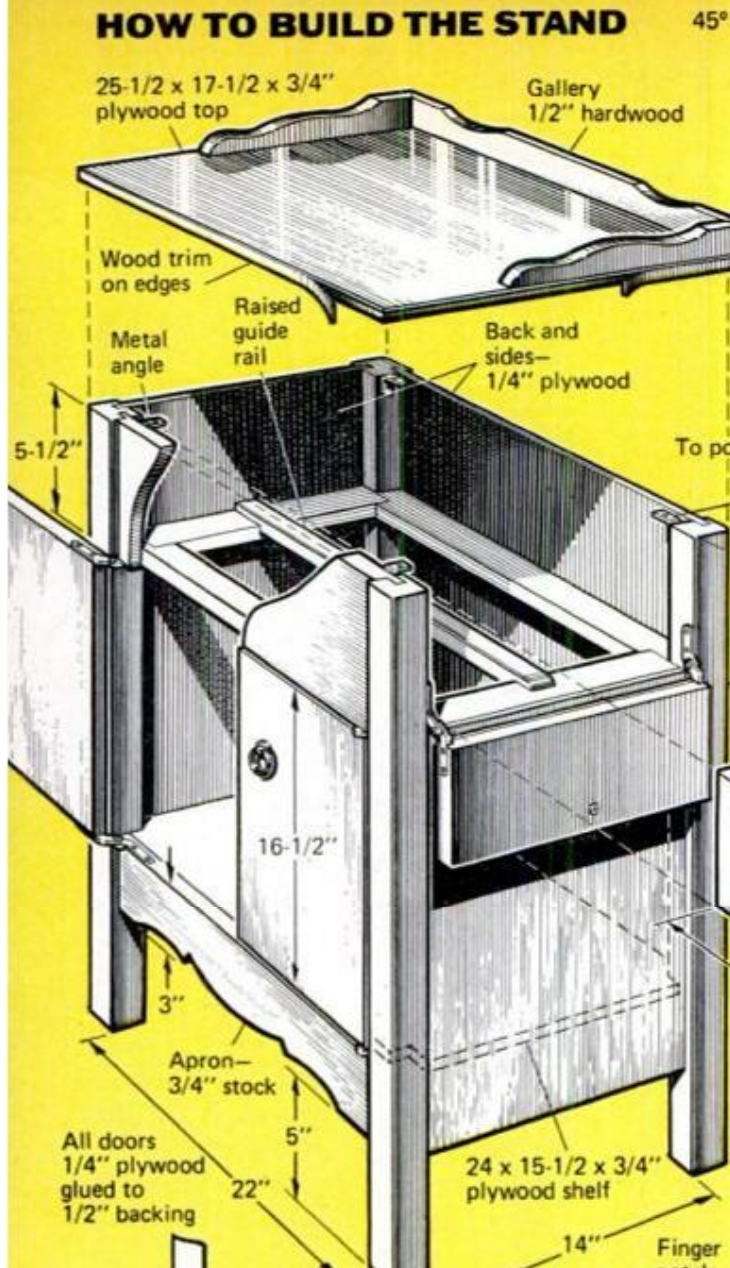
a back-lighted slide viewer for checking and editing your transparencies. The outlets enable you to plug in not only the projector but additional equipment like a



INTERIOR OF STAND can be left as one big compartment for bulky equipment or partitioned off to hold smaller supplies, depending on your own needs

POPULAR MECHANICS

HOW TO BUILD THE STAND

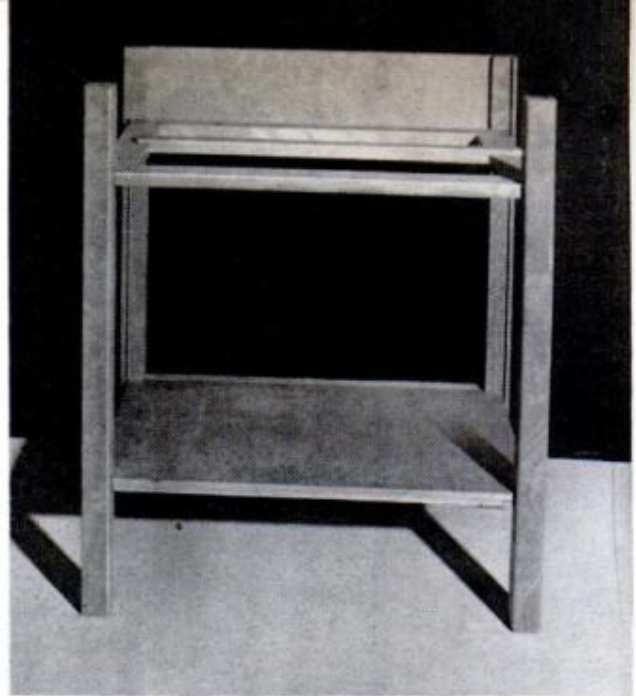


Technical Art by Peter Trojan

Round corners on 1/4" radius



BASIC POST-AND-RAIL FRAME is shown in photo at right. Grooves in corner posts for back and side panels are blind, extending only part way down so they won't show where legs are exposed. Setup for cutting these grooves on dado head is shown above. Mark fence to indicate blind end of post, then drop the post over blade at this point and feed it forward



tape recorder and a floor or table lamp. With a lamp plugged in, you can control room illumination yourself without having to ask someone else to turn the lights on and off every few minutes.

When not in use, the cart rolls out of the way against a wall and can double as a dining room sideboard, mobile snack bar or roll-around stand for a portable TV set. Decorative clear-plastic casters make good wheels since they're trim-looking without being conspicuous.

For a rich appearance, use hardwood-veneered plywood for the top, sides and doors, with matching solid stock for the leg posts, apron and gallery strips. You can build up the $\frac{3}{4}$ -inch thickness for the top, front and doors by gluing $\frac{1}{4}$ -inch veneer plywood to a $\frac{1}{2}$ -inch backing of plain plywood. This trick will let you cut all the outer faces from the same $\frac{1}{4}$ -inch sheet used for the side and back panels, saving the cost of a $\frac{3}{4}$ -inch sheet. Birch is a good choice since it is readily available and less expensive than fancier hardwood plywoods, yet can be finished to simulate almost any wood tone you desire.

Cut the main doors and front panel from a single piece of plywood and do the same for the drop-down side door and the panel below it. This way, when the pieces are assembled, you'll get an unbroken flow of grain for a neat, professional appearance. The exposed edges of the top and doors can be concealed with wood tape. The scalloped edges on the apron and gallery give the cart an Early American appearance. If you have a preference for a more modern style, you can omit the curlycues.

The four corner posts are grooved to take the edges of the side and back panels for a sturdy construction. The grooves are $\frac{1}{4}$ inch wide and $\frac{3}{8}$ inch deep and can be cut on a table saw with a dado head set to a $\frac{1}{4}$ -inch width. Note that they're blind, stopping five inches from the lower ends of the posts so they won't show where the legs are exposed. To cut them accurately, measure five inches from the rim of the dado blade toward the rear of the saw table and mark this point on the fence. Align the blind end of each post with this mark on the fence and carefully lower the post onto the blade, making a pocket cut. Continue the cut by feeding the post forward to complete the groove. This way, all four posts will come out identically grooved. By hand, chisel out the rounded ends of the grooves left by the curved blade so the cuts are square throughout their length.

Use offset knife hinges so the doors will swing fully open without binding. The drop-down door that hides the control panel must be carefully positioned so it clears the drawer in the open position, but makes a snug fit when it's closed. The toggle switches and panel-mount outlets are standard radio parts available at electronics-supply houses. The slide viewer is illuminated by a small $7\frac{1}{2}$ -watt night-light bulb in a candelabra socket. Note that there's a finger notch cut out at the top of the viewer frame. This makes it easy to lift slides out of the frame's recess. When not in use, the power cord for the control panel is kept neatly coiled around a cleat inside the drawer so it's out of the way. ★★★

WANT TO STARTLE your audience the next time you put on a slide show? Try projecting some extreme close-ups of common household objects and ask your friends to guess what they are. Chances are, they'll have a hard time identifying some of the strange-looking results you'll get.

Blown up several hundred times, the eye of a tiny sewing needle comes out so big you could put your head through it. The strands in a lady's stocking look like a cargo net. Bristles in a toothbrush take on the appearance of logs the size of telephone poles. Some typical examples of such effects are shown at the bottom of this page.

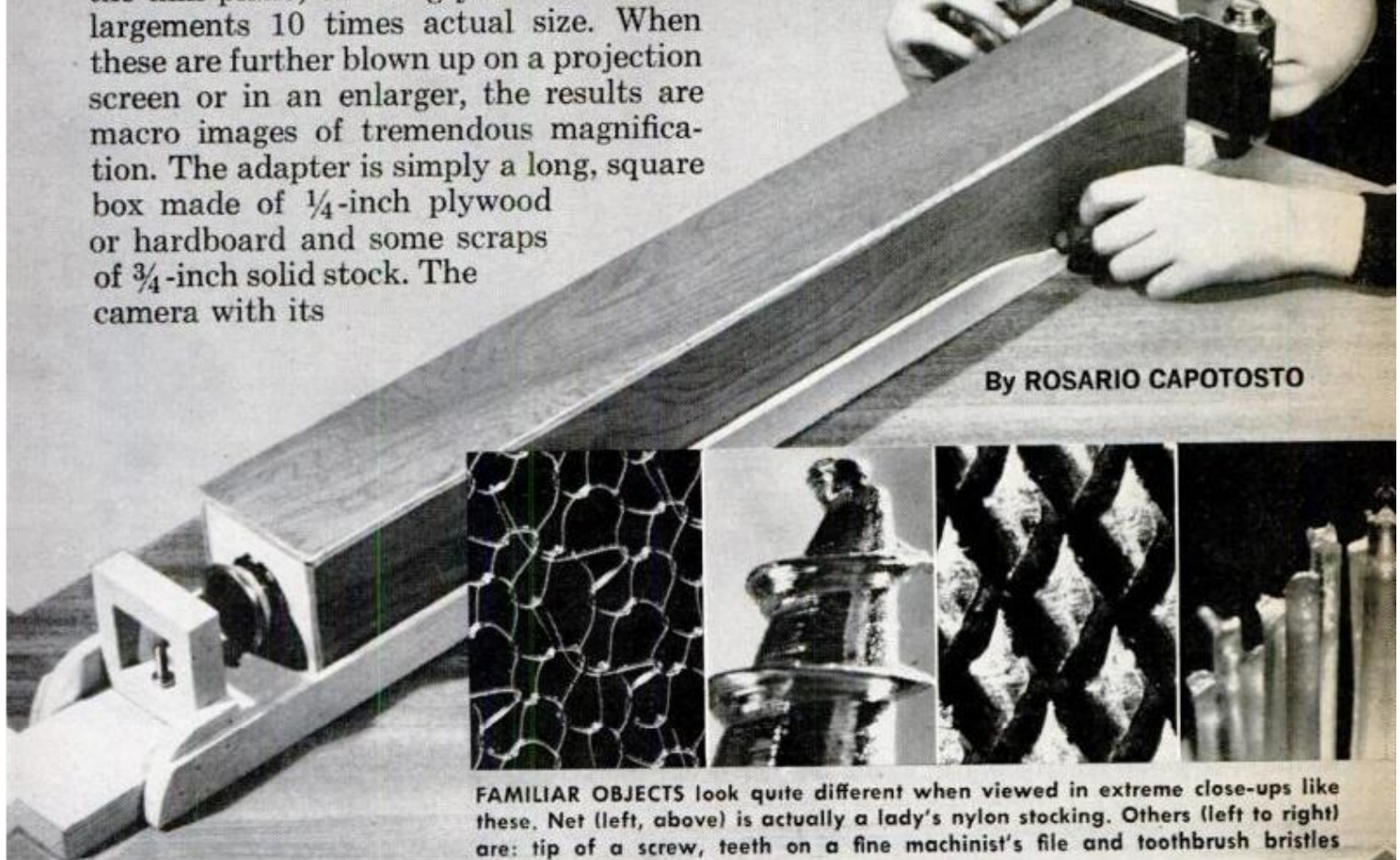
All you need to produce sensational close-ups like these is a 35-mm single-lens-reflex camera and the homemade lens adapter shown here. The adapter is essentially a mammoth extension tube similar in principle to the accessory tubes sold for use with interchangeable-lens cameras, but much longer. It spaces the regular camera lens about 30 inches away from the film plane, enabling you to make enlargements 10 times actual size. When these are further blown up on a projection screen or in an enlarger, the results are macro images of tremendous magnification. The adapter is simply a long, square box made of 1/4-inch plywood or hardboard and some scraps of 3/4-inch solid stock. The camera with its

Blow It Up BIG

This simple setup lets you produce eye-catching close-ups of tiny objects with any 35-mm SLR camera



By ROSARIO CAPOTOSTO



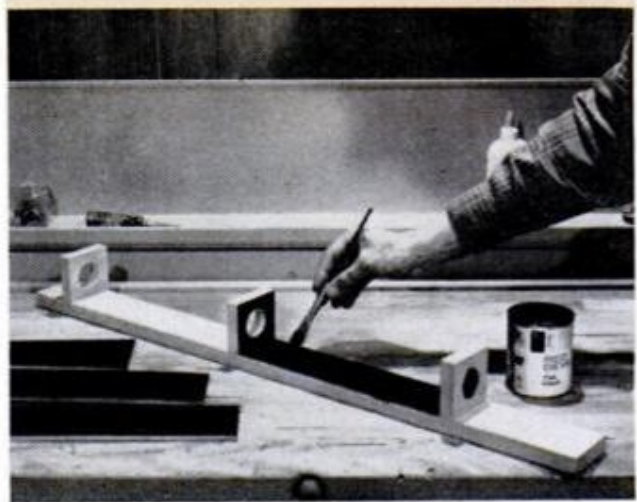
FAMILIAR OBJECTS look quite different when viewed in extreme close-ups like these. Net (left, above) is actually a lady's nylon stocking. Others (left to right) are: tip of a screw, teeth on a fine machinist's file and toothbrush bristles

lens removed is mounted at one end of the box and the lens is inserted in the other end. The lens must be turned around and used backward—with its front facing the camera—because a rule of optics requires the elements to be reversed if the distance to the film plane is increased more than eight times the focal length. So size the opening in the end of the box to take the forward barrel of the lens rather than the rear threaded portion.

To join the hole in the camera body to the hole in the other end of the box, you need a short length of adapter tubing. This can be a standard extension tube sold to fit your camera or, for a less expensive dodge, a piece of 1½-inch-diameter drain tail piece tubing. The latter is a common hardware-store plumbing item and has a flange that makes it easy to attach to most SLR cameras. All you need is an accessory screw-in adapter ring to match your camera (the Practica type shown here fits many SLRs). Clamp the flange of the tubing between the two parts of the adapter ring and screw the assembly into your camera body. Make the hole in the box a snug fit for whatever tubing you use.

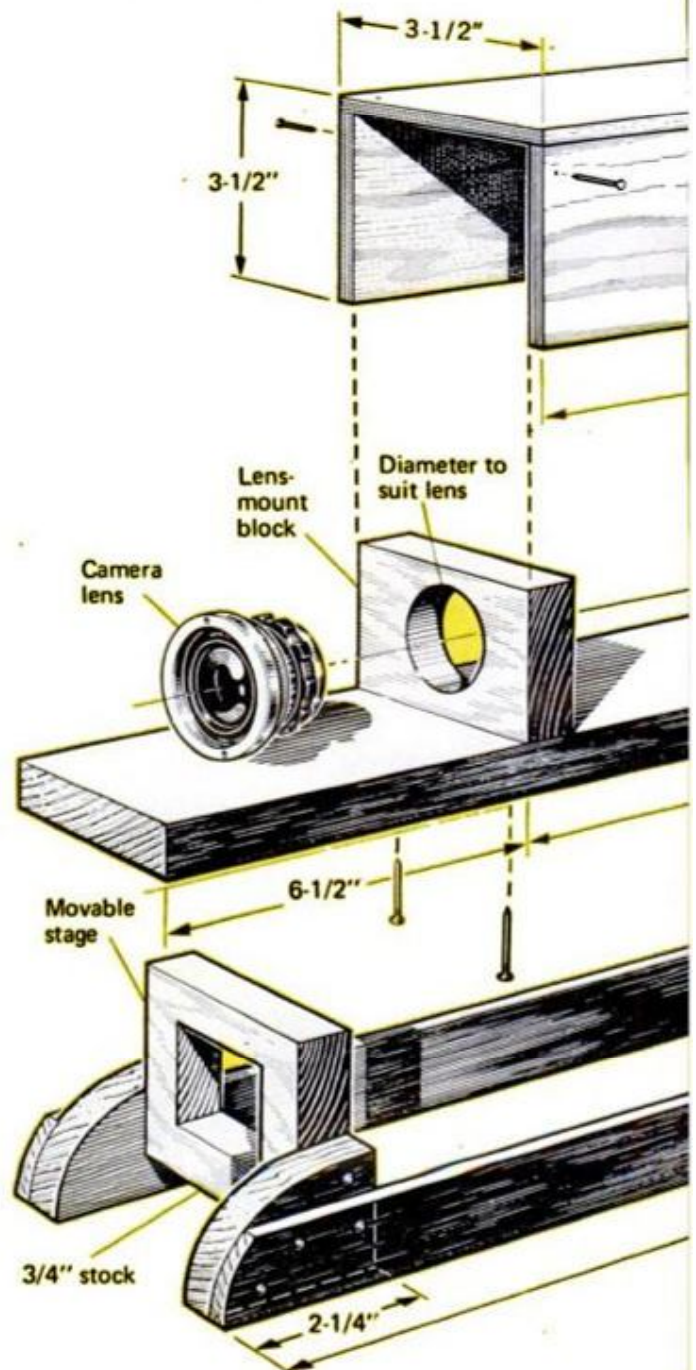
Paint the inside of the box flat black to kill light reflections. A circular light baffle at the box's midpoint also helps to mask off glare. Objects to be photographed are placed in a movable stage made to straddle the base. The stage is slid back and forth to focus the image sharply in the viewfinder instead of focusing the lens itself. Objects too big to fit inside the stage can be stretched across the opening and taped in place.

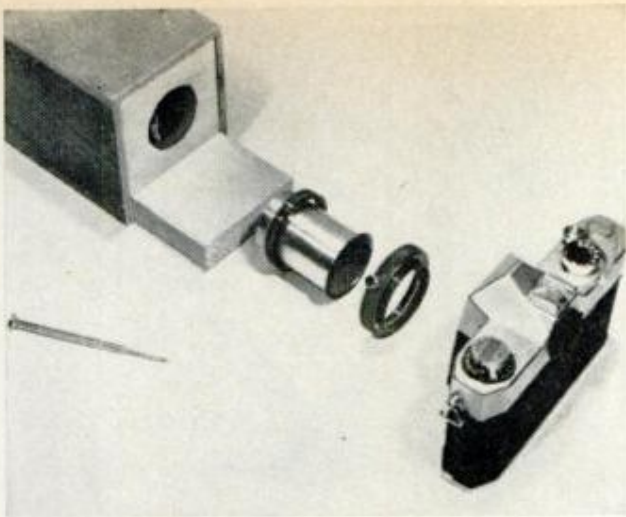
Exposures must be greatly increased because of the extreme distance between lens and camera. A magnification of 10 times requires an exposure increase of 100. Thus, if a light meter reading indicates an exposure of 1/10th of a second at a given lens opening, the required exposure will be 100 times this or 10 seconds. Work with small lens openings for maximum depth of field and place the setup on a solid surface to avoid movement during the long exposures. Use lenses of at least 50 mm in focal length. Shorter focal lengths will put your subject so close to the lens that you'll find it difficult to light properly. An enlarging lens may give even better images than a regular camera lens. Experiment with different lenses and exposure times for best results. ★★



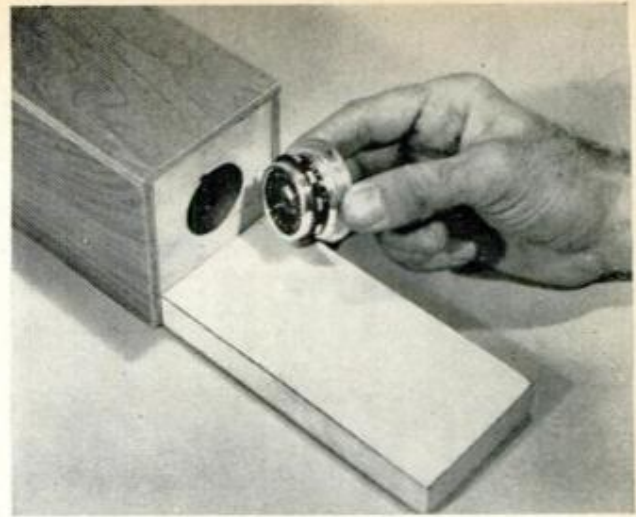
INSIDE OF LENS TUBE is painted flat black to reduce glare that might degrade image clarity. Circular light baffle mounted at center also blocks reflections

LIGHT-TIGHT LENS TUBE

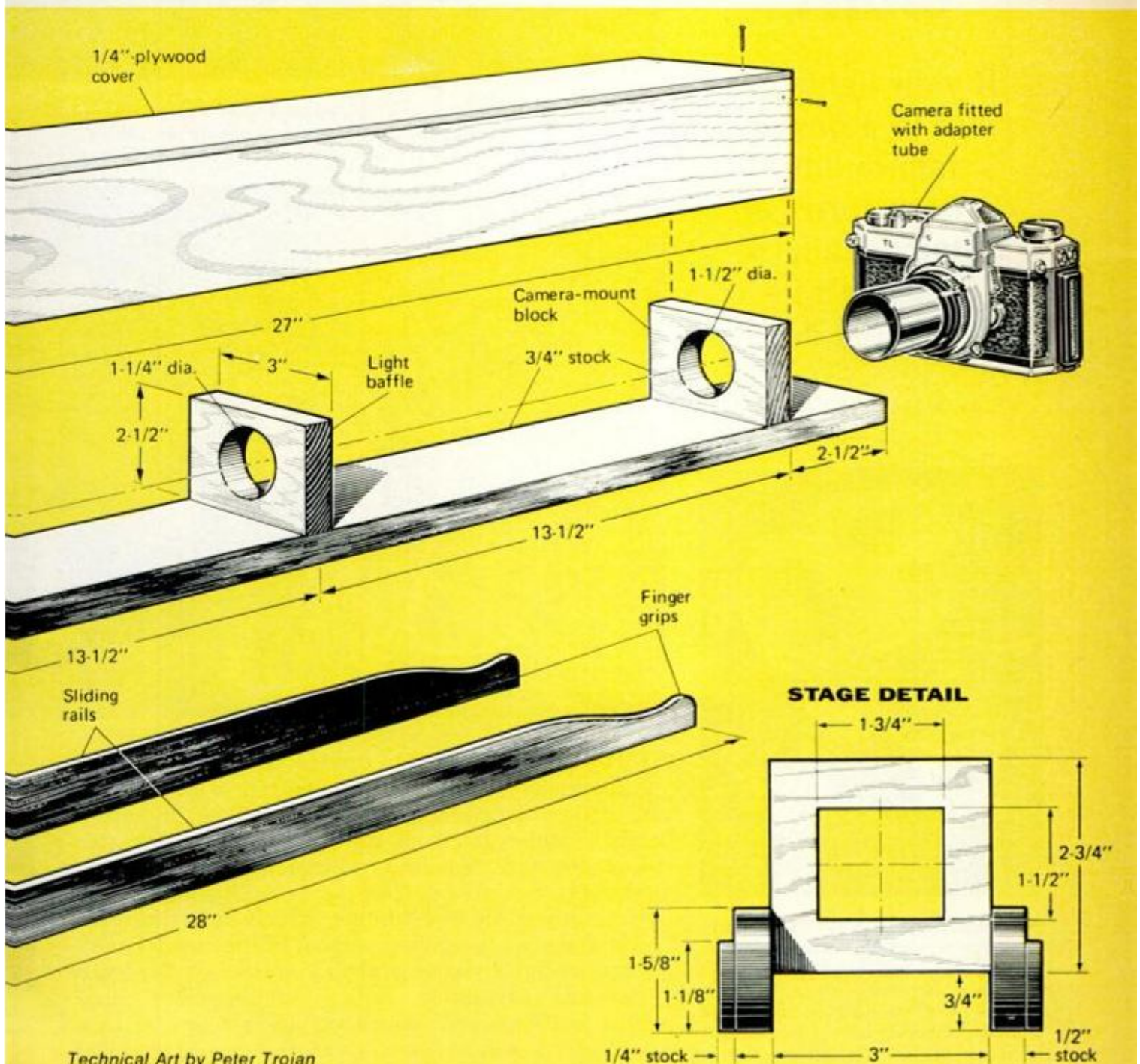




CAMERA BODY can be joined to box with extension tube or short length of plumbing drain clamped between the rings of a standard screw-in lens adapter



LENS IS MOUNTED in hole at opposite end of box from camera. Remember to reverse lens so rear end faces camera, necessary because of long separation



Technical Art by Peter Trojan

NOVEMBER 1970

Build Your Own BLACKOUT LIGHT

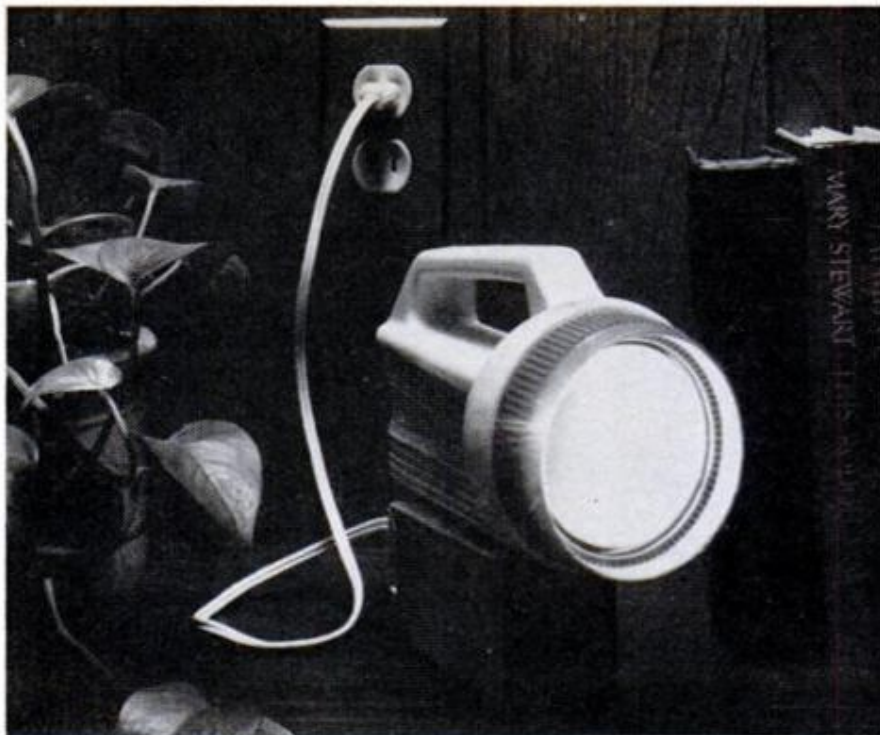
If your lights go out in a power failure, this lantern turns on automatically so you won't be left in the dark

By WALTER G. SALM



RECHARGEABLE BATTERIES, substituted for regular ones that come with lantern, are automatically kept at full power for emergency use no matter how long the light stands around unused. Optional pilot light is held in rubber grommet in end of minibox

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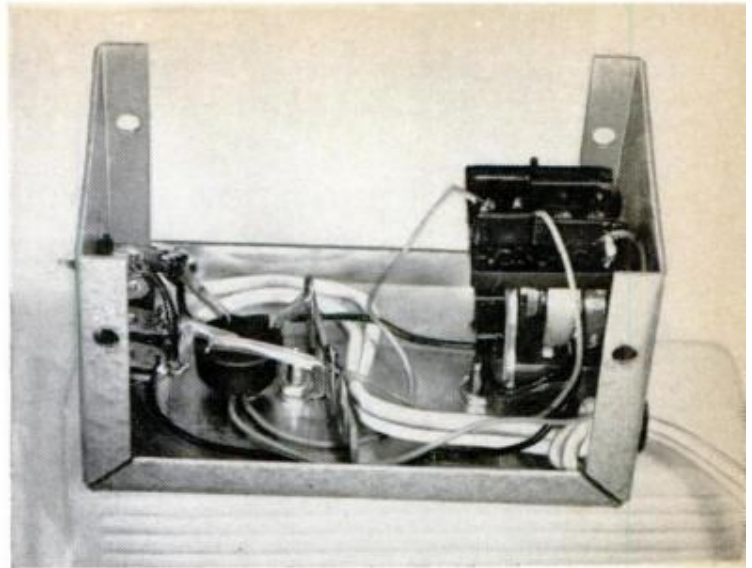
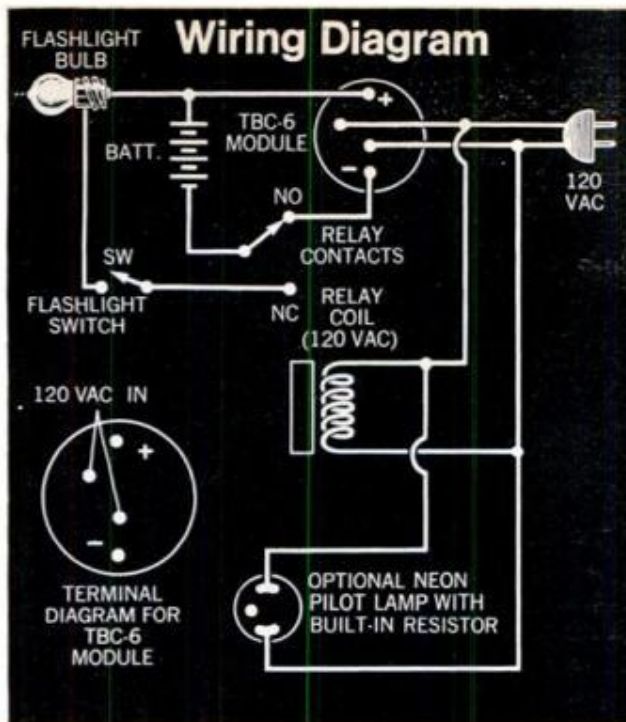
THERE'S ALWAYS LIGHT when you need it with this emergency lantern standing guard. If house goes dark, it turns on (above). When not in use, it's kept plugged in on a shelf or table (below)



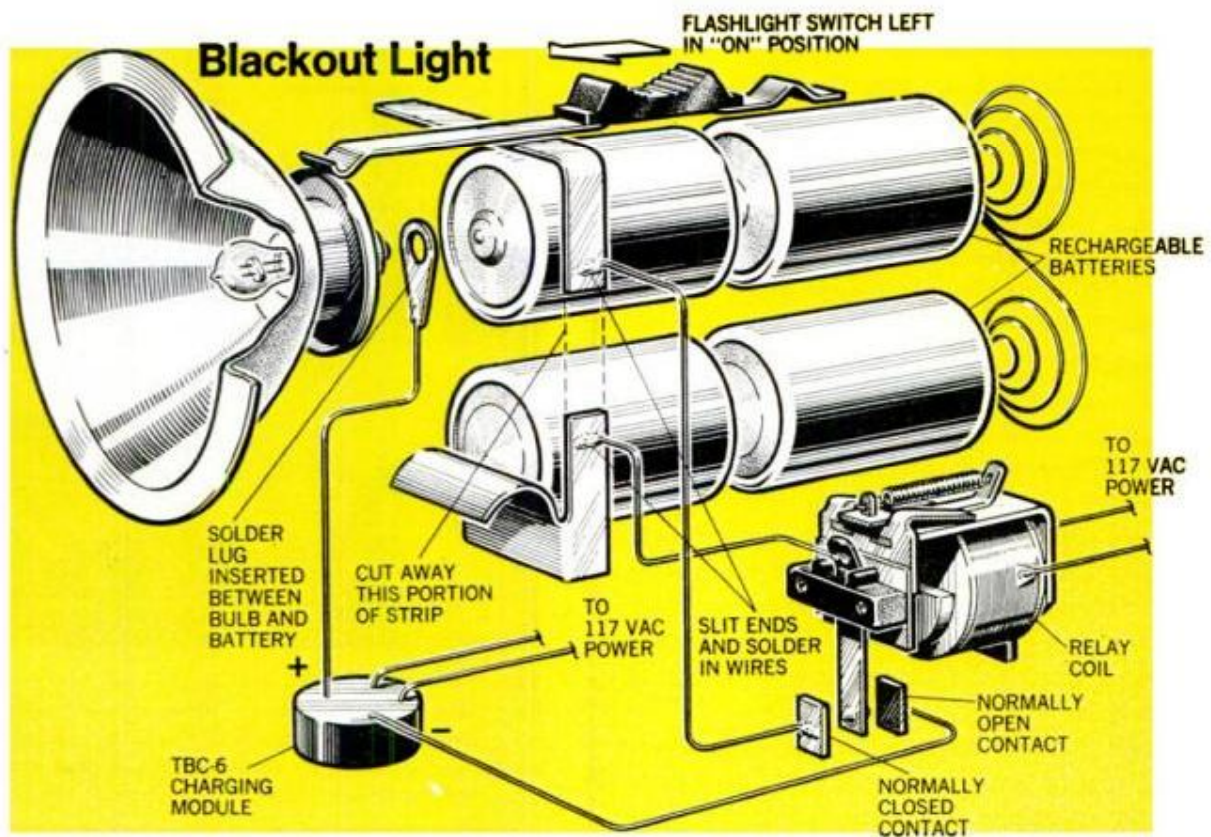
THERE'S NO NEED to fumble around in the dark for matches and candles whenever a power failure strikes. This emergency blackout light automatically switches itself on the instant the power goes off, giving you temporary illumination so you can find your way around. You just leave it plugged into a wall outlet; the self-tripping circuit does the rest.

The light is a simplified version of the costly emergency spotlights you've probably noticed on the walls of stores, restaurants, railway stations and other public buildings. All you need are a few electrical parts and a standard lantern of the design intended

POPULAR MECHANICS



CONNECTIONS INSIDE MINIBOX are made on lug-type terminal strips. Fasten the box to the underside of the lantern with two small machine screws, removing the batteries first to give you finger room inside



to operate with four flashlight batteries. Such lanterns are readily available at hardware, discount and auto-supply stores for \$2 or \$3.

The parts you add are housed in a small 2x2x4-inch metal minibox fastened under the lantern. These consist of a 120-volt, single-pole, double-throw relay and a miniature charging module. Substitute rechargeable nickel-cadmium batteries for the regular ones that come with the lantern. These are more expensive, but last

much longer and insure that the light is always ready to operate at full power. The charging module keeps them constantly charged while the lantern is not in use.

The relay coil is connected to 120 volts a.c. As long as there's house current, the coil is energized and holds the normally open contact closed. This switches in the charger, but disconnects the light bulb so the lantern remains off. In a blackout, power is cut off to the relay and a spring

(Please turn to page 230)

Install-It-Yourself Electronic

With this handy new kit, you can hook up a complete home protection system for only a small fraction of the cost of commercial installations

COMMERCIAL home-protection systems can run to \$1000 or more, but you can install this one for a fraction of that if you buy the parts and do the wiring yourself. For less than \$130, you can have an automatic burglar alarm that will warn you of any attempt to break into your home. For a little more, you can add fire protection as well merely by installing extra sensors in the same circuit.

