

# Popular Mechanics

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How to hang wallpaper  
How to use plastic pipe



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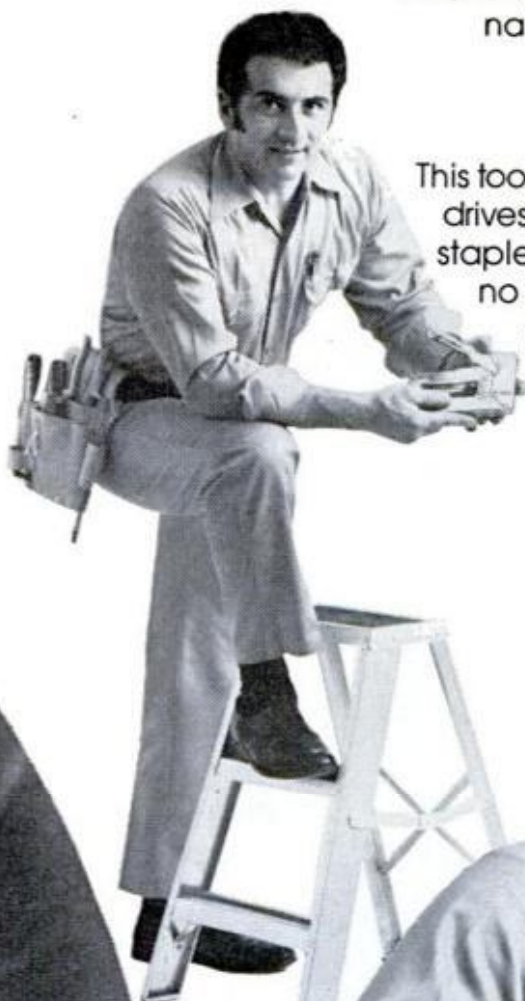


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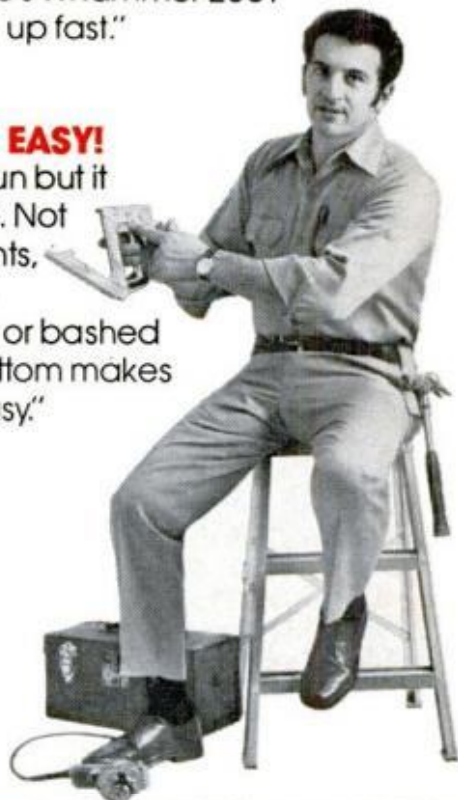
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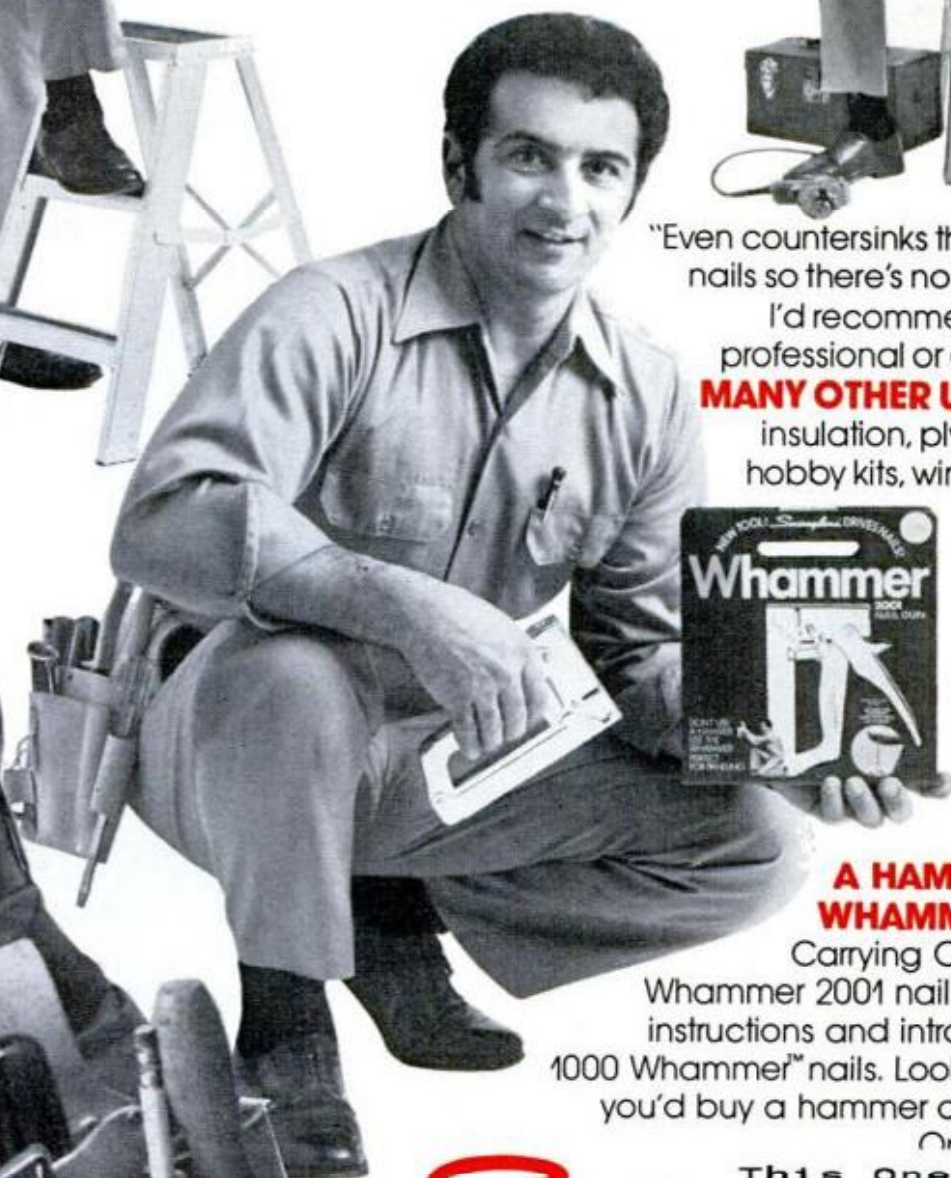
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# Popular Mechanics

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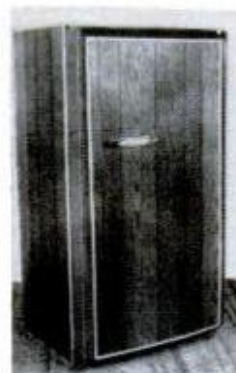
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ON THE COVER: Section of proposed bridge to carry oil, highway and rail systems across Alaska, without disturbing the environment.—*Illustration: Roy Grinnell*

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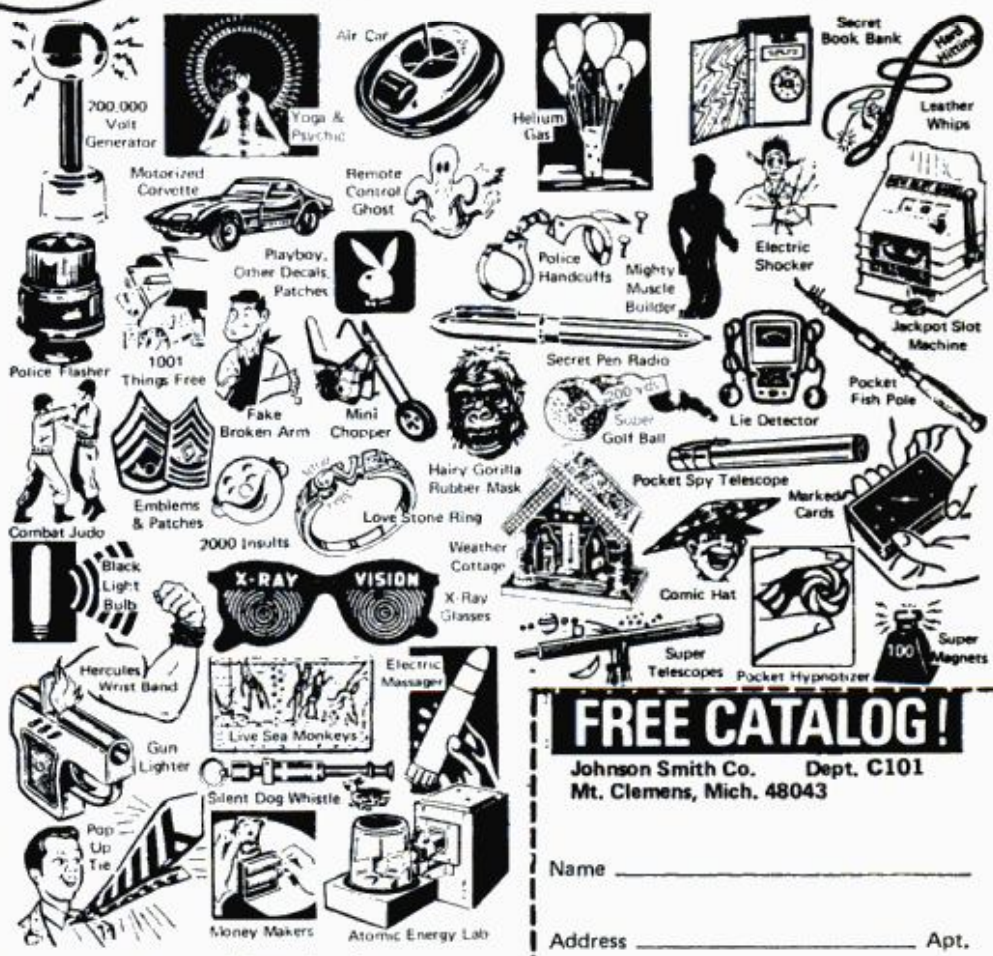
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# LETTERS

## TO THE EDITOR

### She lives on an island, not a mountain

The first picture caption in *Drive to South America?* (page 28, Nov. *PM*) describes an Indian girl as an "Andean girl." That is completely wrong!

That Indian girl is a member of the Cuna Indians on the San Blas Islands in the Republic of Panama. The women of this tribe wear earrings and necklaces of pure gold, as well as the ring they carry in their noses as a decoration.

TALLAHASSEE, FLA.

IRMA R. GROSS

*We regret the error—which was made by a staff caption writer, not by author Ernst Jahn.*

### Before the Astrodome

I must disagree with one point in *Who's Ahead in the Superstadium Game?* (page 104, Nov. *PM*). Though Houston's Astrodome is much larger than the Assembly Hall at the University of Illinois, it was the Assembly Hall that began the age of such domed structures with unhampered visibility throughout.

That dome utilized some 600 miles of wire wound around the rim to support the dome over more than 16,000 seats without buttresses outside or pillars within. It was constructed two years before the Astrodome.

DICKINSON, N.D.

HARRISON LEON CHURCH

### Lighter fluid for candle wax

Your *Clip-and-Save Know-How* articles are great, and being a furniture refinisher, I especially enjoyed reading *How to Repair Scratches in Furniture* (page 102, Nov. *PM*). May I add one how-to on the removal of candle wax?

For almost all finishes I have successfully removed candle wax by squirting it with lighter fluid. This dissolves the wax, and it

can be buffed off with a soft cloth. No scrapers, no added scratches. This method also removes wax from linen and cotton tablecloths and place mats, but you work from the back to prevent colored wax from penetrating the threads. The greasy residue from the lighter fluid washes out.

LOS ANGELES

WILEY HARKER

*Thanks for the tip. We'd advise readers, though, to test on an inconspicuous spot before really putting the fluid to work (as we advise for all techniques in the article).*

### A new body we missed

Having just reviewed your October issue, we found no mention of our product, Sterling, the newest kit body for a VW chassis (*Drop a New Body on the Old Buggy!* page 110, Oct. *PM*). Nor did we find a mention of our company name, California Component Cars, Inc., 2801 San Pablo Ave., Oakland, Calif. 94608.



This car kit was produced in England for two years under the trade name, Nova. It is still being produced there, and we are now the licensed U.S. manufacturer. We are in production at this time.

OAKLAND, CALIF.

CECIL ROBERTSON

### Stay away from carbon tet

*How to Remove Stains From Almost Anything* (page 96, Oct. *PM*) was very helpful and well organized, but the "caution" statement included for the use of carbon tetra-

*(Please turn to page 10)*

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Yes, many M.U.I. graduates earn better than \$10 an hour converting worn-out, faded, torn furniture into fresh, bright pieces any professional decorator would be proud to own. What kind of money are you making now? \$150 a week? \$200? \$250 Are your hours long and your work dull? Raises small, and few and far between? Is that the kind of life you want to live? You can make \$150 to \$250 upholstering just one single chair or sofa these days! . . . and you can often finish a job like that in a day. You'll have to agree that's REAL pay — & it beats what most college graduates make!



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## LETTERS

(Continued from page 8)

chloride does not excuse the many times the solvent was recommended for various household cleaning jobs.

Carbon tetrachloride has been responsible for many poisoning deaths and injuries over the years, and there is no known antidote for the solvent. As a result, carbon tetrachloride (and mixtures containing it) in consumer-oriented products—those intended for household use—was declared a Banned Hazardous Substance by the U.S. Food and Drug Administration on Nov. 17, 1970.

Since carbon tetrachloride is banned, it is unlikely that readers can even obtain it. If they do, I hope they are very, very careful with it and store it out of reach of children.  
MESQUITE, TEX. RICHARD D. TRANT

### Skin on paint leftovers

Was surprised to note you suggested putting leftover paint in a glass jar (*Homeowners' Clinic*, page 86, Nov. *PM*) which has a chance of being broken. The easiest way is just to reseal the can tightly and turn it over. This immediately seals off the air so no skin can form. Have done so for years with oil base or latex—and no problems.  
FLORDELL HILLS, MO. MISS RUTH C. BRINK

Two ways to prevent paint skin: Pour a spoonful or so of solvent on the surface, cover and let sit undisturbed in storage.