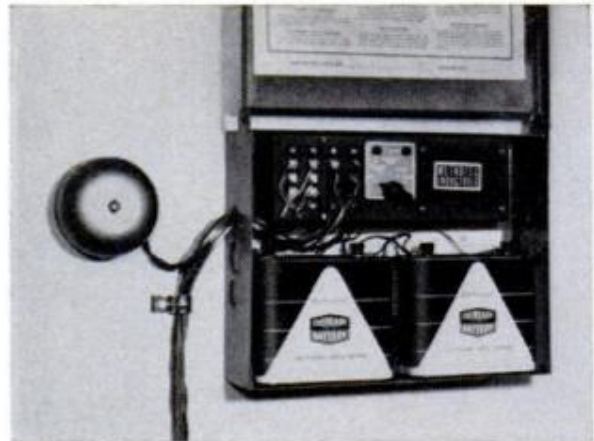
Available in kit form for the first time, the system is sold by Metrotec Industries, long-time maker of electronic protection devices. All parts are sold separately or in a convenient starter package, so you can adapt the system to any size house and extend it later if your needs grow.

The basic burglar alarm consists of a solid-state electronic control box, a large gong mounted outdoors and a series of magnetic reed switches installed on doors and windows throughout the house. If any switch is triggered, the gong sounds loudly outside, alerting you and at the same time scaring off the intruder and summoning help from nearby neighbors or police. A built-in electronic time delay allows you to enter and leave the house without triggering the alarm yourself.

Each switch has two parts—the switch itself and a separate magnet that controls it. The switch contacts are of the normally closed type, but are held open by magnetic attraction as long as the magnet is nearby. You mount the magnet on a door or window sash and the switch opposite it on the stationary part of the frame. When the door or window is opened, the magnet is moved away and the switch contacts snap closed, sounding the alarm. The switch and magnet are housed inside small plastic covers you can paint to match the woodwork to make them inconspicuous.

An alternate type of reed switch, also available, has normally open contacts. In

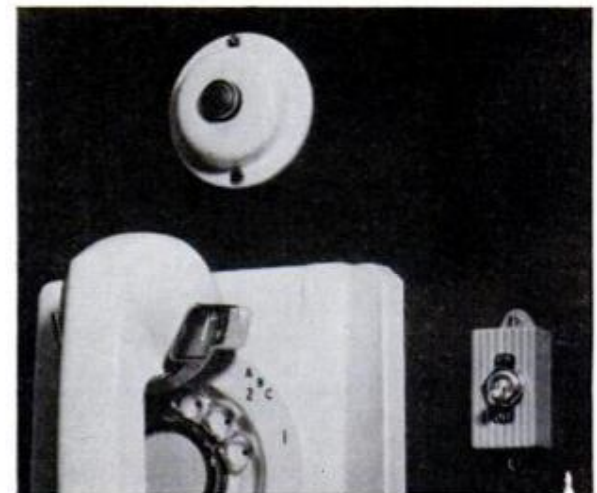
(Please turn to page 208)



MASTER CONTROL BOX can be hidden in closet, pantry or utility room. Powered by two 12-volt batteries, it has a test switch for making checks on system. Next to it is a small indoor fire gong



BASIC KIT OF PARTS includes a master control box, large outdoor gong, 10 magnetic switches, wire and other accessories. Photo below shows round fire sensor and manual panic switch mounted in a convenient location by a wall telephone



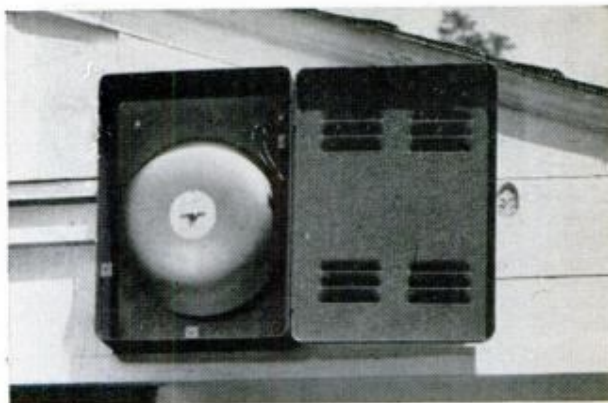
Fire-Theft Alarm

By SHELDON M. GALLAGER

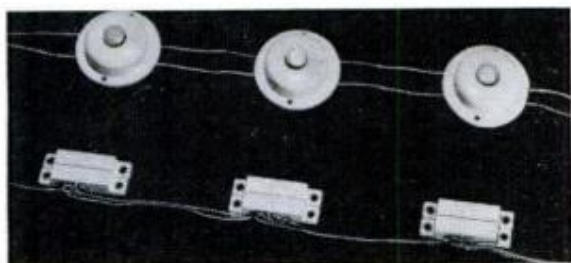


LARGE OUTDOOR GONG

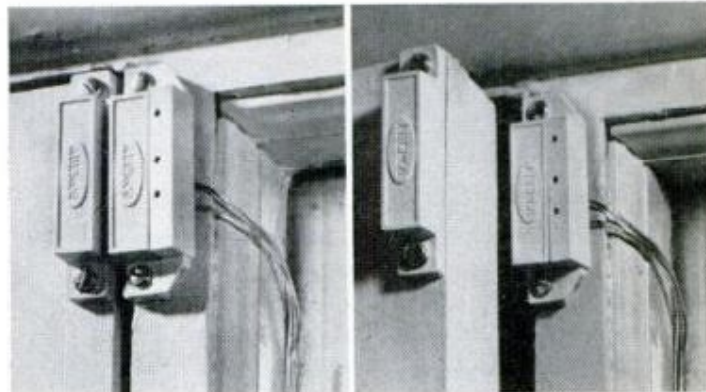
ALARM GONG can be installed on outside wall of house, as here, or behind an attic louver inside. If gong is exposed, accessory metal box (right) is available to protect it from weather



FIRE SENSORS

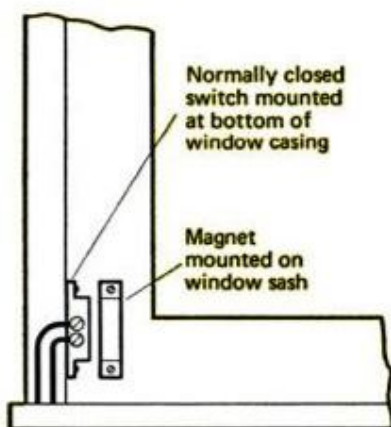
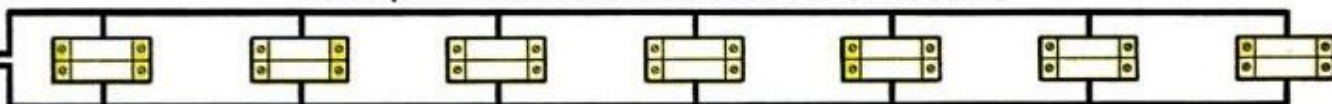


WIRED IN STRINGS, fire sensors and intrusion-alarm switches are easy to install because you merely connect them in parallel across two low-voltage wires wherever needed

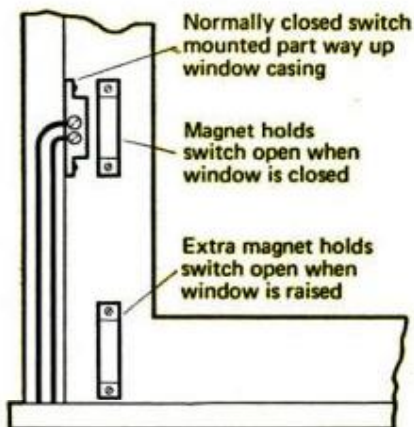


WHAT HAPPENS WHEN A DOOR IS JIMMIED is shown in two photos at right, above. Switch is mounted at top of door frame opposite magnet on door. When door is forced open, magnet swings away and switch contacts close, setting off alarm. Drawings below show ways similar switches can be used on windows

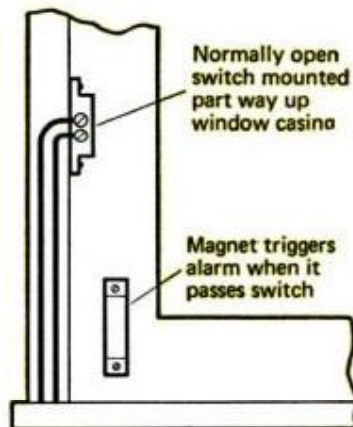
DOOR, WINDOW AND FLOOR-MAT SWITCHES



Single-magnet arrangement permitting no ventilation

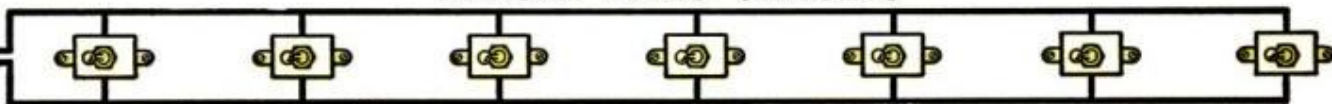


Dual-magnet arrangement permitting partial ventilation



Single-magnet arrangement permitting partial ventilation

MANUAL "PANIC" SWITCHES



EXCITING NEW PRODUCTS

BY CATHERINE BILSKI



ANNOYED with a troublesome, leaky toilet? Fix it yourself with the Fit-All Toilet Tank Repair Kit. The kit contains a new flush lever and a complete ballcock assembly fitted with all the necessary components. It sells for \$6.99 and is made by the Chicago Specialty Manufacturing Co., 7500 Linder Ave., Skokie, Ill. 60076.

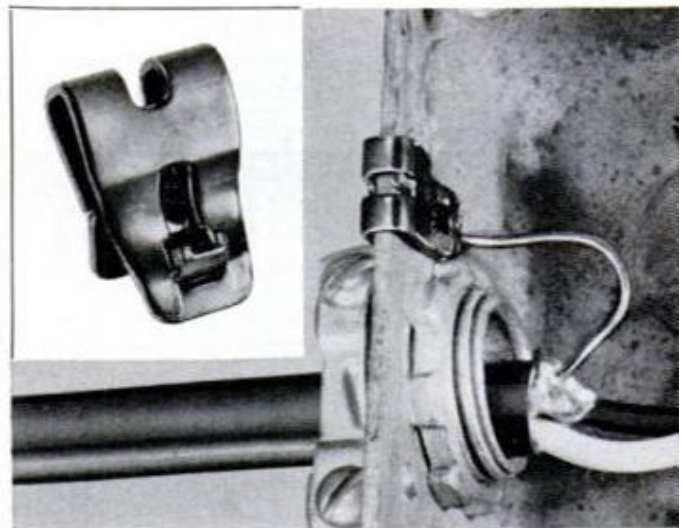


CHANGE IN DESIGN has finally come to the ordinary dustpan. The Taubman Folding Dust Pan sweeps up waste in a flat position, then folds conveniently (by squeezing the handle) to pour waste into container without dust falling back onto the floor. It's sold for \$2 (plus 60 cents for postage) by Samuel Taubman, Dept. 92, 309 Lafayette Ave., Brooklyn, N.Y. 11238.



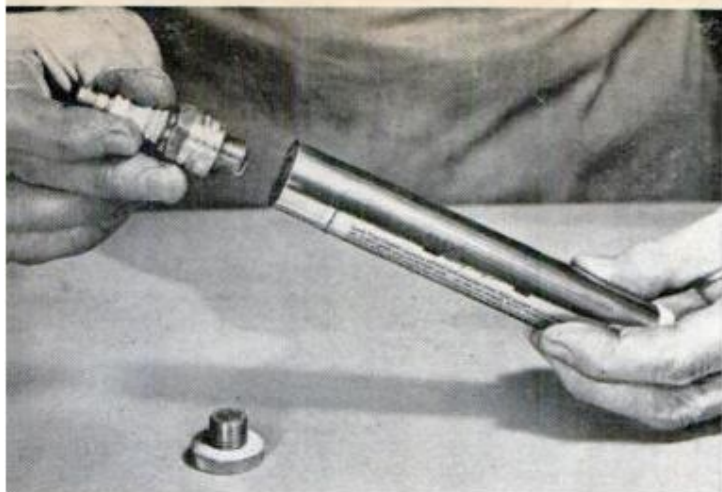
ELECTRIC WALL CLOCK not only keeps accurate time but also displays and changes (automatically) the day of the week, date and month. It's wall-mounted and runs on ordinary household current. Ideal for den, kitchen, workshop, the clock should be a great conversation piece wherever you decide to put it. It sells for \$49.95 from Arlen Industries, 9001 Debra Ave., Sepulveda, Calif.

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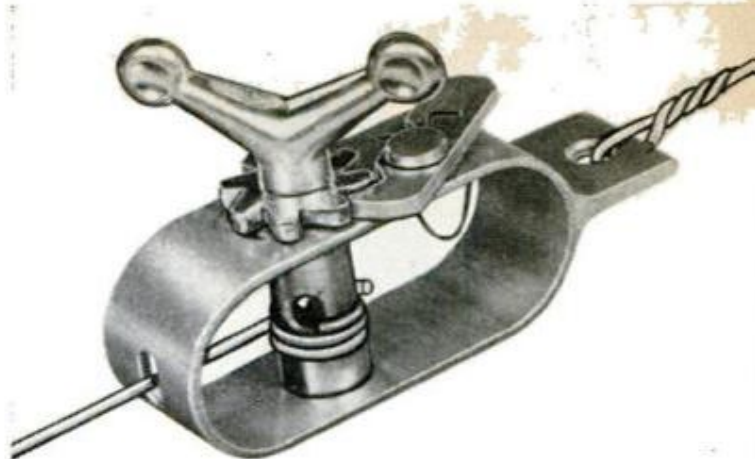


NEW GROUNDING CLIP listed by Underwriters Laboratories for connecting a 12 or 14-ga. grounding conductor to switch or outlet box is easy to install. Thread wire through "G-2" clip, position clip over edge of box and tap in place with hand and screwdriver. Clips, sold at \$2.50 per 100, are made by Holub Industries, Sycamore, Ill. 60178.

POPULAR MECHANICS



RENEW SPARKPLUGS an easy way by treating them with the Hotspark Spark-Plug Cleaner. Just screw a plug in the tube, then follow with a rapid shaking action that causes scouring wires and solvent in tube to remove carbon and other deposits from plug. Tube costs \$4.95 postpaid from Henderson Manufacturing Co., Box 503, Dept. A, Narberth, Pa. 19072.

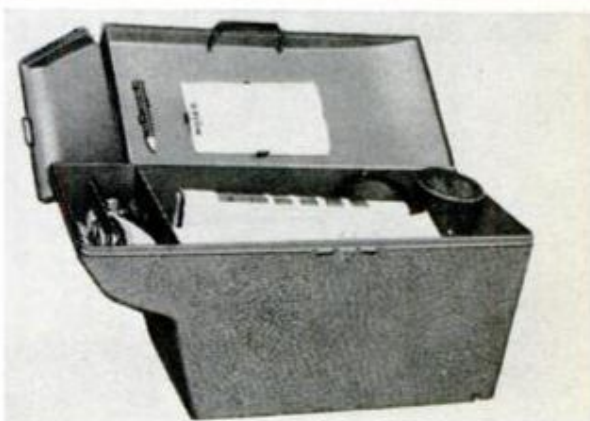


CURE FOR A SAGGING CLOTHESLINE or antenna guy wire is Snap'r Tite. All it takes is a few twists of the wrist to tighten a line. After a wire is slipped through the lip hole and twisted, the line is run through the eye and wrapped or knotted around the spindle. The device is made to sell for 90 cents by North Central Plastic, Ellendale, Minn. 56026.



UNSIGHTLY ALUMINUM SCREENS can be brought back to like-new luster with Aluminum Jelly. Applied with a brush, the gel's unique formula removes pitting that results from oxidation. After its etching action is completed the tacky gel can be completely washed off with water. It's available in four sizes at hardware stores, lumberyards and paint stores. The Woodhill Chemical Corp., Cleveland, Ohio 44128, is the manufacturer.

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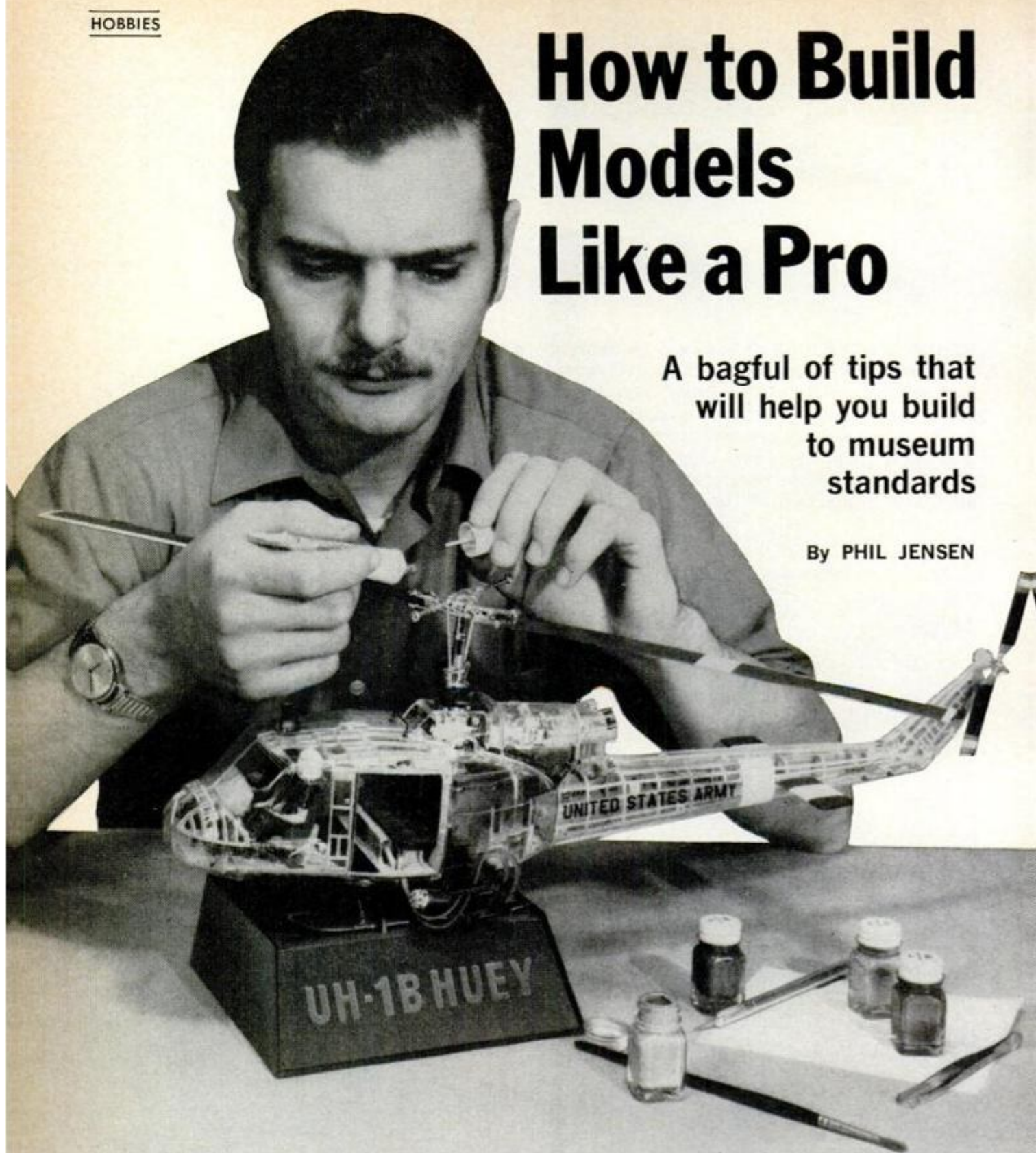
END CAR CLUTTER and have armchair driving comfort at the same time with the help of the Hold-All Car Caddy. It fits snugly in the front or rear of any car without the need for tools and has over 500 cubic inches of storage space with separate sections intended for change and eyeglasses. When closed it serves as an armrest. Priced at \$6.95 postpaid, it's available from Selective Products Corp., 49 E. 41st St., New York, N.Y. 10017.

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How to Build Models Like a Pro

A bagful of tips that will help you build to museum standards

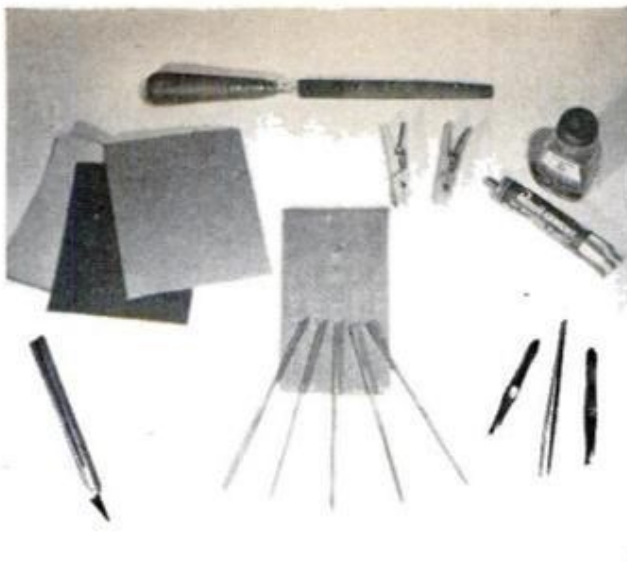
By PHIL JENSEN



FOR MORE THAN A DECADE, plastic kits have been quietly revolutionizing the hobby of model building. Time was when the hobbyist who wanted to recreate in miniature any object from the world around him, had to be a highly skilled craftsman and possess an extensive collection of hand and power tools. Now, however, almost anyone can walk into a store, purchase a kit, and in a few

hours turn it into an acceptable model of anything from an antique car to the latest Detroit hot rod, from a Roman bireme to the nuclear-powered aircraft carrier USS *Enterprise*, from the Wright Brothers' frail biplane to the Apollo 11 spacecraft or the yet-to-be-flown supersonic transport.

Early kits were quite crude and often difficult to assemble, but today's kits are made of top-quality materials with parts



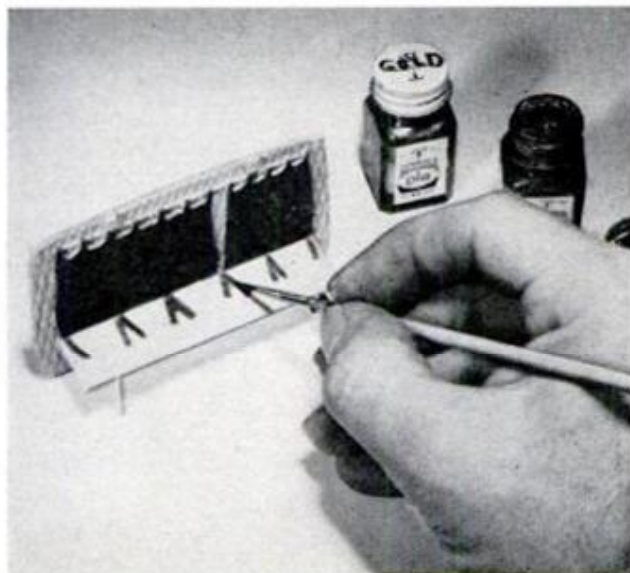
TOOLS NEEDED include knife, jeweler's files, tweezers, sandpaper, emery cloth, clothespins and cement

carefully engineered for ease of assembly. With a little extra care during assembly, a plastic model becomes a masterpiece.

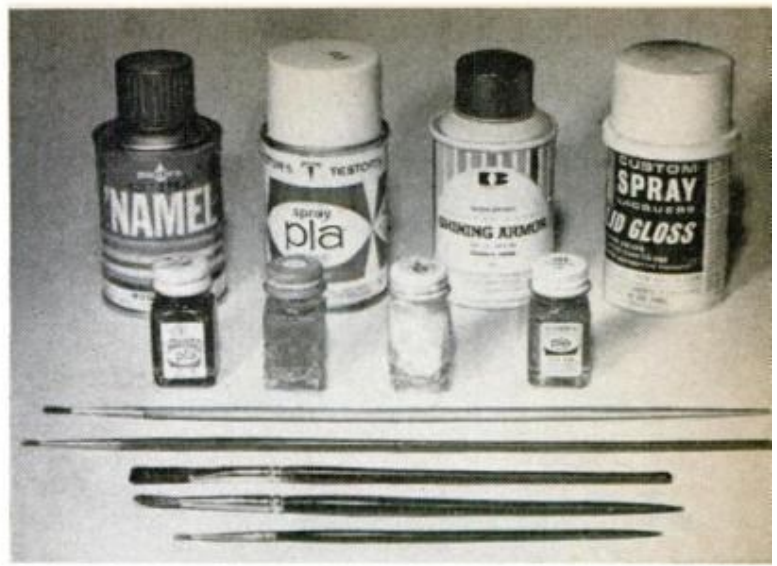
To illustrate the steps necessary for a perfect job, we've chosen Monogram's "Phantom Huey Chopper," a highly detailed, 1/24th-scale replica of the Army Bell UH-1B gas-turbine-powered helicopter.

● *Tools and materials.* Have on hand an X-Acto knife, set of jeweler's files, 8-in. fine-cut mill file and several tweezers. You'll also need medium and fine sandpaper or emery cloth for smoothing rough spots, spring-type clothespins and rubber bands for "clamping" and, if the model includes decals, small scissors. Be sure to buy the cement made for styrene plastics. It comes as a liquid, either in a small bottle with applicator brush in the cap or in a tube. The latter seems to be thicker, thus

WATCH FOR PARTS, such as seat belts, that should be painted although not so mentioned in instructions



NOVEMBER 1970



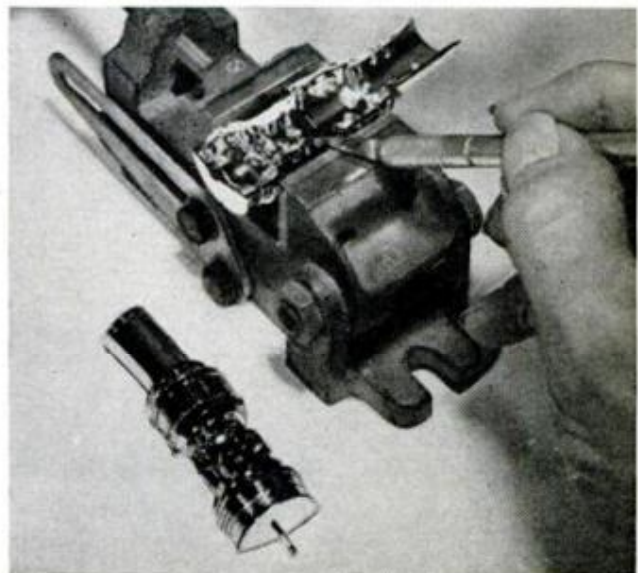
NAME-BRAND ENAMELS are best bet when choosing finish. Suitable brushes for details are shown in front

allows better control, and the resulting joint seems stronger. It's also wise to have a small amount of automobile rubbing compound. If you get cement on a finished surface or clear plastic part, the damage can be rubbed out.

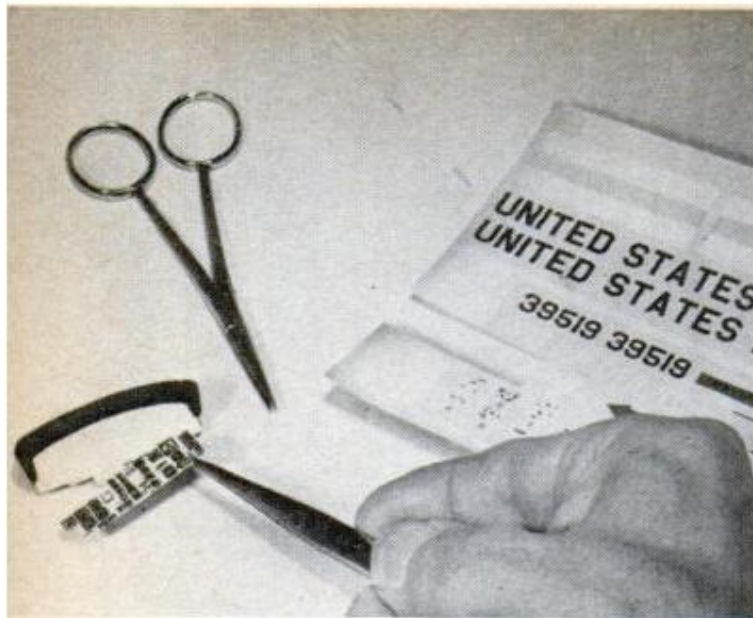
● *Preassembly instructions.* Most instructions recommend that you study all steps before starting. However, it's more important that you understand *each* step before proceeding. Then you can locate and identify the needed pieces. In top-quality kits, parts are usually identified by numbers molded into the parts or adjoining mold-runner and corresponding to those shown in the instructions. If part identification is lacking, general size and shape, as well as mounting pegs or holes, are good clues.

As you proceed, cut each part loose

SCRAPE "CHROME" from all surfaces to be joined. Both halves of detailed jet engine are scraped here



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DECALS PROVIDE FINAL TOUCH of realism. Trim them close to actual pattern so unsightly clear-film edges don't remain. A handkerchief is ideal for smoothing them. If a decal sticks before it's in place, lift off with tweezers, dip in water and reposition it. When decal is dry, rub it lightly to give it a sheen

from the runner and examine it for imperfections. Look for flash, ridges at the mold parting-lines and sinkholes in the surface over the heavy sections. Carefully trim flash and ridges with your knife, then sand, file and polish the surface until smooth. Sinkholes are more difficult. Usually the surrounding surface can be filed until the hole disappears. Again, follow up with sanding and polishing. Plastic putty, available in hobby shops, can be used to fill sinks, but the part must then be primed and painted.

● *Paint as you go.* Spray-paint all large parts before assembly. If this isn't possible (as with auto hoods, trunk lids and doors), tape the parts together on the inside so they all turn out the same shade. For two-tone paint jobs, always paint the lighter tone first. When it's *thoroughly* dry, cover the area to remain that color with masking tape. Press tape edges tightly against the surface to prevent the second color from bleeding onto the first.

Detail painting can be done before or after the part is in place. For example, if you paint a small part in another color than that of the large part to which it will be cemented, you can attach and brush-paint it in place.

● *"Chrome" plating.* Actually an extremely thin layer of aluminum (deposited in a vacuum) plating is easily damaged by careless handling. Thin as it is, this metallic layer interferes with proper

cementing and must be scraped or filed away. Be careful to remove just the unwanted chrome; once it's removed you cannot replace it.

In some cases you may decide the manufacturer has gone chrome-happy and plated parts shouldn't have this shiny finish. Paint may be applied directly over chrome but, according to Monogram, it's better to remove all plating from parts by soaking in flux (zinc chloride). Next day, wash them in clear water and allow to dry. This treatment does not harm the plastic but provides a superior surface for model enamels.

● *Assembly.* The important points are:

1. Check each part for position and proper fit before applying cement. Locating pegs may be oversize, surfaces may not meet exactly or a missed piece of flash may prevent flush mounting. Use your knife and a small file to rectify these conditions.

2. Apply only a minimum of cement, especially on clear plastic parts. For the strongest bond, apply a thin coat of cement to parts to be joined, allow to dry a few minutes and then press them together. Hold the parts until the joint sets, or use rubber bands or clothespins as clamps. Should any cement squeeze out, *do not* try to wipe it away. Let it harden thoroughly and then scrape it away with your knife. Repair any damaged surface with sanding and polishing.

3. Never try to force parts together. Even the best, high-impact styrene is easily broken. But if you do happen to break a part, don't despair. Cracks in large parts can be repaired by cementing; smaller parts such as axles or ship masts, should be reinforced. Drill both ends of the break to receive a short piece of common pin, apply cement and press them together. Allow plenty of time to harden completely.

● *Finishing touches.* Unless parts will get in the way, apply decals after the model is painted and assembled. Trim as shown and follow instructions for applying. Use a smooth cloth to smooth and rub out air bubbles to the edges.

Touch-up painting is a last step. Small imperfections in chrome can be repaired with aluminum paint, but don't overdo it.

The important tip is to *take your time*. If you find yourself tiring, just put the model away and go back to it after a couple of days.

★★★

New tools you should know about



CLOGGED SANDER BELT can be given added life without removal from the machine if you chuck the sander handle in a vise, switch on the motor and firmly press a Dandi-Bar against the belt. Moving the cleaner slowly back and forth will rejuvenate a belt in minutes. (To illustrate, belt at top was only partially cleaned.) Abrasive cleaner, of synthetic-rubber composition, sells for \$6.95. For buying information, write Ken Acker Co., Inc., 3314 W. Loomis Rd., Greenfield, Wis. 53221.

SANDING KIT lets you strip old finishes easily from curved, contoured or flat surfaces (top) because it boasts a pad with a $\frac{3}{4}$ -in.-thick layer of foam rubber. The P-100 Flexbac Pad Kit (directly above) includes the pad, a $\frac{1}{4}$ -in. drill adapter, 5-oz. tube of adhesive and five assorted sanding discs which can be quickly affixed or removed from the pad. Sold at hardware stores for \$8.42, or write to the Carborundum Co., Merchandising Sales Branch, Box 477, Niagara Falls, N.Y. 14302.



COMBINATION PLIER-WRENCH now offered by Channellock, Inc., Meadville, Pa. 16335, is claimed to be easier to lock and release because its quick-release lever is placed outside the handle. It also features drop-forged, high-grade-steel jaws; precision-machined, right-angle teeth; rust-resistant black oxide finish, and plastic release lever that eliminates sting when lever is tripped. In flat (above) or curved jaws. \$4, at hardware stores.

You Can Build This Candlestand Lamp

Tired of hammer and saw projects? Give your lathe a whirl and turn out this good-looking chairside lamp

By WAYNE C. LECKEY, Home and Shop Editor

Technical Art by Peter Trojan

IF YOUR LATHE has become a forgotten tool, maybe it's time to dust it off, oil it up and once again enjoy the fun of watching a spinning chunk of wood turn into a pleasing shape before your eyes.

To start you off again on a lathe project, we built this charming colonial candlestand lamp and photographed it in a true Early American setting in Connecticut. Made entirely of cherry, it has the warmth of colonial furniture. Graceful scrolls of black wrought iron add a distinctive touch to its three-legged base.

While a lathe plays a major part in making this lamp, your bandsaw, router and drill press won't stand idly by—you'll need them for making the base and circular table.

The base consists of three identical parts, bandsawed from 1½-in. stock and butt-glued at the center. The top and bottom edges are rounded with a ¼-round bit in your router. Finally, a 1-in. hole is bored all the way through the base at the center.

Rough turning squares for the upper and lower posts are glued up from two dadoed pieces to form a square hole their full lengths for the ⅛-in. running-threaded pipe.

While you only need to turn one of each post, you'll find it easier to work from a full-size pattern from which you can take divider and caliper measurements directly. Notice that 1-in. tenons are turned on each end of both turnings, the

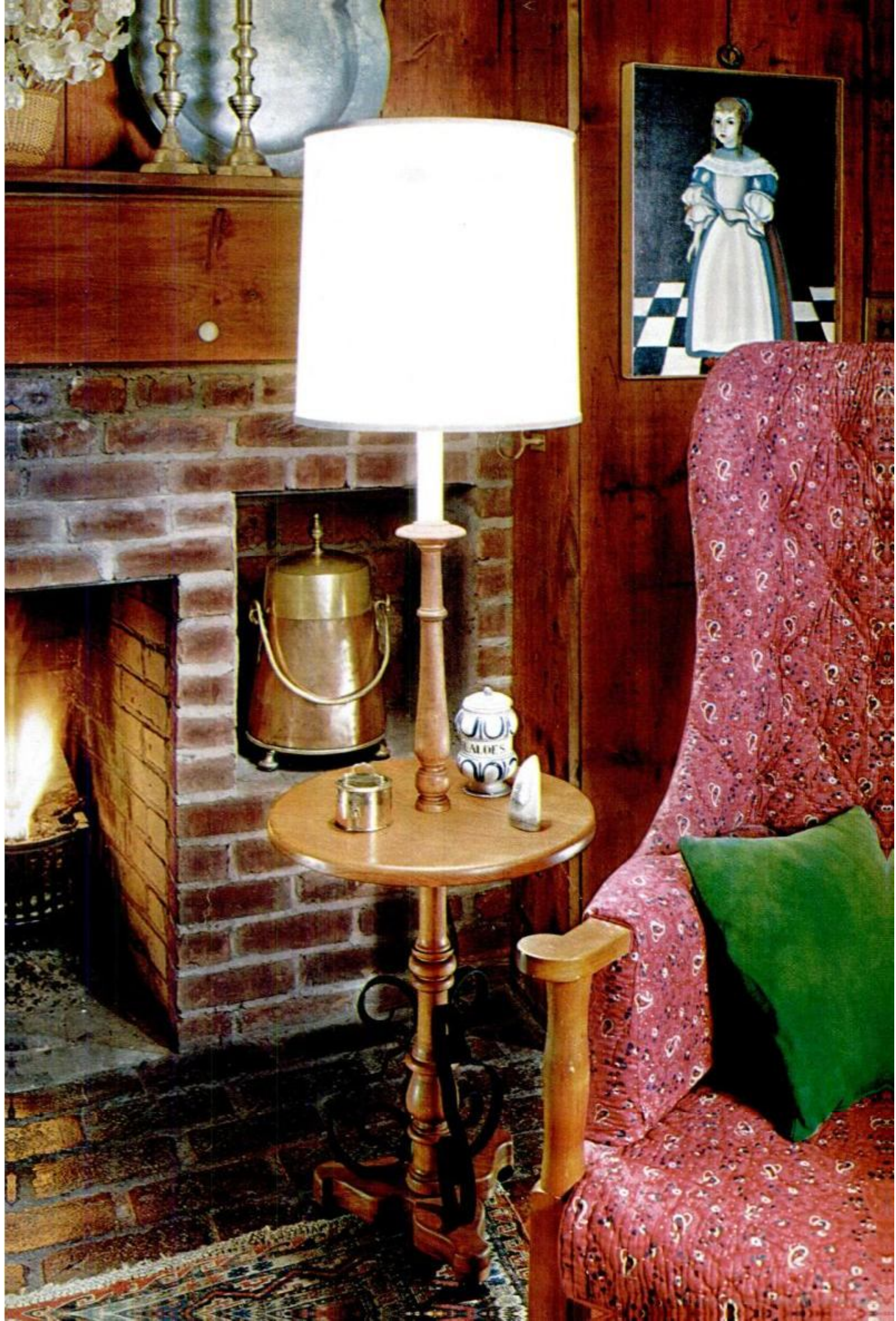


TURNED PARTS can be finished while in the lathe. After turning is completed, sand glass-smooth with extra-fine paper and apply colonial oil stain. Finally, polish with wax and soft cloth while work spins

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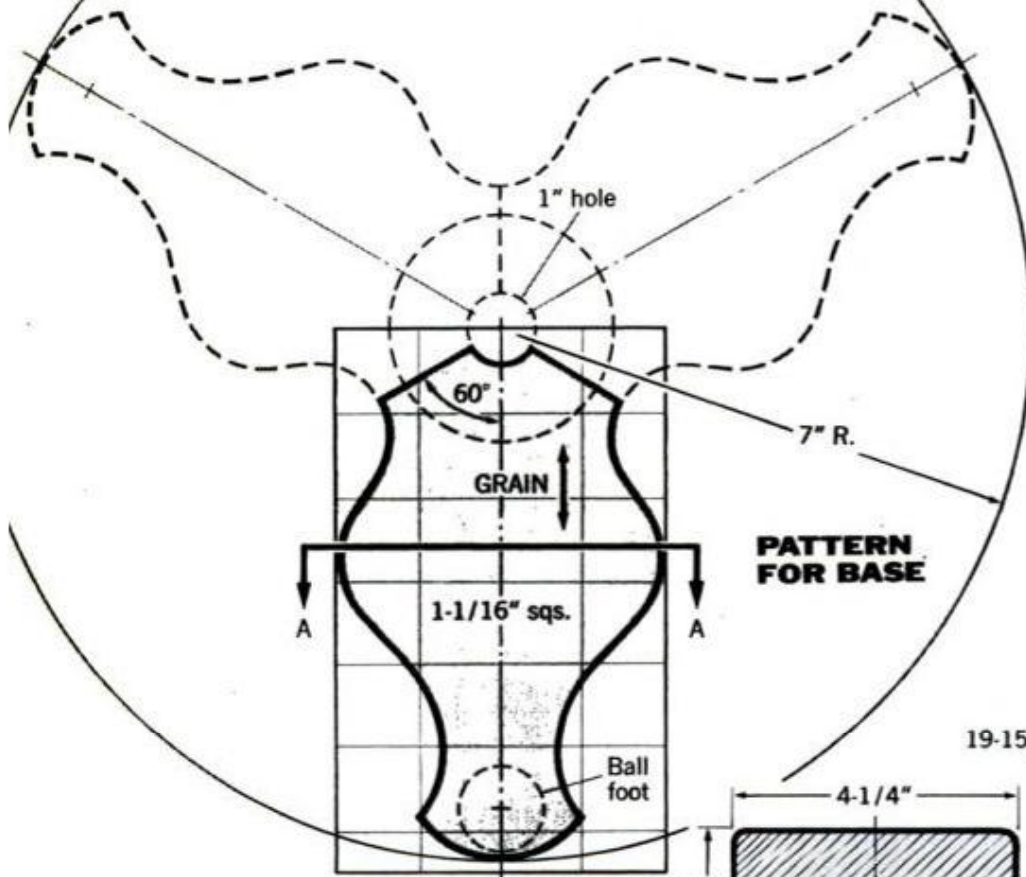


POPULAR MECHANICS

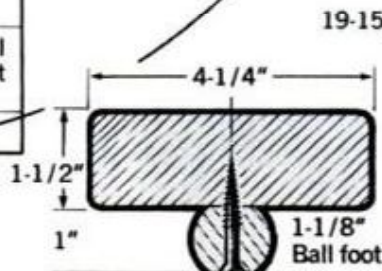


Candlestand Lamp

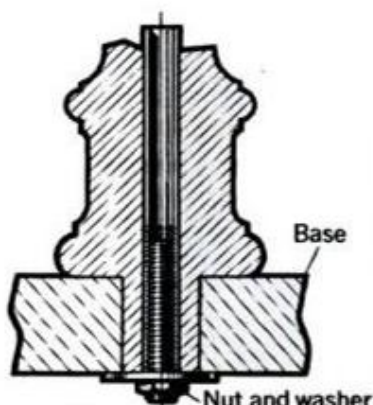
Technical Art by Peter Trojan and Hank Tomkalski



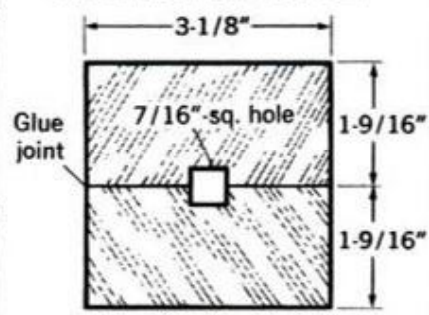
PATTERN FOR BASE



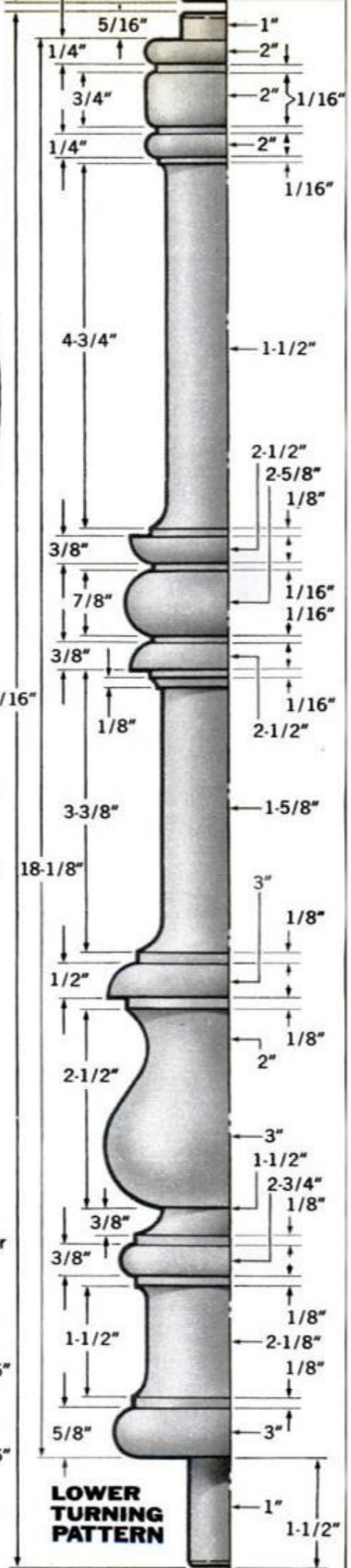
SECTION A-A



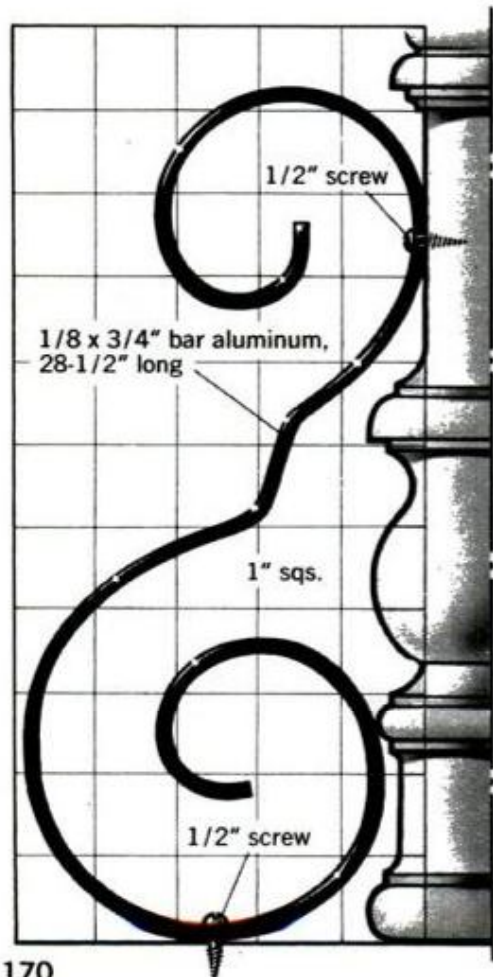
SECTION AT BASE

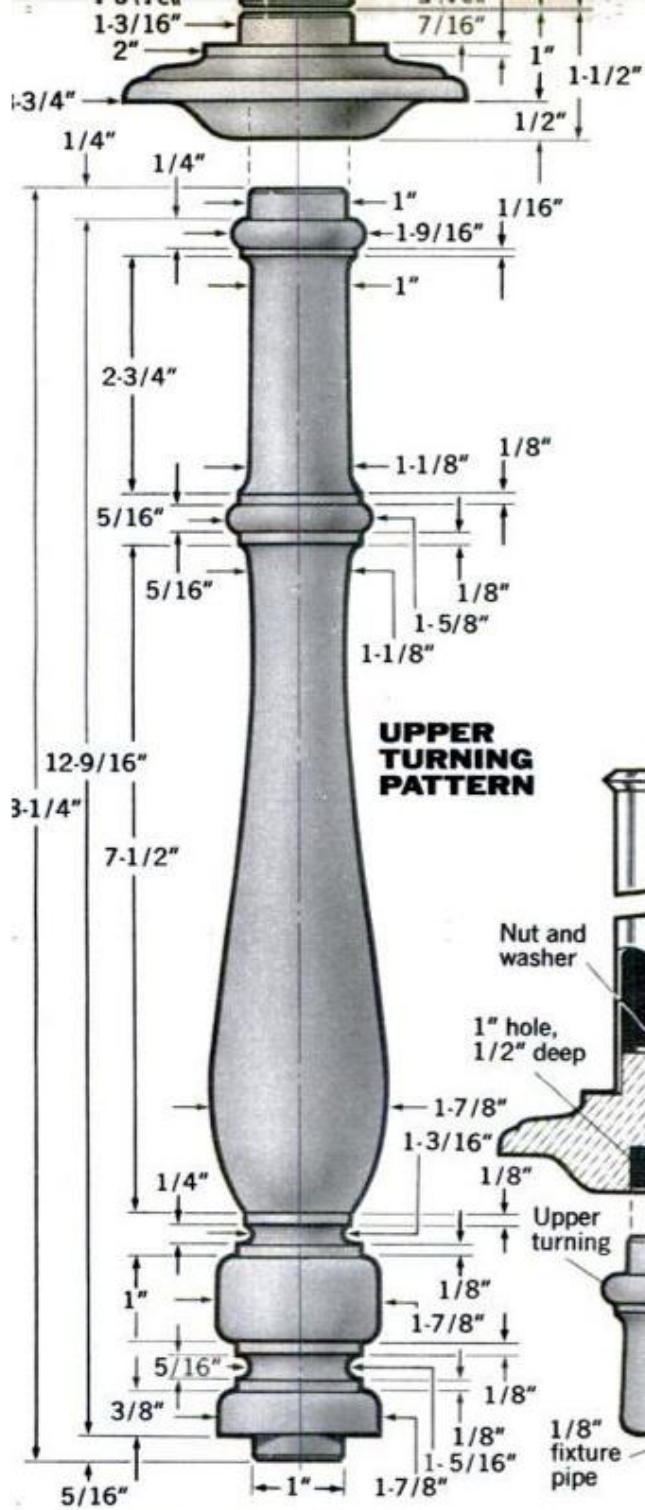


BUILT-UP BLANK FOR LOWER TURNING



LOWER TURNING PATTERN

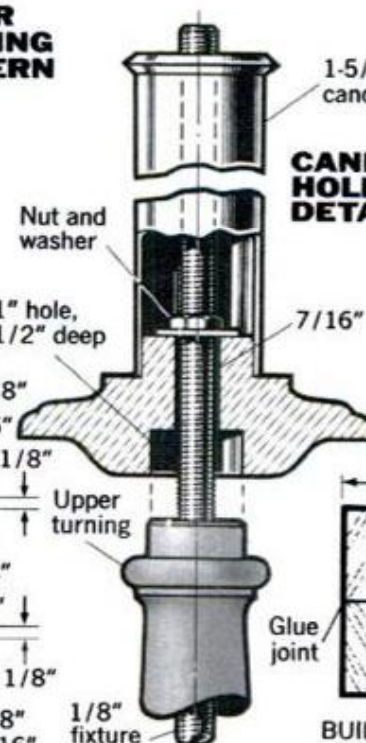




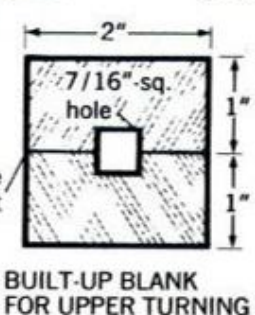
UPPER TURNING PATTERN



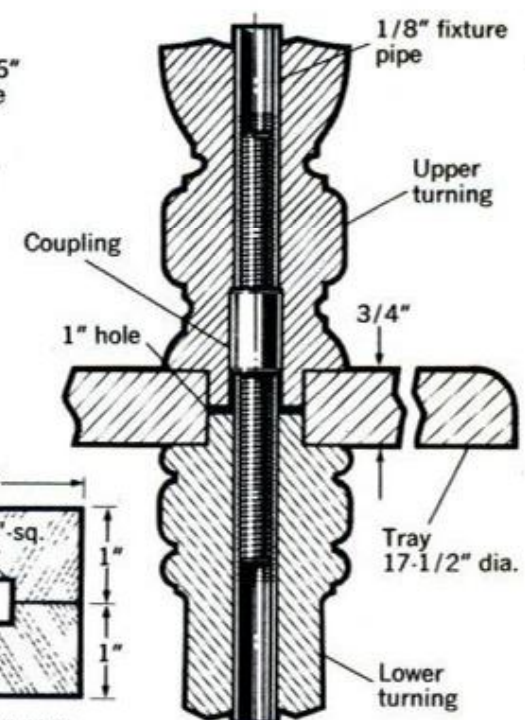
HEAVY-DUTY BENCH SCROLLER forms decorative scrolls quickly. Each scroll requires a 28½-in. metal strip



CANDLE-HOLDER DETAIL



BUILT-UP BLANK FOR UPPER TURNING



SECTION AT SHELF

longest one being that which passes through the hole in the base.

Inasmuch as you cannot buy 1/8-in. threaded pipe in lengths longer than 36 in., two lengths are joined with a coupling. To accommodate the coupling, the square hole in the upper turning must be drilled larger for a distance of 2 in.

The tenons on the upper and lower turnings meet midway in the hole in the table. A slight clearance between the two tenons will assure a tight fit when all the parts are later pulled together by a nut and washer at the bottom of the pipe.

The candleholder is faceplate-turned to fit over the tenon at the top of the upper

turning. Notice that it has a tenon for a 6-in. length of cardboard candle tubing. The brass cap which fits on top of the tubing is a standard lamp fitting. The 1/8-in. pipe should extend about 1/4 in. above the cap for a harp, socket and 14-in. linen shade.

The three wrought-iron scrolls are formed from 1/8 x 3/4-in. aluminum bar, drilled for 1/2-in. roundhead wood screws and then sprayed flat black. You'll need to enlarge the pattern and use it as a guide. Three ball feet, flattened top and bottom for attaching with flathead wood screws, are painted flat black to complete the lamp. ★★★

Merry
Christmas
and a
Happy
New
Year



Build PM's 'Sequence Santa' *Electric* Greeting Card

Fifteen lamps go on one at a time to light a jolly 6-foot Santa in front of your home

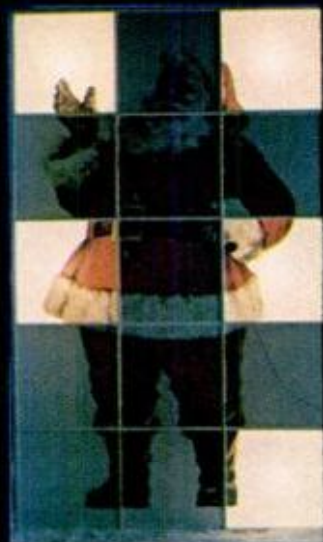
By **WAYNE C. LECKEY**, Home and Shop Editor
Color Photos by Bill Maris Styling by Robert Lofgren

THIS YEAR Santa really gets in the "spirit" of things to the point of actually getting lit. Turning on one at a time, 15 25-watt incandescent lamps illuminate him from behind in a staggered sequence. When fully illuminated, he stays lighted for 6 seconds, then blacks out, only to get lit all over again. This goes on as long as he is plugged in.

PM's 1970 greeting card is an eye-catching yard decoration that could cop first prize in any local Christmas lighting contest, and one that's sure to make your neighbors think you are an electrical wizard.

The display consists of a 5¼-in.-deep light box which has 15 compartments. Each compartment has a window fitted with two panes of Plexiglas with Santa sandwiched between. A removable back panel holds 15 pony-type

STAGGERED LIGHTING SEQUENCE (left) shows how Santa lights up at night. Below: He is clearly visible during the day when the lights are off. Greeting is hand-lettered





PONY-TYPE SOCKETS, bolted to back panel and wired from rear, are fitted with 25-watt incandescent lamps

sockets, one centered in each compartment, which are wired to a motor-driven timer consisting of 15 cams and switches. Each lamp lights at 3½-second intervals and it takes almost a full minute to complete the on-off cycle.

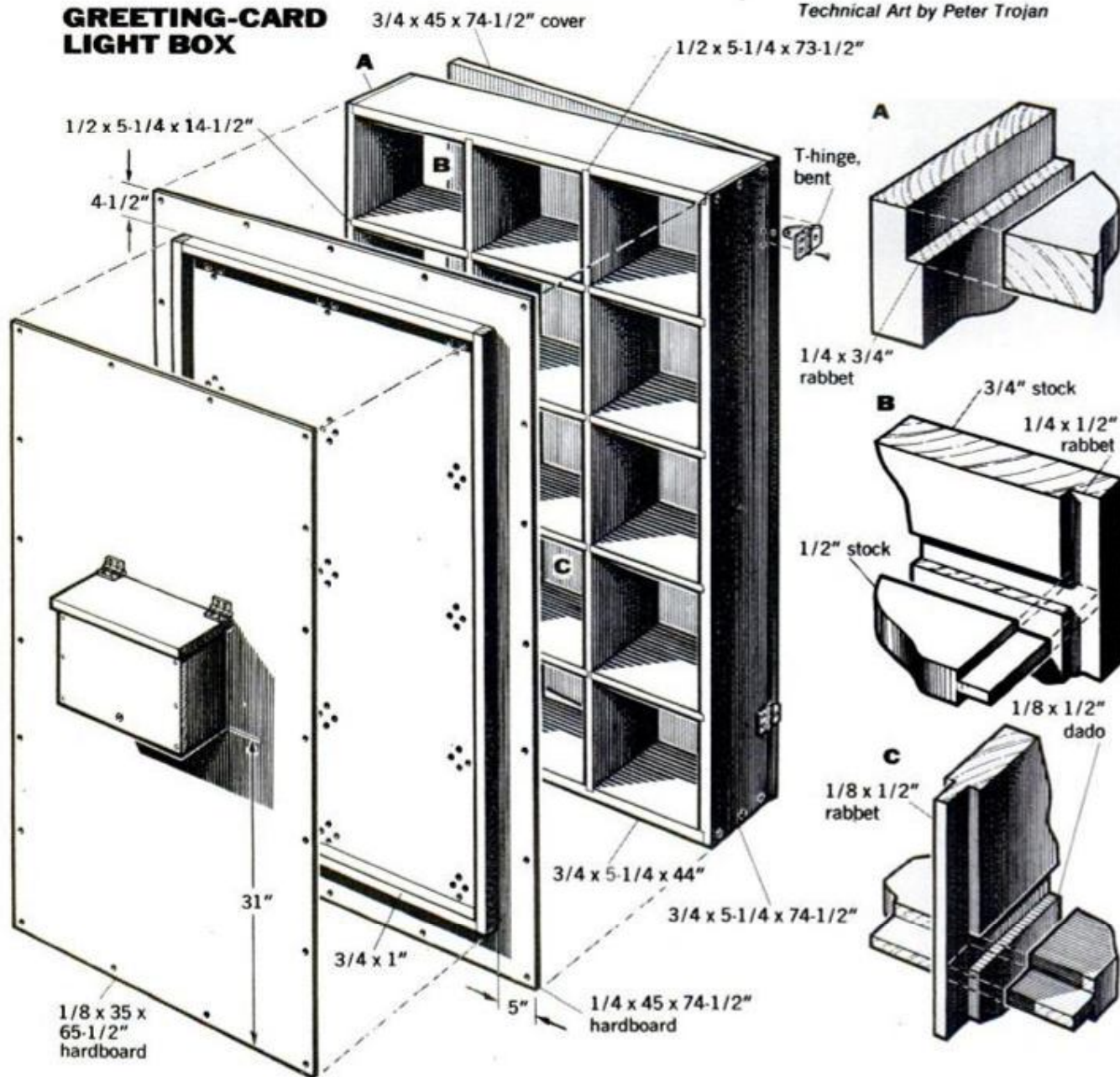
The light box is a simple egg-crate affair made by cutting dadoes in the vertical members to take 12 14½-in. horizontal shelves that are glued in place. The box is painted flat white, both inside and out, and including the inside face of the back panel.

The colorful 6-ft. paper Santa sells for \$2. You can get one from U-Build Enterprises, Box 2383, Van Nuys, Calif.

You cut the Santa pattern into 15 separate sections, after first cutting it out with scissors. To do this, place cutout over the compartments of the box and, with a straightedge, mark the pattern where it

GREETING-CARD LIGHT BOX

Technical Art by Peter Trojan



crosses the dividing members. Cut along the lines with a razor blade.

I used 1/8-in. white opaque Plexiglas for the inside glass and 1/8-in. clear for the outside, but if I did it again, I'd use regular window glass for the outside pane. It doesn't scratch as easily as plastic, which makes it easier to clean after caulking. The windows have to be sealed so that water can't get in between the two panes and wet the paper pattern. One cartridge of caulking will do the 15 windows. I used a white flexible compound containing butyl rubber and dipped a putty knife in turpentine to smooth it. Tub caulk, silicone rubber and even plain linseed-oil putty will also do.

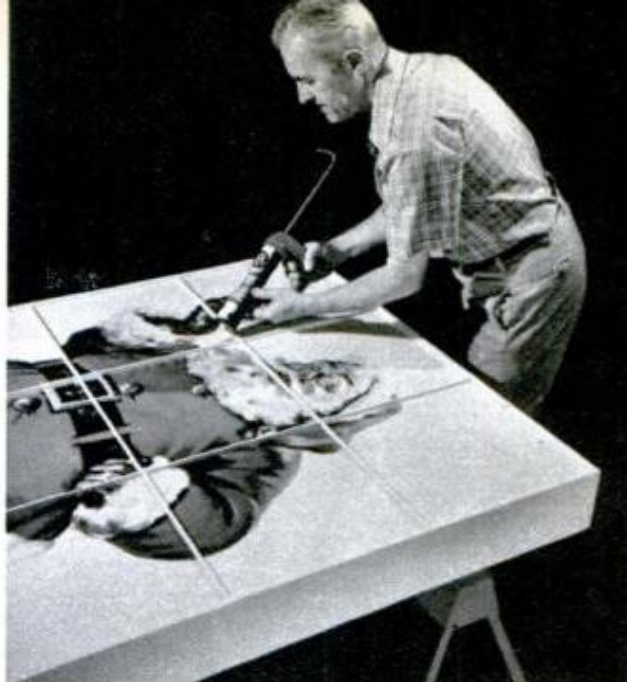
The hinged front becomes a protective cover for the greeting card when stored.

Use small stove bolts to mount the sockets to the 1/4-in. hardboard and follow the diagram to wire them from the rear. I screwed the hardboard back to the box and then sealed the joint all around with waterproof tape.

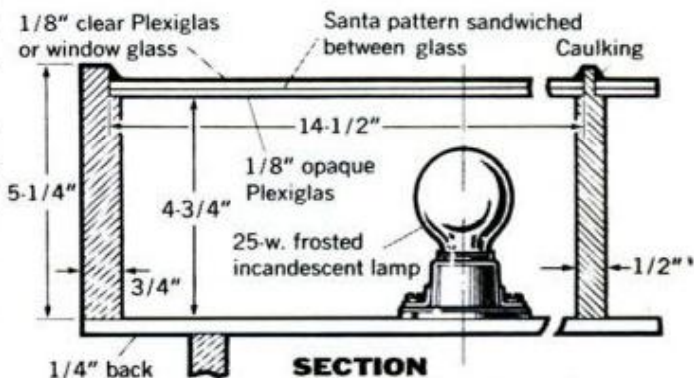
A second screw-on back conceals the wiring which is finally brought out through two holes to reach the timer. Here each wire should be tagged and numbered to coincide with its assigned socket.

A 1-rpm gear motor operates the

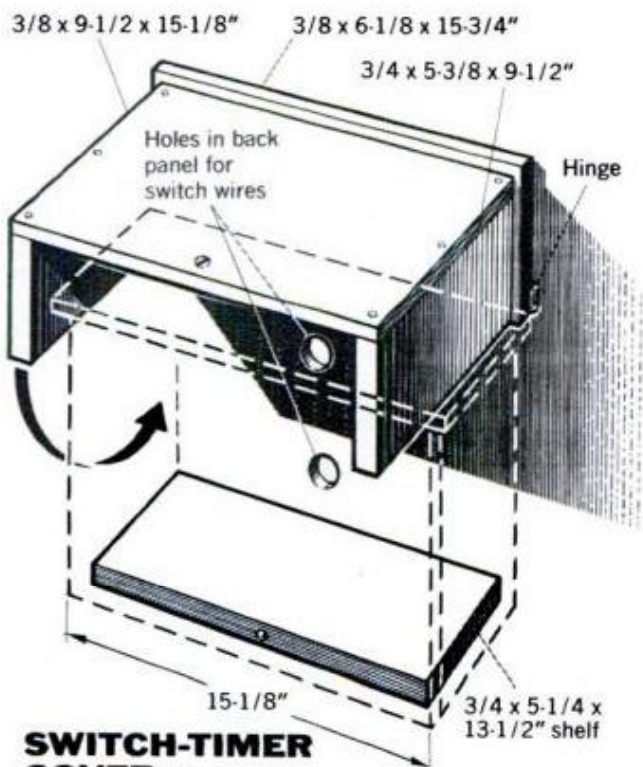
(Please turn to page 202)



WINDOW PANES ARE SEALED with caulking compound so water can't get in and ruin paper Santa



PURCHASED SANTA PATTERN (right) is ruled off and cut in 15 pieces, then placed between window panes



SWITCH-TIMER COVER

NOVEMBER 1970



Early American Wall Clock



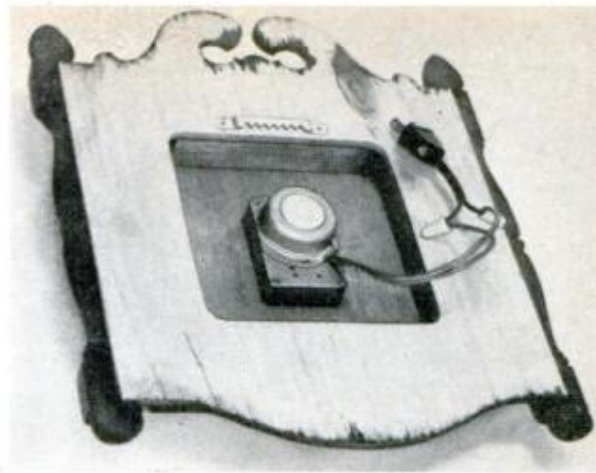
Things to Make



Electronic Checker Game

HERE'S A TIMELY GIFT any member of the family would be happy to find under the tree Christmas morning. It's a charming Colonial-styled wall clock which can be built to operate either by transistor battery or household current, depending upon which movement you prefer to use.

The plans on page 181 will let you make the gift from scratch with materials you probably have lying about the shop now. But happily, if you are pressed for time, a kit is also available. Everything that's needed is furnished in the kit—precut walnut parts, all the necessary materials needed for finishing plus the clock movement. (The electric kit is priced at \$17 while the battery type sells for \$20.) *(Please turn to page 180)*



REAR VIEW OF CLOCK shows movement flush in cavity formed by cutting out center of three-ply back

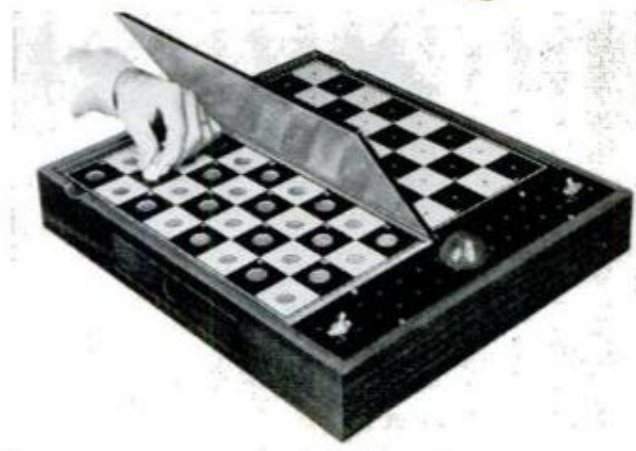
for Christmas

WHAT'S SO DIFFERENT about this checker game? Nothing, except it's booby-trapped. Like wandering through a mine field, you unknowingly can land on a mine and "blow" your man off the board. That's what makes it so exciting, so different and so difficult to win.

While it's a patented, battery-operated game and circuitry, *PM* readers are free to make one for themselves (*but not for sale*) thanks to inventor Donald A. White of Indianapolis, Ind., who holds the patent on the electrical system utilized.

Here's how it's played: Two players decide on the number of "booby traps" each wishes to set—perhaps two to six. Each then preprograms his side of the board by removing from two to six cardboard discs from any square on the hidden board.

Now the game begins. Using eight to ten checkers per side, each player sets up his checkers in any squares he chooses in the last two rows (except, of course, the booby-trapped squares). Play calls for a forward move to any forward



SQUARES ARE BOOBY-TRAPPED by lifting cardboard insulators (discs) from the holes in hidden board



EACH CHECKER IS A SWITCH which sets off a horn on making contact with metal plate in hidden board

Things to Make for Christmas

square by any checker. You may not peek at the hidden board after play has started, so if you booby-trap your own man with a "beep" from the built-in bike horn—off the board he goes!

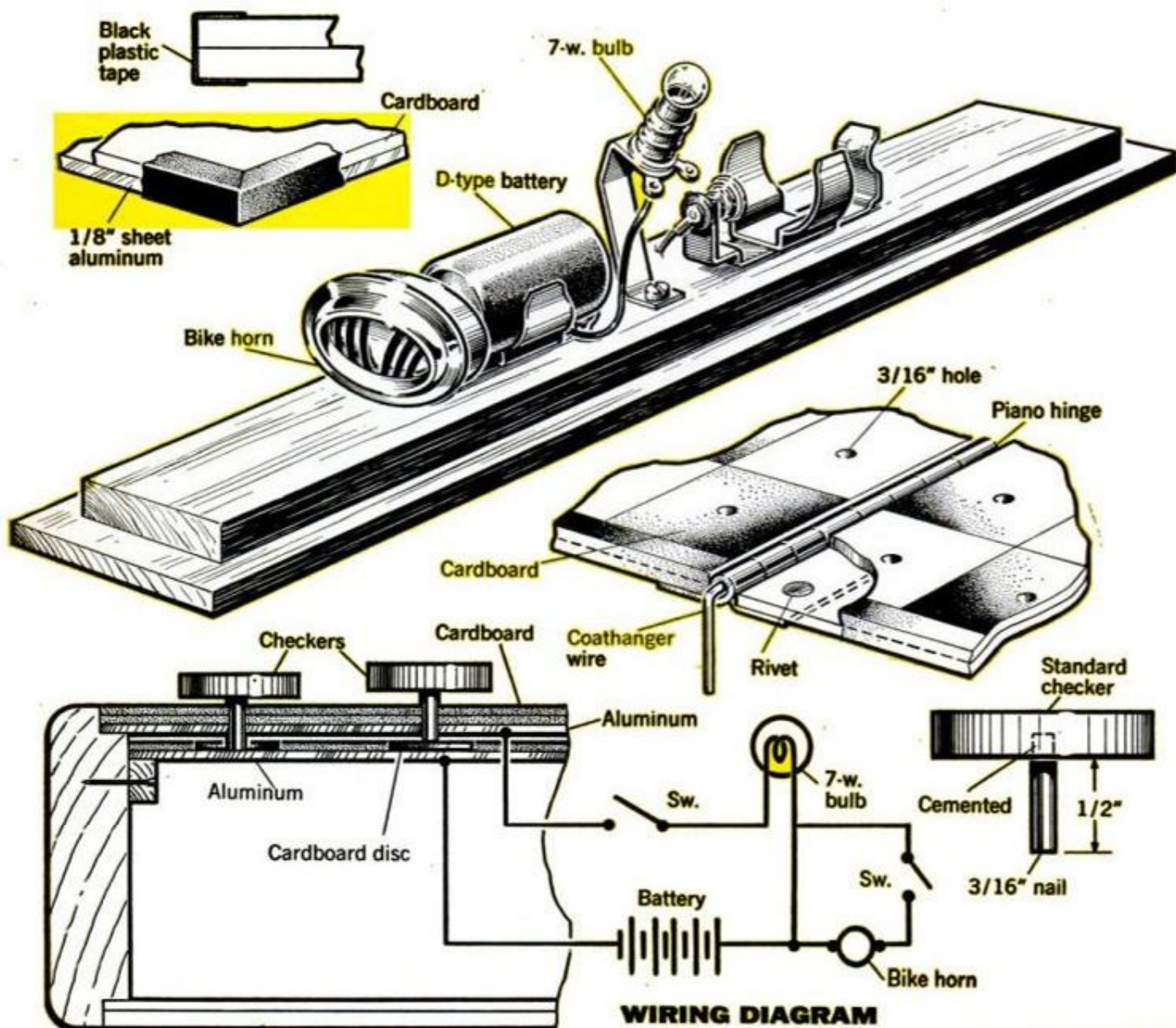
You are never required to jump an opponent, for if by jumping one or more of his checkers you wind up with a beep, his men stay and your offensive checker goes.