Cut a wax-paper or foil circle using the can base as a guide. Put this disc on top of the paint. It will float—good for many years.  
CANOGA PARK, CALIF. HENRY VAN NOY

As I am cleaning the brush, I squeeze a few drops of thinner onto the surface of the paint in the container and then very carefully put the lid on and place it on the shelf. If the can is not shaken in storage, the thinner evaporates and there is no skin left on the surface.

WHITE PLAINS, N.Y. DOLF BEIL

Some time ago a painter told me you can leave the paint in the original container. The trick is to get rid of the oxygen in the air in there. He suggested holding the opened can behind a car's exhaust pipe and then quickly slide the cover into position. I find there is never a film this way. With

quart cans, I just breathe into the can two or three times and slide the lid into place.

For oil-base paints, this has been a perfect trouble solver for me.

SIOUX FALLS, S.D. LYNN LOOMIS

### Fifth-wheel trailer from a kit

The article on the Small Fry Fifth Wheel (*Big Trailer for Small Trucks*, page 102, April '73 *PM*) was very interesting. However, sometimes to be a believer you have to try it for yourself. After visiting the plant to see how the trailer is constructed, I decided to purchase the 18-foot kit.



The plans were complete and gave step-by-step instructions plus helpful hints. The materials were of good quality. Working evenings and weekends, I finished the kit in three months. I would recommend the Small Fry kit; the end result looks as though it is a professionally built trailer.  
VANCOUVER, WASH. LOREN OWINGS

*Indeed it does. For other readers who are interested, the firm is Small Fry Enterprises, Inc., 3094 S.E. Tualatin Valley Highway, Hillsboro, Ore. 97123.*

### Where do you find S4S lumber?

I plan to make picture frames as my winter project. The article, *Good Art at a Price You Can Afford* (page 73, Feb. '73 *PM*) is going to be my bible, but I am baffled by one thing. Harry Wicks, the author, made reference to "surfaced-four-sides (S4S)" lumber as if it were an easy-to-find stock item. I have never heard of S4S nor, apparently, have several of the lumberyards I have contacted.

LAMBERTVILLE, N.J. BILL LISSENDEN

*Many lumbermen also use the term D4S—dressed four sides. Both S4S and D4S mean the same thing: the lumber is smooth*

on both sides and both edges. There is nothing mysterious about purchasing it. The clear pine that lumberyards sell, for example, is S4S. If it's not, it's simply a lower grade of pine intended for use where the quality of wood surface is not important.

### Index for your PM collection

Your magazine contains excellent material, and I, for one, like to keep copies on hand. However, after one has accumulated a number of copies and wants to refer to an item he remembers, it is one heck of a job to go completely through many copies to find the item wanted.

Could you have a plain ruled page next to the cover? Then when one wants to have something available later, all he has to do when reading is make a note of the item and the page number. In this way a quick reference would be available.

ALBUQUERQUE, N.M.

E. D. MCGWIRE

*We think we've got an easier way. It's the Annual Index which will enable you to locate any article which appeared in 1973*

in just a few seconds. The 1973 Annual Index will be available late in January for \$1.49 plus 20 cents postage and handling. (Annual Indexes for 1972 and 1971 are available for the same price.)

### Easy way to clean downspouts

I have a further suggestion to *How to Keep Your Gutters and Downspouts Functioning* (page 100, Oct. PM).

1. Omit the "pipe strainer" in the gutters. They block up and require a ladder to keep clean.

2. Cut off the downspout or leader 8 inches from the bell of the drain tile, at the ground.

3. Place a brass screen or brass plate with perforations in the bell.

4. Put a "boot" around the downspout about 12 inches long and a size larger than the downspout. This fits over the downspout and into the bell of the drain.

This makes it possible to retrieve dirt, seeds and leaves at the ground. Let the rain bring the leaves down to you.

SCRANTON, PA.

J. J. LAUDIG

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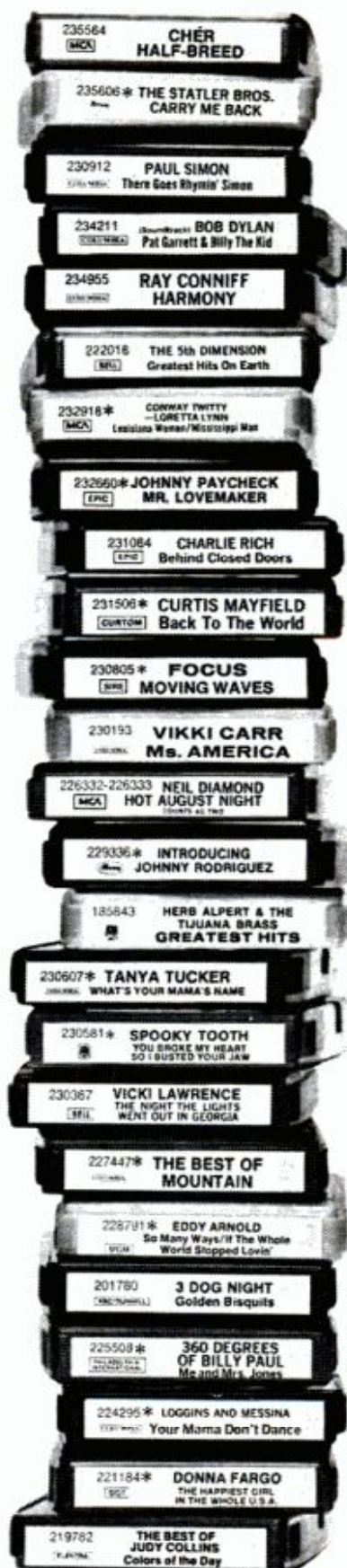
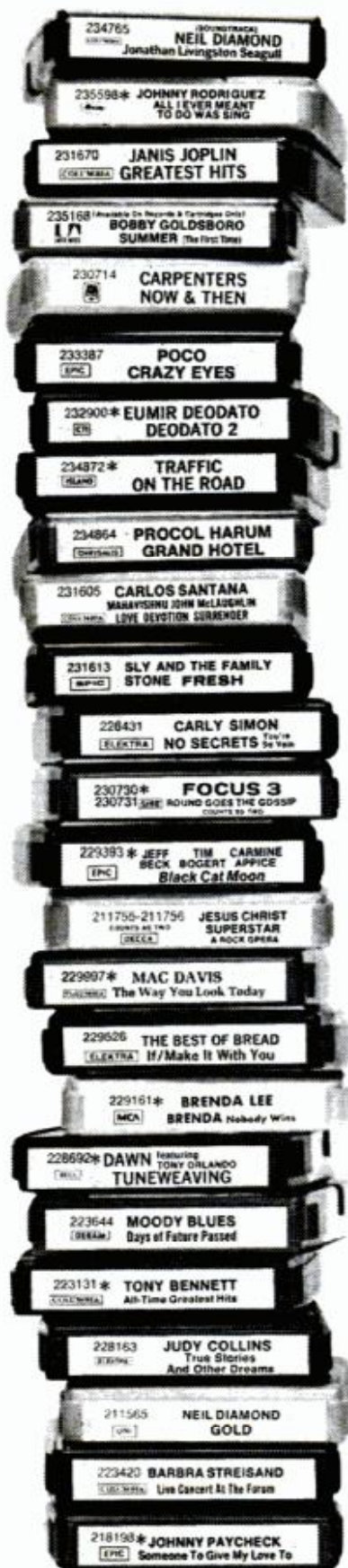
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\* Selections marked with a star are not available in reel tapes



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You may accept or reject selections as follows: every four weeks (13 times a year) you will receive a new copy of the Club's music magazine, which describes the Selection of the Month for each musical interest... plus hundreds of alternate selections from every field of music. In addition, about six times a year we will offer some special selections (usually at a discount off regular Club prices). A response card will always be enclosed with each magazine.

...if you do not want any selection offered, you just mail the response card by the date specified

...if you want only the Selection of the Month for your musical interest, you need do nothing—it will be shipped automatically

...if you want any of the other selections offered, order them on the response card and mail it by the date specified.

You will always have at least 10 days in which to make a decision. If for any reason you do not have 10 days in which to decide, you may return the regular selection at our expense and you will receive full credit for it.

You'll be eligible for our bonus plan upon completing your enrollment agreement—a plan which enables you to save at least 33% on all future purchases. Act now!

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(But I am always free to choose from any category)

- Easy Listening 2  Teen Hits 7  Classical 1  Country 5

Mr.  Mrs.  Miss.....  
(Please Print) First Name Initial Last Name

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

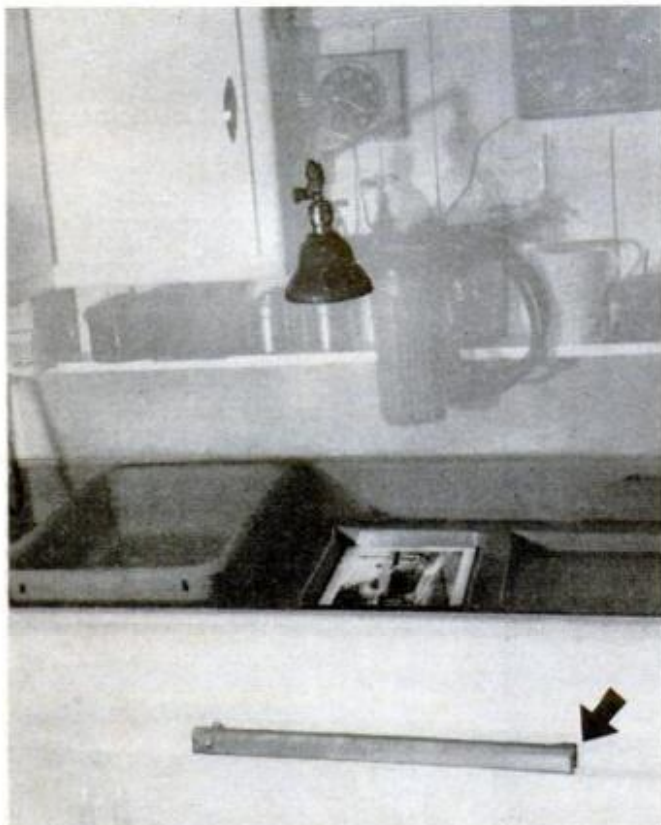
Do You Have A Telephone? (Check one)  YES.....  NO  
APO, FPO addressees: write for special offer P35/S74

# PHOTO HINTS

## FROM READERS



An inspection light above the fixing tray is convenient; here's how to switch it on and off easily.



### Knee switch for print-inspection light

The best way to judge the quality of your prints is with a white light over the fixer tray. But turning that light on and off as needed can be both a nuisance and a potential shock hazard. This knee switch can take care of both of those problems.

All parts are standard hardware or electrical items, except for the wood pressure bar. Dimensions of the bar are not critical, but its  $\frac{1}{4}$ -inch holes should be counterbored  $\frac{3}{4}$  inch to receive the washers on the switch actuator (4, on photo, facing page) and spring assembly (3). Locate the bar at knee level on your sink or counter front, near the fixer tray. The light may be turned on safely once the print has been in the fixer 20 seconds.

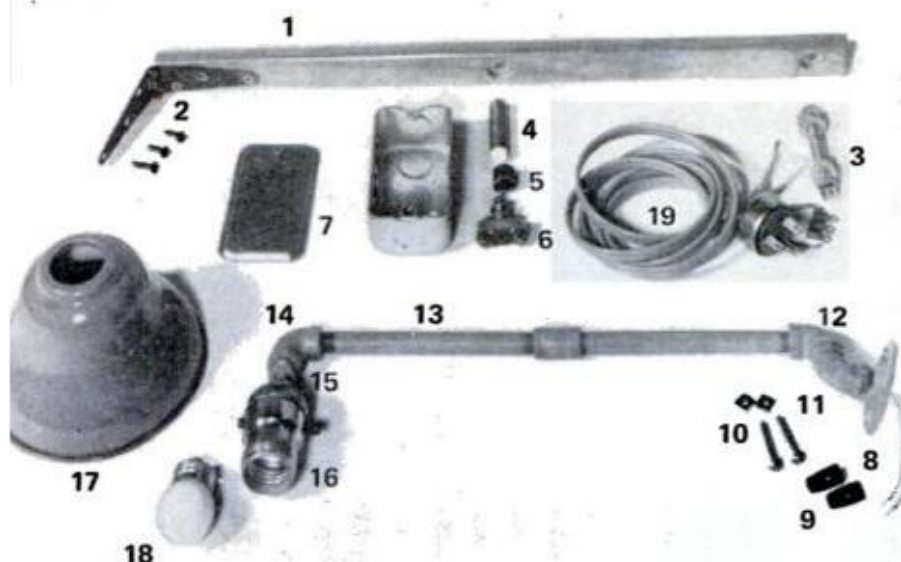
Parts are shown in approximately their assembled relationship. The switch (6) is a normally-open type, mounted in a standard receptacle box, with washers holding it in place in one of the box's knockouts. Locate this box under the sink, where it won't get splashed, and make sure it's properly grounded to the third wire of the three-wire plug, or directly to a waterpipe.

Where you mount the light fixture will depend on your darkroom setup. My light is mounted with pipe fittings to the side of a cabinet, so it can be swung out of the way when not in use. The wire runs through the pipe, then inside the wall to the box under the sink. Make sure everything is solid and protected from moisture, and ground the light assembly either to the third wire or a water pipe. It's wise to use a socket with a switch you can turn off when loading film, so an accidental nudge of the knee switch won't cause a darkroom disaster. ★★★

Nudge the attractive wooden bar (arrow) with your knee, and the inspection light goes on. Release it, and the inspection light goes off again.



## List of parts for inspection light



**Exact parts needed** will depend on your darkroom's layout, dimensions and other requirements. But as the picture shows, all parts can be made from standard switches and electrical hardware, stock pipe and pipe fittings, wood, metal rod, and other normal odds and ends from your shop. Even the guide bolt and compression-spring assembly (3) is made up from common, easy-to-find hardware.

1. Pressure bar, 13/16 x 1 1/4 x 20" hardwood.
2. 3" strap hinge and screws.
3. Guide bolt, compression-spring nuts and washers.
4. 1/2 x 2" metal rod with rubber bumper at switch end.
5. 1/2 x 3/4" bronze bearing.
6. Momentary switch N-O (normally open).
7. Receptacle box and cover.
8. 1/4" pipe waste nut and thread nipple.
9. Solderless connectors.
10. 3/16 x 1 1/2" mounting bolts plus nuts.
11. 1/4" elbow.
12. 1/4" elbow and thread nipple.
13. 1/4 x 12" pipe.
14. 1/4" elbow.
15. Reducer 1/4 to 1/8" pipe, plus 1/8" pipe thread nipple.
16. Standard switch socket.
17. Bell-type reflector.
18. 7 1/2-w. frosted lamp.
19. Three-wire cord with grounding plug and crimp connectors.



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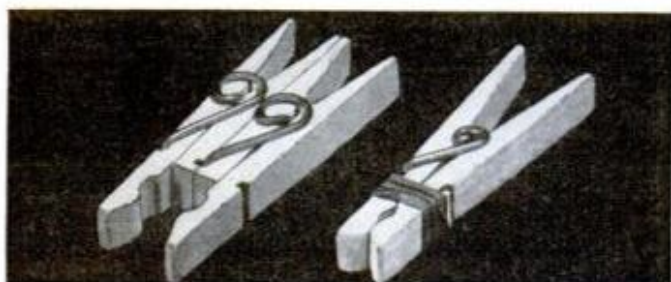
# HINTS

## FROM READERS



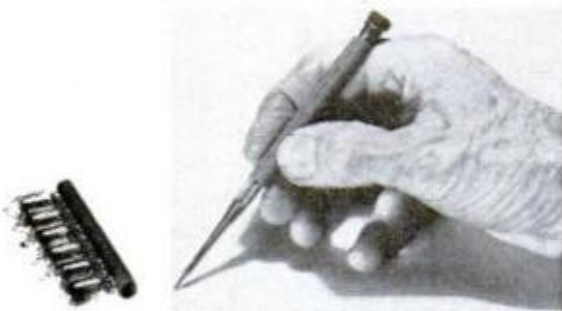
### Pencil as push stick

New pencil with soft eraser makes good push stick when you rip thin stock on bench saw.—*Victor H. Lamoy, Upper Jay, N.Y.*



### Clothespins as small clamps

Increase jaw width by cutting one jaw off each of two pins and gluing them together. Add gripping power by wrapping with rubber band.—*John Krill, North Lima, Ohio*



### Slip-proof grip for small tools

For a smooth grip, I covered my scribe with a plastic tube which is used to protect the bases of A-G (all-glass) flash bulbs.

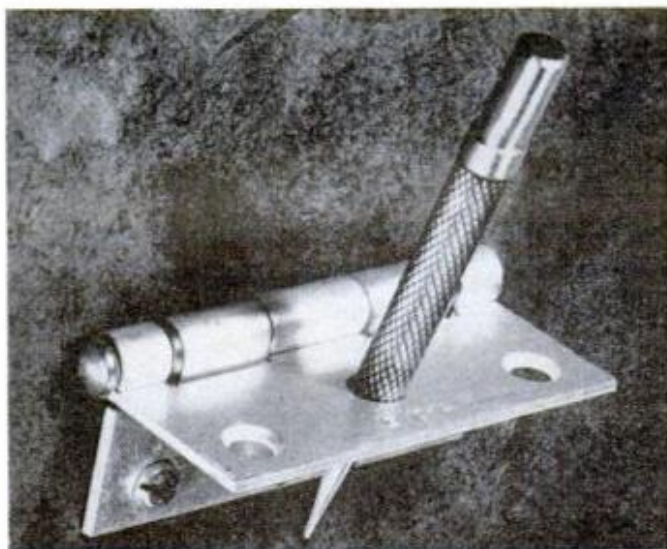
—*Walter Burton, Akron, Ohio*



### Quick paintbrush hanger

One way to soak a paintbrush in paint thinner without the bristles touching bottom of container and fanning out is to attach an adhesive-backed plastic picture hanger to the brush handle. Place metal hook upside down and clip over edge of the container.

—*Bernt G. Halverson, Gainesville, Fla.*



### Old hinge makes new holder

An old hinge turned backward for rigidity and screwed to the wall over your workbench—where you can't brush against it—makes an excellent holder for punches or nailsets.—*Ralph O. Fritts, Amsterdam, Mo.*

New square-cornered Sylvania picture tube

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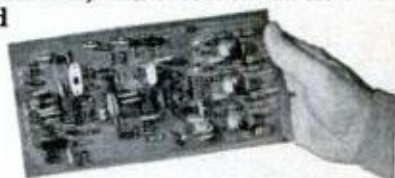
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## SCIENCE WORLDWIDE

### Now: A study of energy use in homes

Ohio State University researchers are starting a two-year project designed to determine how much energy "typical" American homes consume for heating and cooling. The study will include seven homes in the Columbus, Ohio, area and eight others in various parts of the country.

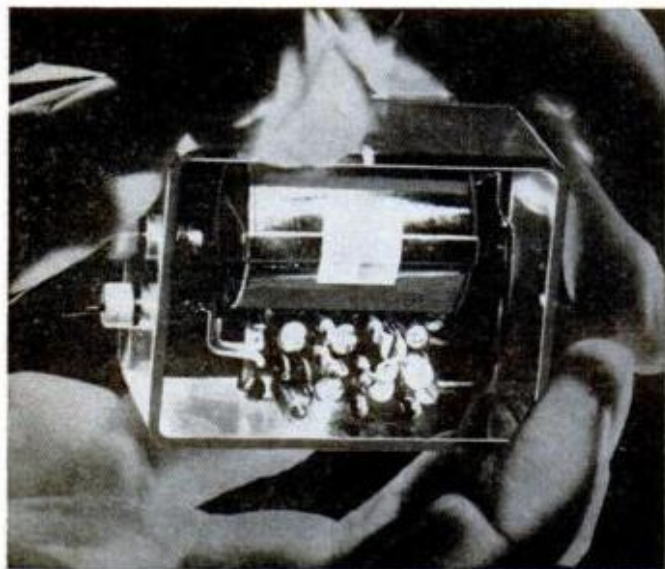
Houses will be in the \$30,000 to \$40,000 range and will be occupied by families with an average of two children. In Columbus, each house will be monitored by a built-in computer for some 300 data points, including inside and outside temperatures, humidity, solar radiation, wind speed and direction, and power consumed by appliances. "We will pin down exactly where the energy goes," explains a researcher, "and will attempt to relate living habits to energy use."



### Skylab spider spins space web

The behavior of two spiders—Anita and Arabella—aboard Skylab 3 provides clues to the adaptability of man in space. So says Dr. Peter Witt, a researcher at Dorothea Dix Hospital, Raleigh, N.C., and the breeder of the spiders. It took the spiders only two days to adapt to the weightlessness of space and to start spinning webs. The spiders functioned on an instinctive level, and that's what interests Dr. Witt.

"I think now we can expect that many nonintellectual functions in animals, including human beings, are far more adaptable and able to be reprogrammed and reorganized than we ever thought," says the researcher. Photos of the spiders, including picture shown, were made with a 35-mm camera.



### Ten years without stopping

An atomic pacemaker developed in West Germany is designed to have a lifetime of 10 years. Still undergoing tests, the tiny unit is powered by an encapsulated speck of plutonium 238. As it decays, plutonium releases energy in the form of heat. Thermoelements transform heat into electric pulses that regulate a patient's faulty heartbeat.

### Vacation from saccharin advised

Dieters who regularly sweeten food with saccharin are advised to "occasionally discontinue its use for several days and thus allow for tissue clearance." That advice is contained in a recent report published by

*(Please turn to page 22)*

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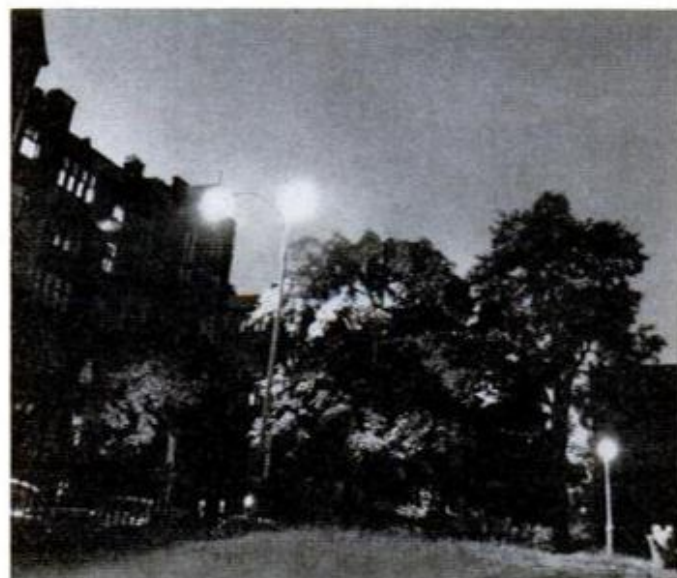
## SCIENCE WORLDWIDE

(Continued from page 20)

the American Chemical Society. Research with rats indicates that saccharin accumulates in the bladder and causes tumors, according to the report. However, the chemical is rapidly cleared from the bladder once it's removed from the diet.

### Waste injection creates problems

Over 1 billion gallons of oilfield brine and industrial waste are pumped underground daily in the United States, according to U.S. Geological Survey scientists. They warn that problems associated with waste injection will multiply in the future if such practice continues to expand without better knowledge of the underground environment. In some areas—notably those of Barstow, Calif., and Long Island, N.Y.—the conflict between waste-water injection and freshwater removal from the subsurface environment is already creating water-quality problems.



### Safer streets but weaker trees

The high-intensity sodium street lights used in cities to reduce nighttime crime may be killing nearby trees. Dr. Henry M. Cathey, a Department of Agriculture scientist, says the lights make trees susceptible to air pollution by making them grow faster than normal. In addition, young trees become vulnerable to frost damage by growing longer into the late fall. ★★★

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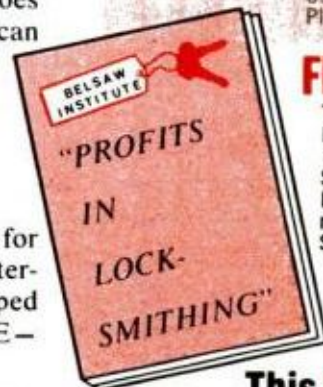
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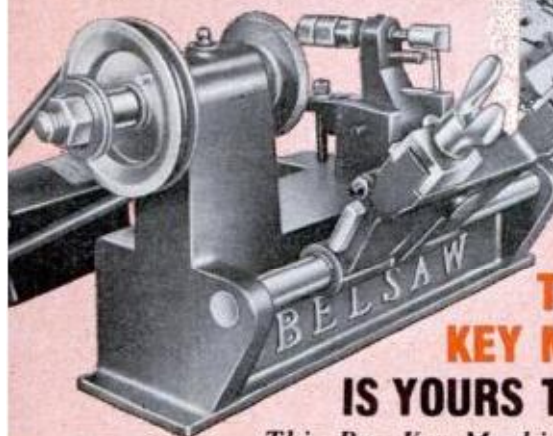
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## IMPORTS AND MOTORSPORTS



### Bumping back-seat drivers

How do you seat passengers in cars with the engine in the middle? Most mid-engine cars are sporty two seaters—driver and passenger. There's no more room after you put the engine smack in the middle of the car. But the seating in these two cars takes a different tack. Above is the Matra-Simca Bagheera, a production model just introduced by Chrysler France. The 1300-cc engine is behind the handsome three-abreast buckets—and the whole package is only 3.2 inches wider than the Porsche 914.

The car below goes one better and seats a driver and three passengers in an arrangement that's so simple and logical that no one ever thought of it. This show car, called the Trapeze by designer Bertone,



simply moves the front seats closer together and flanks the engine compartment with the "rear" passenger seats. The resulting trapezoidal shape gives the car its name. The passengers have more leg room, more visibility forward and can get in and out easily.

### Big bikes of '74

BMW gets bigger—gracefully. The new R 90/6 is shown below in profile. The "cockpit" in the lower photo is that of the R 90 S model—the hot version of the 900-cc R 90/6. BMW has been in the business of building big bikes for years (its model line starts at 600 cc) and its trademark is the shaft drive and impeccable engineering and workmanship. The latest machines are the



sportiest ever, but BMW has not succumbed to boosting revs for sheer power: a BMW is first and foremost a motorcycle that balances power, comfort, safety and reliability perfectly and tastefully. A welcome change

*(Please turn to page 26)*



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## IMPORTS AND MOTORSPORTS

(Continued from page 24)

on the 600, 750 and 900-cc machines is an instrument pod that gets the speedo and tach out of the headlight housing. Two more instruments on the "S" are voltmeter and electric clock. Makes it easier to stick to an ETA, you know.

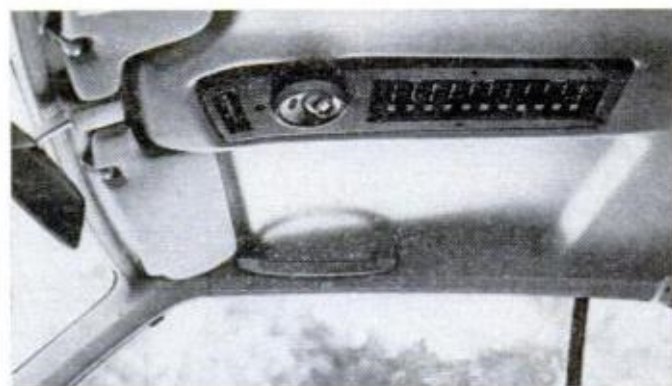
Mama mia! That's one big Benelli—with lots of chromed spaghetti running aft. Six



pipes, count 'em. The 750-cc Benelli is the world's first production six-cylinder motorcycle. It's a lotta bike and you can get your hands on it for a buck: That's the price of the color poster from Cosmopolitan Motors, Hatboro, Pa. 19040.

### The riding mechanic is back

On-board diagnosis is one of the new features on the '74 Toyota Corona hardtops. The overhead console in the two-door and SR models is called an Electro Sensor Panel (ESP). Warning lights in the overhead are



connected to sensors that monitor brakes (lining wear, fluid and vacuum assist), fluid levels (engine oil, radiator, battery and windshield washer) and lights (head, tail, brake and license). There's a map light in the overhead, too. ★★★



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\$450 mark in five days."—*T. E. Baylor*. Wall: "I work just 2 or 3 days a week. Best month was \$1200."—*J. R. Johnson*.