Like regular checkers, electronic checkers has the same objective of capturing a "king." A king is identified in the normal way with an extra checker on top. The king can move sideways as well as backward, giving him extreme flexibility but

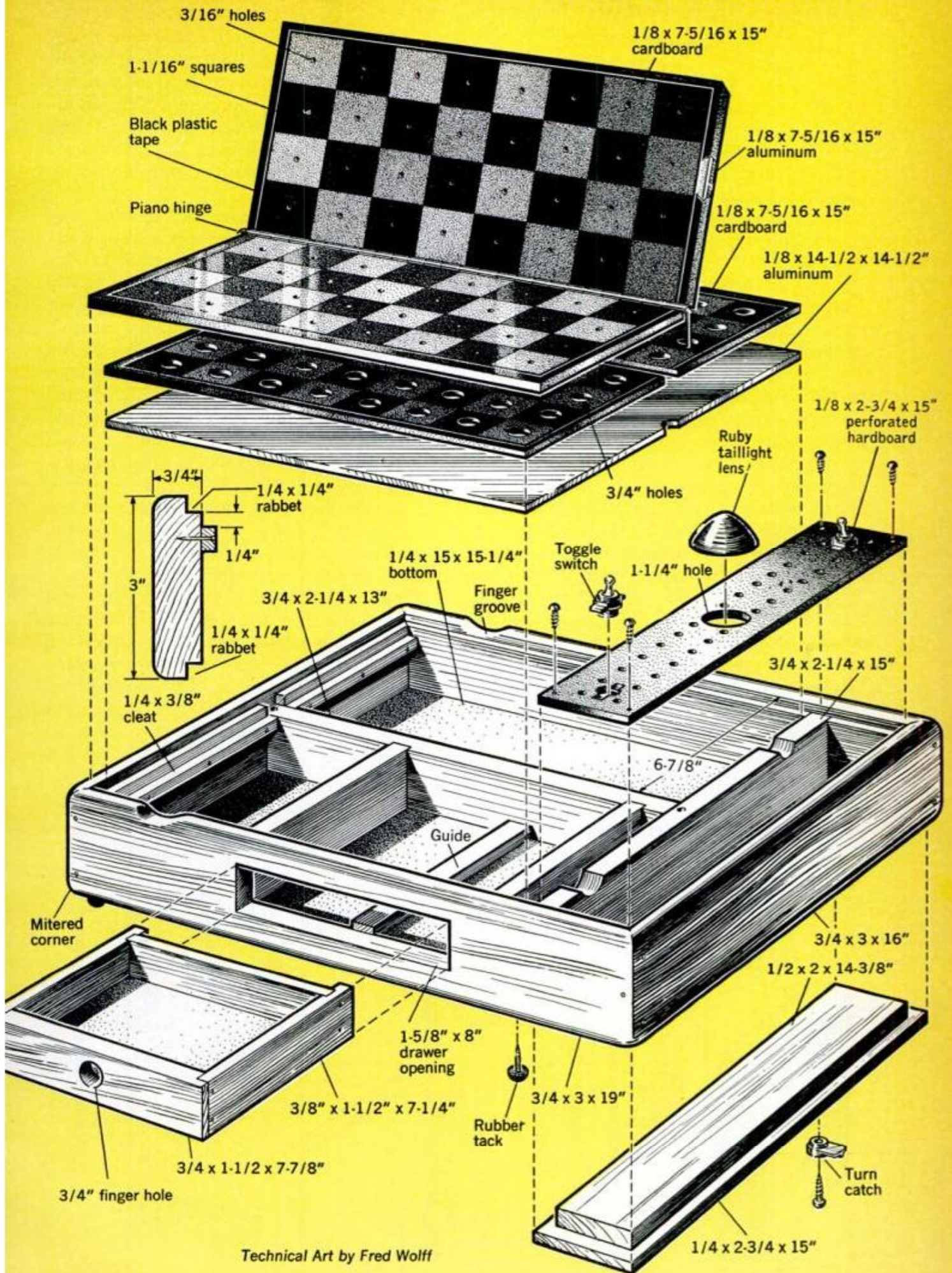


BOOBY-TRAP HOLES in the bottom checkerboard are punched out with sharpened end of scrap of conduit no guarantee against landing on a booby-trapped square.

Basic game logic, of course, is an attempt to lure your opponent into each
(Please turn to page 214)



ELECTRONIC CHECKER GAME



Technical Art by Fred Wolff

Things to Make for Christmas

(Continued from page 177)

If you decide to build your own clock, the movements can be purchased separately. The kits are sold by Gaston Wood Finishes, 3630 10th St., Bloomington, Ind. 47401.

Building from scratch. The spindles (half-turnings) require a little lathe work. To turn them, you must glue up a turning square from two pieces of stock. The time-tested method for such work is to glue the pieces together with a piece of cardboard (or wax paper) between. Use a white glue and when the turning is completed, the parts can be quickly separated by prying apart at the cardboard joint with a knife blade.

The back. The best bet for making it is to draw a full-size pattern and, when satisfied with the shape, trace it onto the piece of plywood. Use a bandsaw or jigsaw to cut it out and then sand the plywood edges thoroughly. (Hint: After sanding the edges, stain them with a black felt-tip pen.) Finish the back by boring the four corner holes for the center (movement) cutout. Finish the back by sawing out the center.



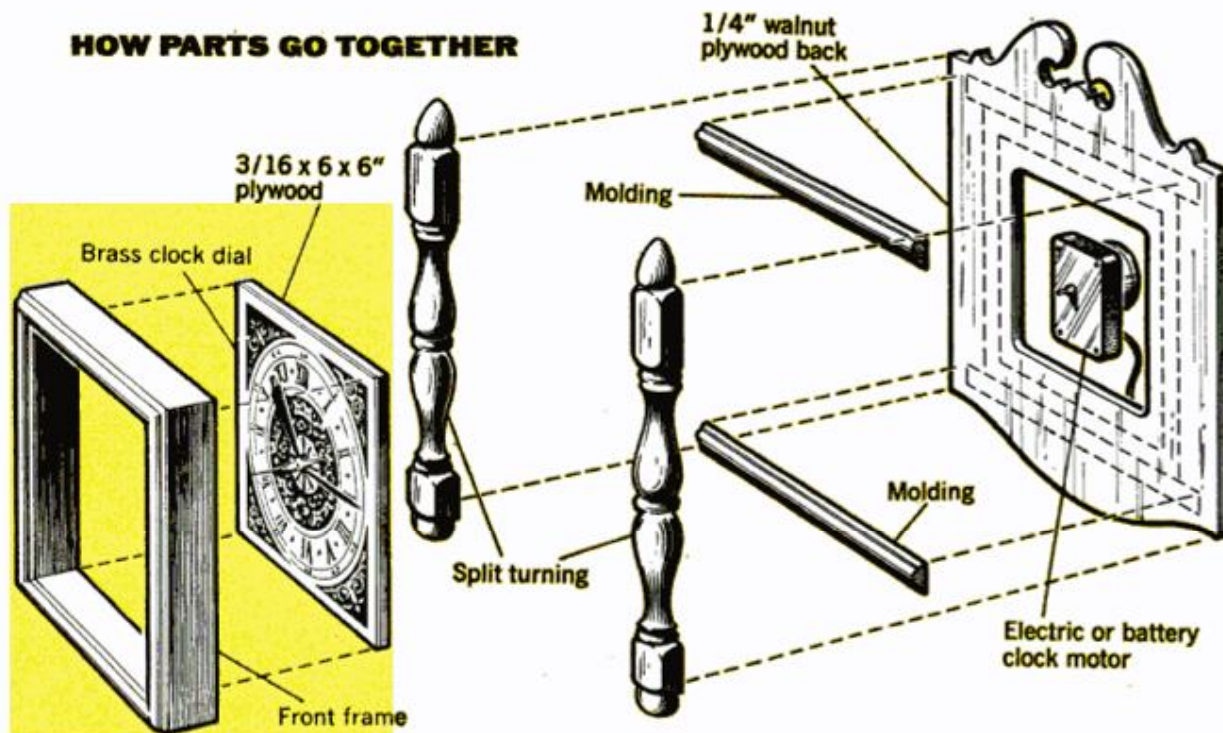
Next, miter and glue the frame-pieces (B) together. Use brads and glue to attach the spindles and fit the short strip of molding (A) between. (The molding used can be of any

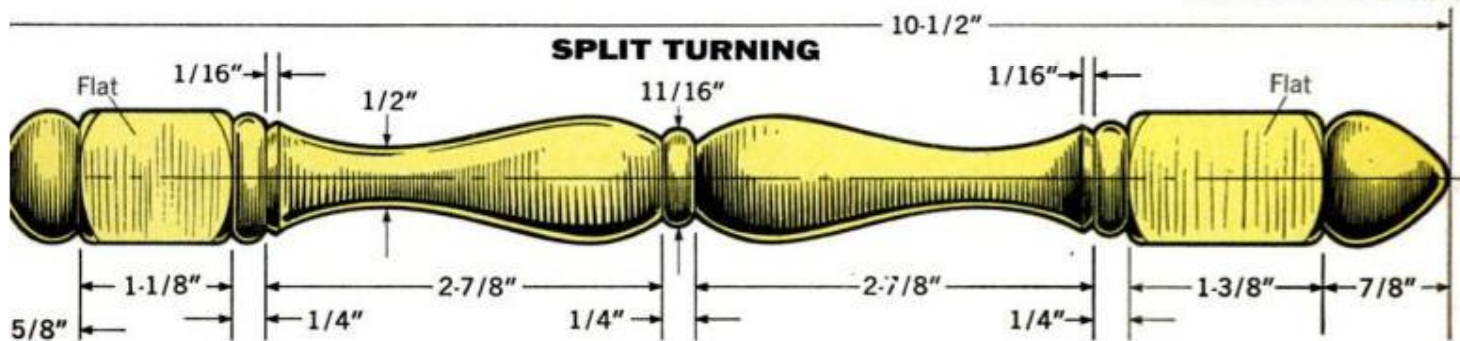
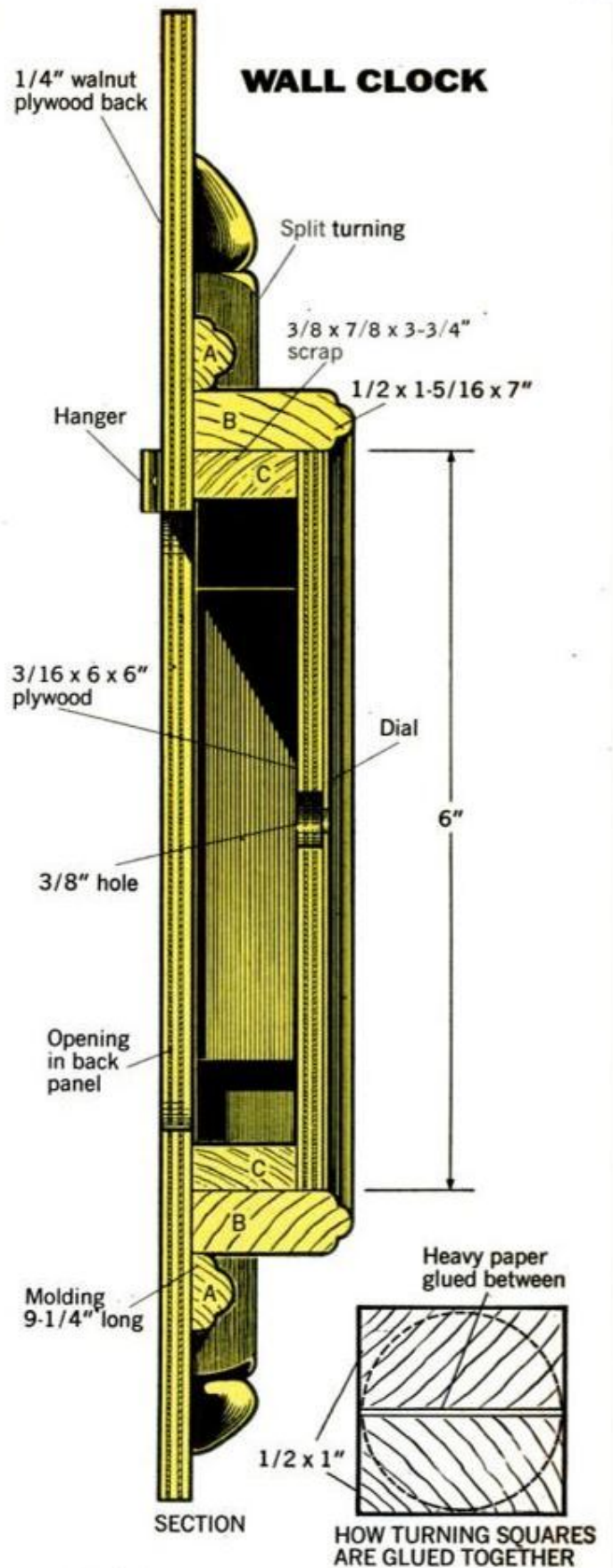
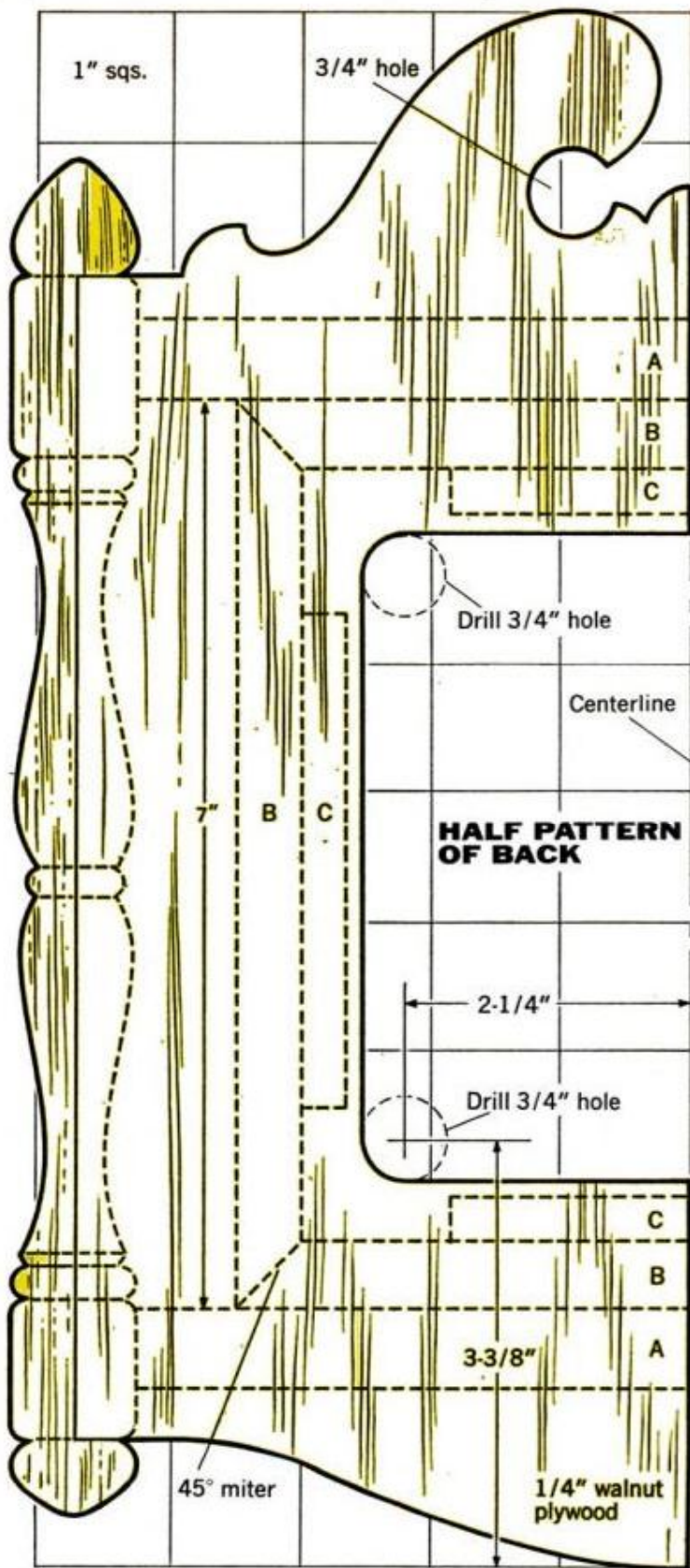
shape but, for appearance sake, it should not be any wider than the strip shown in the drawing).

The case shown was left natural and finished by brushing on a wet coat of waxing lacquer which was allowed to dry for about two hours. Next, it was lightly sanded with a very fine grit sandpaper. After the piece was thoroughly dusted, a second coat of the lacquer was applied and allowed to dry overnight. Though not a must, another sanding and a third coat of the lacquer do give the toughest finish. If you prefer a dull, hand-rubbed finish, wait about two weeks then rub the lacquer coat with a 4-0 grade of steel wool and apply a paste wax such as Butcher's following the directions on the can. Then buff the case with a piece of flannel or other soft cloth.

Finally, glue the dial panel in place and bore the hole in the center. Notice that the hole size varies depending upon the movement used— $\frac{3}{8}$ in. dia. for the electric version and $\frac{5}{16}$ in. for the battery operated. Install the dial and movement and affix a wall hanger to the back to complete. ★★★

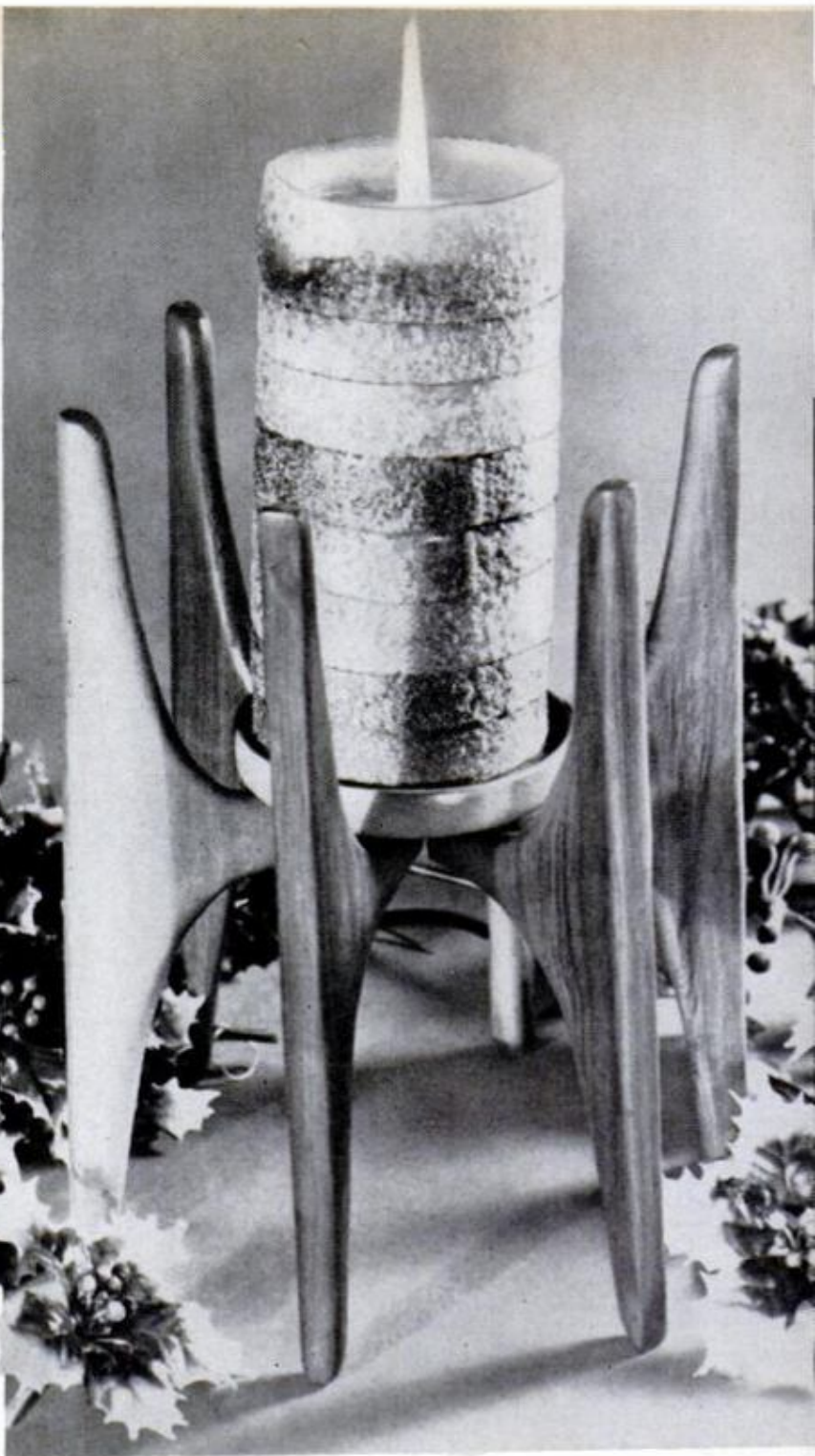
HOW PARTS GO TOGETHER





Things to Make
for Christmas

Holiday Candle Stand



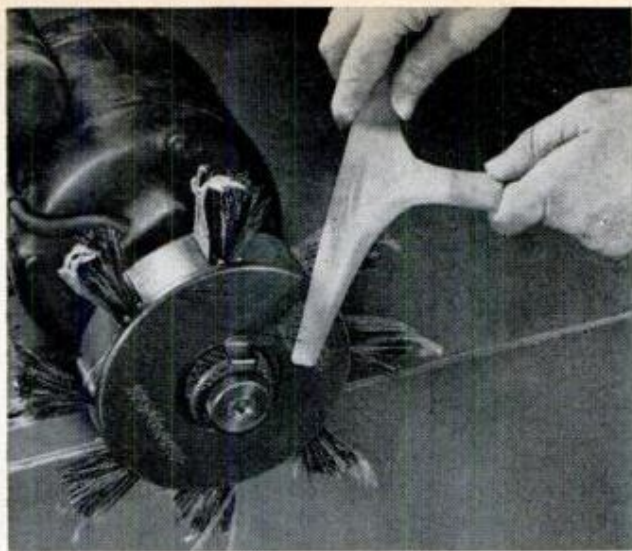
DESIGNED TO HOLD jumbo candles up to 3 in. in diameter this attractive candle stand makes a festive centerpiece for the Christmas holidays.

First make a full-size pattern for one of the arms and trace it on your wood. If you have a bandsaw, you can saw all six arms at one time by tacking the $\frac{1}{2}$ -in. stock together in the waste areas. A router with a corner-rounding bit makes quick work of rounding the edges of the arms, but you also can do it with a contour sander or a sanding drum in the drill press. If you have to do it by hand,

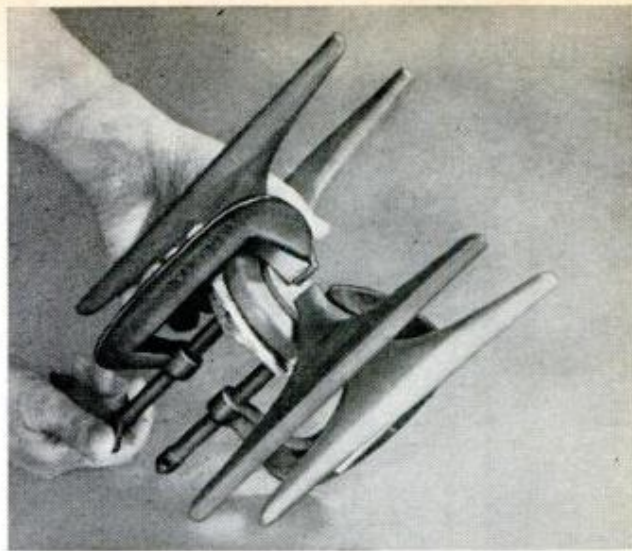
start with a coarse sandpaper and finish with fine.

The candle cup is lathe-turned from a $\frac{3}{4}$ -in.-thick disc and recessed $\frac{1}{8}$ in. Again, if you don't have a lathe, it can be built up from three jig-sawed discs.

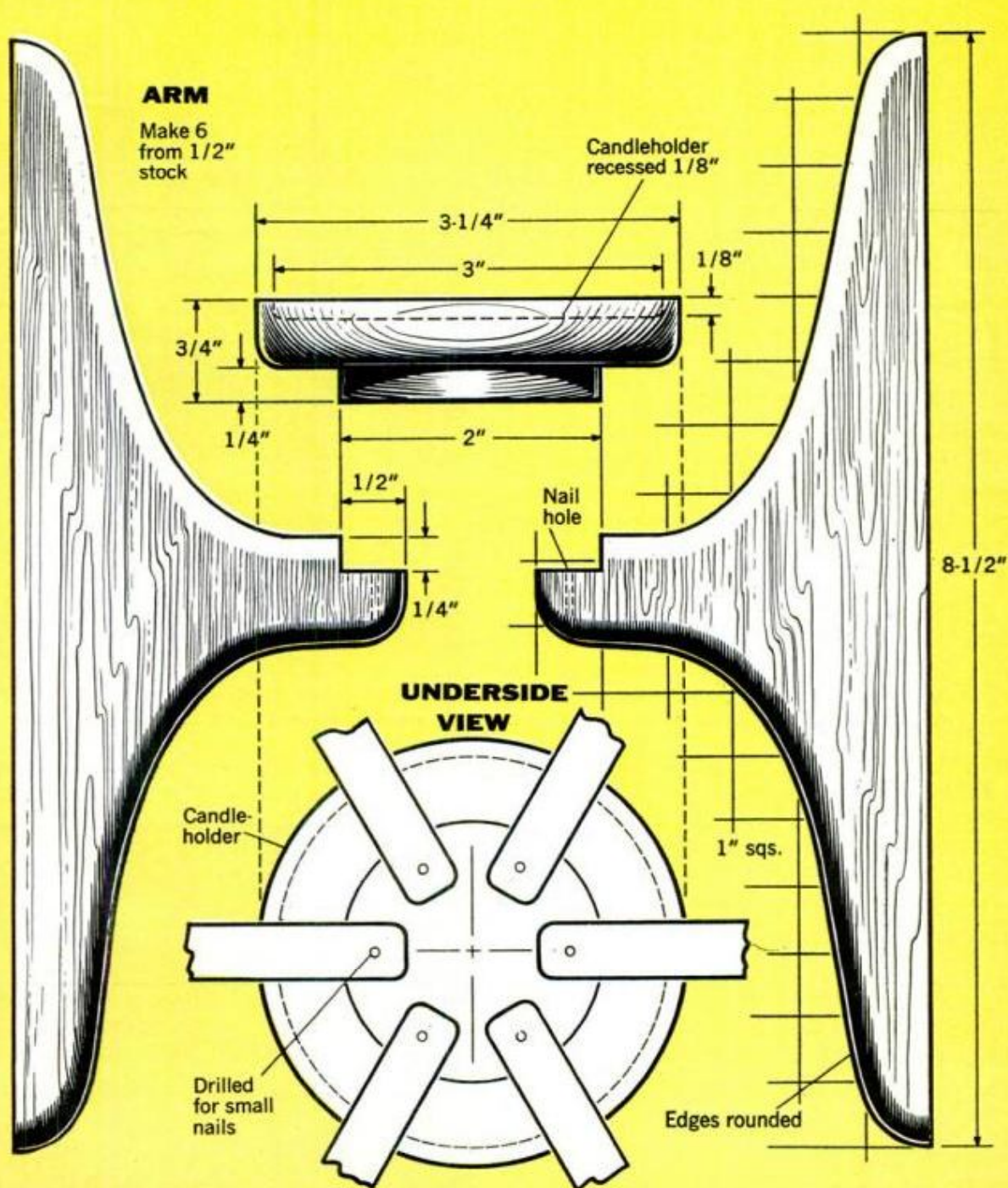
If you have used open-grain wood such as mahogany or walnut, apply paste wood filler before assembling the parts. Glue and nails are used to attach the arms to the cup. Add two arms at a time, one opposite the other and clamp. Complete the stand with self-rubbing clear satin finish.—*Elma and Willard Waltner*



AFTER SAWING OUT the arms, all edges are rounded with a Sand-O-Flex contour sander or sanding block



THEN THE ARMS are glued and nailed to bottom of candle cup and held with C-clamps until glue dries



Things to Make
for Christmas



Toast Rack

HERE'S a smart breakfast-table accessory that holds six pieces of toast and jelly. You'll want to make it from choice pieces of teak, rosewood or mahogany and finish them flawlessly. It requires $\frac{1}{4}$ -in. stock for the top and $\frac{3}{8}$ -in. for the bottom.

The bottom is simply a piece cut 3 in. wide and $8\frac{1}{2}$ in. long and then beveled all around. You can do this on your bench saw by tilting the blade $\frac{1}{16}$ in. Bevel the ends first so you won't chip the wood when beveling the sides.

Cut the top piece $3\frac{3}{8}$ in. wide and 11 in. long and strike lines diagonally from the corners to locate the center. Ends are tapered at bottom and sides. Plane the bottom first on a line $1\frac{1}{4}$ in. in from the end and to $\frac{1}{8}$ -in. thick. Next mark $\frac{3}{16}$ -in. side tapers and plane them.

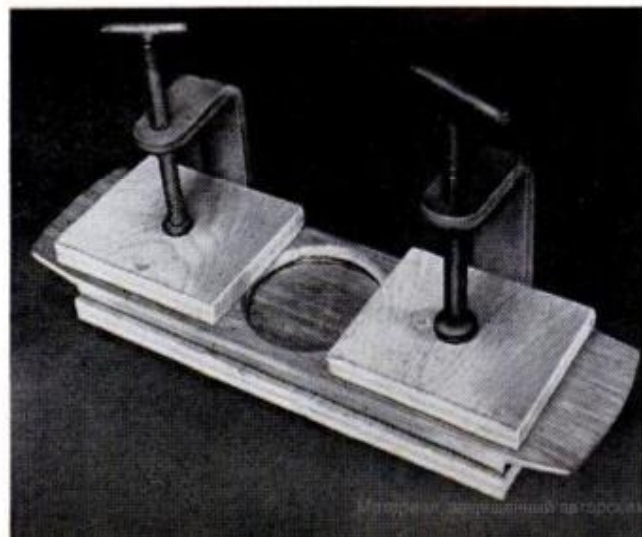
To mark the round ends set your compass $5\frac{1}{2}$ in. and swing it from the center point. If you don't have a disc sander, you can round the ends with a sandpaper block. Now take your plane and bevel all edges of the top piece slightly inward.

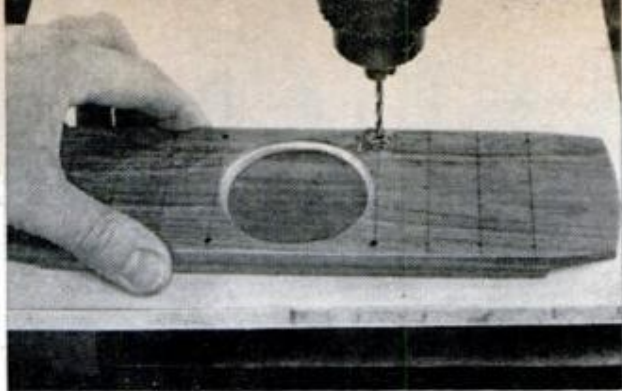
The well for the jelly container is made



WELL FOR JELLY DISH is lathe-turned by mounting work on faceplate. Lathe must have a 12-in. swing

WHEN GLUING top and bottom pieces together, place scrap under C-clamps to prevent marring



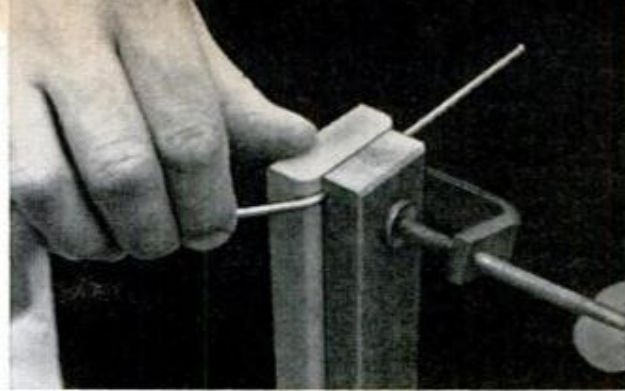


DRILL HOLES $\frac{1}{4}$ in. deep and $\frac{7}{8}$ in. apart along each side for the eight stainless-steel wire racks

to fit the contour of the dish. The neatest way to do this is with the work mounted to a lathe faceplate. If you don't have a lathe, you can tilt the table on your jig-saw and saw the tapered hole. Now both top and bottom pieces can be glued together.

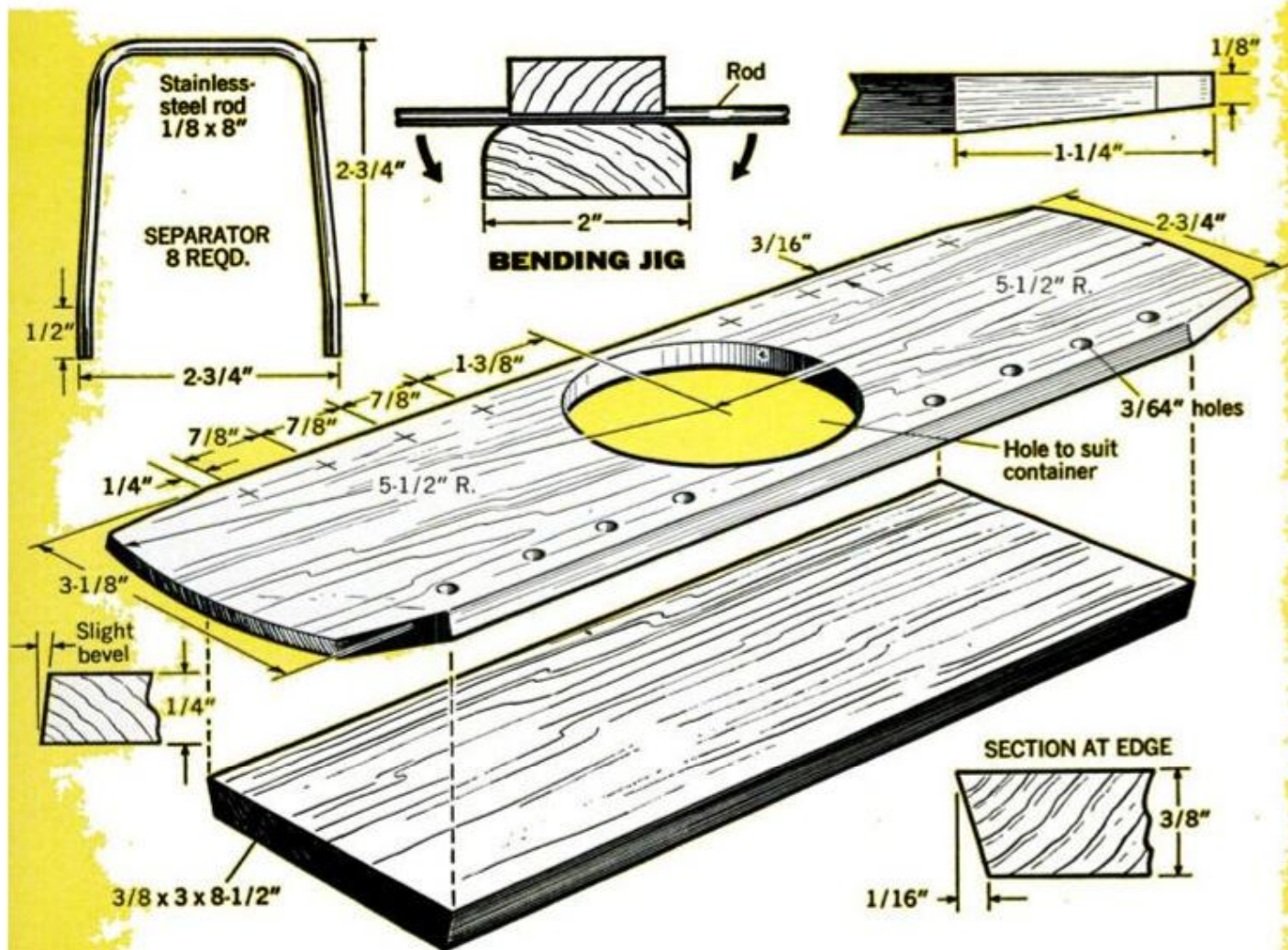
Holes for the eight stainless-steel racks are drilled $\frac{1}{4}$ in. deep, and if you have an old bit, you can make it drill a tapered hole for a tight fit by grinding the lands on the bit to a slight taper for $\frac{3}{16}$ in. from the point.

The polished stainless-steel rod that is used for the toast racks is hacksawed to



THIS IS HOW each wire rack is bent alike after being clamped tightly between two pieces of hardwood

length, the ends filed square and chamfered slightly. All can be bent alike if you use a jig made from two pieces of hardwood about 12 in. long and screwed together at one end. The edges of one piece are rounded as shown and a small V-groove is filed across the other. The rod is clamped tightly between the two pieces of wood with nut and bolt, then bent by using finger and thumb pressure only. Notice that the very ends are bent parallel by gripping them $\frac{1}{2}$ in. with pliers. Finally, the racks are pressed firmly in the holes and tapped lightly with a mallet.—Kenneth Wells



BUILD THIS KITCHEN

Its chopping-block top, king-size storage area and walk-around convenience make this work

IF YOU HAVE THE NEED—but not the wall space—for additional countertop work area in your kitchen, why not consider the advantages of this attractive island work center? Besides its generous work top (more than 13 sq. ft.), the elegant cabinet below will permit your wife to store almost all her kitchen utensils out of sight. And, from a practical standpoint, she'll have the advantage of being able to work from all four sides of a food preparation table—a luxury chefs have enjoyed for years.

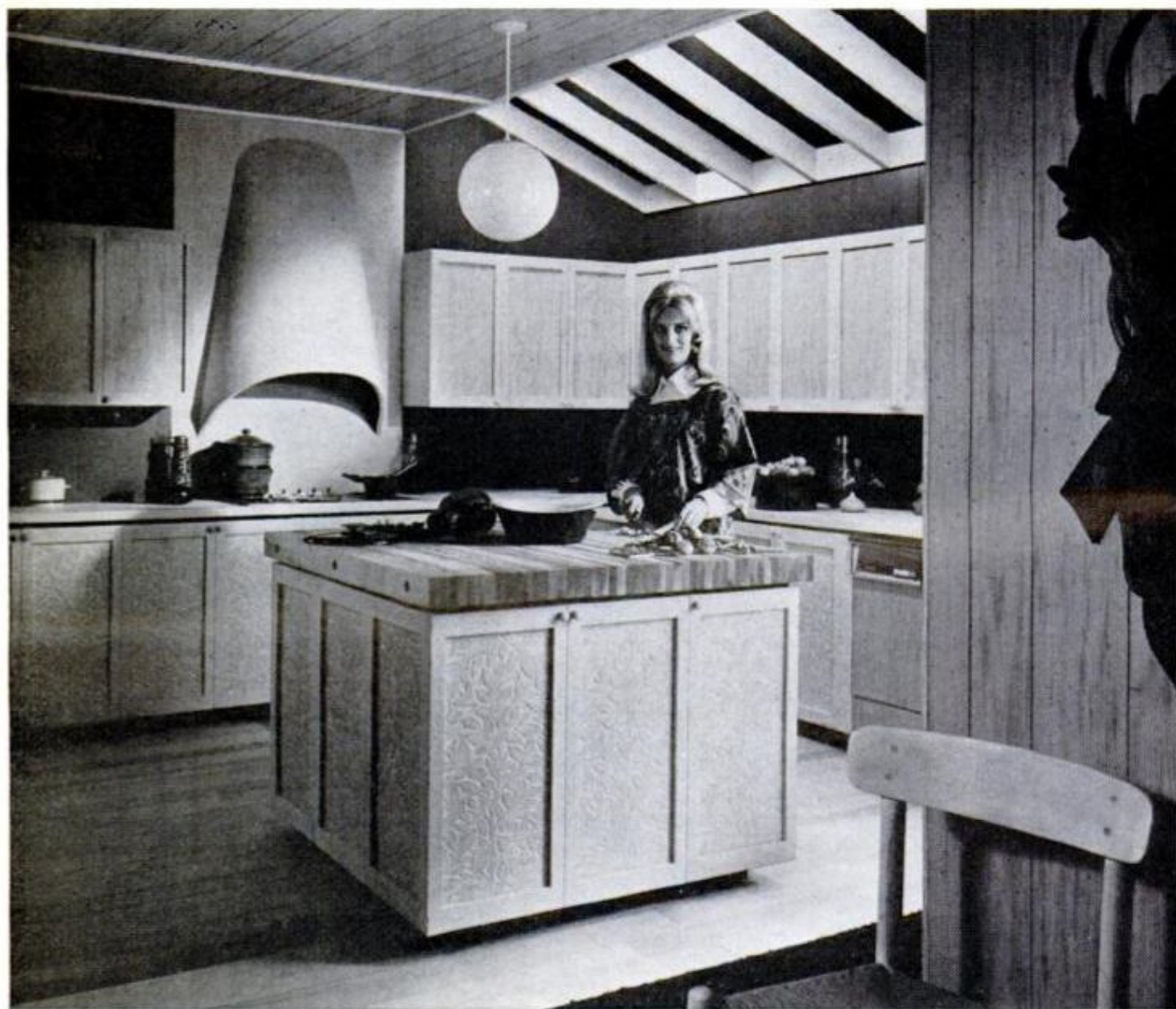
Designed by Marsh Wall Products Co., Dover, Ohio, the cabinet has a laminated chopping-block top that offers:

- A surface where foods can be chopped, pounded, cut and scraped—with cleanup afterward a snap.

- A top that can be quickly and easily dressed to almost-like-new with a belt sander in the event tool marks, cuts or scratches start to make it unsightly.

Building the center. Since the cabinet rests on a base nailed to the finished floor, a mock-up—left in place for a while—is a good idea. Simply lay the 2x4s in the chosen location and leave them there. Then, after a couple of days of walking about the planned center, you'll know whether you have picked the best site. If you find that a mobile island would be

EMBOSSSED-LEAF PATTERN gives this island work center its elegant look. Hardboard panels are available in two colors: ivory-white (shown below) and a darkstained, walnut-like finish that's used for a natural look



ISLAND

center the handiest counter in the kitchen

more desirable, you can fit the base with lockable casters instead of nailing it down, but be sure to adjust the vertical dimensions accordingly.

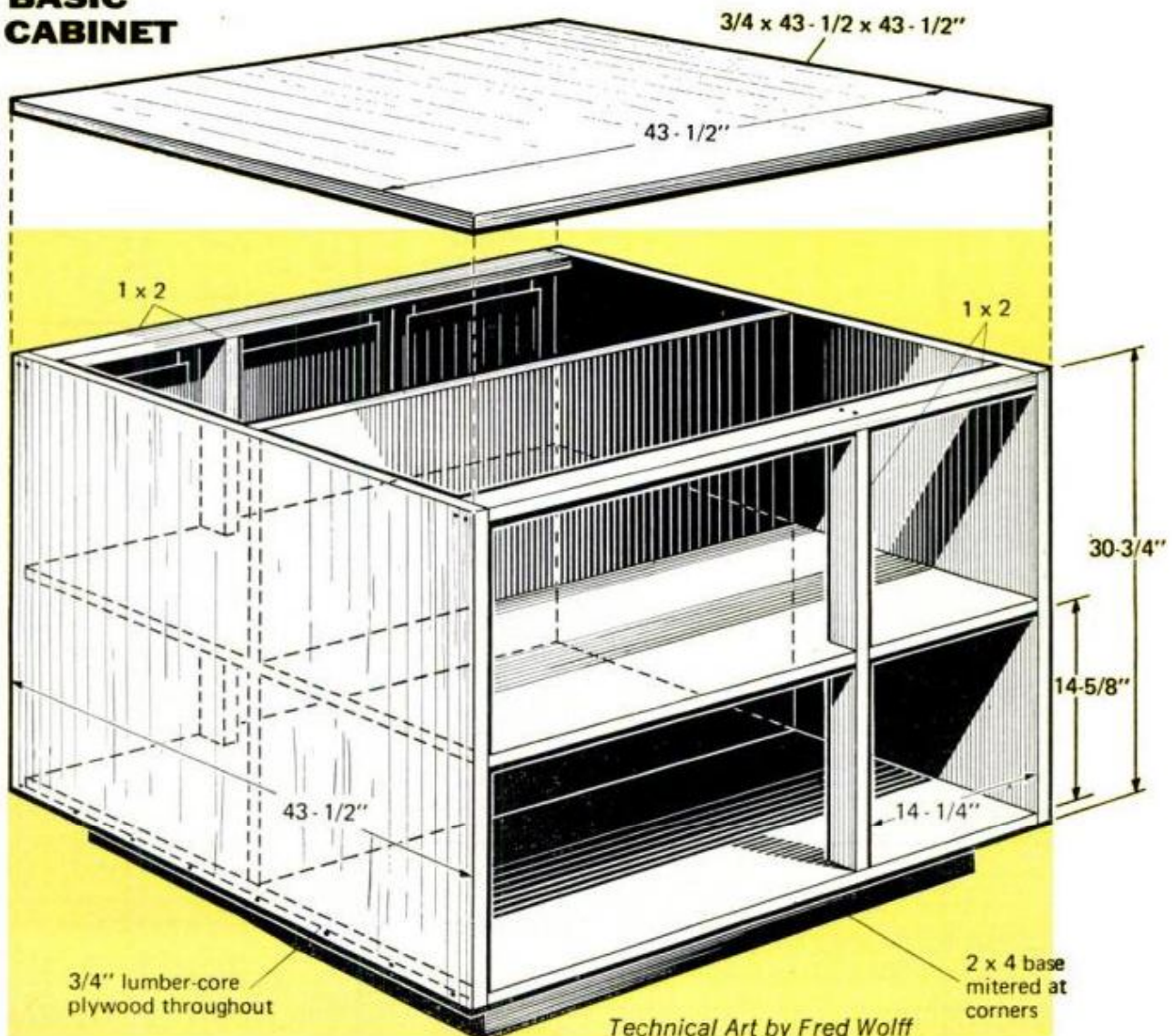
The cabinet. Constructed of $\frac{3}{4}$ -in. plywood and 1x3 pine, the cabinet is kept simple by using butt joints rather than grooving and letting in the members. (For example, shelves rest on one-by cleats.) For maximum strength, use plenty of wood screws and waterproof glue.

Chopping-block top. Birch or maple should be your choice for the laminated top. Both hardwoods have handsome grain characteristics, are long-lasting and are extremely resistant to scratches and mars. To insure lineup for the holes in the 47 pieces that receive the threaded rods, take



TEXTURED HARDBOARD comes in 16x96-in. panels, requires no finishing. It's available at lumberyards

BASIC CABINET

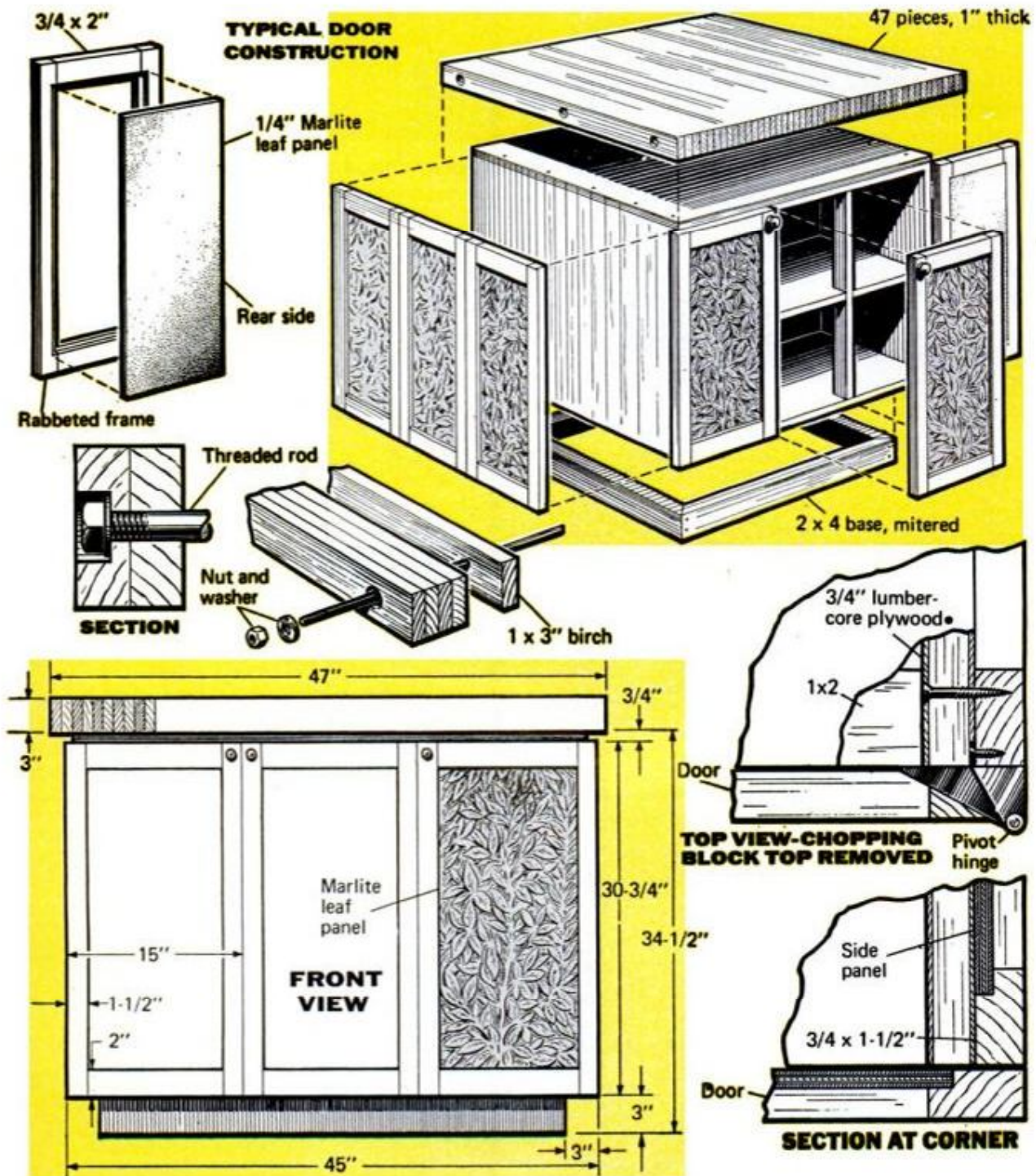


time to set up a jig. A simple way is to cut a 47-in. length of inexpensive material, mark off and bore the three required holes. Then use this pattern as a drilling guide. Since the holes may vary slightly from edges or ends, mark each piece as it's drilled with an arrow for up and an X at one end to keep holes matched.

With all boards cut and drilled, slip the rods through. Next, apply waterproof glue liberally to all meeting surfaces and draw the boards tight with bar clamps. (If you have good, warp-free stock, the joints should be mere hairlines with glue oozing out evenly.) Wipe off all excess glue with a damp cloth, and set the top aside to dry

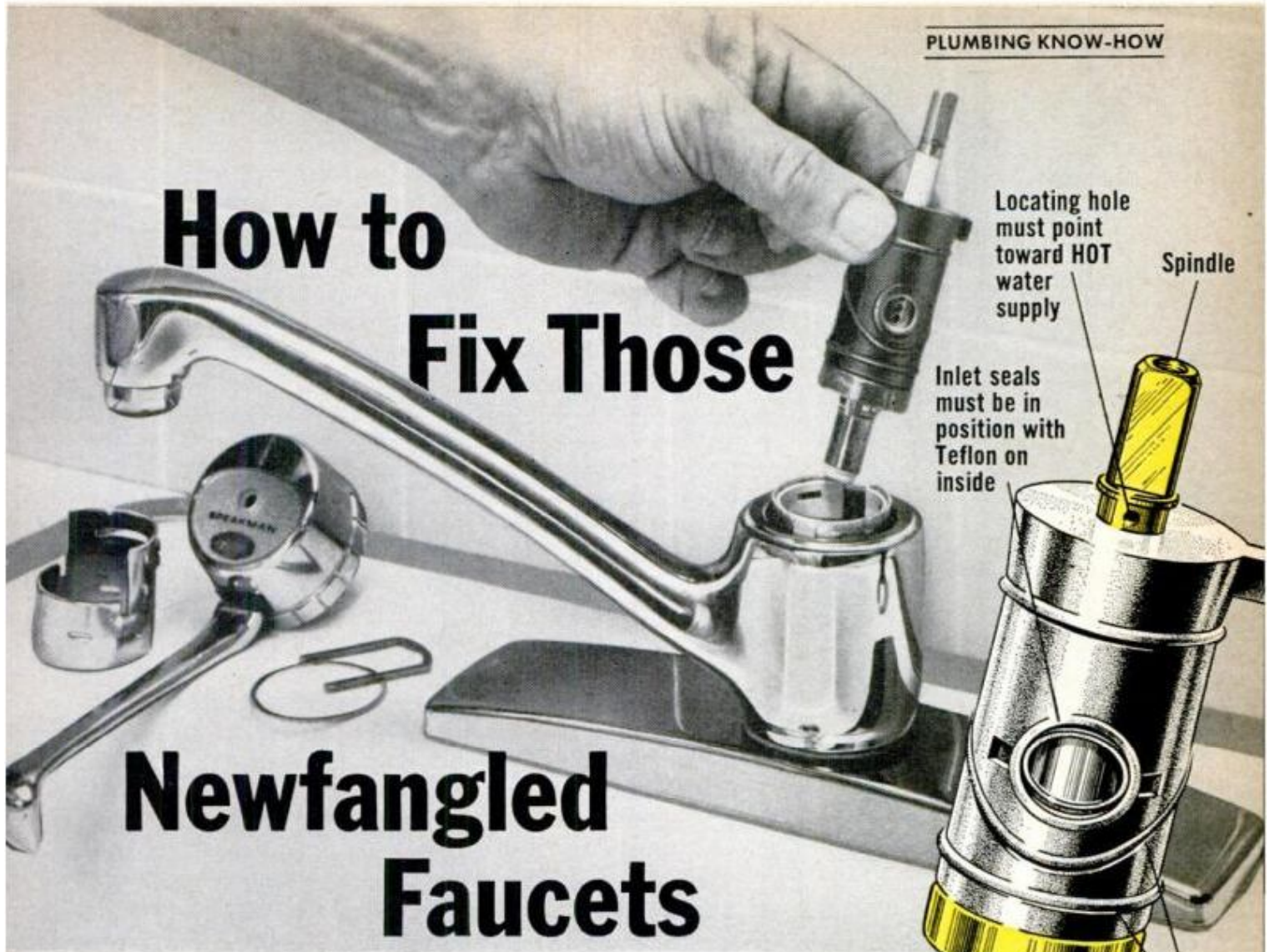
overnight. Next day, counterbore the holes, cut rods to exact length, slip on the washers and run the nuts tight. Do not remove the clamps until all six nuts are fully tightened.

The embossed-leaf pattern inserts (Marlite) in the 12 panels are let into rabbets on the inside back edges of the stiles and rails. These can be cut and rabbeted assembly-line fashion at one time. Assemble the frames and cut the hardboard to fit. Again make match-marks in case of variations. With inserts removed, paint or stain the frames and then reassemble them. The top, of course, should not be painted.—Harry Wicks, Workshop Editor



How to Fix Those

Newfangled Faucets



They may be more sophisticated now, but that doesn't mean you can't be the repairman. You can still do the job and with just a little know-how

By **STEVEN J. HOWARD**
Technical Art by Fred Wolff

WHEN IT COMES to water faucets, homeowners generally think in terms of two types—those with one handle and those with two. Plumbers know otherwise. And that's why homeowners pay plumbers to fix leaks that they, with a little knowledge, could have fixed themselves.

There are six different types of faucet designs. Four are of the compression type and two are used in single-lever faucets. All six were developed within the last 25 years. Before that, faucet design remained virtually unchanged for many years.

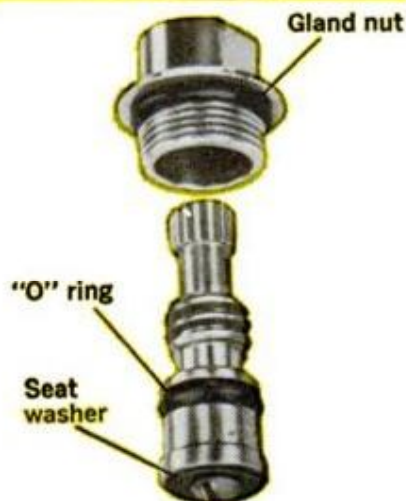
Compression faucets. Most two-handle faucets are of the compression type to



REMOVABLE STEM CONTROL
 for one-handle faucet has complex series of O-rings. Note ports



WASHERLESS FAUCET (above) eliminates seat washer and O-rings. Brim of diaphragm fits barrel, prevents spout leaks



permit separate control of hot and cold water. A compression faucet is basically a screw (real name: stem). When you tighten that "screw," you cover the water-supply hole and shut off the flow. When you reverse the procedure, the water flows.

The four different designs of compression faucets evolved, more or less, to solve a problem that plagued their predecessor. The first change, about 25 years ago, did away with the big conical nut that sat atop the fixture. This nut compressed a stringy packing material that was wound around the stem to keep water from leaking out around the stem. This string packing, unfortunately, was not very sturdy and it usually failed every few months.

The improved version was designed with the packing shaped like a washer. When water drips from around the stem, indicating failure of the packing washer, you simply slide it off the stem and replace it.

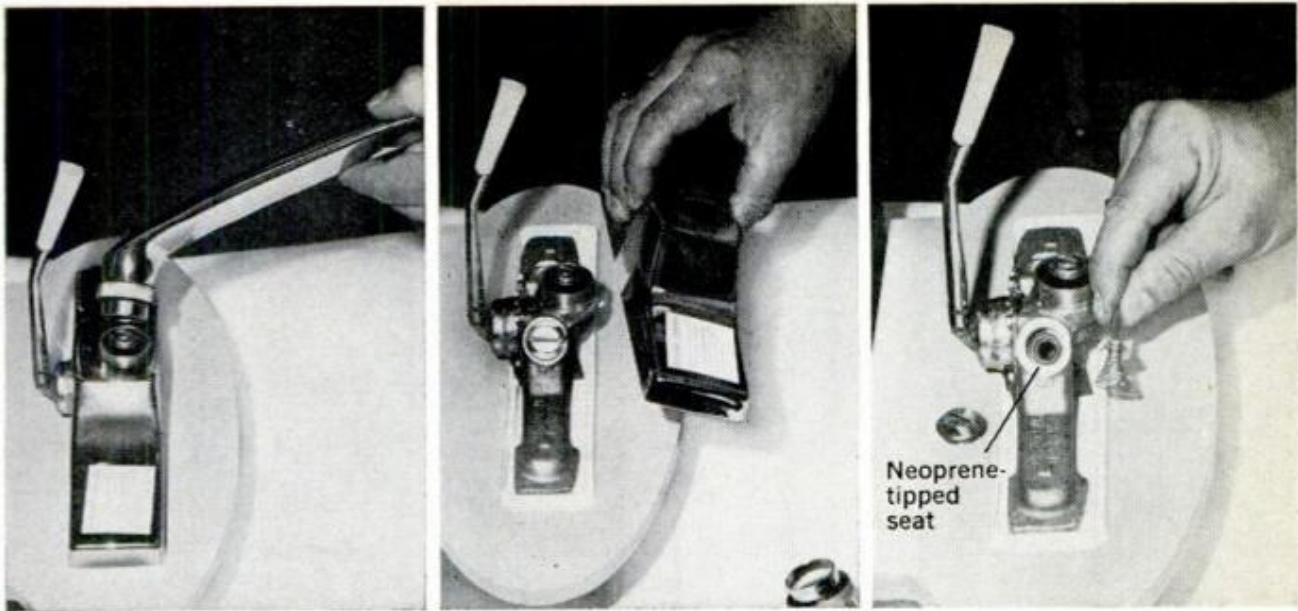
Though the newer design eliminates the conical nut, it does require a smaller (gland) nut to keep the stem assembly in place. This nut, *which is used in all compression faucets*, should never be over-tightened when being replaced. Tighten the nut finger-tight, then turn it $\frac{3}{4}$ of a turn with a wrench.

The packing-washer faucet was followed by the replaceable seat fixture. When a faucet drips from the spout, you know immediately that either the seat-washer or the seat itself is damaged. The one thing that can cause damage to washers and seats (besides chemical additives) is high water pressure. If the pressure in your area is more than 65 p.s.i., you should install a pressure reducing valve. (You can get this information by calling your local water company.) This inexpensive component will add life to seat washers and seats and will eliminate, or at least minimize, pipe noises. If the seat, which is an integral part of the faucet barrel, is badly damaged or worn, the whole faucet should be replaced.

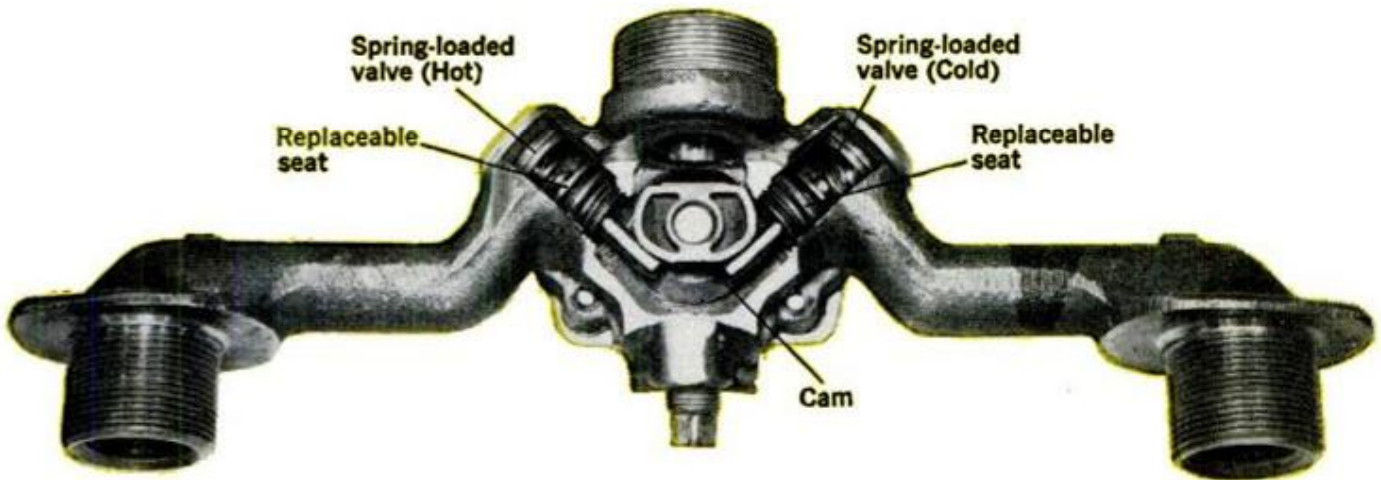
The next version changed all that. These, both in the single-lever and compression types, have a removable seat. Using a tool that you can buy for about \$1 in a hardware or plumbing supply store, you simply back the seat out of the barrel. If your faucet drips from the spout and replacing the washer doesn't help, replacing the seat will stop the leak. Another tip: Buy replacement parts made by the manufacturer of the faucet if possible so that you're assured of the correct fit.

After packing-washer faucets, another style arrived on the scene. This featured a removable barrel. It is essentially the same type faucet as the first except that when you remove the stem, you also remove the barrel. The advantage is one of economics: If the threads of the barrel become distorted, you

EXPLODED VIEW OF O-RING FAUCET shows packing has been eliminated. This type of faucet prevents water from traveling up the stem and helps to stop overtightening and distorted threads



LEAKY SINGLE-LEVER FAUCET is repaired by 1. removing the spout, 2. taking off cover, and 3. removing damaged seat after taking off slotted cover and valve. Cutaway (below) shows principle on which cam works



don't have to throw away the faucet but simply replace the barrel. If you have a removable barrel faucet, keep in mind that the seat is an integral part of the barrel. Thus, to replace the seat, the entire barrel must be replaced.

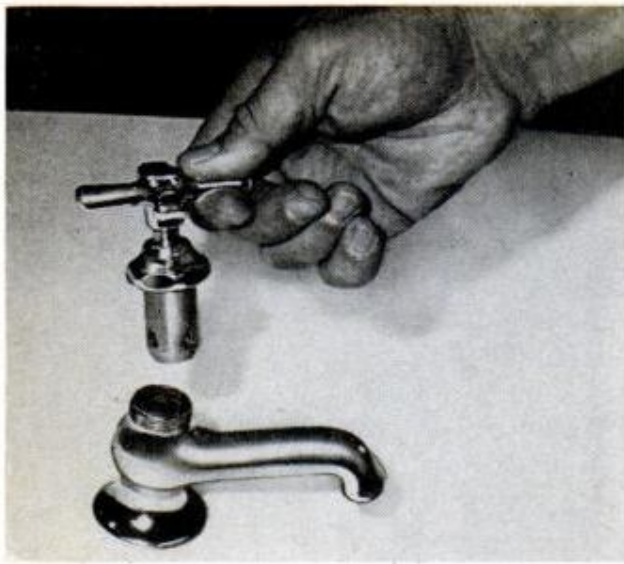
A major development in faucet technology was the introduction of the O-ring compression faucet. It eliminated packing. The rubberized O-rings prevent water from traveling up and corroding the stem. If water leaks from around the stem, you know immediately that an O-ring has ruptured and must be replaced (with the right size).

O-rings last longer than packing, especially if you lubricate them with a heat-proof grease once every two years. Without the lube they will probably crack. O-ring design also helps to prevent thread distortion due to overtightening. (An

O-ring contacts a flange in the barrel. Thus, stem travel is limited.)

The newest type of compression faucet, which was developed in 1960, eliminates the stem washer entirely. This does away with faucet chatter (which is caused by a loose washer) and also gets rid of one of the major causes of spout leaks.

In this type, a strong neoprene diaphragm eliminates packing or O-rings and the brim of the diaphragm prevents the water from traveling up the stem. The crown of the diaphragm fits over the tip of the stem and covers the water supply hole when the faucet is closed. When the faucet is opened a mere quarter turn, water pressure forces the resilient diaphragm up to allow a full-on flow at the spout. According to American-Standard, the company which developed the washerless faucet, the faucet won't drip as long as the



BARREL FAUCET features a seat integrated with barrel. If seat fails, the entire barrel must be replaced

diaphragm remains intact and that, it claims, should be for years.

Single-lever faucets. Whether water control is by a lever or push-pull method, there are two basic designs. The type depends upon the manufacturer.

One of the most popular types is the tipping valve design which employs a single cam and two spring-loaded stems—one for hot-water control, the other for cold. When you shut off the water, the cam disengages the two tipping valves and the valves, under spring tension, close over the seat to stop the flow of water. When you turn the water on, assuming the handle is kept in the center position, the cam engages both valves. The cam overcomes the force of the springs and tips each valve open an equal amount.

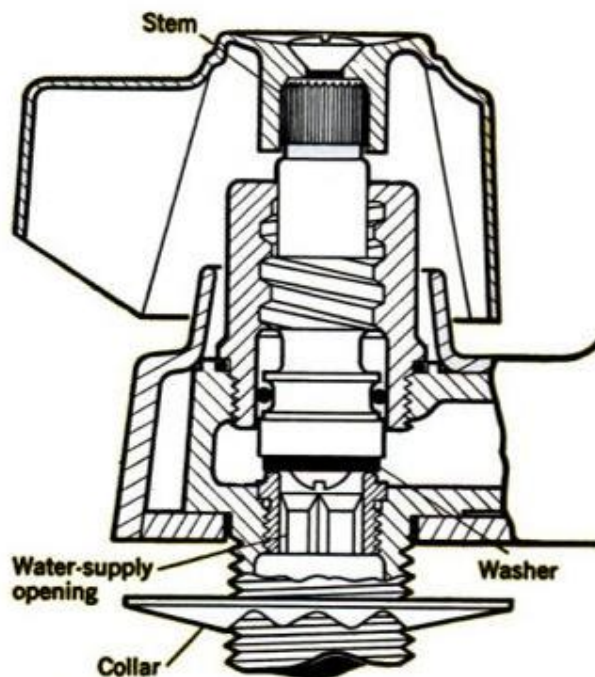
To make the water warmer or colder, the handle is moved to the left or right. As this happens, more force is put on the respective valve by the cam and is taken off the other valve. This allows one to open more than the other.

The one-handle tipping-valve faucet employs a neoprene covered seat for each valve—two in all. This seat can be damaged, especially in high-water-pressure areas. It is removable, however, and can be replaced.

Before replacing the seat, it's a good idea to try a little "quick and dirty" repair. If the faucet drips from the spout, some dirt may have become lodged on the seat. Quickly opening the faucet to full on and closing it several times will usually flush the dirt particles away.

Another popular type of control for

How a Compression Faucet Works



HEART OF COMPRESSION FAUCET is the stem. When faucet is closed, the washer seats over the water supply hole, shutting off flow of water to the spout

single-handle faucets is the renewable cartridge, such as that made by the Speakman Co. (Wilmington, Del. 19899) and shown on page 189. It's essentially a barrel inside a sleeve with a series of ports machined into both to allow water to flow at a controlled temperature. As you rotate the stem one way or the other, you will be opening some ports and closing others to permit the mixing of hot and cold water, or a full supply of one or the other.