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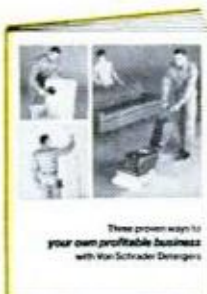


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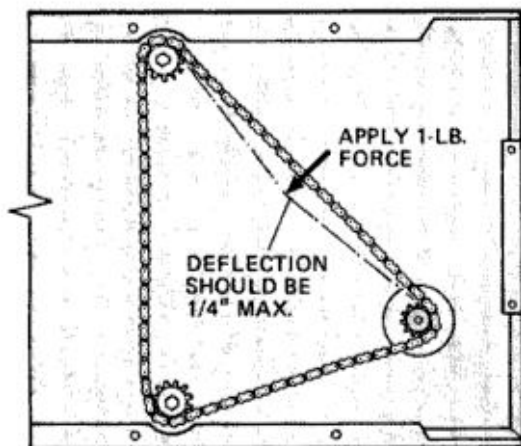
## APPLIANCE CLINIC

BY PAUL MANN

### Compactor clang

*I have a trash compactor that is making much noise. I'm sure it is being caused by a loose drive chain. Can I tighten this chain myself?—Max Berns, North Miami, Fla.*

Certainly. Generally the way to adjust a compactor's drive chain (in most units, it's made of rubber and resembles a bicycle chain) is as follows: Disconnect power and loosen bolts of the motor and drive unit. Pull motor and drive unit toward the rear of the compactor and retighten mounting bolts while holding the drive unit steady. Turn the appliance on its side and check chain for proper tension as shown; a spring scale is helpful here. If deflection is more



than  $\frac{1}{4}$  in., pull motor and drive unit farther to the rear, if possible; if not possible, replace the chain—it has stretched.

### Wrong as rain

*The other day a serviceman pointed out why our dishwasher isn't working. A pin-hole has rusted through the tub beneath the brace that holds the bottom spray arm. Whoever installed the spray arm at the factory apparently cracked the baked enamel beneath the brace, and now it has rusted through and shorted out the motor. Anyway, the serviceman said there is no way to repair the hole, and I'd be better off buy-*

*ing a new dishwasher although the rest of the appliance is in perfect condition. Is he right?—Jack Rettke, San Clemente, Calif.*

No. Manufacturers of dishwashers and automatic clothes washers frequently use two-part epoxy for repairing such holes. You can get an epoxy kit, probably in a matching color, from a dealer who sells supplies for your dishwasher or from a parts dealer for another washer manufacturer. Many hardware stores also carry epoxy, but be sure what you buy is strong enough to withstand heat and pressure of a dishwasher; most two-part kits are. Clean the spot with a wire brush or sandpaper down to bare metal, wipe area with turpentine or mineral spirits, then apply epoxy as directed.

### Wall-oven woe

*In the last year, we have had to have the heating elements in our RCA Whirlpool MK 30 (model HE-29H) wall oven replaced twice. They have burned out. The problem is confined to the bake section of the unit. No trouble so far with the broiler section. Can you tell me why new elements don't last?—Robert Jeffries, Woodbridge, Va.*

First, misuse. Some people have been known to use the oven to heat a room. An oven isn't built for such heavy, continuous operation; the thermostat will never cycle off, and unusual strain on elements will cause early failure. Second, your model number indicates an oven about 10 years old. During this time, the wires leading to the elements from the thermostat could have dried out and become brittle, causing a poor connection that is not shiny, but looks discolored. If this is your problem, you will have to cut out the bad wire and splice in a new section, or, if the wire is completely deteriorated, remove it entirely and replace with new wiring. *Caution:* disconnect power by tripping circuit breaker

*(Please turn to page 30)*

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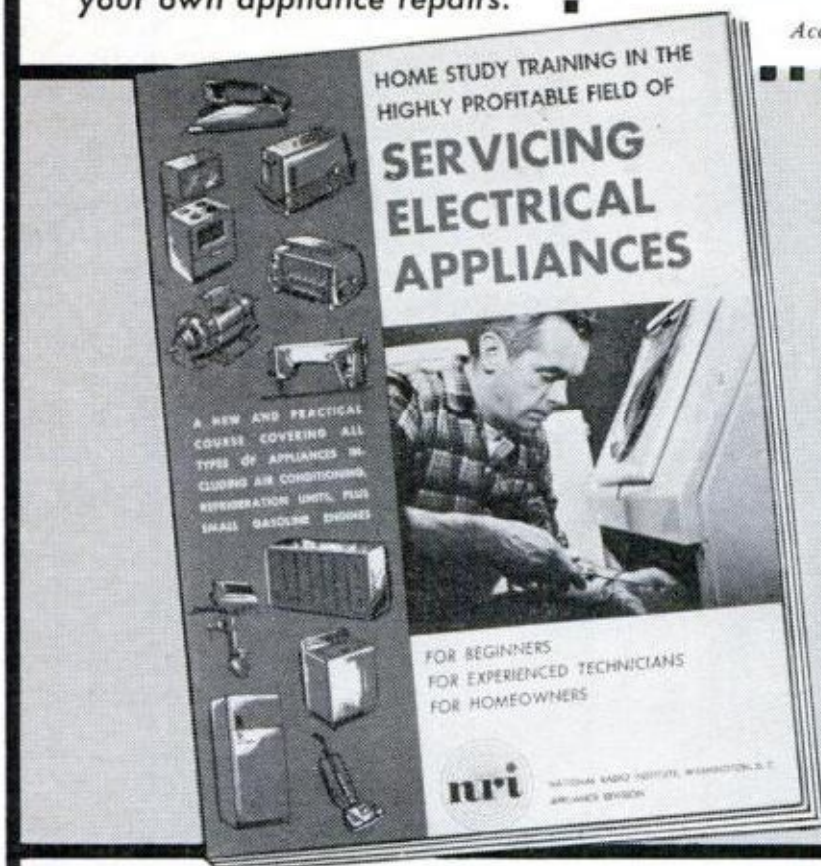
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## APPLIANCE CLINIC

(Continued from page 28)

or pulling fuse before inspecting wiring or attempting repairs.

### Too cool

*Our 17-cu. ft. non-self-defrosting Hotpoint thin-wall refrigerator is about 10 years old. We are presently experiencing a problem of condensation forming on the sides of the unit, and it appears that rust is starting to develop under the paint. Can the side panels be cut out and replaced with stainless steel? How can I stop condensation?*  
—M. G. Uhrich, Stamford, Conn.

The cause of this condition often is a buildup, over the years, of ice in and around the insulation. This leads to cooler sides that come into contact with the warmer air of the room—and the result is condensation. Fixing the problem may be tougher than explaining it. If you can, disconnect the refrigerator and let it stand idle several days, giving the ice a chance to melt. The alternative, other than to get rid of the unit, is to have the liner pulled out and new insulation installed. This will cost from \$150 to \$200. In no event should you start cutting outside panels. There is a chance of hitting the tubing, and once you do that you can junk the refrigerator.

### Right way and wrong way

*Paul: Caution your readers to make sure that the plumber who hooks up a water heater does so the right way. We had a guy connect ours backward, causing water to run cold after a few minutes. Test the installation while the man is still there by turning on the hot water and feeling the two pipes at the top of the tank. The input line should get cool, and the discharge line should get hot. The top of the tank is generally marked to spell out the way pipes should be connected.*—John D. Young, San Diego, Calif.

John: Thanks for the tip.

★★★

*If you have a question about any appliance, send it to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be answered in this column.*



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## ALL OUTDOORS

For sportsmen stuck indoors during inclement weather, there are a number of instruction volumes, story collections and guides that deserve special attention. Nearly every outdoor sport has associated indoor activities—from fly-tying to hand-loading, ski-waxing to travel-map collecting—that can be learned or read about during winter hours by the fire.

**Books** recently published include several of particular interest. For the boatman who builds his own or, like most of us, does his own maintenance, International Marine Publishing, Camden, Me., has brought out *The Mariner's Catalog*, a \$4.95 assortment of sources for tools, fittings, gear, supplies and plans in the style of the *Whole Earth Catalog*. Though many items aren't covered in this first edition, the collection is a good source book for any amateur shipwright. International has also issued *Fiberglass Kit Boats* by Jack Wiley, a comprehensive coverage of the many now available. For all-around do-it-yourself fitting out and upkeep, *Modern Marine Maintenance* by John Duffet, from *Motor Boating & Sailing*, is the answer. Biggest bargain for a beginning boatman is *The Skipper's Course* prepared by the Coast Guard and \$1.50 by mail from Consumer Product Information Center, Pueblo, Colo. 81009.

**Shooters** should appreciate the new Winchester *Hunter's Handbook* for 1973-74 and Erwin Bauer's *Hunter's Digest*, published for \$6.95 by Digest Books. Recreational vehicle shoppers can do some worthwhile prepurchase homework with tow and trailering guides from the major car manufacturers. One of the most complete is the *Recreational Vehicle Buyer's Guide*, available from Chevrolet dealers. Its 84 pages cover well the types of rigs around, advantages, equipping and handling.

**Fishermen** have a bonus book of seashore and offshore stories from George Reiger, former PM outdoors editor. Critics are calling his 750-page *Profiles in Salt Water Angling*, newly published by Prentice-Hall, a superb and robust collection of salty biographies as the best of fishermen

Photo: Charles Strang



**Latest, fastest high-hp** is six-cylinder Evinrude 122-cu-in. shown leading at Paris 6-Hour. It flipped and a 122 Johnson won. Mercury also unveiled a T-3 two-liter.



**Pow-R-Pak** is new front-wheel-drive motor-home chassis from AM General Div., American Motors. Holiday Rambler will be first to feature RVs with special unit.

tell how it's done. Zane Grey, Hemingway, Kip Farrington, Philip Wylie, Mike Lerner, Tommy Gifford and Lefty Kreh are among the experts in this volume that is being rated as the definitive study of this booming sport and the adventurers, sportsmen and scientists who have made it possible. Extensive illustrations record champion fish and fishermen.

**Travelers** who appreciate the outdoors may rank *Florida*, a \$25 beauty from Rand McNally, as the most attractive book of the year. All of Rand McNally's park, map and camping books can be recommended. And

*(Please turn to page 34)*





# wasting your money!

On Simple Car Repairs and Maintenance...  
On Repair-Shop Gyps... On Used "Lemons"... On Paying More  
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nine basic systems of your car, how they work and what to do when they don't.  Which kind of tire—radial, bias ply or belted bias—is best for you?  Why you should walk, not drive, to the new-car dealer at trade-in time.  Why babying a new car can turn it into an oil burner.  How a cold glass of water can remedy a bad case of vapor lock.  What you can tell about a used car without even touching it.  How to be sure the mechanic really changed the parts that were to be replaced.  Your car is skidding: what do you do?  How to jump a dead battery—safely and in the proper sequence.  No-fault insurance: what it is and isn't.  How to get most stains out of all kinds of upholstery.

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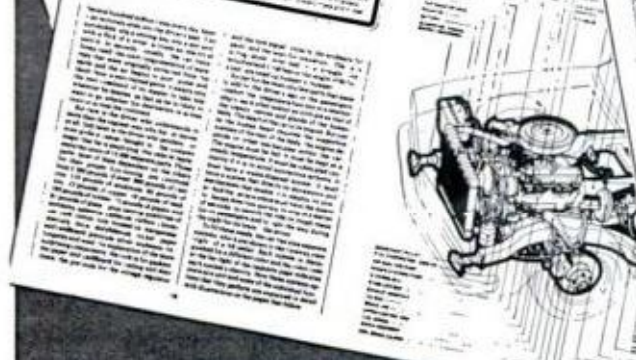
TIRES: THE OVERLOOKED UNDERPINNINGS



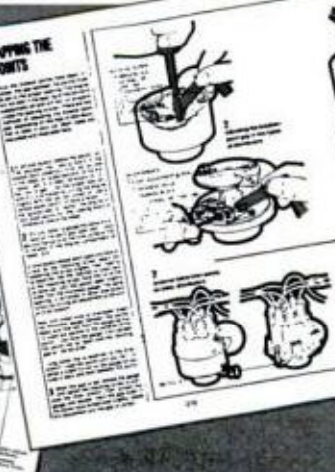
AIR FUEL SYSTEM  
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THE ESSENTIAL  
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GRIPPING THE  
POINTS



## ALL OUTDOORS

(Continued from page 32)

for hikers, there is the excellent *Backpacking—One Step at a Time*.

**Back-yard boatyard.** You can build your own boat as a hobby without complying with Coast Guard standards for safe loading, powering and flotation. Noncompliance is a bad idea, however. Your finished boat should be as safe as possible; it may someday save your life. And, if you ever might want to sell it, it must then meet Coast Guard recreational boat requirements.

Whether you build for personal use or sale, you need from your state boating administrator or the Coast Guard an assigned hull identification number, often called a HIN. While checking with them for assignment of this number that may help discourage boat thefts, it is wise to get copies of the recreational boat standards, too. The Coast Guard has found that some small back-yard operators who turn out only a few craft think the standards do not apply to them. But anyone who builds a boat for sale, or thinks he might sell it someday, must comply. Safer boats are a likely result.

**RVs—bigger, smaller.** Recreational vehicle previews for '74 show a trend in trail-

ers toward larger fifth-wheel models with more room and refinements. Meanwhile, motor homes are more popular in mini sizes of chopped vans, chassis mounts and camper conversions that take less money to buy, less gas to run. Next change we'd like to see is a softer ride for medium-length motor homes. Some expensive models have smoothed-out suspension but others ride like the stiff-legged truck bodies they're built on.

**Packs to sacks.** A variety of hikers are finding a 25-pound backpack isn't necessary for overnight on the trail. While out testing new gear, we've noted a number of campers who have switched from big back-busters to small ruck and knapsacks—usually without a frame—that can carry the essentials. The small European-type sack should gain popularity as the Alpine hut system reaches this country and climbers need less food along and can leave sleeping bags at home.