This control is prevented from leaking by a complex O-ring arrangement. If the faucet begins to leak, the entire stem should be replaced. It's a tough job trying to replace the O-rings, and it isn't worth the time or effort. ★ ★ ★

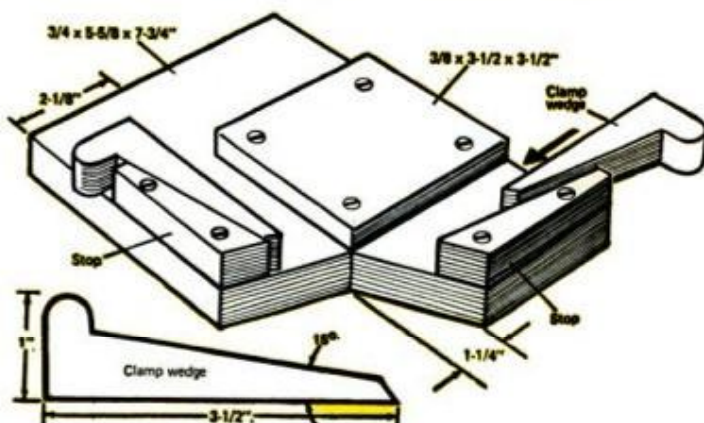
Emergency reseating job

When you find it necessary to reseat a water faucet that has a removable seat, but you can't put your hands on a reseating tool, try this trick. Back out the culprit using an Allen wrench of the proper size. Then hold the seat between thumb and index finger and rub it against a bastard-type file until smooth. Finish smoothing with a fine-grit sandpaper, apply a small amount of pipe dope to the threads and replace the seat.—*Herbert E. Serold*

HINTS FROM READERS

Improved picture-frame vise

Whenever you look at a picture frame you automatically judge the maker's craftsmanship by tightness of miter joints. Though commercial miter-vises are available, it is a simple matter to construct a shop version (such as the one shown at right) out of scrap. As the drawing indicates, the base of the vise is a piece of $\frac{3}{4}$ -in. plywood. The corner of the base is cut at an angle to provide hammer clearance for nailing the picture-frame joint. Use $\frac{3}{8}$ -in.-thick plywood for the stop blocks and attach with flathead screws. Cut the wedges from $\frac{3}{4}$ -in. plywood; if cut in the shape shown, they can be tapped out easily with a hammer. You can build a variety of sizes to suit various width moldings, but care should be taken to insure that the plywood used for the base is not warped.—*Frank L. Rush*



Eliminates pail cleaning

The worst part of the job when changing the crankcase oil in your car, I think, is the cleanup job that follows the primary task. The last time I did it, my wife came up with a good idea that perhaps other PM readers can use. Simply line the drain-pail with a plastic bag. When you're finished, knot the bag at top and throw the mess away.—*William C. Shepherd.*

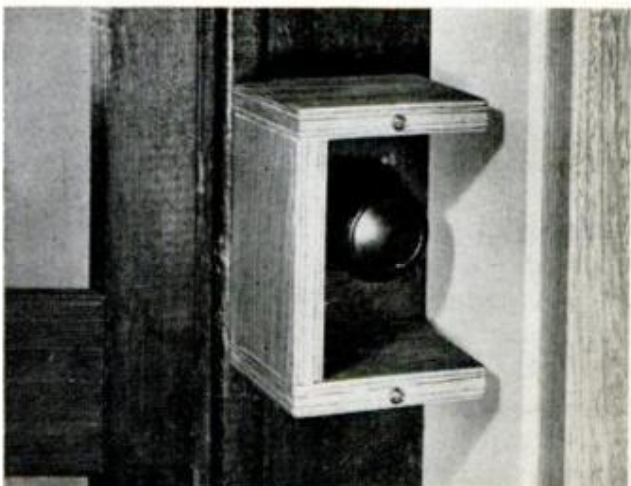


Always-available pouring aid

Lacking a funnel and having to pour liquid from a large container into one with a small mouth, I usually caused a dribbly mess. But if you try this simple trick that job becomes a snap. Simply hold a screwdriver, pencil or rod against the lip of the supply container and the liquid, when poured slowly, will follow the rod into the smaller jar or can.—*R. S. Tupper*

Thiefproof your storm door

Even if he breaks the glass in your storm door, a prowler won't gain access to the inner door if you attach a box around the inside knob as shown. Make certain that the outside edges of the box are positioned to clear the casing when the door is opened; they can be cut with a curve or sloped to match the arc of the storm door when it swings.—*Denny Ulmer*



Make This Faceplate Lathe From Odds and Ends

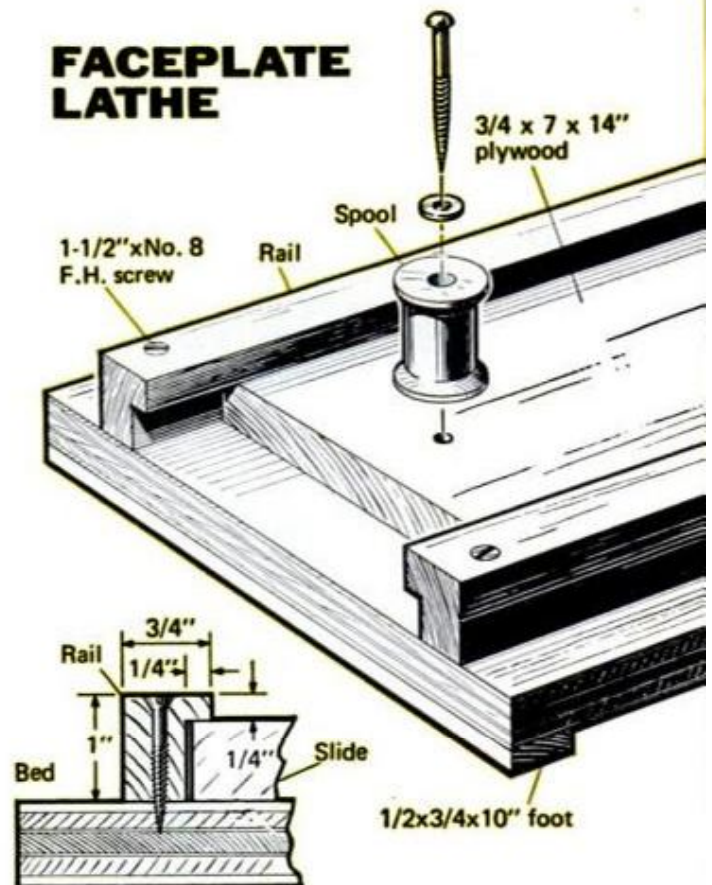


A FACEPLATE LATHE for wood turning is a rather simple machine intended for making things that can only be faceplate-mounted. But that doesn't limit its capabilities. For example, possible projects include wooden bowls, plates, wheels, trivets, candlesticks, knobs, door stops, decorative plaques, round boxes and lids and other items loosely classified as discs or short knobs. Since this little lathe has no tailstock, it will not handle work between centers.

The lathe shown was built around a design suggested by John A. Roznick of Milwaukee. The headstock is an electric motor with a sheave (V-belt pulley) securely mounted on its shaft. Fastened to this sheave is a wooden disc that becomes the faceplate. If thick enough, it can be converted into a chuck for holding partly turned workpieces for final turning. Through a center hole in the disc, a wood screw can be inserted for holding small-workpiece blanks. Large pieces are fastened with several screws.

The motor is bolted near one end of the baseboard. Most of the remainder of this board is occupied by a sliding panel on

FACEPLATE LATHE

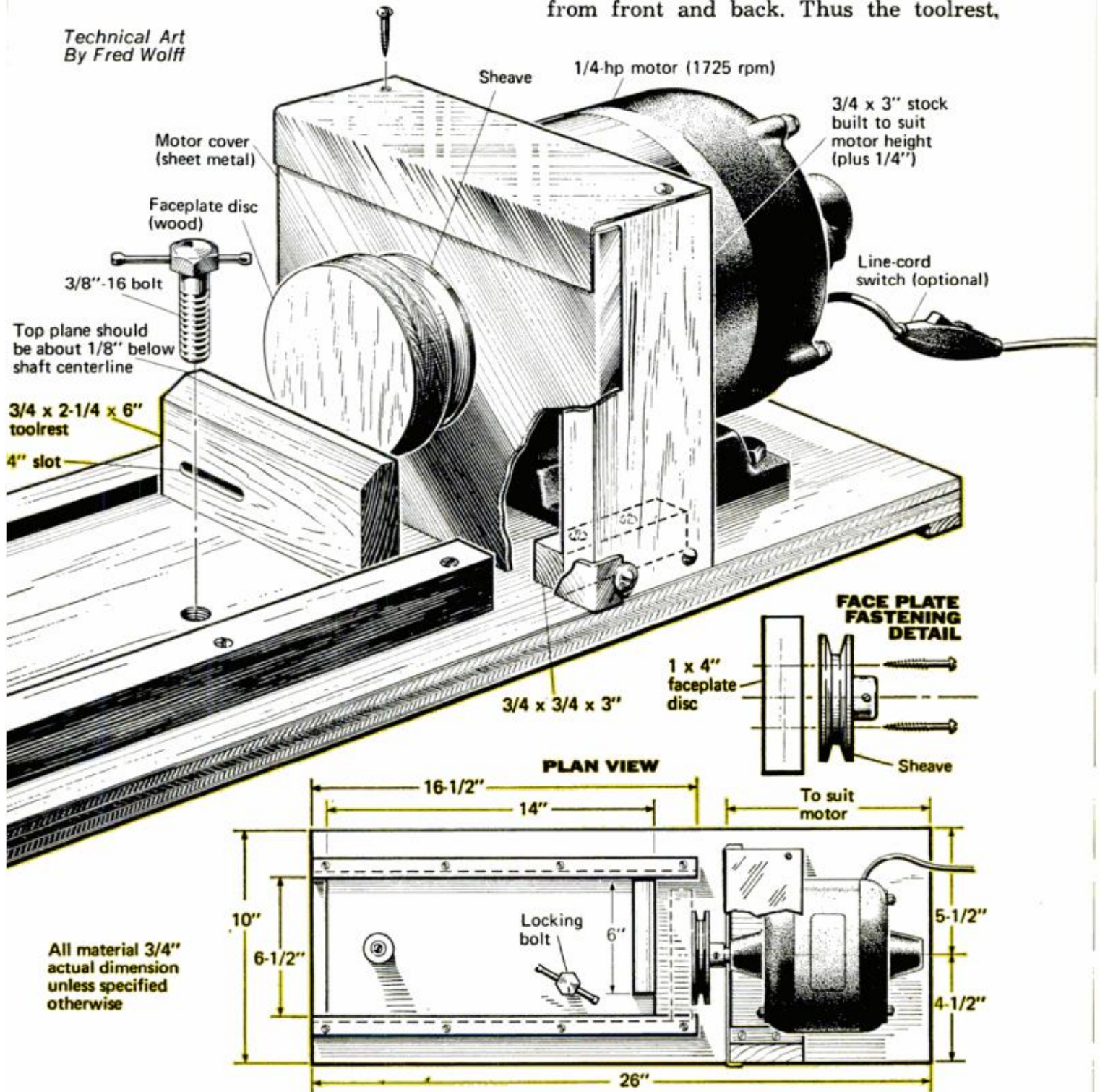


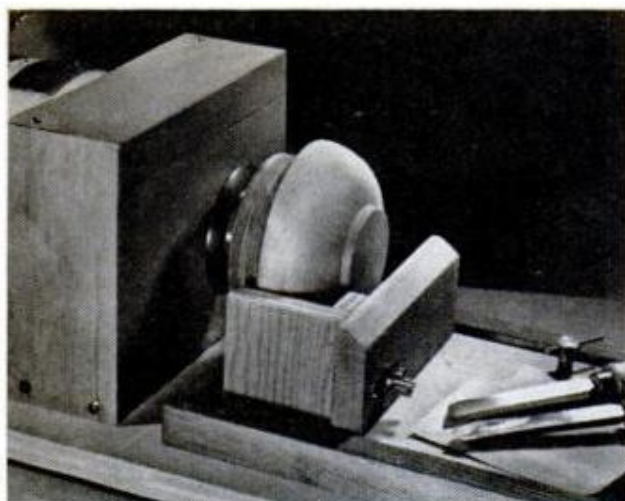
which is mounted a toolrest—a piece of $\frac{3}{4}$ -in. wood extending crosswise, parallel to the faceplate with its top edge about $\frac{1}{8}$ in. below its center. Because it is sometimes desirable to turn the side or edge of a mounted workpiece, small auxiliary toolrests can be clamped to the main rest.

Though dimensions of the various lathe elements are shown in the drawing, modifications may be necessary to suit a particular motor. In the model shown, the motor has a base-to-shaft height sufficient to permit the turning of bowls and the like a little over 6 in. in diameter. One

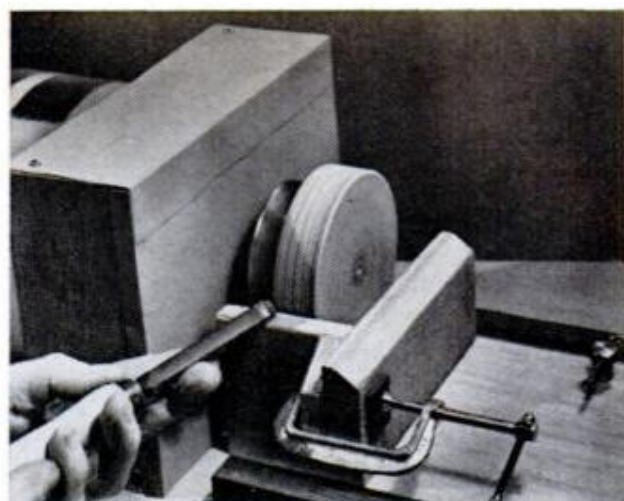
possible drawback is that a motor usually provides only one turning speed. But no trouble was experienced in producing smooth work at 1425 rpm. Conventional single-phase motors often operate at 1725 rpm. Speed higher than that, particularly for a novice, would be less desirable.

The baseboard can be any unwarped plank $\frac{3}{4}$ in. thick or thicker. The motor is mounted so its outer end is about even with one end of the baseboard. Although the motor can be centered front-to-back, our version was positioned about 1 in. nearer the back edge of the base, while the toolrest slide was mounted equidistant from front and back. Thus the toolrest,





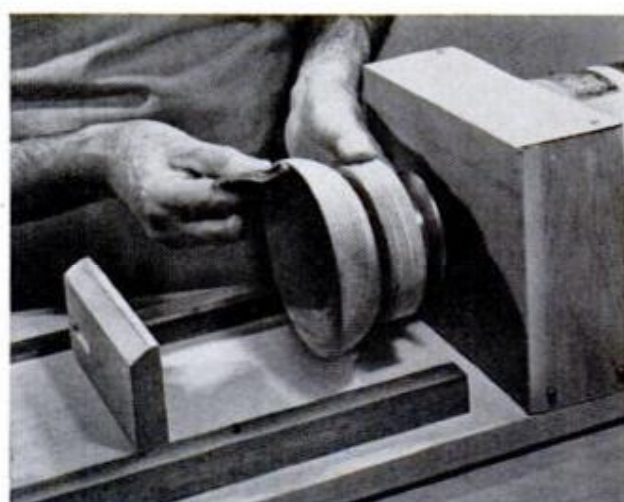
TO TURN BOWL, auxiliary rest is bolt-fastened to the main rest, blank is held on faceplate with screws



FACEPLATE consists of glued-together plywood discs. Here, an auxiliary rest is used to true its edge



CENTER SCREW through the faceplate held this knob for turning. Auxiliary rest in the foreground was used



FOR FINISHING, bowl bottom is anchored with a center screw in shallow cavity turned in faceplate disc

somewhat forward of the faceplate center, provides better support for the turning chisels, which normally engage only the front half of a workpiece, and make it easier to work with auxiliary toolrests.

The main toolrest can be fastened to the sliding panel with nails or screws across the end next to the faceplate. Channels for the sliding panel are formed by two L-section strips as indicated in the drawing on page 194.

A large spool or other knob is mounted with a wood screw near the outer end of the sliding panel to aid in adjustment. Optional is a locking screw to clamp the panel in place. This can be a bolt operating through a threaded hole at any convenient point on the panel. That shown is near the rear edge and toolrest; its end bears (not too forcibly) against the base when the panel is locked. A possible improvement would be to mount a spool-like handle or small hand wheel on the bolt and install it

in place of the spool shown. Then the same handle could move the panel, lock or unlock it.

A shield installed around the motor helps to prevent it from being smothered by chips and dust. This consists of two upright wooden strips to which is fastened an L-shaped piece of sheet metal (tin-can material) having a hole for the motor shaft. This shield should not cut too much cooling air from the motor.

A sturdy sheave should be used for the faceplate support. Sheaves that show signs of cracking, or do not run true, should be avoided. The sheave should have two set-screws to lock it securely to the shaft. These must be tight at all times during operation. Sheave diameter is not particularly important, if it has sufficient space for drilling three or more equally spaced holes through which husky wood screws can pass to secure a wooden faceplate disc or chuck to the sheave. ★★★

The Jointer Ain't What It Used to Be

Fixed rear table and a depth-of-cut lever combine to make Rockwell's 6-inch-er really new and different

By WAYNE C. LECKEY, Home and Shop Editor

HOW DO YOU BUILD a 6-in. quality jointer for as low as \$169.50? You toss conventional jointer design to the wind and come up with a machine so radically different and simple that it costs less to manufacture.

The Rockwell Manufacturing Co., Pittsburgh, Pa., has done just that with its new Delta 37-600, which I have just tested and found to be a real workhorse. It's a tool you'll be eager to try.

The one thing I missed in testing this "stripped-down" design was a fence-tilting scale. To set the face to angles between 45° and 90° you have to use an adjustable protractor. But a flip-up positive stop lets you return the fence to 90° as quick as a wink.

If you know your jointers, right away you'll notice that this one has only one adjustable table; the rear one is an integral part of the base and doesn't move. While this limits the tool to plain jointing and rabbeting (tricky cuts are out), there's no rear table to get out of kilter and the one-piece casting makes this fixed table as solid as a rock.

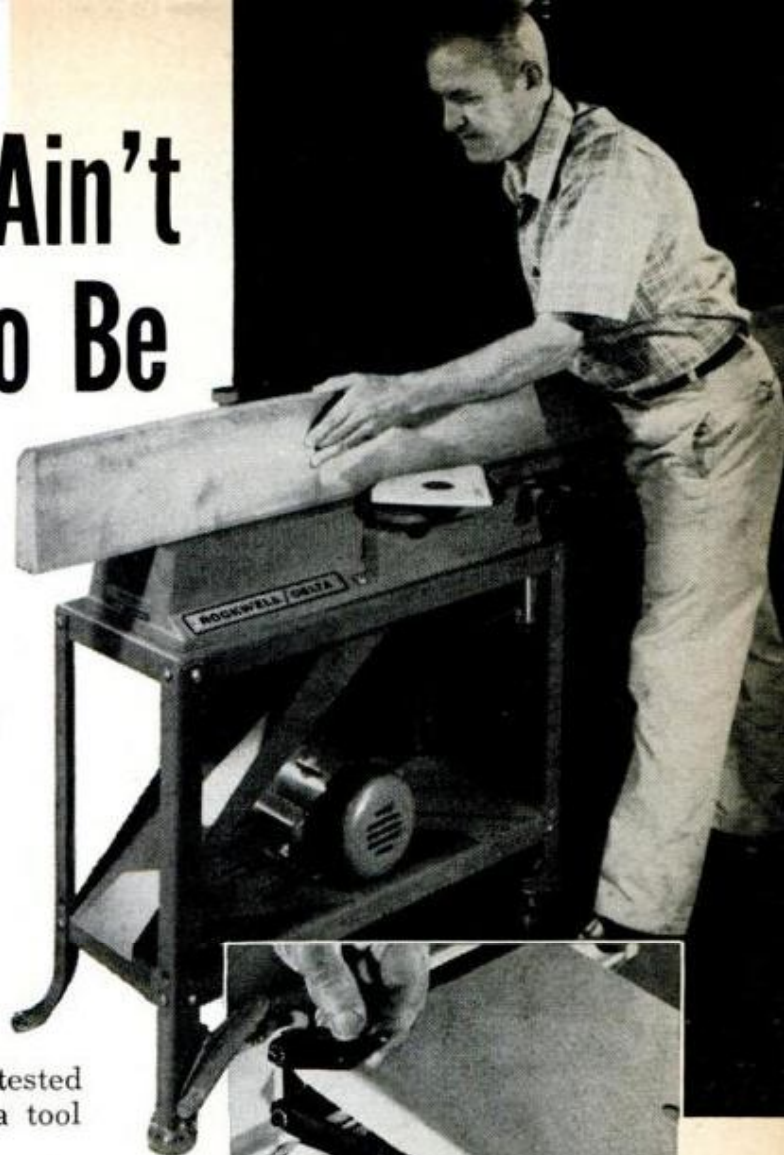
Another unique design feature which departs from the conventional is its quick-action, depth-of-cut control. It's done by a lever instead of a crank. A calibrated locking knob on the front table permits quick accurate depth selection by a mere up-and-down movement of the lever.

When driven by a 1725-rpm motor, the tool delivers 12,600 cuts a minute which dress a board as smooth as silk. It will take up to a 3/8-in. cut at a time and will run a 3/8-in.-deep rabbet. It sports a clever, tilting two-way fence, swinging cutter guard and a husky three-blade cutter head.

Of course, stand, chute, motor, belt and switch are extra. The \$169.50 is the price of the basic machine which is still a good buy for what you get. ★★★

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PIVOTING FINGER drops against positive stop to return fence to 90° position



POINTER-FITTED LEVER sets depth of cut; maximum is 3/8 in. Knob locks setting.

TO ADJUST FENCE crosswise, loosen knob and push guard along guide rod

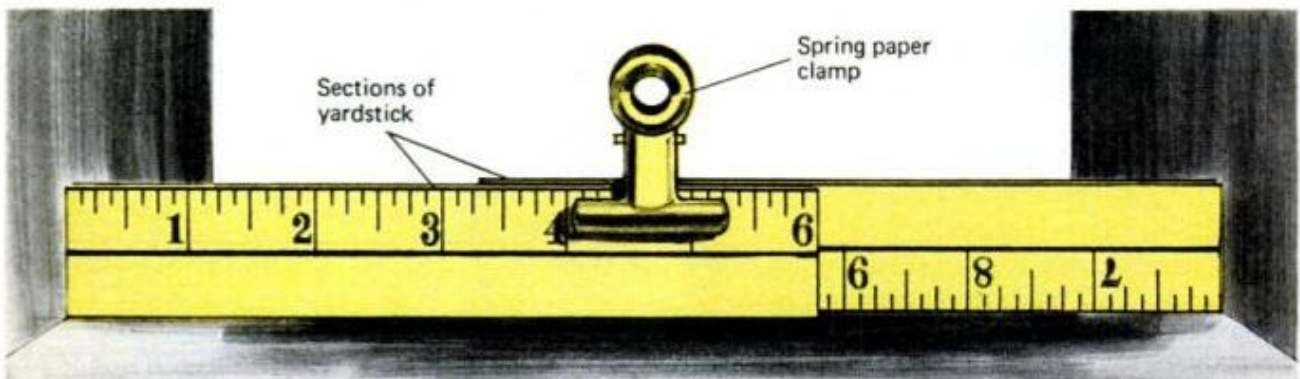




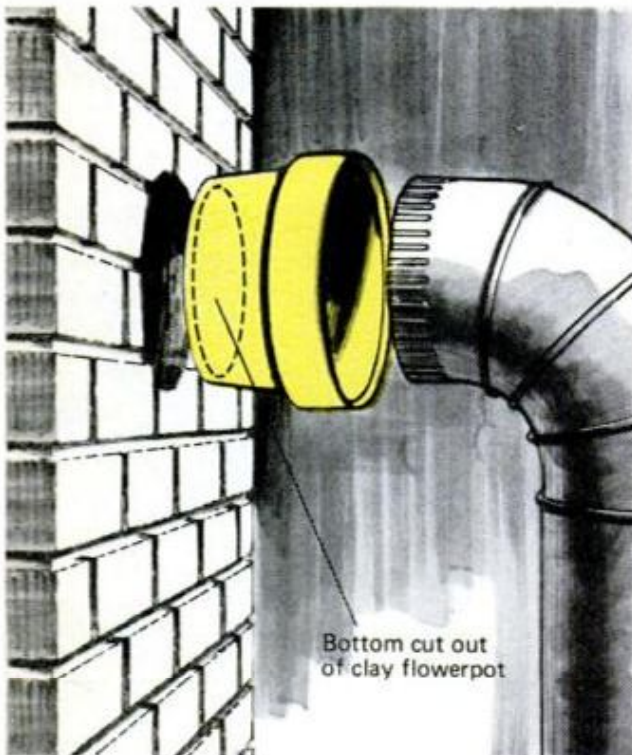
SOLVING



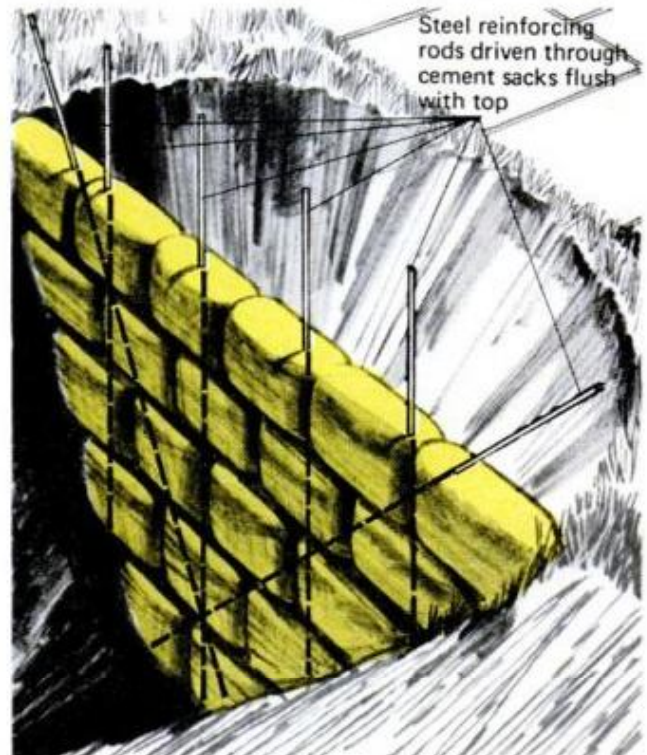
SUSPECTING A LEAK in a masonry wall I gave the questionable area a "close-up" look using a pair of binoculars rather than drag out and climb up a ladder. This beats climbing every time.—Andrew Vena



ACCURATE INSIDE MEASUREMENT is possible using two 6-in. sections cut from a yardstick and a spring paper clamp. The ruler shown is for taking dimensions in the 7 to 12-in. range.—Charles Niedrach



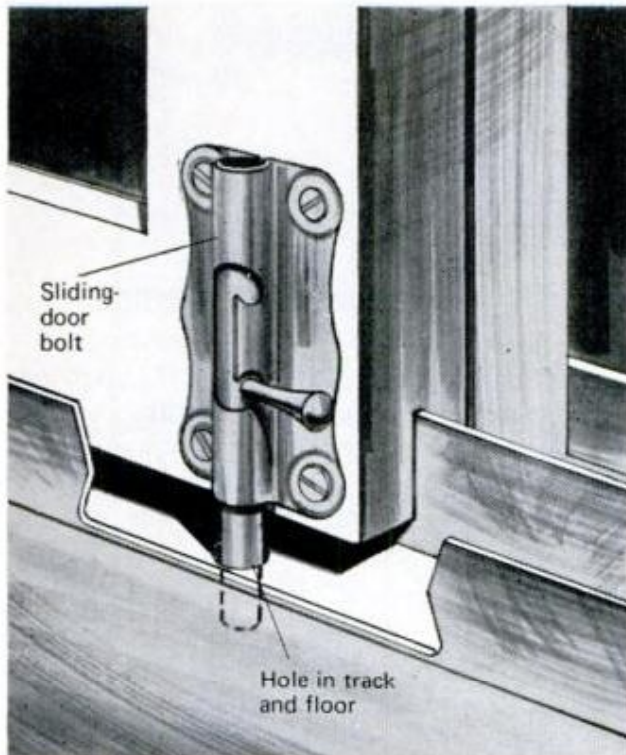
EMERGENCY CHIMNEY THIMBLE can be made quickly from a common clay flower pot. Pick a size to suit pipe going in chimney, cut off bottom with a chisel, and then mortar it in place.—Bruce Smithson



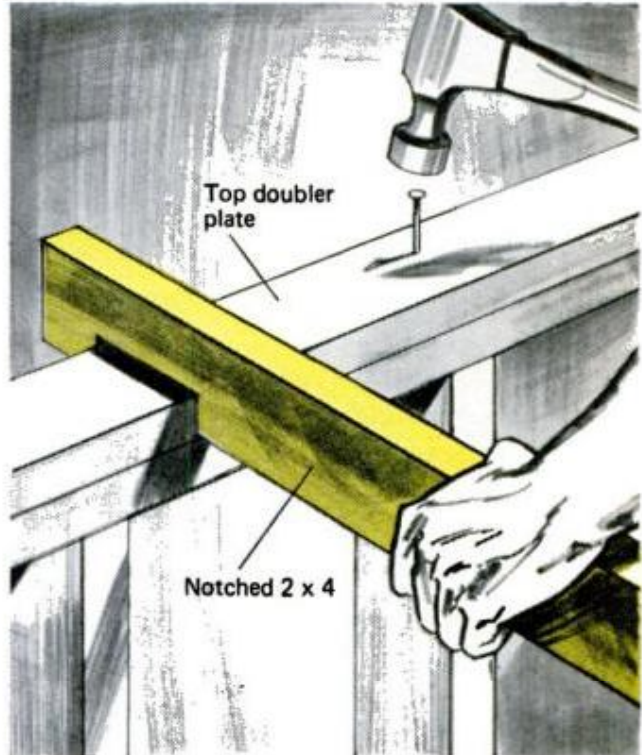
RECENT FLOODS made building a retaining wall along my patio a must. I used sacks of Portland cement and drove reinforcing rods through the bags. Eventually, the wall became rock hard.—P. S. Kistler

HOME PROBLEMS

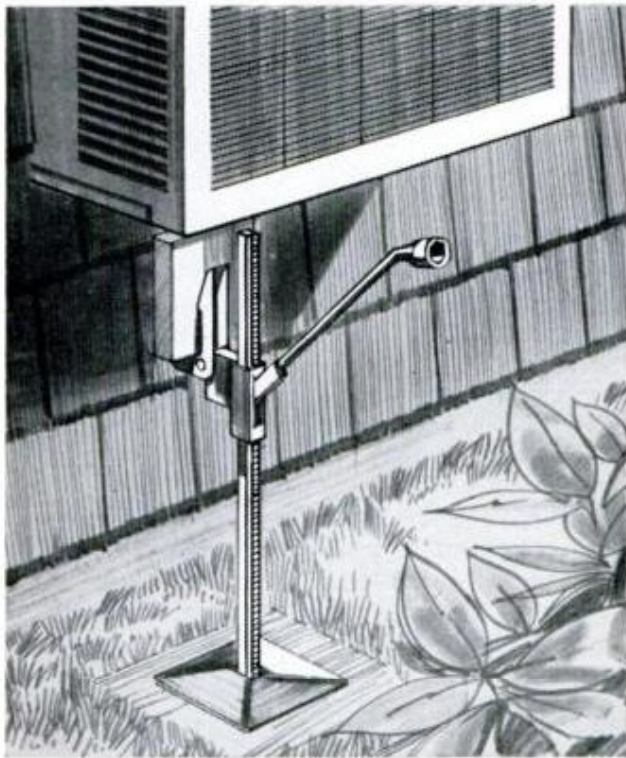
Illustrations by Adolph Brotman, Worman Associates



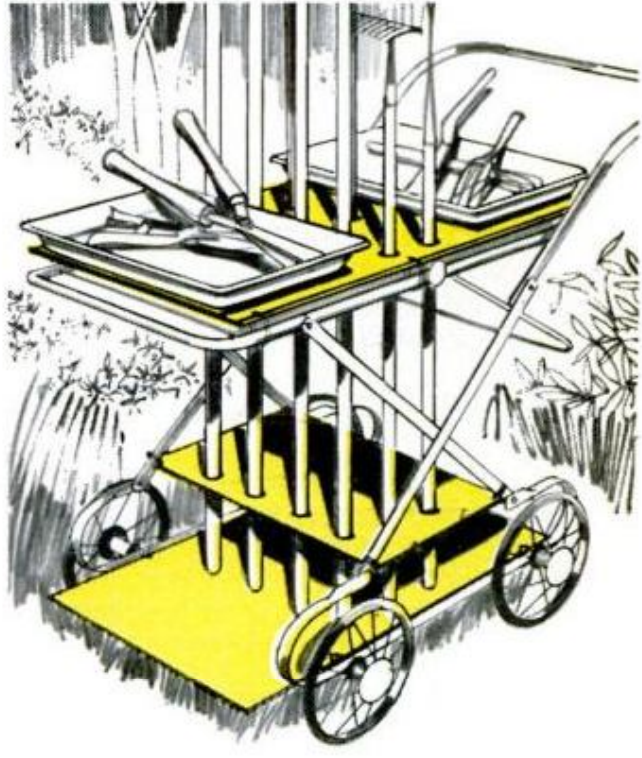
BURGLARPROOF your sliding-glass doors by attaching a barrel bolt with sheet-metal screws to the lower corner of the inside door frame. Drill a hole in the track and floor for bolt.—Dean W. Walton



WHEN ADDING A NEW ROOM to your home, you'll find a notched member handy for pulling top wall plate in line with one under it as you nail. Idea is especially handy when you work alone.—Daniel Bousha



BREAK THE RUST SEAL between the slide-out track and an air conditioner by using a jack and a suitable length of 2x4. Just jack up each outside corner of the conditioner until the seal is broken.—S. N. Stresnic
NOVEMBER 1970



HAND-HAULING OF GARDEN TOOLS is a tiresome job you can eliminate by making a yard caddy from an old baby buggy as shown. Align shelves, drill holes, attach shelves with 10-ga. wire.—Ruth L. Smith

HINTS FROM READERS



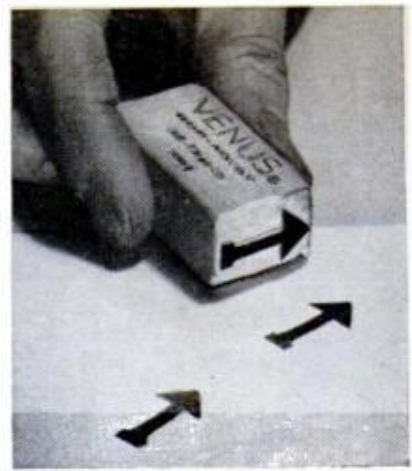
Cigar-tube coin bank

Empty metal or glass tubes that are often used to package individual cigars make excellent coin banks. Tubes are not only convenient for coin collectors but are suitable for storing parking-meter and toll change in the glove compartment.—*Lee Griffin*



Get a better grip

Removing a wire brush from your bench grinder can be a hand-scratching experience if the mounting nut is the least bit stubborn. For a scrapeproof grip, tighten a C-clamp to serve as a handle while you loosen the nut with a wrench.—*Bob Brightman*



Improvised stamp

If you ever need a rubber stamp to print arrows, rectangles or other special patterns, try carving it from an eraser before you plunk cash down for a custom-made one. An eraser that is not crumbly, yet rigid enough to hold its shape, is best.—*W. Ervin*

Chucking small drill bits

Often, when working with drills smaller than a No. 50, many drill chucks will not close tight enough to grip the drill securely. (This is especially true if the chuck is slightly worn.) If you snip off a short length of cored solder-wire and force the drill into the core, the expanded shank will fit snugly when the chuck is tightened.—*Stanley Clark*

Plaster wall removed easily

Removing plaster and woodlath from an existing wall can be an eye-filling, dirty job. A simple technique I use is to punch holes at top and bottom between studs. Next, I lower a heavy rope and tie it to a short length of 2x4 that spans the studs (on the outside) and serves as an anchor. Then from across the room, I simply give a hefty yank.—*Herbert Bowen*

NEXT MONTH IN SHOP AND CRAFTS

THE SKY'S THE LIMIT WITH THIS 200-POWER TELESCOPE. It's not a toy but a precision instrument you can build for less than \$50. With it, you can study the heavens or have just plain fun scanning the landscape. Presented in two installments, the first part gets you started on grinding and polishing the mirror. It's in *PM* next month.