**Full-time 4-W-D.** Shifting into front drive as you leave the pavement may soon be an out-of-date option. More four-wheel-drive models announced for 1974 are engineered for permanent four-wheel operation on and off the turnpike. Slicker cabs and bodies are being offered. No need to rough it any more in the driver's seat just because the roadbed gets rocky. ★★ ★

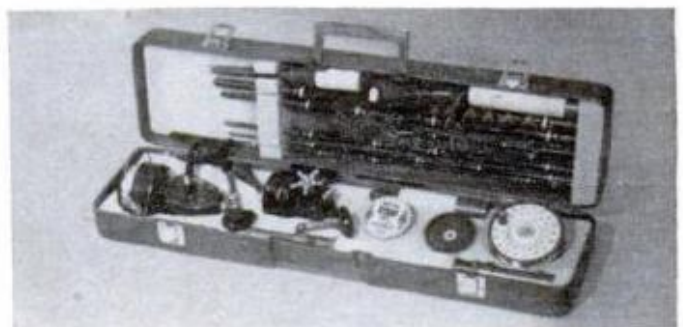
(More photos on page 36)



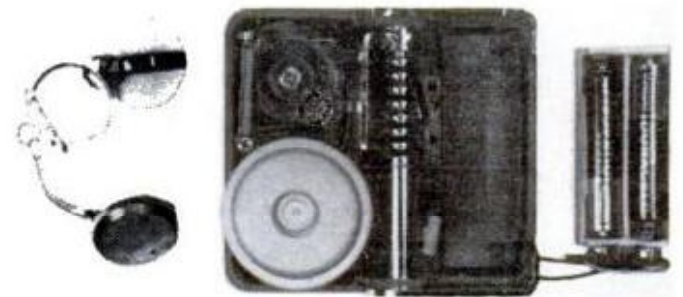
**Power trim for jet drives** is now option from Jacuzzi Jet Marine. Toggle switch at helm allows driver hydraulic control through 10° vertical arc of deflector.



**Weightlifter all-electric anchor hoist** is newest bass boat (or any craft) accessory. From Motor-Guide Div., Hershede Hall Clocks, \$100 12-v. unit lifts 190 pounds.



**Traveling fishermen** get "eight rods-in-one" with deluxe Berkley PC8C Travel Pack providing four spinning outfits, two for fly-fishing plus two more for spin/bait.



**Pocket-size alarm** that sounds off after the slightest movement, Honkie Ski Alarm locks on with magnetic key. Sold for \$15 by JFK Marketing, Walnut Creek, Calif.



**IF THE SECOND CAR IN YOUR GARAGE  
IS A PICKUP,  
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Since you use your pickup as a true suburban vehicle (big loads, small loads, no loads) it does a job for you somewhere between a truck's job and a sedan's.

So you need tires that can work for you somewhere between a truck's and a sedan's. You need Firestone's Wide Oval Tire System. Here's how it works:

**On the front**, you put Firestone's Transport 500 Wide Oval<sup>®</sup> truck tires. They're the steering part of The System, with a wide, wide tread designed to build stability under your pickup and help "float" it over soft stuff.

**On the rear** go Firestone's Traction All Season<sup>™</sup> Wide Oval truck tires, the drive part of The System. Their treads are computer designed to behave nicely at highway speeds, but to really dig in and move your pickup through grass, mud, dirt and snow.

See your Firestone Dealer or Store. Ask for The System. Compared to regular truck tires, it'll improve both the performance and the looks of your pickup.



**The Wide Oval System**

**Firestone**

## ALL OUTDOORS

(Continued from page 34)



For foredeck ventilation or cabin-top light, \$195 hatch from Bomar Co., Houston, Del., has waterproof fitting, transparent Lexan top guaranteed unbreakable.



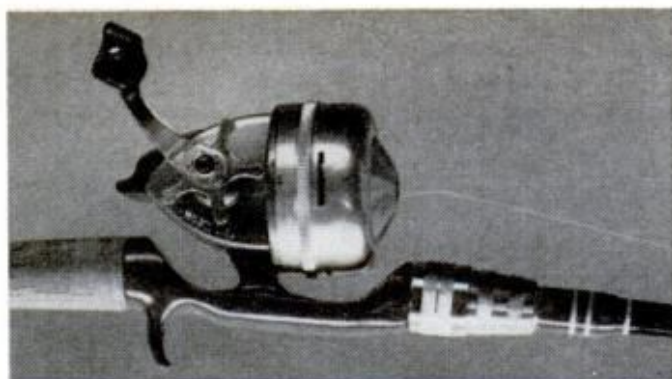
Spare & Dolly, made by Dutton-Lainson Co., Hastings, Neb., mounts on tongue of boat or travel trailer, holds tire in position for rolling trailer on spare. \$10.



Swimobile, 5-hp twin water-jet unit, is claimed to tow swimmers at 8 mph for three hours on less than 1 gallon of gas. Minijet Sportscrafts sells it for \$330.



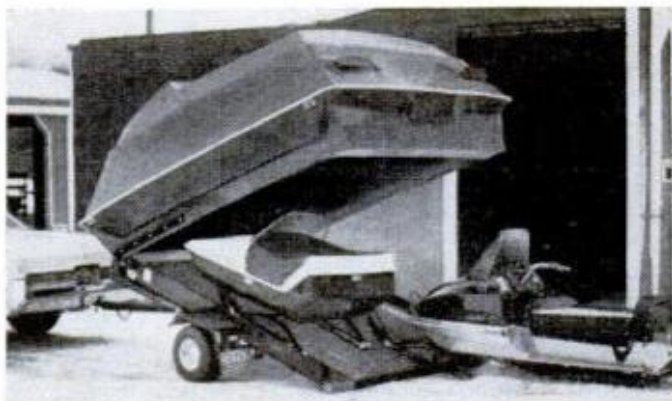
The works in one kit is offered by Eagle Claw ECTB tackle box assortment that includes Trailmaster five-way rod with lifetime guarantee, reels for spinning, spin and fly-casting plus gear. About \$100.



Two closed-face spin-casting reels are new in extensive Browning line. Heavy-duty Model 5130 is \$18; light 1130, \$16. Both have star drag, carbide pickup.



Gun case to last lifetime is claim for Executive model by Challenger Mfg. Corp., Mount Vernon, N.Y. Big enough for two long-barrel scoped target rifles, \$118.



Two-under-one cover for snowmobiles is called Versa-Cap by Lakeland Manufacturing, Manchester, Mich. The fiberglass streamlined cover fits most double trailers.



GMC crew-cab pickup can haul travel trailer, take fifth-wheel hitch and rig, mount slide-on camper or carry work loads. Dual rear wheels add cargo capacity.

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# Simulators teach old salts new tricks

A school for merchant marine officers teaches them how to use radar to avoid collisions, how to navigate electronically and operate automated ships.

by Erik H. Arctander

“Our ship is in the middle of Ambrose Channel, headed for the Narrows,” Jim Hopkins said. “There are the ship’s bridge controls between the two radars—why don’t you take her the rest of the way into New York harbor? Remember, we’re doing 30 knots to speed things up.”

Actually, we were in a building in Linthicum Heights, Md., and the radars were part of an electronic simulator. I’ve run in and out of New York dozens of times as a mate on tankers and cargo vessels, but the rapidly changing picture on the radar scope looked so realistic that I felt tension building up in my chest.

Everything went beautifully at first. Jim had electronically moved the bright spot representing our ship from the center of the 16-inch scope to the lower right. As I watched, the bright spot moved diagonally toward the upper left, between a double line of white dots representing buoys.

Once clear of Ambrose Channel, I headed almost due north for the Verrazano-Narrows Bridge—a short straight line near the top of the scope. In four minutes I would cover the two remaining miles to the Verrazano, pass under it, and be home free.

“See your targets coming down out of the Narrows?” Jim’s voice broke in on the loudspeaker. He’d left my student’s compartment and taken over the instructor’s control station outside. His voice was a simulated broadcast over VHF-FM channel



**Simulated arrival** in New York harbor appears on radar scope (top photo). Student’s ship is brightest spot seen at lower right on screen. Line leading northwest from ship is course between double line of buoys.

**Instructor’s station** has panels showing beginning position of student’s ship, course, sea conditions and the like. Panel at right lets instructor set course and speed of each ship that student will encounter.

*(Please turn to page 40)*

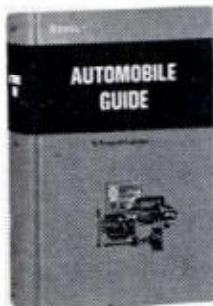


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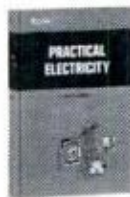
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## SIMULATORS TEACH OLD SALTS NEW TRICKS *(Continued from page 38)*

6, used for internship safety communications.

Sure enough, four elongated blips in a column were dead ahead and closing fast. They turned out to be a flotilla of destroyers, also doing 30 knots, and before we got clear of one another the adrenalin flowed freely. I blew whistle signals you could hear, switched the rudder control to hard right, and missed a collision by only 1500 yards—nine ship lengths. I was shaken up.

This exercise is part of a four-week course called Collision Avoidance Radar Simulator given at an unusual "grad" school—the Maritime Institute of Technology and Graduate Studies. Since Feb. 1972, the Institute has trained some 1000 ship's officers.

The Institute is housed in a modern building on a 50-acre campus in suburban Baltimore. Financed by contributions from lead-

in license advancement. The last is a six-week study program designed to help officers upgrade their licenses—from third mate to second, from second to chief mate, from chief mate to master.

The Automated Bridge Console Trainer, a two-unit simulator, provides the basis for an intensive four-week course in "bridgeman-ship." Jim Hopkins, senior instructor, led me to the simulator after we'd finished the run into New York harbor.

"This small console," he explained, "is all that's on the bridge. It has various engine controls and indicators. The big one—a General Electric Central Operating System—is in the engine room. It's exactly what you'll find running high-pressure steam-turbine plants aboard several ships right now.

"We're not trying to make engineers out

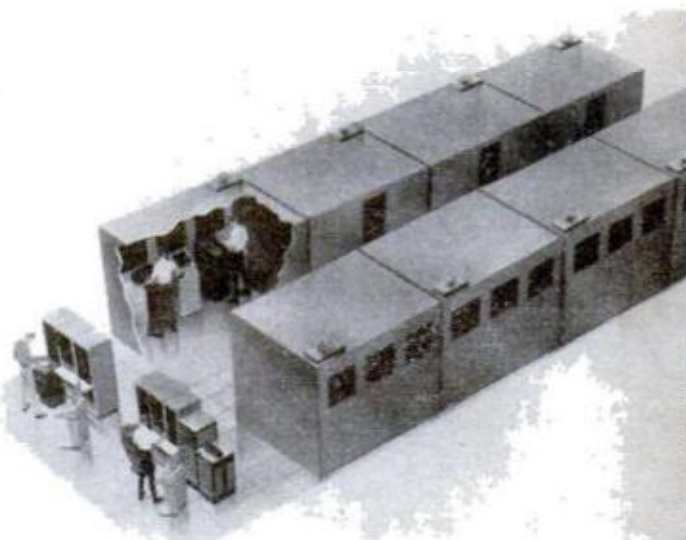


**Bridge control console**, set between the two radars in each student compartment, has buttons or knobs to control engine speed and direction, rudder angle, the ship's whistle, VHF-FM radiophone. Readouts give the speed and heading of student's ship.

ing American steamship companies, the \$10-million facility is used to upgrade the skills of the 12,500 officers who belong to the International Organization of Masters, Mates and Pilots.

"The new kinds of high-speed dry cargo ships and tankers, with their sophisticated loading gear and automated bridge controls, require considerably more technical skill than has previously existed," says Capt. Thomas F. O'Callaghan, union president.

In addition to collision avoidance, the Institute offers courses in cargo-handling methods, operation of bridge consoles and



**Sixteen students** can be accommodated in the eight training compartments used for the collision-avoidance course. There are two instructor stations. Each trainee must use radar to navigate his own simulated ship so as to avoid collision in harbors and at sea.

of our captains and mates," Jim said. "We just want them to understand how the system works, how various malfunctions will affect their maneuvering decisions, and what they can do to restore the plant to full operation. Almost everything in the engine room is duplicated, so when something breaks down it's often a matter of switching over from one piece of equipment to another.

"Once they learn how the system works and how to operate the bridge controls," Jim continued, "we create problems for

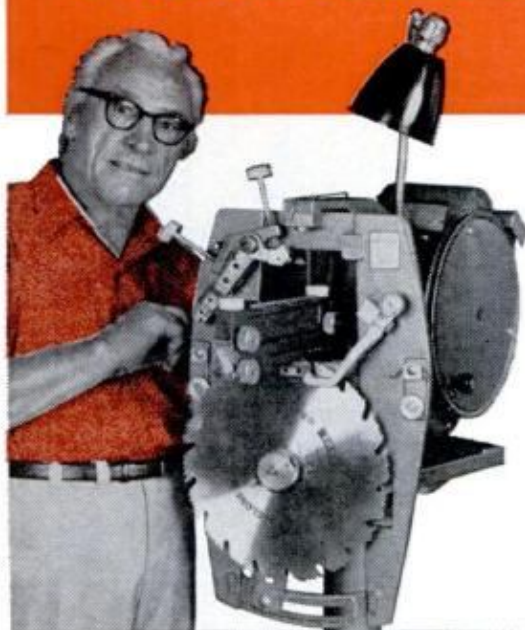
*(Please turn to page 42)*



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People, just like yourself, all over the United States are making extra cash—\$20 to \$30 a week—right now in their spare time. "My spare-time saw filing business has made me \$952 these first ten months," says R. T. Chapman. Many start part-time, find it so profitable that they build year-round service business. You can, too, simply by following easy Foley plan.



## Town of 150 Supports Profitable Business

Here's the story from Dick and Jo Ann Koester after being in business less than a year. "We have acquired another Foley Saw Filer and for the past two months we have been in full-time operation. As we live in a small town of 150 population in farm area we use our truck to pick up saws in five nearby towns. With a family to support and plans for building to our house we had to pick up a business fast and already sharpen an average of 15-20 saws a day. Business for the future looks even better as good machine filing is our best advertising."

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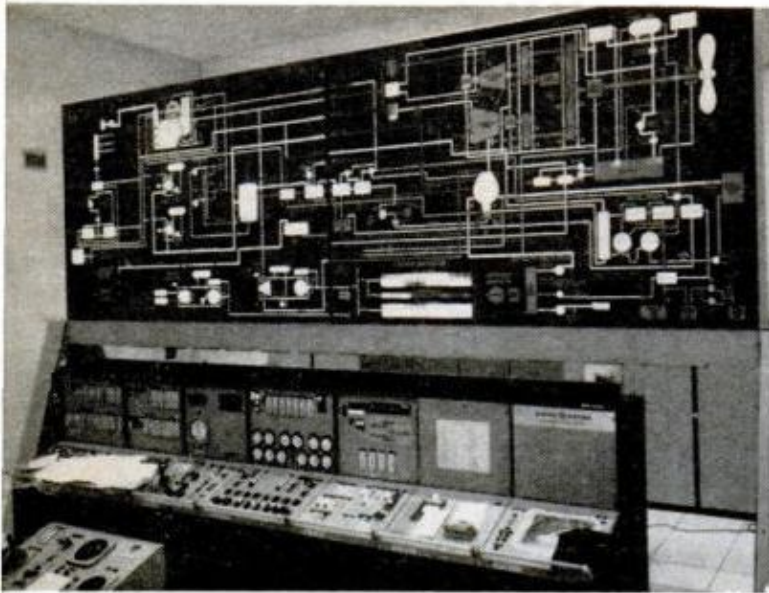
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**Automated Bridge Console Trainer** has small bridge unit (lower left corner of photo) and large engine room array. Commands from the bridge control ship's machinery through engine room console. Display board shows electrical, propulsion and other systems.



**Training in loading and cargo handling** is provided by long control panel and display board showing a hypothetical tanker configuration. Computer-controlled, board shows if pumps are working, if valves are open or closed, type and level of cargo in 23 tanks.

## SIMULATORS

*(Continued from page 40)*

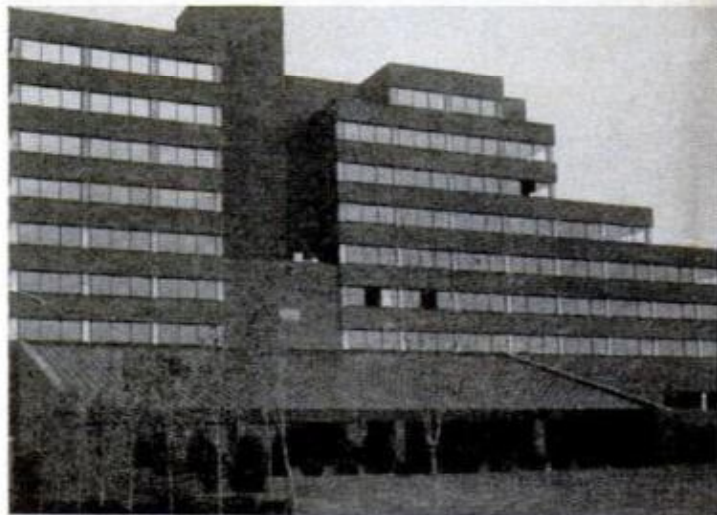
them with this malfunction box. I might punch the button marked *No. 1 Feed Pump Governor Valve*. The computer simulates failure of that valve and the student sees the system begin to deteriorate on the lighted display board over the engine room console. Indicators change on the bridge and engine room consoles as well.

"When the student has caught and corrected that malfunction, I might turn the *Sea Water Temperature* knob way up to 90°. This changes the vacuum and sets off another chain of difficulties for the student to diagnose and correct."

A few years away is the Total Environment Simulator, a kind of master bridge trainer that will include most of the simulators already in use.

"An officer will be so totally integrated into the trainer that he'll think he's at sea," says William P. Jameson, program engineer at the Link Div. of the Singer Co., builder of the Institute's simulators. "We'll combine the radar, automated engine room, and electronic navigation simulators with some others to create a total illusion. When the officer comes on the 'bridge,' his depth sounder, ship-to-shore radio, course recorder, engine and steering controls will all work.

"What he spots on the radar scope he'll see by looking out the wheelhouse windows. He'll be able to navigate at sea, maneuver



**Residence center** contains accommodations for 100 officer-trainees, is equipped with a dining room, gym, game room and sauna. Another building houses the simulator labs, classrooms, offices, library, auditorium with seating for 250, and maritime museum.

the ship into port, even dock and undock."

"What we have even now is unique," declares Jim Hopkins. "We teach ship's officers in days what they might take years to experience randomly aboard ship. And they learn safely, without risking a grounding or collision."

To many deck officers like me—who first shipped out on 8-knot Liberty ships equipped with little more than a magnetic compass, chronometer, sextant and binoculars—all these electronic gadgets seem incredible. Now, at last, there's a first-rate graduate school to teach us old sea dogs new tricks. ★★★

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Solid-State Color TV 315 Sq. In. picture

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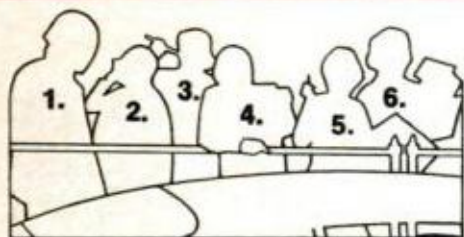
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# Can you spot the Camel Filters smoker?

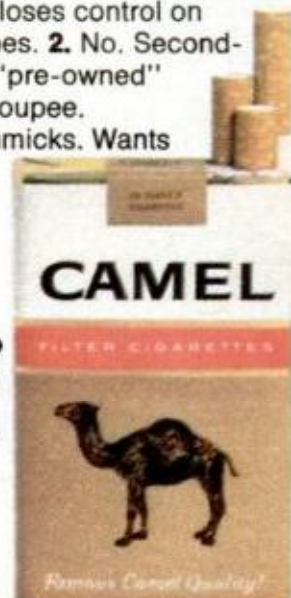


©1973 R. J. Reynolds Tobacco Company, Winston-Salem, N. C.



Here at the Speedway everybody has a gimmick... almost everybody. Try picking the one who doesn't go along. **1.** Nope. He's "Third Turn" Abanian. Has been in 263 races. Gimmick: always loses control on third turn where Bubbles Fickfern stands (see #5 below). He doesn't smoke. His car does. **2.** No. Second-Hand Sam Slick, used car dealer. Gimmick: buys what's left of Abanian's cars. Smokes "pre-owned" cigars. **3.** Hardly. He's Reggie J. Van Phynque II. Gimmick: filthy rich. Wears cashmere toupee. Smokes double-vented cigarette. **4.** Right. He likes his racing without far-out fads or gimmicks. Wants his cigarette that way, too. Camel Filters. Honest, no-nonsense. Fine tobacco. Easy and good tasting. **5.** Bubbles Fickfern, racing groupie. Gimmick: 18 stopwatches... with Mickey Mouse hands. Smokes Fellinis. **6.** Fellini. Gimmick: never sees a race; too busy following other sports events on portable TV and radio.

**Camel Filters.**  
**They're not for everybody**  
**(but they could be for you).**



Warning: The Surgeon General Has Determined  
That Cigarette Smoking Is Dangerous to Your Health.

19 mg. "tar", 1.3 mg. nicotine av. per cigarette, FTC Report SEPT.73

## THE BICYCLE SHOP

BY EUGENE A. SLOANE

If a bicycle frame is out of line, pedaling will be harder and riding may be dangerous. An out-of-line frame makes steering on busy streets difficult and can cause high-speed wheel shimmy on downhill runs.

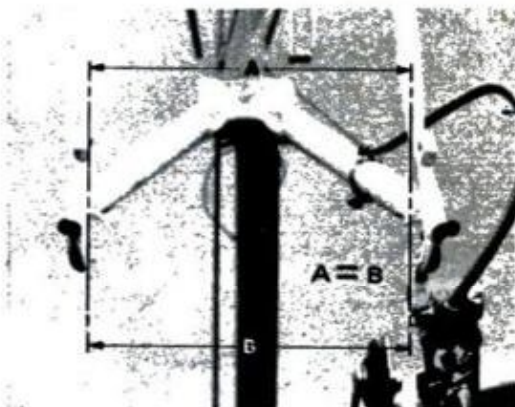
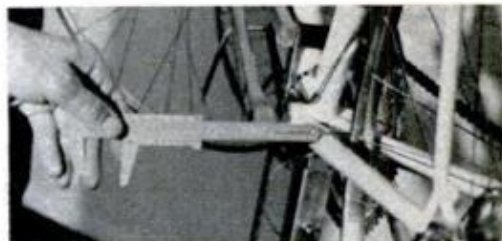
A frame gets out of line, generally, in one of two ways. A cheaper bike with a welded frame may be pulled from an automated welding machine and stacked before the joints are cooled and hardened and the still-flexible frame is thus knocked out of alignment. This is fairly rare. Most likely to cause misalignment is an accident that bends one or more main frame tube members. Typically, the rider runs head-on into something like a parked car (I know, I've done it). If he's lucky, all that results is a bent top tube and, possibly, fork and down tube. If you're buying a used bike (or even a new one) it pays to check for frame alignment.

For several of the following steps, it's best if the bike is stripped of wheels and cranks.



**1. If you're buying a new bike, especially an expensive one such as the one shown, look at the head tube where it joins the top and down tubes for telltale evidence of frame bending, even though the frame may have been straightened again. Look for crinkled paint at places where tubes typically buckle under impact (arrows).**

**2. Check seat and chain stay alignment in two ways. First, with a ruler, make sure the rim is the same distance from chain and seat stays on both sides (top photo, next column). The rim should be correctly aligned before you make this check. Second, make sure the dropouts in the rear stays are parallel with each other. Place two pieces of aluminum angle (about 30 inches long) on inside faces of the dropouts (dotted lines in the second photo from top, right) and measure distance between straightedges at top and bottom. Measurements should be identical. If not, gently twist dropouts back into alignment with adjustable wrench.**



**3. Check the down tube against stay alignment. Put a piece of string from the rear dropouts to the head tube, as shown. Measure the distance from any point on the string to the down tube. Repeat on the other side of the down tube. Both measurements should be identical. If not, the stays or the down tube have been bent.**

**4. Check head tube lateral alignment. Put a straightedge against the head tube and rim. Repeat measurement on the other side. Straightedge should lie flat against the rim on both sides. Test also shows if the fork blades are bent from one side to other. (The bent fork puts the wheel axle—and, thus, the rim flats—at an angle.)**

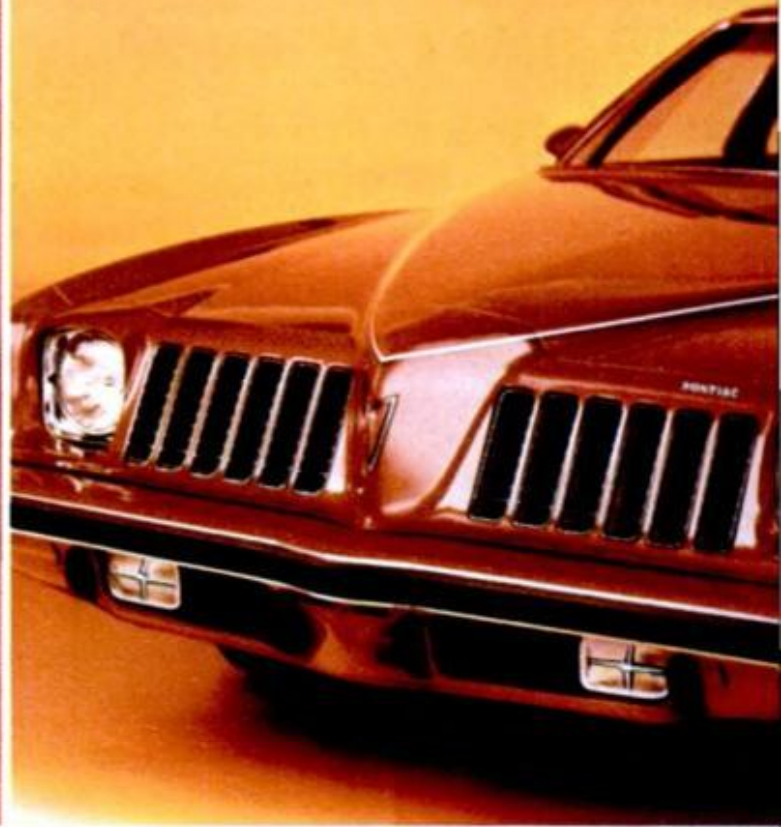


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1974 BUICK LESABRE



1974 PONTIAC GRAND AM

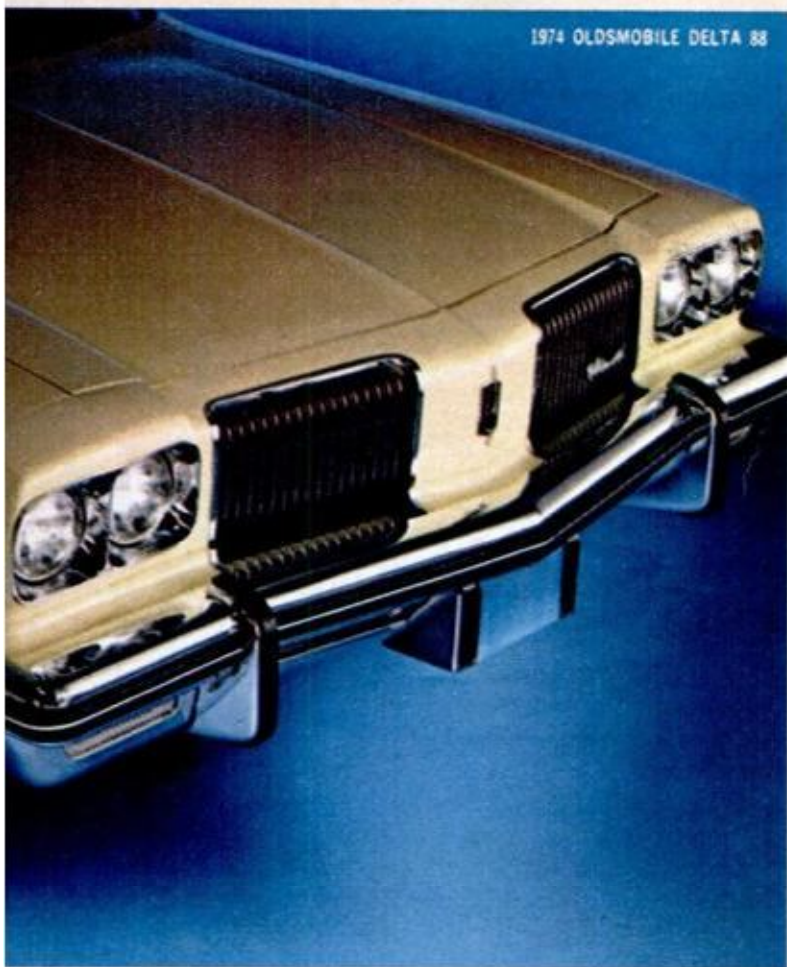


1974 CHEVROLET CHEVELLE LAGUNA TYPE S-1



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The Chevelle Laguna Type S-3 from Chevrolet has a resilient front-end nose cone that "gives" on minor impact.

Pontiac's Grand Am has a squeezable nose that helps shrug off dents.