40 GREAT IDEAS FOR HOME AND SHOP. Here's a roundup of time and money-saving tricks that can be used by every member of the family. You'll learn ways to use discarded products, how to care for your tools—and more. Pick up December *PM* and be in the know.

NOW: COOKOUT FUN INDOORS, ANYTIME. A kitchen countertop electric grill with its own built-in exhaust system that quietly whisks smoke and odors outdoors, duplicates the wonderful flavor of patio charbroiling. And with accessories it becomes a rotisserie, a shish kebab, a french fryer for choice hors d'oeuvres and a nonstick griddle. It takes only a few hours to install. Be sure to watch for this December *PM* do-it-yourself project.

HOW TO INSTALL PUSHBUTTON DRAPES. How lazy can you get, but oh how modern you can be. Kirsch's motorized hardware lets you open and close window drapes by pushing a button. A status symbol for any window, pushbutton drapes are convenience plus for high windows that are difficult to reach. See how easy it is to install the hardware by reading this home-improvement article in the December issue.

PUMP THAT'S LIKE A HEART

(Continued from page 131)

70 years. There are about six quarts of blood in your body and it all passes through your heart every minute. It's been estimated that every day your heart pumps enough blood to fill a 4000-gallon tank car, that in those same 70 years your heart will pump some 500,000 tons of blood.

The surgery of a heart transplant is a simple procedure, less difficult and demanding than many other types of open-heart surgery and one which any competent heart surgeon can perform. The operation is somewhat like cutting a pumpkin. The bottom three-quarters of the recipient's heart is removed, leaving the stem (a goodly portion of the atria) with all its venous connections intact. Then the new bottom is sewn on and connected to the pulmonary and aortic arteries. The Liotta mechanical heart of Dacron Silastic resembles a human trans-

. . . mechanical devices are not rejected and there is no limit to their supply.

plant and is attached in the same manner.

But the name of the game in transplantation is "rejection," and Cooley, the most active surgeon as well as a pioneer in this field, doubts we will ever have a permanent transplant because of this constant threat of rejection. And Houston's Dr. DeBakey told me, "We have not solved the rejection problem and I can't see it in the immediate future." This, together with the limited availability of donors, makes it certain that heart transplants, as DeBakey put it, "can never be very widely used for the treatment of heart disease or have a very significant impact on the problem." But mechanical devices are *not* rejected and there is no limit to their supply.

At the National Heart and Lung Institute in Bethesda, Md., Dr. Frank Hastings spelled out the problem: "Rejection is the only thing that allows us to fight infection, so we want only to selectively, not completely, destroy it. I don't see a good solution to this problem and even the transplant surgeons are discouraged."

Domingo Liotta, describing the only mechanical heart ever put into a human being, recalled the intensive work that went into its development. Liotta has long been a heart surgeon, but while building artificial hearts for 10 years, he worked

"18 or 20 hours a day" for months when he had some problem.

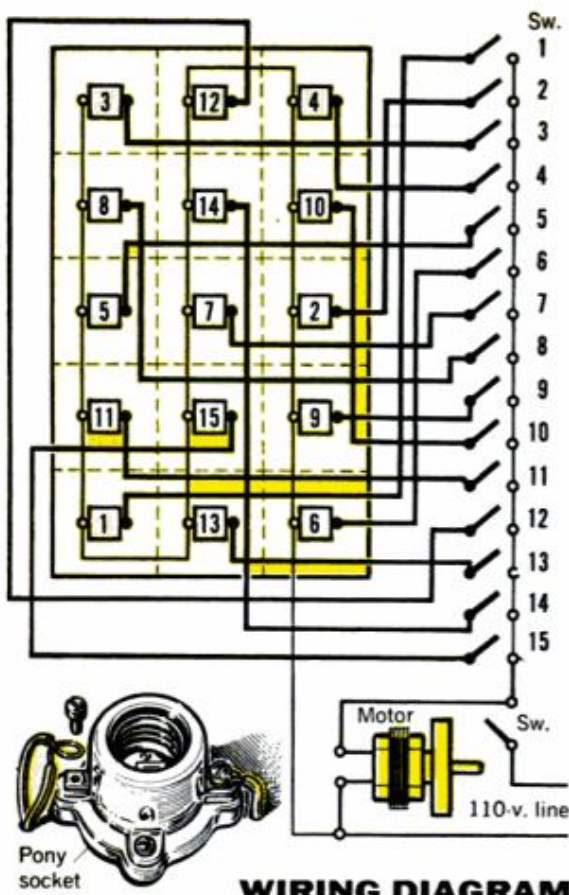
"We're just at the beginning of a long, long journey," said Liotta, "and it is very possible the mechanical devices may be the answer. When we implanted Mr. Karp's heart many of the difficult problems of the laboratory were absent. It was a very simple thing to handle the pump (artificial heart). I was surprised how simple it was—simpler than with experimental animals! We will continue to experiment, but we will keep some artificial hearts on standby so that if a patient needs one to stay alive, Doctor Cooley will go ahead."

Dr. Frank Hastings of NHLI sees only a limited role for heart transplants: "I think the major use of transplants will be before adulthood—the artificial heart is completely impractical for replacing the heart of newborn infants with congenital heart disease because you would have to keep replacing it as the child grew."

Both his background and his present position have made Hastings more knowledgeable about the mechanical heart than any other single American. "The heart is only a pump," he says, "but any pump you build is designed around the type of fluid (oil or water or blood) and also around the energy you're going to use—electric motor, gasoline engine or whatever." Hastings points out that the right ventricle (its walls are thinner than the left's) pumps with about one-fifth the energy of the left ventricle because the capillaries of the lungs can't absorb any more energy. He regards the Liotta artificial heart as smooth-working and likes the fact that it drives the right ventricle with less energy than the left.

However, the Liotta heart has to be attached to a machine which supplies its power. Hastings believes that this air-driven heart—with one exception, all today's artificial hearts are air-driven—has two drawbacks which must be overcome before it can become a permanent heart: First, pencil-size air hoses pass through the skin leaving an opening for infection. (A permanent device must be fully implantable.) Secondly, he believes that any movable diaphragm will eventually allow air to escape. If, for example, some air got into the blood and escaped through the lungs, the heart would lose power.

Hastings thinks it's possible to have a permanent artificial heart within three to four years, "and it's even conceivable that it could be less." Meanwhile the best summary of progress to date may be Domingo Liotta's: "This is an early hour of the morning of a long, long day." ★ ★ ★



WIRING DIAGRAM

SINGLE STRAND of insulated wire is bared, looped through hole to connect all sockets in parallel wiring

ELECTRIC GREETING CARD

(Continued from page 175)

switching timer. This, plus 15 refrigerator-door switches, a length of $\frac{1}{8}$ -in. threaded pipe, a lamp finial, nuts and two switch-mounting aluminum strips can be

purchased as a kit for \$19.95 (plus postage) from Honacast, Inc., 131 E. 169th St., Bronx, N.Y. 10452.

The 15 timer cams are cut from $\frac{1}{4}$ -in.-thick tempered hardboard with a hole cutter to a $4\frac{1}{4}$ -in.-dia. Cam No. 15 is divided into 17 equal divisions along its circumference and serves as a master pattern for marking the pie-shaped divisions of the others.

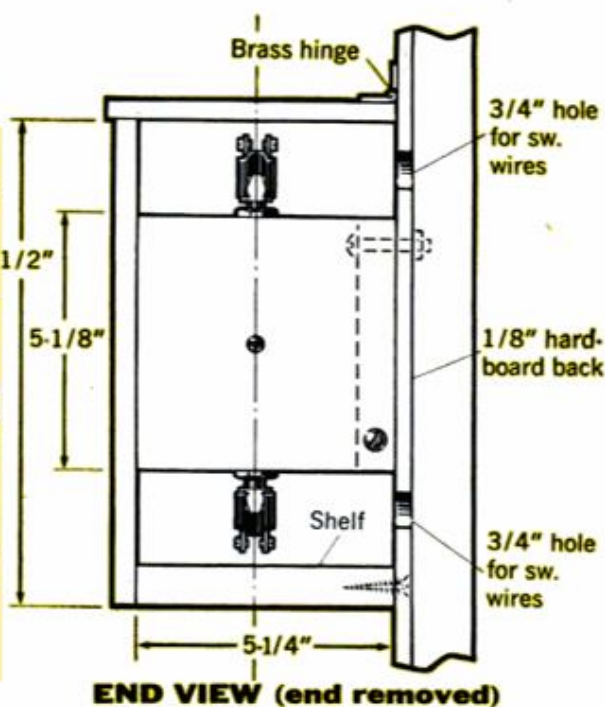
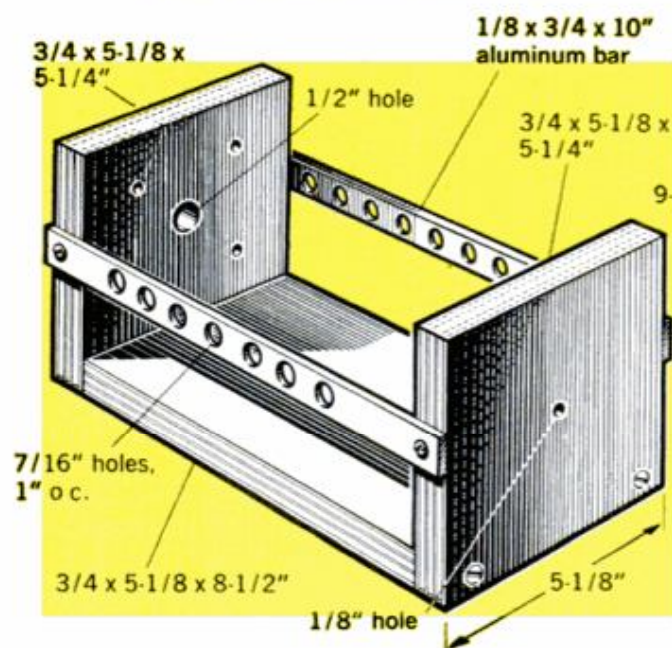
The divisions on each cam are cut by mounting the blank cam on a jig attached to the miter gauge of your bench saw. The blank rotates on a $\frac{1}{4}$ -in. bolt and is held by a nut. With the saw blade $\frac{1}{4}$ in. above the table and running, two cuts are made across the edge of the blank at the division lines marked A and B on the blank. Then the jig is backed off and the edge between the cuts is removed by slowly rotating the blank across the top of the running saw blade. This is done a little at a time by rotating the blank right to left, then left to right, stopping each time at the A and B cuts. At each pass the blank is advanced a little farther into the blade, until you reach the full depth of the cut. Each cam is made this way.

My hole cutter makes a $\frac{1}{4}$ -in. center hole which made it necessary to redrill them with a $\frac{3}{8}$ -in. bit so the cams would slip over the $\frac{1}{8}$ -in.-pipe shaft.

When the switching timer is viewed from the motor end, the cams rotate counterclockwise. Because a refrigerator-door switch works the opposite of a common switch (the light goes off when the button is pressed) the leading edge (A)

(Please turn to page 204)

SWITCH-TIMER CHASSIS



"With my budget when the engine packs it in so do I."



Tom Davey's in racing for the fun of it. He's not a pro with a spare engine and a big fancy pit crew. He pays his own way. And he knows that a cham-

pionship he's been chasing all year can go up in smoke — right out the tailpipe.

That's why he uses Gulfpride® Formula G. Formula G's low ash content helps keep plugs and rings clean. And it won't turn to foam or break down when the old mill is turning over 30% faster than it was designed to.

Which is more than Tom can say for other racing oils he could name. Because he's come face to face with bearings that were the victims of oil breakdowns.

And that's why he switched to Formula G.

Not a bad reason for you to switch, either — whether you're driving a muscle car or the family wagon. Because chances are your oil is going to be running hotter around town or on the highway than the oil in a race car equipped with an oil cooler.

It's nice to know, too, that we sell Formula G at Gulf stations. Because not only is it a racing oil, but it also meets all passenger car manufacturers' new car warranty standards.

Tom knows. Which is why he uses Formula G in the car he drives to the track, as well as the car he drives on the track.

He knows that if he blows the engine in one, he loses the race. But if he blows it in the other, he rides the bus.



GULF OIL COMPANY — U.S.

ELECTRIC GREETING CARD

(Continued from page 202)

of each cam must be rounded a bit as shown so it will ride up on the button when it makes contact.

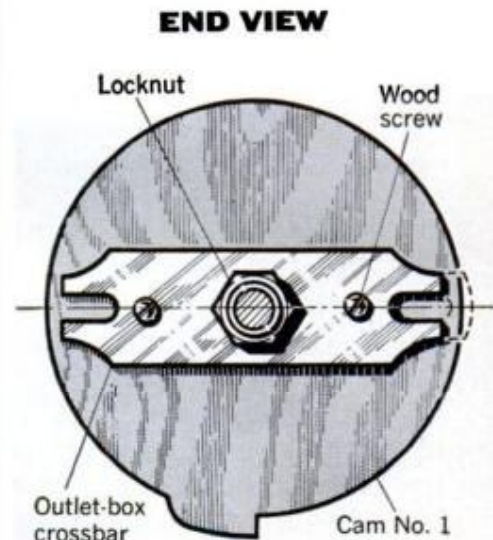
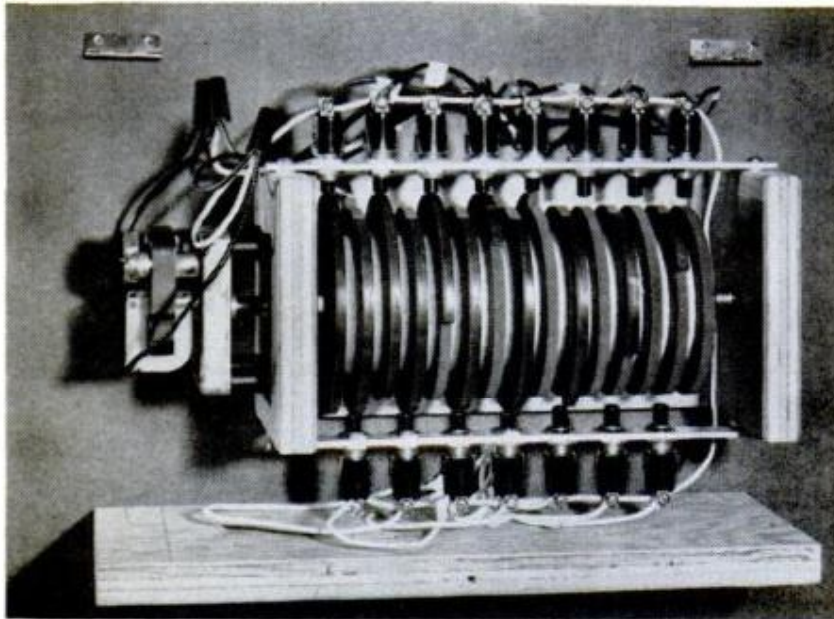
The cams are spaced $\frac{1}{4}$ in. apart on their shaft by $2\frac{1}{2}$ -in. hardboard discs which are glued to the cams to hold them in a fixed position. Notice that the even-numbered cams, when viewed from the end, face to the left; the odd-numbered ones to the right.

When gluing the cams and spacers to-

gether you must keep points A on cams 1, 3, 5, 7, 9, 11, 13 and 15 in line with each other so they will depress the switches in unison. Likewise, points B on cams 2, 4, 6, 8, 10, 12 and 14 must be aligned at a point 180° from the others. A tapped outlet-box fitting called a crossbar is used to keep the glued-up assembly from turning on the threaded shaft.

It doesn't require much pressure on the switch buttons to break contact so you'll want to adjust the switches to bear the minimum. The two nuts that hold each

(Please turn to page 206)



HOW CAM ASSEMBLY IS LOCKED TO PIPE SHAFT

SWITCHING TIMER makes use of 15 refrigerator-door switches to control the lamps individually. Slowly rotating $4\frac{1}{4}$ -in. dia. cams cut from hardboard are operated by a 1-rpm gear motor to depress switch buttons

TIMER SWITCH

$1\frac{1}{4} \times 2\frac{1}{2}$ "-dia. spacers between cams

Spacer
 $3\frac{1}{4}$ "
 1/250-hp shaded-pole gear motor, 1 rpm
 Cotter pin
 Spacer

Refrigerator-door switches spaced 1" C to C

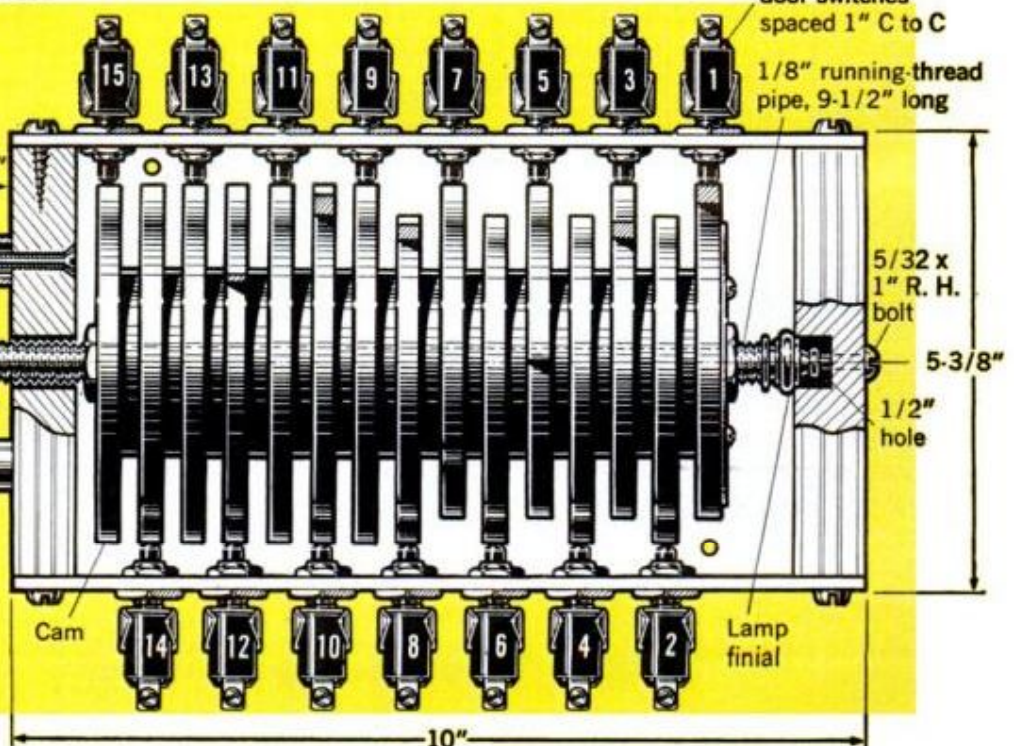
$1\frac{1}{8}$ " running-thread pipe, 9- $\frac{1}{2}$ " long

$5\frac{1}{32} \times 1$ " R. H. bolt

5- $\frac{3}{8}$ "

$1\frac{1}{2}$ " hole

FRONT VIEW



“Even with extra asbestos and a firewall, our Autolite battery took an awful roasting during our Lime Rock win. We’re tough on batteries. But you’re tougher on yours.”—Parnelli Jones

Parnelli Jones believes a top driver ought to know almost as much about race-car systems as the top mechanics. So when Parnelli talks, you listen carefully.

“In our Trans-Am Mustang, we tuck the Autolite battery up under the right instrument

cowl. Despite the heat shield my feet get really hot. And that battery gets hotter—maybe 200 degrees—because it’s higher up, and it’s not ventilated. So you can figure on a lot of evaporation in 2½ hours of roasting.”

That’s no problem for Autolite batteries. Their Star-Ful reservoir has up to three times more water above the plates—to deliver full power, despite evaporation.

“Racing’s tough on batteries. You’re tougher. We’ll change batteries almost every race. You stick with yours for 10, 20, 30 thousand miles and never care a bit about dirt and salt and moisture collecting on top of it, and making a nice path for electric leaks that can stop a battery cold.”

With Autolite, you can forget electric leakage. The one-piece construction virtually eliminates self-discharging across the battery top.

Next time, get an Autolite battery. It passes the toughest test in racing. And the toughest test there is. Your kind of driving.

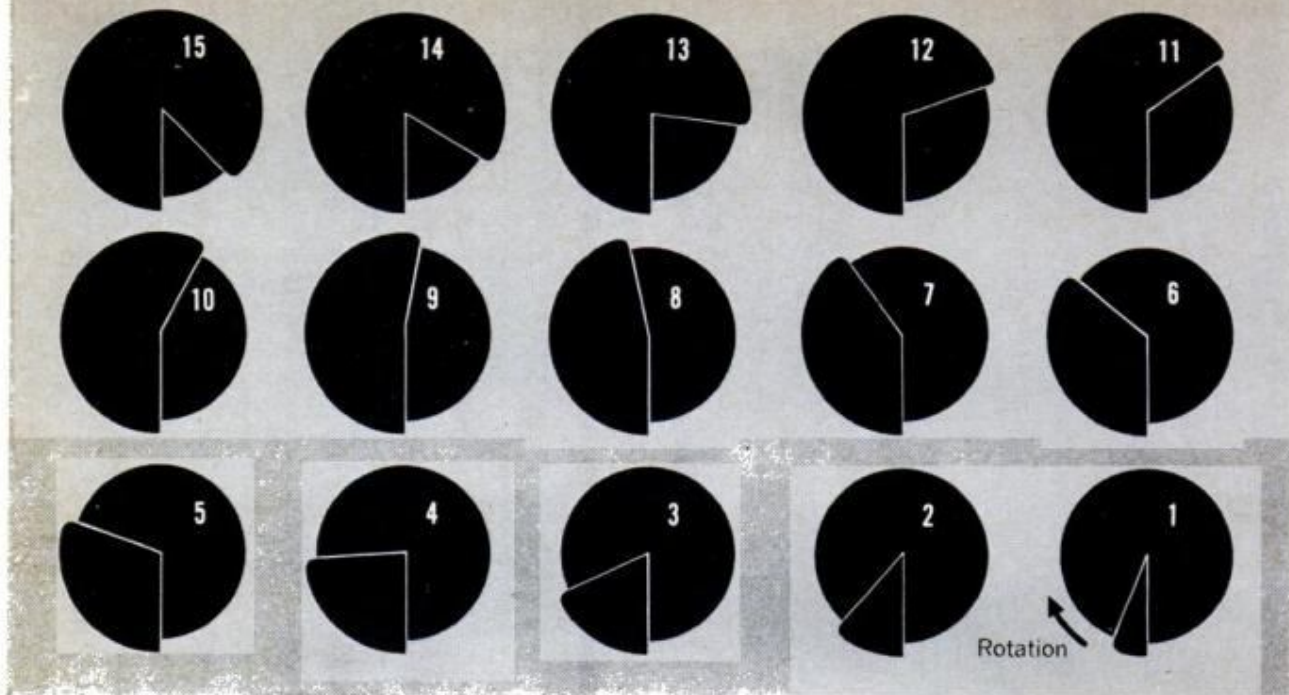


Autolite 

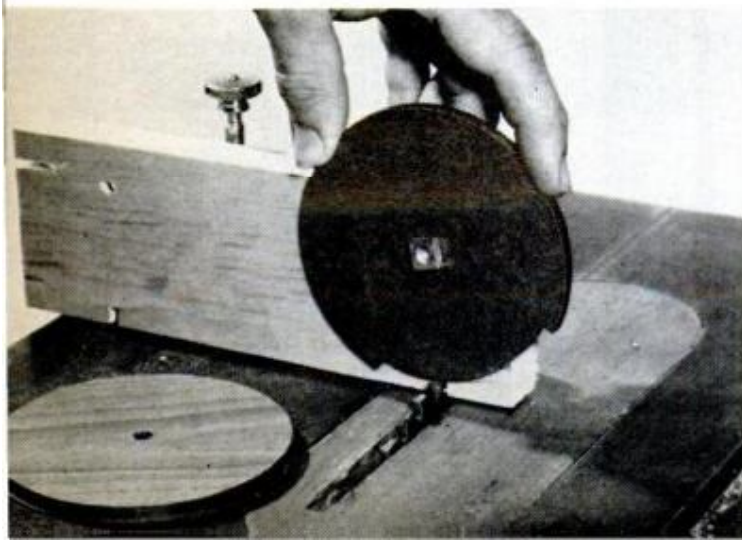


We pass the toughest test.

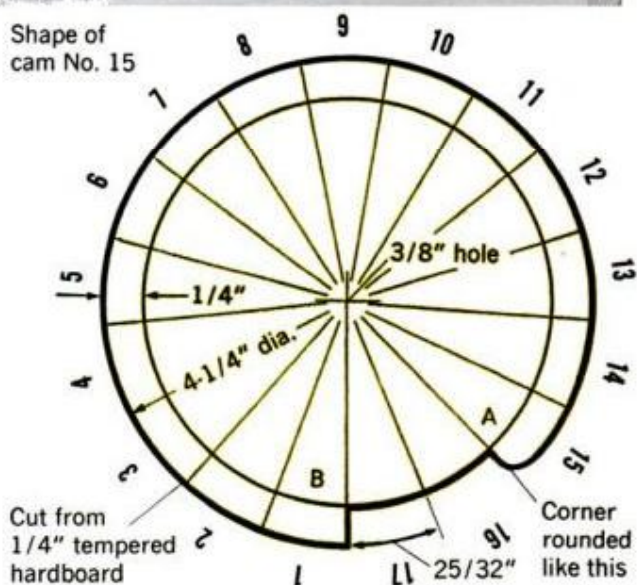
CAM PATTERNS



CUT CAM BLANKS from $\frac{1}{4}$ -in. tempered hardboard with hole cutter in drill press. Clamp work each time. Below: Blanks are mounted on jig on bench saw for cutting final shape by rotating over top of blade



Shape of cam No. 15



ELECTRIC GREETING CARD

(Continued from page 204)

switch make it easy to move them in or out.

The particular lighting pattern used is optional. You may prefer to have the lamps go on in a different sequence than mine. Use a heavy weatherproof extension cord to bring 110-v. current to the display. It can be turned on by a switch wired into the circuit or simply by plugging it in at the house.

The switching timer bolts to the back cover, which is also sealed with waterproof tape, and is protected by a hinged hood. Your greeting card will have to be braced to keep it standing in a wind, although its open cover helps to brace it. If the ground isn't frozen, stakes will help anchor it. ★★★



The snow shovel for the man over 40.

A snow shovel coated with industrial-strength no-stick TEFLON-S*. The wettest snow can't stick to it. Even ice and mud slide off easily. A TEFLON-S coated shovel gets you out of the weight lifting events—and back to the TV and the spectator sports a lot faster.

TEFLON-S lubricates itself, too. Rust can't get a grip because moisture runs off. Seasons of use

can't wear out the no-stick surface that makes your work lighter.

This winter, look for the TEFLON-S quality seal at your store. It's on snow shovels that nobody should be without.

It's also on no-stick handyman and garden tools that work smoother, easier, faster. These are the best performing snow shovels and tools you can buy.

*Reg. U.S. Pat. Off. for Du Pont's non-stick finishes.



Better things for better living
...through chemistry

ELECTRONIC FIRE-THEFT ALARM

(Continued from page 160)

this case, the contacts stay open until the magnet is moved near them, then they close, tripping the alarm. The drawings show how this type of switch can be used if you want to leave a window partly open in summer for ventilation without sacrificing protection. Here, the magnet and switch are positioned a short distance apart so the window can be raised slightly without triggering the alarm. If an intruder attempts to open the window wider, the magnet slides past the switch, the contacts close and off goes the gong.

You can also have ventilation with the normally closed type of switch by mounting two magnets on the window sash, one at the bottom and one part way up the side. One magnet holds the switch contacts open when the window is shut and one holds them open when the window

Current draw is so low the batteries need not be replaced more than about once a year

is partly raised for air. If the window is opened beyond either position, removal of the magnets allows the switch to close, sounding the alarm.

The system is admittedly not designed to thwart the experienced professional equipped to cut through doors and windows without opening them, but it can go a long way in helping to stop the growing number of burglaries committed by inexperienced amateurs, such as vandals, thrill-seekers and drug addicts. In addition to the door and window switches, you can also get thin, pressure-actuated floor-mat switches for use in locations where it might be difficult to install the magnetic type or to add extra protection. These are 18x30-inch pads that can be hidden under rugs to activate the alarm whenever an intruder unknowingly steps on one.

Also included in the system are manual "panic" buttons—small surface-mounted toggle switches—that can be installed throughout the house at key points, such as alongside a bed for use at night. These enable you to activate the alarm yourself any time you suspect there might be a prowler outside without waiting for any door or window switches to be tripped. They can also summon help in an emergency if someone is home alone and suddenly becomes ill or has an accident.

The switches are wired in continuous strings—like Christmas-tree lights—mak-

ing the installation job easy. You just run light-gauge, two-conductor wire from one switch to the next throughout the house, connecting them all together. The end of each string is fastened to terminals on the master control box. The switches are wired in parallel so that if any one is triggered, the circuit in the master control is closed, setting off the alarm.

The control itself can be mounted anywhere it's out of sight yet readily accessible, such as in a closet, pantry or utility room. It operates on two 6-volt lantern batteries so it's independent of house current and not affected by power failures. Current draw is so low the batteries need not be replaced more than about once a year even though the system is constantly in use. The wire to the switches is so thin you can run it almost invisibly along baseboard moldings and up door and window casings. Because of the low voltage, it can also be buried in walls without special precautions.

Fire sensors are hooked up in the same way as intrusion-alarm switches, except that they require slightly heavier wire and are connected to different terminals on the master control. Several types of sensors are available. One, set to trigger at 135° F., is designed for general living areas. A second won't trip until the temperature reaches 190° F. and is intended for normally hot locations such as attics and furnace rooms. There's also a rate-of-rise sensor that reacts to sudden changes.

Along with the heat sensors, an additional, smaller indoor gong is connected to the control. In a fire, both this and the outdoor gong sound off together, while only the outdoor gong responds if there's an intrusion. This makes it easy to tell instantly what triggered the system.

The basic control and large outdoor gong are priced at \$129. Included with them as a starter kit are 10 magnetic door and window switches, one manual panic switch, two fire sensors (one high-temperature and one low-temperature), 350 feet of hookup wire, mounting brackets for use in special situations and installation instructions. You can specify either the normally open or normally closed type of switch or a combination of both. Extra switches are \$3.20 each.

The small indoor fire gong sells separately for \$11.50. Extra fire sensors are \$2.85 each for the fixed type and \$7.50 for the rate-of-rise type. Panic switches are \$1.40 each, with the floor-mat type \$8.50. Also available are additional hookup wire and other accessories. The kit and other supplies can be purchased from Metrotec Industries, 1405 Northern Blvd., Roslyn, N. Y. 11576. ★★★

Taste too hot to handle ?

A pack of KOOL Filter Kings cigarettes is the central focus, resting on a piece of weathered driftwood on a rocky shore. The pack is white with a prominent green square containing the word 'KOOL' in white, bold, sans-serif letters. Below this, 'Filter Kings' is written in a green, elegant script font. At the bottom of the pack, it says 'MILD MENTHOL CIGARETTES'. Two cigarettes are visible protruding from the top of the pack. The background is a scenic landscape featuring a blue river or stream flowing through a rocky, moss-covered terrain with dark, jagged cliffs under a cloudy sky. The overall mood is rugged and natural.

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the way
up to
KOOL

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CIGARETTES

KOOL

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MILD MENTHOL CIGARETTES

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THINGS THEY DON'T TEACH!

(Continued from page 99)

pan of sealed asphalt. It's surrounded by an apron of loose gravel. The surface lubricant is plain water from underground sprinklers, and it's fantastic how slippery wet pavement can be. All tires on all cars are bald, and by juggling tire pressures, cars can be made to lose their grip later or sooner, depending. A VW on bald tires and wet pavement doing 25 mph around 90° bends feels roughly equivalent to the same car on good tires and dry highways doing 90 mph through normal curves.

Ordinarily, an average day's enrollment at skid school runs from four to six students. These are often highway patrolmen, firemen, driver-ed instructors, or employees of a company sent en masse to sharpen their driving. In these cases, they ride four to a car—instructor and three students who alternate behind the wheel. Just as often, though, students come on their own, individually. That's what I did.

The car oversteered—hung out its tail—but stayed perfectly under control.

The fee is \$50 for the whole course which, considering that obedience training for a dog usually runs \$48, is a real bargain.

The day I attended skid school, I was the only pupil. After the understeer/oversteer lecture, Bruce and I hopped into the VW and started slowly circling the pan. He drove first, increasing his speed gradually. After three laps we were hitting 30 mph and sliding most of the way around this squared circle. I wasn't at all frightened. The car oversteered—hung out its tail—but stayed perfectly under control.

Then Bruce and I switched seats. I, too, started out gradually, picking up speed, and by the third lap I was doing about 25 mph. The VW poked out its rear on the first three turns, but nothing to worry about. On the fourth turn, she got a little out of hand—the rear end passed the front—and that's when Cinemascope started. Bruce told me I wasn't supposed to do that until the "loss of control" section coming up next, but, ". . . fine spin-out anyway."

Most people don't know what the terms "understeer" and "oversteer" mean. Confusing. But it's easy to remember when you think of it this way. Instead of "understeer," think of "un-steer"—the car won't steer no matter how much you

crank the front wheels. You entered the turn too fast and the car wants to keep plowing straight ahead. For "oversteer," you remember the "O," which reminds you the rear wheels want to make a circle around the front. It's that simple.

Next, Bruce and I got out of the VW and into one of the Corvairs. I asked Bruce why he'd chosen Corvairs. He said these early models have pretty terrible handling, but they can be set up either to understeer or oversteer, and they're much more forgiving than the VWs—much slower to react and actually harder to spin out. How right. After the rabbit-like Volks, the Corvair seemed like a hippo on skates. It wallowed, it plowed, and turning the wheel was like trying to shut a sluice gate.

Finally we switched cars again, this time getting into the BMW. Here was almost neutral steering, meaning the car would slide sideways through fast turns rather than trying to keep going straight (understeer) or swapping ends (oversteer). By manipulating the throttle, this slight sideslipping could easily be controlled. Bruce told me that, eventually, if pushed hard enough, the BMW would understeer and, beyond that, end up with final oversteer. But we didn't go that fast.

After an hour or so of this, Bruce said I was familiar enough with understeer/oversteer and that we could get on with the "loss of control" section. The school uses an excellent manual, written by Bruce, and he again gave a little lecture on what to expect.

We went out on the skid pan once more and got into the trusty VW. This time Bruce told me to *make* it spin. On purpose. I'd already spun out once, so it shouldn't be too hard to do again. I took off briskly in low, shifted to second, floored the gas, and made it through Turns 1, 2 and 3. At Turn 4, the rear did its thing—swapped ends with the front. Good. Easy as pie. Bruce seemed pleased, because some students couldn't induce a spin the first time they tried. Meanwhile, I was sitting there wondering how I was ever going to learn to control one.