Oldsmobile has a hinged grille that swings back when the bumper gets bumped.

Buick, like most other GM cars, is available with protective bumper strips and bumper guards, front and rear.

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APPROVED FOR VETERANS TRAINING

## THE BICYCLE SHOP

(Continued from page 47)

5. The seat tube may be bent sideways. Check with a straightedge against bottom bracket hanger parallel to seat tube, but not touching tube. Measure distance from straightedge to seat tube in several places. Repeat on other side of the bike (i.e., on both left and right sides of bottom bracket hanger). All of your measurements should be identical.

6. Next comes a test for general alignment. First, make sure both front and rear wheels are perfectly straight in the dropouts. The rear wheel should be centered between seat and chainstays on both sides. The front wheel should be centered between both fork blades. Both wheels should be true (see *The Bicycle Shop*, page 40, April '73 PM for wheel-truing instructions). Wait for a rainy day, or wet down 20 feet of pavement. Ride the bike perfectly straight, holding the handlebars tight. Check your tire marks. The wheels should track true; the rear wheel should follow right on the mark of the front wheel. Now try riding "hands off." If the frame or any of its members happen to be bent, the bike will go to one side or the other and you will have difficulty keeping upright with your hands off the bars.

7. Check to see if any main frame member (top, down or seat tube) has been bent. Put a straightedge against the tubes. The straightedge should lie flat on the tubes and no "air" seen between straightedge, tube.

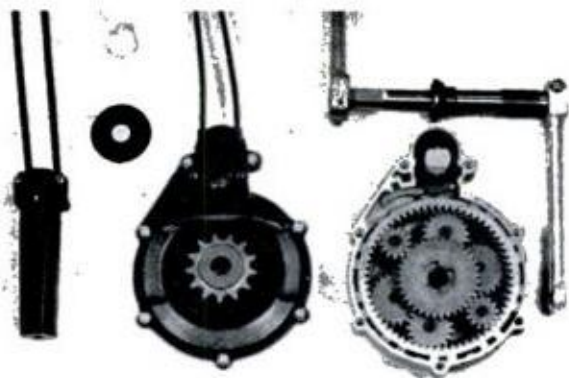


8. Sometimes the fork can be bent backward in a front impact so that the blades, while aligned from side to side, are out of line vertically. Remove the fork, lay it flat on workbench. Put a straightedge alongside the fork head (drawing) and measure from straightedge to the point where it hits the side of the fork blade. Repeat measurement on opposite side of fork head and fork blade. Measurements should be identical.

*About straightening frames:* Aside from straightening rear dropouts (Step 2), I do not recommend your trying to straighten frame members. It takes special tools and skill. Leave it to a bicycle mechanic. But it is important you know that your bicycle frame is accurately aligned, and you can do the tests for alignment yourself.

Remember the general rule about frame alignment is that all tube members must be aligned with respect to each other. Given the simple tests in this article, I am sure you can devise others to suit your own desire for still further accuracy in checking frame alignment. ★★★





### New transmission for coaster-brake bike

You can convert a single-speed coaster-brake bicycle into a three-speed model by adding a new transmission developed by Dana Corp. Speed changes are made by turning twist-grip control on the handlebar. It fits all bicycles with standard  $2\frac{1}{4}$ -inch-diameter crank hanger and  $\frac{1}{2}$ -inch-pitch chain. Maker is Dana Corp., Dana Cycle Systems, 6955 Wales Rd., Northwood, Ohio 43619.



### New designs to come from 'robot' bike

Japanese bicycle makers have developed an electrically driven "robot" bike which they're using as a test vehicle. A number of measuring instruments mounted on the bicycle feed data to a collection center via cords. Purpose of the testing is to determine the best, safest and easiest-to-assemble design. Machine is operated by engineering dept. of the Japan Bicycle Industry Assn.



### Front suspension kit for 10-speeds

Three inches of front-wheel "bump travel" are provided by a new front suspension kit that fits most 10-speed bicycles. The kit includes fork, swing arm, brake assembly, mounting hardware, shock cord. Get information and order forms for patent-pending device from Pantheon Vehicles, 5846 Denny Ave., North Hollywood, Calif. 91601.



### Sidecar bicycle

Using scrap material found in his garage, West Coast photographer Ralph Emerson took a week to fashion this sidecar chopper bike for his son, Jim. Sidecars are enjoying a resurgence on motorcycles, but few bicycles are fitted with them.

## DETROIT LISTENING POST

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### Leaner looking cars from Ford

Ford is going back to the squared-off, lean look in styling as its cars come up for new bodies. This is the shape Ford pioneered a decade ago—long hood, short deck, thin roof, sharp corners. Everybody in the business tried to imitate it. But as GM cars moved away from the Ford shape and took on the outline of a loaf of French bread, Ford followed suit and rounded off the corners. Now Ford figures the time is right to get back to the lean look, flatten the flab and return to angular lines.

### Chrysler readying half-year models

Chrysler may not have the variety of cars offered by GM and Ford, but the company believes it has a strategy that will enable it to match GM and Ford almost car-for car. Almost, because Chrysler is vulnerable in one area. It doesn't have a domestic small car. But Chrysler isn't worried about rival automakers topping it in other areas. Without making much noise about it, Chrysler has built more flexibility into its cars than any other manufacturer. That means the company can swing either way with certain basic models, making them more luxurious or less luxurious, dolling them up or stripping them down, upping the price or cutting the price, depending on what people want to buy.

As of now the trend is to spiffier cars. So within the next few months you will see a wave of new-model announcements from Chrysler. New versions of Plymouth, Dodge and New Yorker. New prices, too.

### New Vega, Pinto for 1976

GM and Ford are on the verge of locking up design and engineering specs on the successor cars to Vega and Pinto. When those cars were introduced, both companies promised to forego annual styling changes and stay with the basic package for five

years. That pledge will run out with the '75 models.

Both companies have weighed the idea of bringing the replacement cars out under new names, a notch below Vega and Pinto in size and price. But the feeling now is that the small-car market is becoming too splintered and segmented—the proliferation of models could become as bad as it was in the medium-price field a few years ago. So you'll see new versions of Vega and Pinto in 1976, but under the same names.

### Bendix fuel injector in future Ford?

Bendix, which has been nursing an electronic fuel-injection system for several years, says it has sold the unit to an automaker for use on a '75 car. Probably T-bird, although Bendix won't identify the make. The Bendix unit is generally considered the most advanced system in the industry and has even drawn praise from GM engineers who have been pushing a made-by-GM version to compete against it.

### Fake back seats on way out

If you've traveled any distance in the back seat of a Vega, Maverick, Pinto, Mustang, Gremlin, Hornet, even a Nova—any of the small cars out of Detroit—you know they don't have a real back seat. What passes for a back seat is a narrow thin shelf, great for carrying groceries but not very comfortable for humans with rumps, knees, legs and the other appendages that are standard on *Homo sapiens*. These are really two or three-person cars. Two-person if they have bucket seats in front. Three-person if they have a bench seat. Detroit's been building two-people and three-people cars for years, but the auto companies refuse to call them that. They insist on the fiction that they are four or six-passenger cars.

Detroit still isn't ready to admit building

*(Please turn to page 54)*

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Lons, 17 mg. "tar," 1.3 mg. nicotine, av. per cigarette, FTC Report Sept. '73

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**DETROIT LISTENING POST**

(Continued from page 52)

two-person automobiles. But the automakers are coming around to the point where they are going to admit making four-passenger cars: 2+2, meaning two people in front, two in back. There will be three 2+2 cars next year and they will be called that, no fudging. Chev's Vega will be a 2+2, Ford's Pinto and the new commuter car coming from American Motors. AMC might even go so far as to skip the make-believe about the back seat and call its mini exactly what it is, a two-person automobile.

**GM talking big numbers for its rotary**

GM is so confident its rotary engine will be a winner it is already working up projections on the number of Wankels it will build three and four years from now, even though the first off-the-line-car won't be out until next July. You will have to wait a couple more months, until September, to buy one. GM is looking at a first-year run of 150,000 to 175,000 rotary-powered cars with increments of 75,000 to 100,000 units per year after that, snowballing to 500,000 units annually by 1977-78.

The question still kicking around at GM is who gets the Wankel after Vega? Which car line? GM isn't saying. But it could be the car that gets second dibs on the engine doesn't exist now. A new car? Right. There's a camp in GM that feels the only way to realize the full potential of the engine is to design an all-new car built expressly to accommodate the rotary, instead of dropping the engine in an existing vehicle. So there's a dark horse in the running for the Wankel after Vega paves the way.

**Detroit demanding recyclable materials**

Automakers are looking at anything and everything in the way of new materials or new uses for old materials. For a lot of reasons. To cut costs. Cut weight. Improve durability and reliability to avoid having to recall cars to repair defects. But the best material for the job doesn't necessarily get the nod. After a material qualifies on all other counts, Detroit is asking a new question these days: Can it be recycled? If not, no sale. ★★



# I'd like to give this to my fellow men... while I am still able to help!

I was young once, as you may be—today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my

summer home, my Cadillacs, my winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Victor B. Mason

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

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

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

## I Have All The Money I Need

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

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to

gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

## A Fascinating and Peculiar Business

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

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

## Are You Mechanically Inclined?

While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and

ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

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

## Does Happiness Hang on Your Decision?

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

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## HOMEOWNERS' CLINIC

BY W. CLYDE LAMMEY

### Sticking window sash

*My windows are weatherstripped units and several stick to the point that they are almost impossible to raise and lower. What can I do to make them slide easily?—Mrs. A. R. Bell, Oklahoma City.*

Is the weatherstripping tight? If not, use nails where needed. Also, there are preparations in convenient spray cans for freeing stubborn windows. Your paint dealer should have them. Usually the best way to apply them is to raise the lower sash and spray both exposed sections of metal weatherstripping. Then lower the upper sash and spray both strips. Raise and lower both sashes several times to distribute the lubricant uniformly.

### Drawer trouble

*Two drawers in one of my chests—not old—stick when only part way open. I can't pull either one all the way out. I tried rubbing bar soap on the exposed sides, but it doesn't help. What do I do now?—Mrs. Don Kerney, Lincoln, Neb.*

Don't use soap—it just makes matters worse. The drawer sides have absorbed moisture and swelled, and soap will attract more moisture. Instead, put a 25 or 40-watt bulb inside the drawer, using an extension cord and placing the bulb in a chinaware dish—or use a trouble lamp with a basket guard. Keep close watch that nothing overheats. Heat from the bulb will dry the wood and in time permit you to open the drawer. Then remove the soap and spray lower edges of the sides with one of the silicone sprays available in aerosol cans.

### More drawers

*I have an old chest of drawers in which the drawer runners are badly worn, so much so that the drawers drop down an inch or two when opened. How can one possibly repair*

*such a defect without taking the chest apart?—Ronald Tate, Columbus, Ohio.*

Perhaps the simplest way is to fit a tapered filler strip of hardwood in the groove worn by the drawer sides. This is a cut-and-try procedure, but it does avoid removal and replacement. Cut the tapered filler strip—use hardwood—a little wider than the groove, plane to fit, glue in place. Then plane the top down until the drawer will slide in all the way without sticking. If the drawers close flush, the end grain of the strips may be exposed. In this case, cut the strip a trifle short, glue in a second filler block with grain running horizontally and stain it to match.

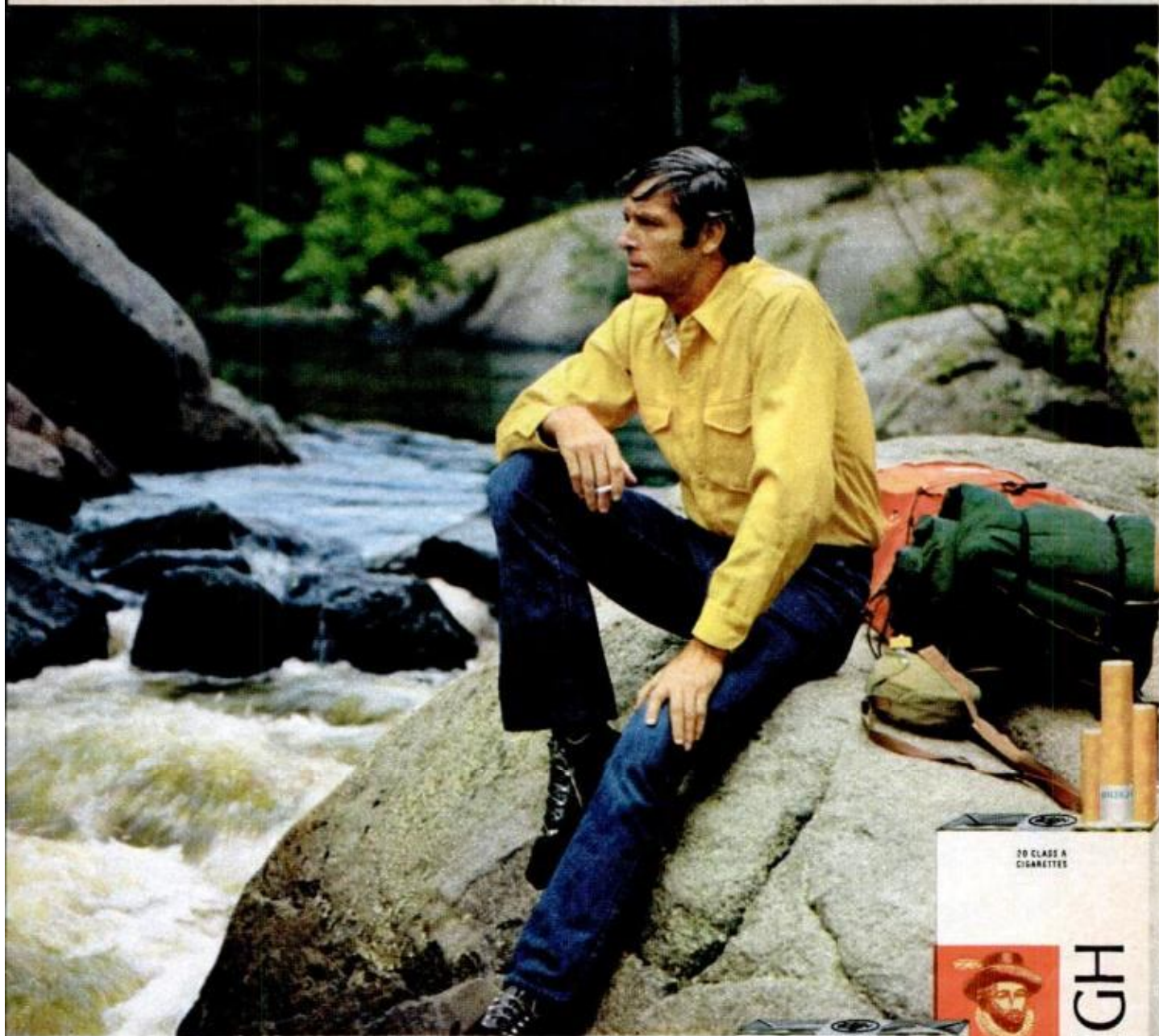
### Renewing workbench top

*I have an old cabinet workbench with hardwood top, which is nicked and battered from long use. I tried hand planing, but the wood was too hard and cross-grained. Sanding with a portable sander was not much better. What now?—H. Wilson, Indianapolis.*