The next two times I tried to spin, we didn't. So it had just been beginner's luck after all. But later it was easy, and we spun and spun and spun. I was getting the hang of it.

Then Bruce told me to avoid a certain group of pylons by spinning out just in front of them. An induced spin is sometimes a fair substitute for brakes. He doesn't recommend it, but there are situations where a controlled spin can be an effective way to miss, say, a car stalled

(Please turn to page 212)

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THINGS THEY DON'T TEACH!

(Continued from page 210)

on an icy street, when brakes do almost no good at all.

To induce the spin more rapidly and with greater precision, Bruce told me to yank up on the VW's emergency brake. This locked up the bald rear tires and got the back half of the car coming around the front in jig time. I now had no trouble inducing the spin, but I wasn't too great about *where* I was spinning. Time after time I broadsided those pylons. I still hadn't mastered the art of defensive spinning when it was time to move on.

Up to this point, Bruce was simply letting me experience slides, spins and feeling various steering and handling characteristics. He wasn't telling me anything about controlling these . . . not telling me what I was doing wrong. And I knew I was doing all sorts of things wrong. It must have taken considerable restraint not to give me advice.

. . . controlled spin can be an effective way to miss a car stalled on an icy street . . .

Time had come, though, for our third lesson, "regaining control." I was going to learn how to combat or at least control these helpless skids, slides and spins.

I knew the old maxim, "Always steer into a skid," and that's what I'd been doing. This advice works to a degree. I soon found, though, that once I'd steered into a skid and the car had caught itself, the skid reversed and, like a flash, I was involved in a totally different situation—skidding the other way. By the time I realized this and tried to resteer into the secondary skid, I'd lost it—we were spinning. And once spinning, there's nothing to do but sit there.

The whole idea of the school is to teach you how to avoid, first, the skid. Or, second, if you do get caught in a skid, how to avoid a spin-out. There are instances when you can get a car through a corner faster with a controlled skid. But for normal, everyday street driving, skids are to be avoided at all costs, because even a controlled one can get out of control in a big hurry. So back in the classroom, Bruce went through his "regaining control" lecture. Here he told me how to hold the steering wheel: at 3 and 9 o'clock. Then he said I shouldn't cross my hands on the wheel when turning. Rather, feed the wheel from hand to hand, elbows bent

just slightly, and don't use the wheel for bracing. We tried it on a dummy steering wheel inside the classroom.

Then back on the skid pan, we tried it again. The idea was to push the car as fast as possible around the pan, pretending that each edge meant a 100-foot drop into space. Spin-outs meant disaster.

Bruce watched my hands. I felt self-conscious. I noticed myself crossing arms, which got me tangled up, and then after that I tried flinging the wheel rim from lock to lock on its own momentum. This was in the Corvair—the sluice-gate steering. Flinging is all right, Bruce assured me, but keep the wheel under control at all times. Also *anticipate*. And be aggressive, because half-corrections are as bad as none at all. Accurate, sensitive corrections of the wheel plus a quickly responding foot on the gas controls a skid.

Here's the general idea. First, you're approaching a turn too fast. Commit the car by steering into the curve. In an oversteerer—and often in an understeerer, too, if the rear tires lose traction—immediately anticipate that the tail will swing out. So let off the gas and steer toward opposite lock—into the skid. Again, immediately anticipate the car's reaction to *that* and come back toward original lock, all this while helping hold the rear tires in line with the gas. You end up getting through the turn sliding sideways slightly toward the outside of the curve. But if you're not right on course, at least you haven't spun out. You've controlled the skid.

In an understeering car, you again commit the front wheel to the turn. You're going too fast, so when you find the car not turning, give enough gas sharply to get the rear hung out slightly. This will push the front end into the turn. Again, you have to balance between the steering wheel and the accelerator.

Anticipation is the key. If you don't anticipate . . . if you wait to react to the reaction of your car once it starts to slide in a tight turn, it's too late. You're already spinning, and then there's nothing to do. But anticipation takes experience and practice. The skid school gives you safe, controlled practice.

We spent the last hour alternating between the various cars, practicing. Bruce made it more interesting by yanking up the emergency brake in the middle of a fast turn. The idea was that I had to catch the car before it could spin. Sometimes I did and sometimes not. I got better as the final hour rushed on. At one point, one of the Corvairs snapped an axle. A bit later, as we were circuiting in the

(Please turn to page 214)

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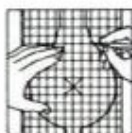


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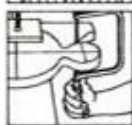
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THINGS THEY DON'T TEACH!

(Continued from page 212)

other Corvair, Bruce told me to really flog it. I did, but he wasn't happy, so he set his foot on the accelerator and planted it. We approached Turn 4, and I was seasawing like a walking beam when the rear end let go. It lurched off the asphalt into gravel. A tire popped off the rim, and the wheel dug in. Up came the left side of the car several feet in the air, almost before we knew what happened.

By then it was 4:30 and time to quit. Skid school was over. Back in the classroom for a final wrap-up. Bruce asked me what I thought I'd learned. Two things, I told him. First, that a car starts to spin a lot faster than I'd suspected possible. Once it does spin, it's too late to do anything. Second, that skids and spins are avoidable, and I thought I had a much better understanding of how to prevent and control them than I had before.

I consider the time extremely well spent, and I heartily recommend skid school to anyone who *thinks* he's a good driver! ★★★

ELECTRONIC CHECKER GAME

(Continued from page 178)

booby trap on your side of the board. He will often hit the same trap twice. You will know when a square on his side is "safe" if he's used it. But the longer you play, the harder it is to remember what squares are safe.

The circuitry is simple. Each checker has a metal stem. When it is inserted in a square and touches both metal liners in top and bottom playing surfaces, it completes the circuit, the bike horn beeps and the red light glows. When the bottom plate is insulated from the checker by a removable cardboard disc, nothing happens. The stems can be flathead rivets epoxied to a set of regular checkers. ★★★

CRUISING THE CASCADES

(Continued from page 137)

campsites, or you can try the Swissmont Hotel, Stehekin Lodge or Stehekin River Resort (zip code 98852).

For general information contact Lake Chelan Chamber of Commerce, Box 216, Chelan, Wash. 98816; for North Cascades National Park information, the district manager in Chelan (phone Chelan 524); for snowmobiling services in National Forests of the Pacific Northwest, Box 3623, Portland, Ore. 97208. And have fun! ★★★

SITZEN SIE SKI?

(Continued from page 127)

weight equipment, the sport of skibobbing began to grow by leaps and bounds. During the last decade it's estimated some 300,000 Europeans have tried it. Inevitably, competition was organized, with the first world championship races held in Austria in 1967. Eighteen countries sent representatives and even more are expected for the 1971 meet, probably to be held somewhere in the western United States. Skibobbing is even being promoted as an Olympic event for 1976!

The skibob does not lack for thrills—the world's downhill record, now held by Erich Brenner, is a respectable 102 mph. For the average person, skibobbing is both respectable and widely available. Many skibobbers are skiers who have either switched or use both methods as circumstances and their moods dictate. Although some resort areas are still reluctant to accept the innovation, at latest word the American Skibob Assn. lists over 100 ski areas where the bobs are rented and welcome.

What is a skibob? First, it is a sturdy, one-track steerable device with front and rear runners, the total length of those not exceeding 230 centimeters (7.55 feet). It should not weigh more than 25 pounds, and its seat should not be more than 24 inches high. Positive locking for the handlebars is necessary, for they cannot point directly back toward the rider and must not jam his knees when turning. These should be no more than 24 inches wide and 30 inches high (above the bottom of the front runner).

Several large winter sports manufacturers now make skibobs, which sell between \$100 and \$200—about the price of a good ski outfit. Heavy-duty models can also be rented at many resorts for \$3 to \$5 per day. In addition, kits are sold for home assembly at somewhat lower prices by the American Skibob Manufacturing Corp. of Littleton, Colo.

So the story of *sitz ski* is good news to the majority of Americans, sports-minded but formerly unable to find a comfortable home on the ski slopes. The overwhelming popularity of the snowmobile has shown the existence of this group—and these thousands of snowmobile owners will find that towing a skibob behind them is not only great sport but adds an extra seat. Used sensibly, here is a safe key with which another segment of winter-locked America can be opened. Anyone interested in further details may contact the American Skibob Assn., Box 1055, Littleton, Colo. 80120. ★★★

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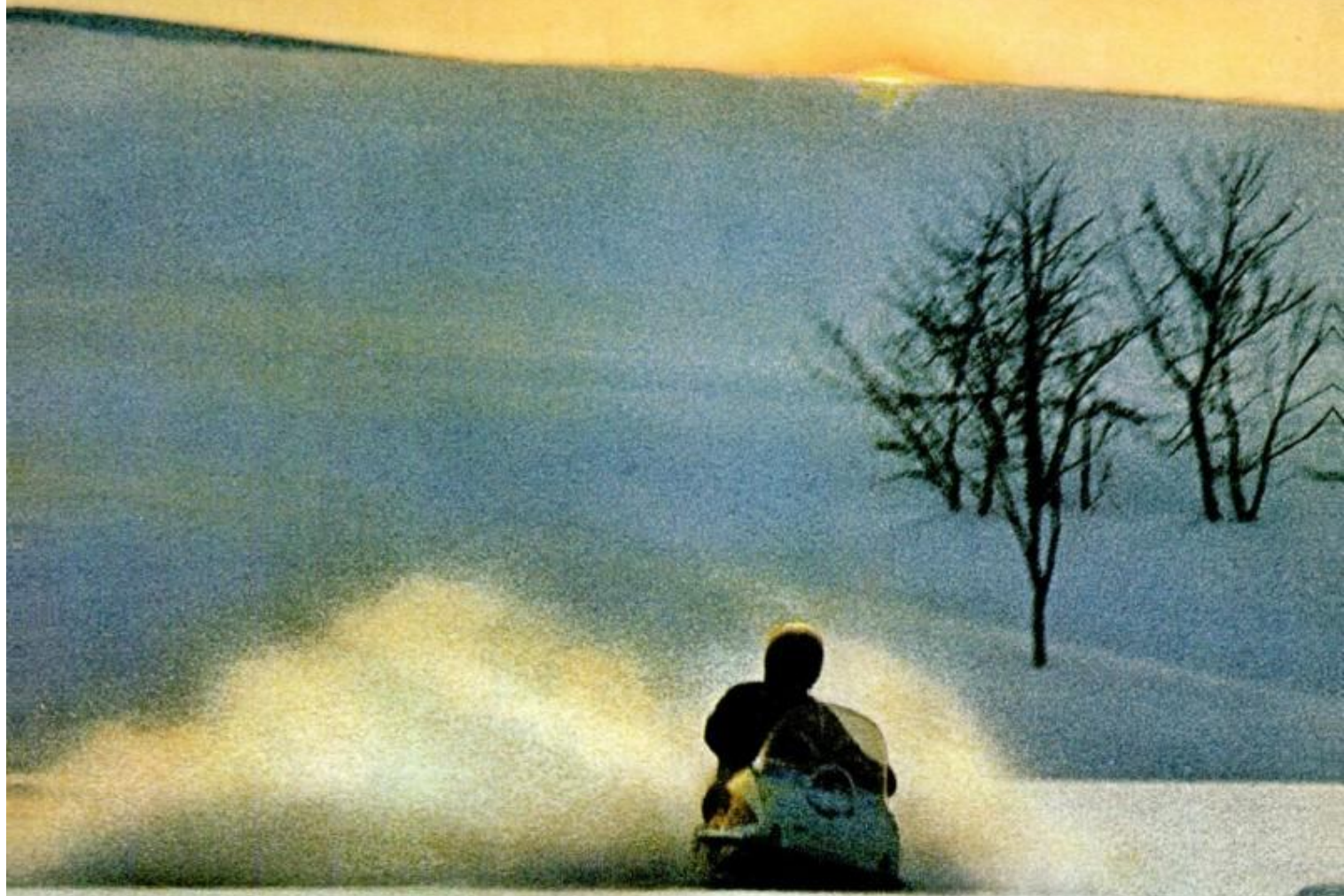
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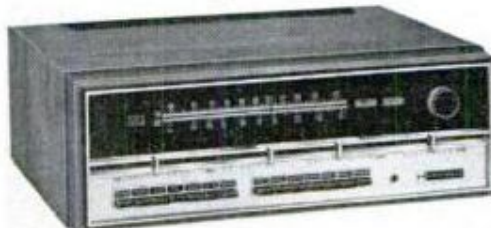


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BLACKED-OUT GAMES ON TV

(Continued from page 103)

rounding network affiliates in Columbia or Augusta, Ga., Birmingham or Montgomery, Ala., and Chattanooga, Tenn. Viewers around Denver have Pueblo, Colo., to the south and Cheyenne, Wyo., to the north to choose from.

This doesn't necessarily mean, of course, that you can get any blacked-out program you want merely by flipping the dial to an alternate station. There are some unavoidable limitations to the signal-stealing sport. Not all affiliates broadcast the same programs as their parent network. In some cases, affiliates near a blacked-out area will blank their channels, too, for the sake of network cooperation even though they're beyond the prescribed blackout radius. Also, the transmitting power of smaller affiliates may be limited.

Improving your TV reception can, however, bring you a much wider range of viewing possibilities despite these prob-

. . . rotor can often improve local reception as well as pull in distant stations.

lems. Even if you can't bring in a local game, you may be able to snare another contest to watch from a more distant city—one that isn't blacked out. You'll also have many other programs to choose from.

To get distant stations, you'll need two special aids—an electronic booster to beef up weak signals and a rotor to beam your antenna toward their source. Most new stations you try for will not lie in the same direction as your present local ones. This means you'll have to aim your antenna for each station you want to watch.

Antenna rotors come in two basic types—manual and automatic. Manual models are less expensive and sell for \$25 to \$35. With this type, you must watch the screen while turning the control knob, hunting back and forth until you have the best picture. You must also hold onto the knob until the antenna swings into position.

With automatic models, you establish the correct settings once and mark the dial at those points. Thereafter, all you do is turn the knob to the desired mark, let go and the antenna will swing to that position by itself, then stop. This generally adds \$15 to \$20 to the price of a rotor.

Installing a rotor requires no special skill or tools. The motor housing clamps to your present mast and has a socket to hold the antenna. If the antenna extends far

above the rotor, side sway may put a strain on the motor's gears and bearings. To overcome this, manufacturers offer an accessory thrust bearing you can add to steady the antenna. The rotor control at the TV set connects to the motor with a low-voltage, multiconductor cable.

One surprising bonus you get with a rotor is that it can often improve local reception as well as pull in distant stations. Since ghosts, caused by bouncing signals, arrive at the antenna at a slightly different angle from the main signal, you can adjust the rotor to tune out the reflections.

Electronic boosters can't manufacture a signal that isn't already there, but they can help you keep what signal you have. There are two basic types to choose from—indoor and outdoor. Outdoor boosters, usually called preamplifiers, mount up on the mast near the antenna. Their job is to amplify weak signals before they enter the lead-in to overcome losses in the line between your antenna and TV set. Such losses are particularly critical if the lead-in is long or you live in a deep-fringe area more than 50 miles from the broadcasting station. The problem is aggravated on the higher channels and especially serious on UHF. A preamplifier can take out snow if it's introduced in the lead-in, but not if it's in the signal to begin with. In this case, it will simply amplify the snow.

Preamplifiers require a separate power supply mounted inside the house, usually in the attic or an upstairs room. This plugs into a wall outlet and feeds low-voltage current to the booster up on the antenna. Manufacturers offer preamps in different models to cover various combinations of regular TV (channels 2 to 13), UHF (channels 14 to 83) and FM radio.

Indoor boosters are designed mainly to compensate for signal losses introduced by multiset installations. If two or more sets try to share the same antenna, the signal is weakened to the point where none of them will be able to get a good picture. Indoor boosters, called distribution amplifiers or amplifier-couplers, are installed at the inside end of the lead-in and feed a separate, amplified signal to each of several sets. The typical home version can handle up to four TV sets and FM radios combined.

In choosing a booster, be sure its impedance matches that of your lead-in. There are models for regular 300-ohm twin-lead and the newer 75-ohm coaxial cable. Indoor and outdoor boosters range in price from about \$30 to \$60. Both are easily installed simply by connecting your antenna to the input terminals and your TV set to the output terminals. If you're

(Please turn to page 222)

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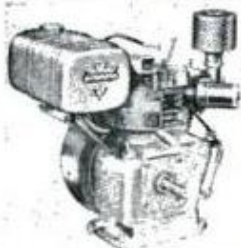
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BLACKED-OUT GAMES ON TV

(Continued from page 220)

reaching for distant stations, try the outdoor type first. In some cases, an indoor amplifier can improve picture quality even where only one set is involved, but it is most effective on multiple sets.

If you want to go after a really far-off station, you can install a special single-channel antenna known as a "yagi" (named after its Japanese inventor). Unlike conventional antennas, which are a compromise for receiving many different channels, the yagi is designed to tune in only one particular channel. This makes it highly sensitive and one of the most powerful antennas you can buy.

Yagis are not particularly expensive, but you'll need one for each channel you want to watch. Models for Channels 2 to 6 cost about \$15 each, while those for Channels 7 to 13 are somewhat less.

You can mount a yagi on the same mast as your regular antenna, but you should space it at least 8 feet away to avoid interaction between the two. Since this will probably add considerable height to your mast, calling for guy wires, you may find it simpler to mount it on a separate mast on another part of the roof. In any case, you'll need a separate lead-in to your TV set and a way of switching conveniently from one antenna to the other. Special antenna selector switches are available.

If your present lead-in is more than three years old, it should probably be replaced. Tiny cracks in the insulation allow dirt and moisture to bridge across the wires and leak off precious signal. Foam-filled twinlead is slightly more expensive, but much more weather-resistant than the older flat style. Shielded twinlead can be helpful where you're plagued by local interference. Most rugged of all is coaxial cable, now used in many professional installations. For this, you'll need small matching transformers at the antenna and TV set to balance its 75-ohm impedance to the normal 300-ohm load.

You'll find antenna accessories sold at TV dealers, radio-parts stores and mail-order electronics-supply houses like Allied Radio in Chicago and Lafayette Radio in Syosset, N. Y. Some prominent makers in the field include Blonder-Tongue Laboratories, Inc., 9 Alling St., Newark, N.J. 07102; Channel-Master Corp., Ellenville, N.Y. 12428; Finney Co., 34 W. Interstate St., Bedford, Ohio 44014; Jerrold Electronics Corp., 401 Walnut St., Philadelphia, Pa. 19105; JFD Electronics Co., 15th Ave. at 62nd St., Brooklyn, N. Y. 11219, and Winegard Co., 3000 Kirkwood St., Burlington, Iowa 52601. ★★★

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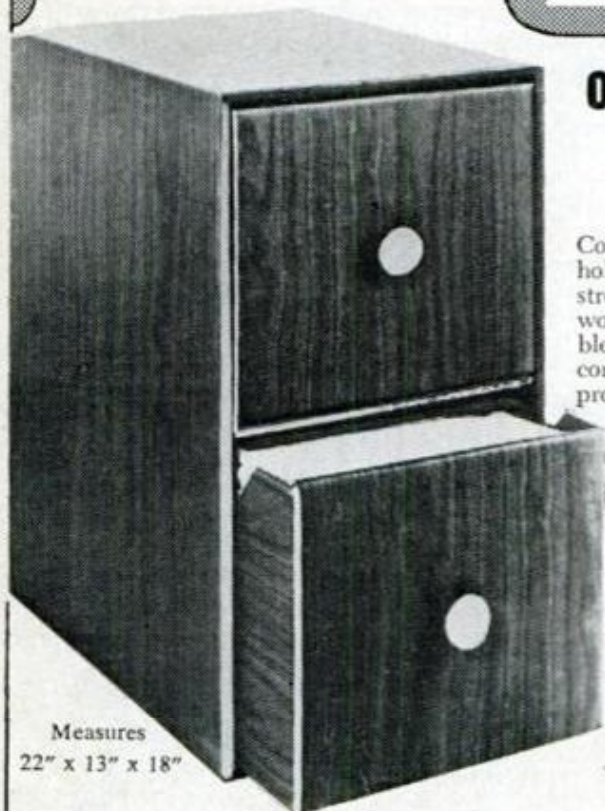
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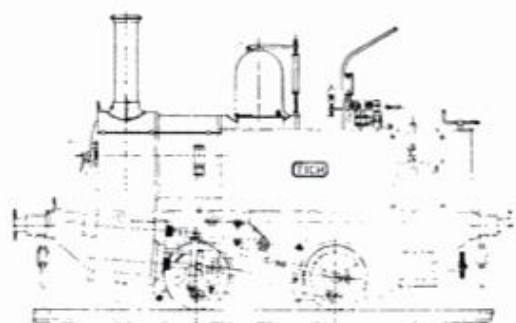
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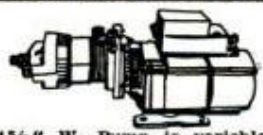


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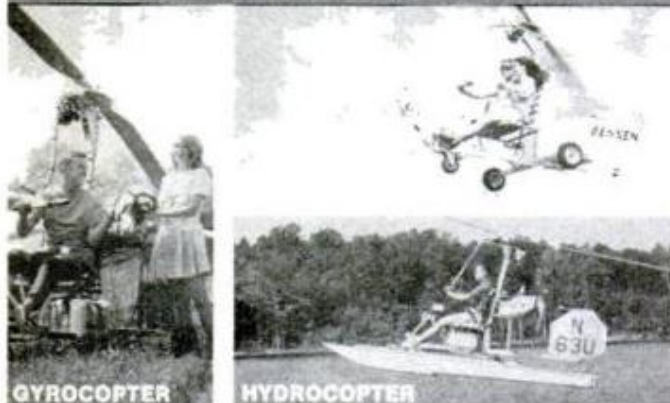
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HOW MUCH CARBURETOR?

(Continued from page 147)

four-barrel systems for their V8s that will bolt on) but you would get a little more power from an aluminum "hot rod" manifold (Edelbrock, Offenhauser, Weiland, others) because they have bigger, better-shaped passages.

Don't go too big with a four-barrel. Special racing four-barrels now offer up to 2¼-inch barrel diameter (on all four!) and up to 1400 cu. ft. per minute (c.f.m.) airflow capacity—enough to deliver 800 hp with minimum restriction! You wouldn't want to use anything like this on the street. These racing carbs have no air-valve secondaries, wide-range metering systems, often no choke systems, and would be impossible for everyday driving. Forget them. We suggest a rated airflow capacity of 700 to 850 c.f.m. for hot street engines over 300 hp and with the air-valve secondary. This would take in the GM Quadrajet, the bigger Holley performance carbs, the small Carter Thermo-Quad and the latest Carter AVS performance carbs. They're all good, flexible street carbs.

These special performance carburetors often require a special matching manifold to get the most out of them. If you don't want to spend this much, the Holley Carburetor Co. of Warren, Mich., has a unique program that offers replacement four-barrels for all popular engines that bolt on the stock manifold and hook up to the stock-throttle linkage and fuel lines—they give an average boost of 10 to 15 hp at the rear wheels. This is possible because Holley carbs have cleaner, more streamlined venturis and nozzles than most other carbs, so give less restriction in relation to barrel size. You can bolt on 10 or 15 more horses in an hour for about \$50. That's a bargain these days in any area of the hop-up business.

Holley also has a deep-breathing two-barrel that can replace the two-barrel on most late engines, using a special adapter for the manifold (available in the hot rod shop where you buy the carb). The rated airflow capacity of 500 c.f.m. is about twice that of the average two-barrel, and some racing men are developing over 400 hp with this carb today!

So far we've covered single-carb installations. Some fellows insist on multiple carbs if for no other reason than hairy looks when they lift the hood. The basic choice here is between two four-barrels or three two-barrels. Plenty of hardware is available if you want to go this way. The 3-2 setup was quite popular on

(Please turn to page 228)

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HOW MUCH CARBURETOR?

(Continued from page 226)

factory performance engines a few years ago, so some factory triple manifolds are available (Olds, Pontiac, Chevy, Ford, for example). The hot rod industry offers dual-four-barrel or triple aluminum manifolds for all popular V8s. Total venturi area available with either setup is generally greater than that of the bigger four-barrels, so you can expect a modest power increase.

But don't forget that over-carburetion problem at the low end. You can use progressive throttle linkage with multiple carbs to let you cruise on one carb and then gradually open the other throttles as the foot pedal approaches wide open. This is a pretty good compromise. But you can still stumble when you punch the pedal to the floor at low speeds, and all barrels flop open suddenly. The engine can't help but gulp before it grabs. There's no easy way around this, short of using the complex vacuum setup on the Chrysler triple system. You pay the price for the image and slight extra hp you get with multiple carbs. Can you live with it? Think it over.

It boils down to the prime rule on hopping up carburetion: A little more carburetion is almost always good. The secret is knowing when to stop. ★★★

BUBBLE UP BOATING

(Continued from page 150)

capacitor motors are essential for extreme cold weather operation.

One improvement is scheduled for next year. Our 30-minute timer will be changed to a 10-minute control. In sub-zero weather it's better to run the system at frequent intervals to assure that ice won't form. Our dock neighbor set his controls 4 minutes on and 6 minutes off and had more free water than we did operating 12 minutes on and 18 off.

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Each time we inspect our Alice L floating free in a harbor of thick ice, we're glad we took the time to find out about safe and economical wet winter storage—even though it took us two seasons to get the details right! ★★★



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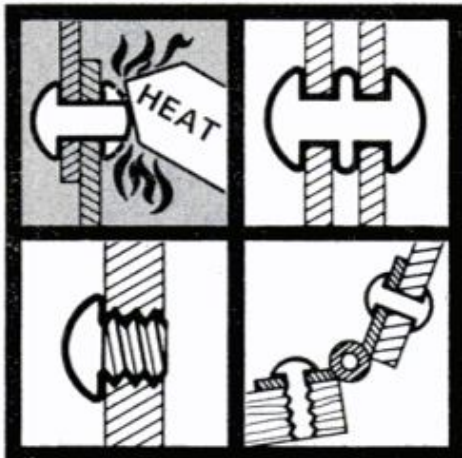
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BLACKOUT LIGHT

(Continued from page 159)

moves the contacts to the normally closed position. This switches out the charger and connects the batteries to the bulb so the lantern flashes on. Once on, the lantern can be unplugged for portable use just like a conventional flashlight.

It's necessary to make two modifications to convert the lantern to automatic operation. Such lanterns typically have four flashlight cells in series with a metal clip contacting the base of the last battery in the string. A metal strip runs from this clip to the lantern switch. Cut away a small portion of the strip, as shown in the drawing, leaving a gap. Solder wires to the cut ends of the strip and run them to the relay contacts as indicated. When the contacts close in a blackout, current flows to the bulb socket just as if the strip had not been cut apart and the lantern lights. The regular lantern switch is left "on" to complete the circuit. Cement the cut clip back in place if it tends to be loose.

The second modification requires running a lead from the positive terminal on the charging module to the tip of the first battery. The simplest way to do this is to slip a solder lug with a wire attached to it between the battery tip and the light-bulb base. Tape the lug to the battery so it can't shift out of place.

The negative lead from the charging module goes to the normally open contact on the relay so the charger is switched into the circuit when the relay is energized. A diagram shows how to identify the positive and negative leads on the charger. Run the three wires from the lantern down through a hole in the bottom and into the metal minibox. Use No. 22 stranded hookup wire for connections.

Most of the parts can be obtained from Lafayette Radio, 111 Jericho Turnpike, Syosset, N. Y. 11791. Rechargeable nickel-cad D cells are \$2.10 each (Lafayette No. 34T3502). The relay is a Potter & Brumfield type KA5AY (Lafayette No. 30T8730, \$3.50). Lug-type terminal strips for making connections are five for 20 cents (Lafayette No. 32T1206).

The charging module is a Cordover type TBC-6 priced at about \$1. It can be purchased at radio parts stores or by mail from Midway Radio, 58 W. 45th St., New York, N. Y. 10036. If you wish, you can add a neon pilot light to give a visual reminder that the lantern is plugged in. (This is Lafayette No. 34T5208 and includes a built-in resistor.) Mount it in a 5/16-inch rubber grommet in the end of the box. Also use a grommet to protect the a.c. power cord where it enters the box. ★★

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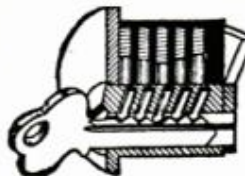
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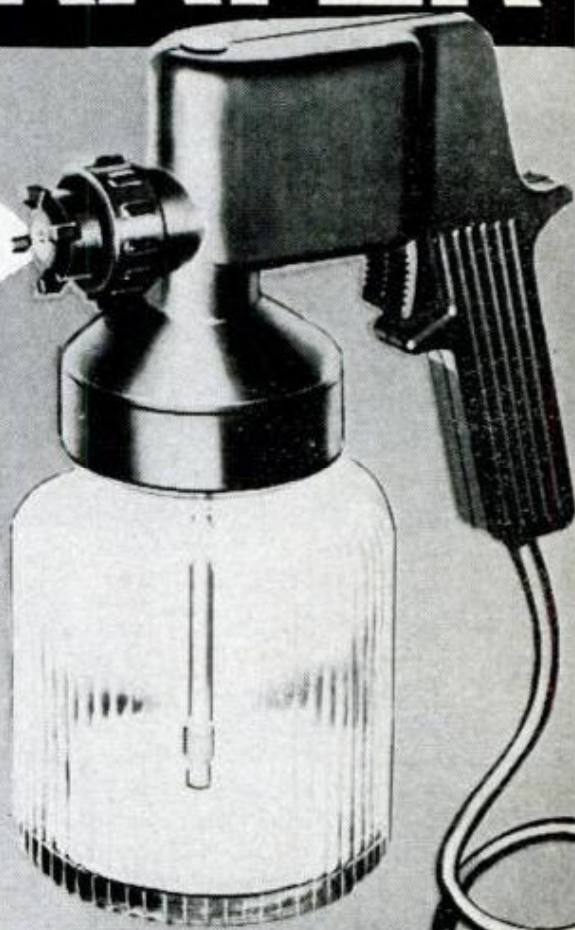
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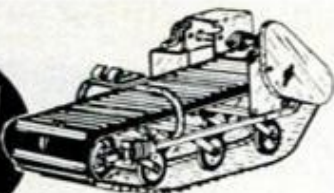
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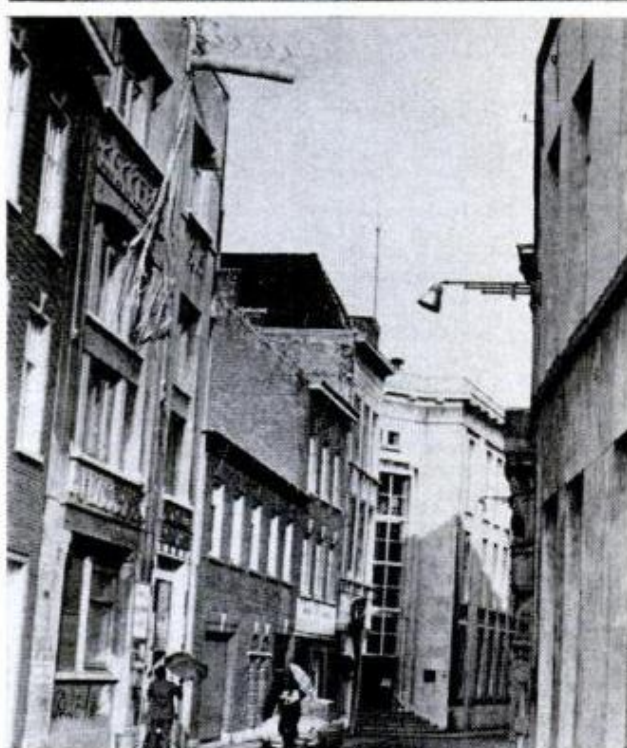
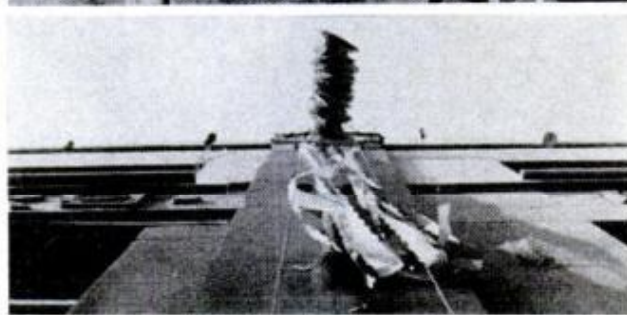
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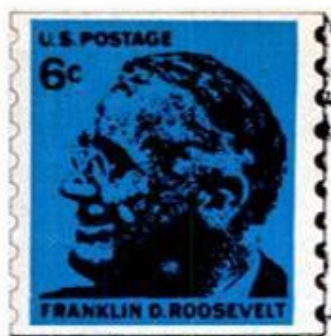
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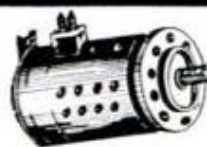
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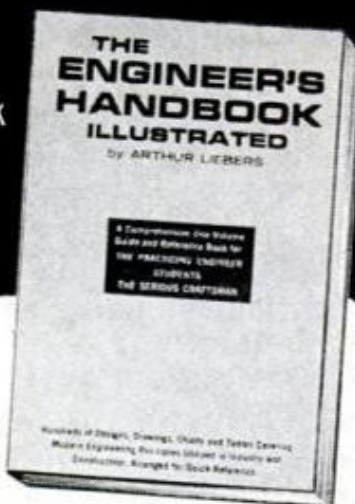
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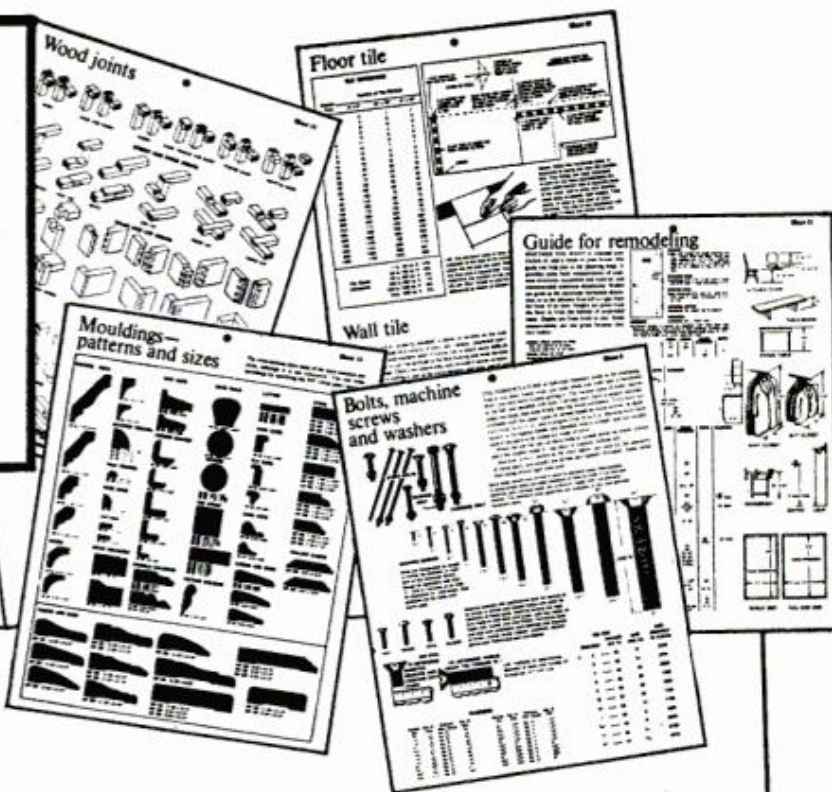
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