Scrub with a strong detergent and stiff-bristle brush to remove dirt and grime. Take off the vise and planing stop, if any. Sharpen your jack plane to a razor edge and set the iron to take a paper-thin shaving. You should be able to plane the top smooth. If the wood offers resistance to the hand plane, buy a cabinet scraper and scrape the surface smooth. It will take some doing and frequent resharpening, but as a rule the scraper works when nothing else will. Then sand the top down, using a coarse-grit belt (No. 40) in a belt sander and working up to fine grit in steps. Apply boiled linseed oil or the newer Danish oil finish. ★★★

*Do you have a home maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. While letters cannot be answered individually, problems of wide interest will be discussed in this column.*





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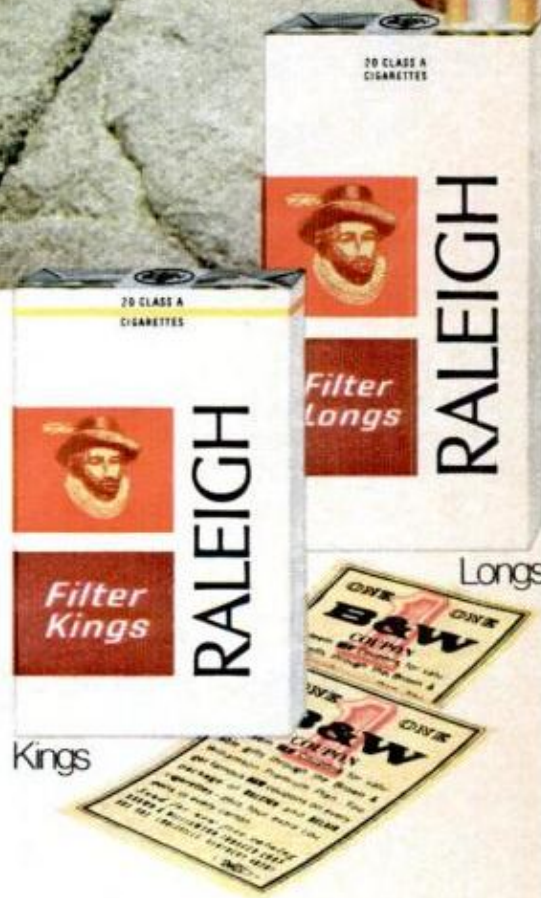


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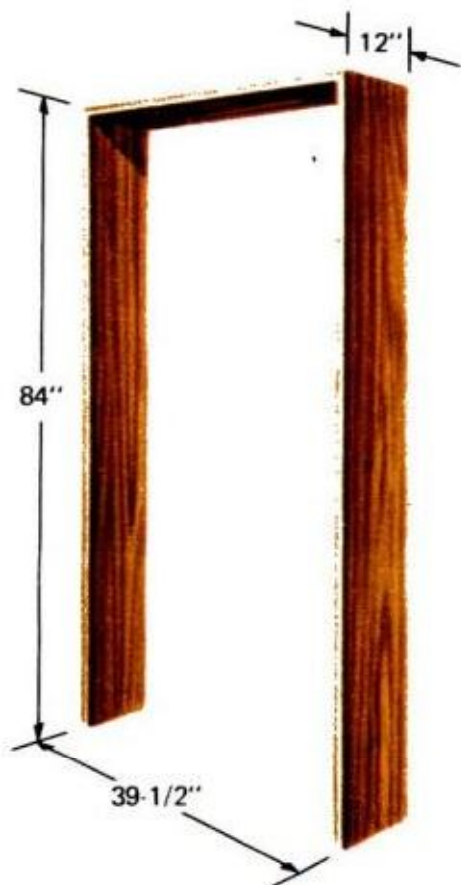
Filter Kings, 16 mg. "tar," 1.2 mg. nicotine; Longs, 18 mg. "tar," 1.3 mg. nicotine, av. per cigarette, FTC Report Sept. '73



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# Easy-built modular furniture to suit any need

Starting with one basic frame, you can create five different pieces. All offer the same advantage: They have efficient, built-in lighting to suit the task.



BASIC FRAMEWORK FOR ALL CONCEPTS

**The challenge:** Create a versatile module that can be used in almost any room for any purpose and lighted to suit the particular function the piece is designed for. Designer Bill Ingham at General Electric fielded the challenge and came up with a series of good-looking furniture pieces—like the handsome room divider shown below.

The basic frame with its standardized dimensions can be quickly adapted to serve any number of family needs. The five most common uses are shown on





## All start with the same module

these pages—sewing center, serving bar, desk unit, grooming nook and room divider. The initial framework, as shown in the drawing on the preceding page, is the same regardless of which unit you wish to build. The idea is to get the most use from a minimal amount of space—essentially a simple enclosure measuring a foot in depth,  $39\frac{1}{2}$  inches in width and 84 inches in height.

The material to use on this project is

$\frac{3}{4}$  in. A-D (which means good one side) plywood. And stick to the very basic construction techniques. For example, if you want to be fancy and miter-joint corners, you can. But the job will actually be stronger if you simply use butt joints, glue and screws. For even greater rigidity, the vertical members can be edge-rabbeted and dadoed to accept horizontal wood members.

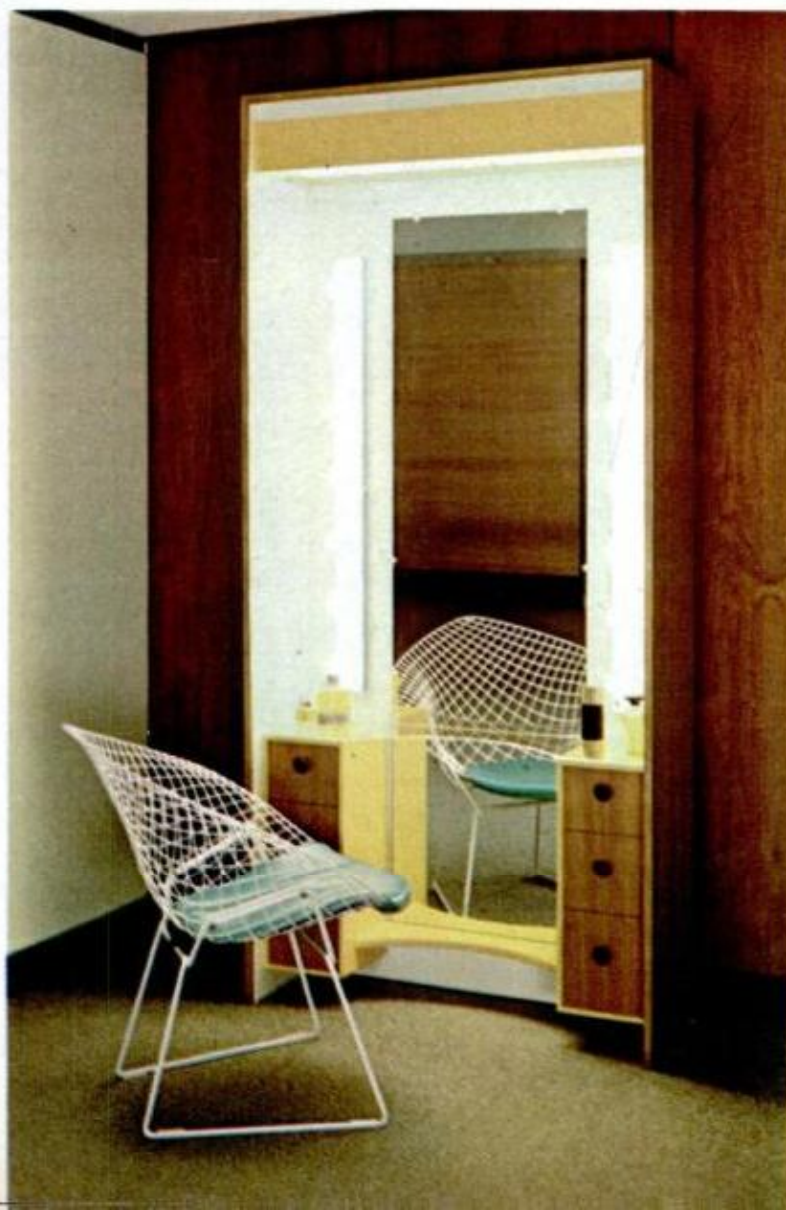
Finishing the various pieces is a mat-

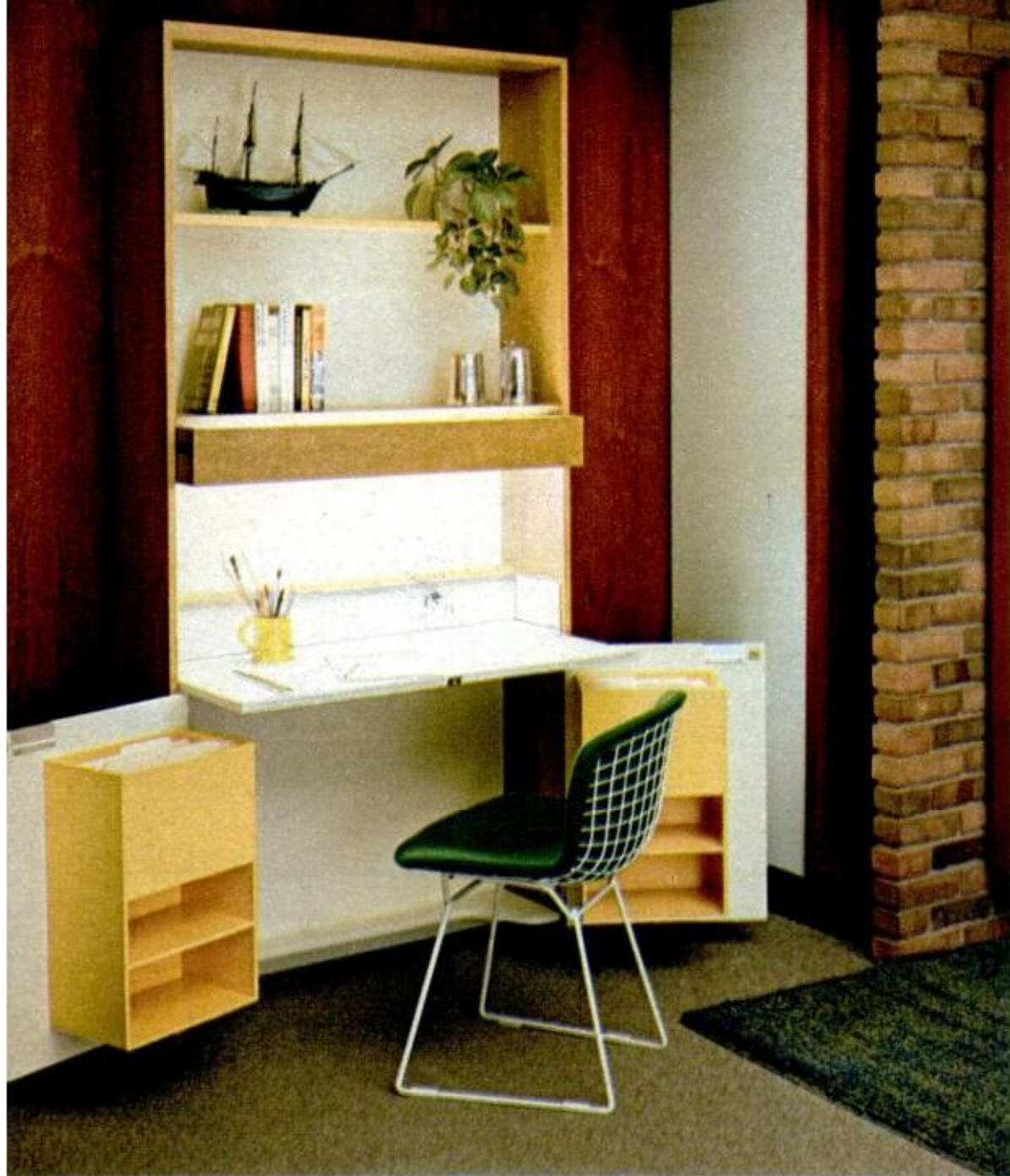


**Sewing center** (on opposite page), when closed, appears to be a wardrobe. Opened, a full-length mirror is revealed on the left door and a storage unit on the right door.

**When used** as a bar-counter, above, modular unit provides convenient storage lighted by deluxe fluorescent lamps.

**Personal grooming center** for the lady of the house is a scant 1 ft. deep by 39 in. wide. Height can be varied to suit room decor. The unit shown here is 7 ft. tall.





**Modular design** can also be used in an attractive desk-storage unit. By opening the lower cabinet doors to expose filing space and lowering the upper door, you get a 24-in. desktop. The lighting unit pulls out to deliver an effective light up to decorative shelves as well as desktop illumination.

ter of personal preference. They can be painted, stained if a cabinet-grade plywood is used, or covered with plastic laminate. Or the units can be finished using a combination of two or more finishes.

If you decide to paint the module, you can use standard fir plywood throughout, but remember to seal the wild grain with a suitable plywood primer/sealer (such as Firzite) or the grain will show through your finish coat of enamel.

Here are general construction hints for working with plywood. If you cut

with a handsaw, use a crosscut saw—not a rip saw—and work with the “good” side up (so the splintered edge will be on the D or “bad” side). To cut plywood with a portable saw, use at least three lengths of 2x4s across a pair of sawhorses and lay the plywood good side down. Use a plywood (fine-tooth) blade and make certain that two of the 2x4s are beneath the portion of wood the saw is riding on. The third 2x4 should be beneath the waste or cutoff piece. A Surform file or plane does a fast, neat job of trimming cut plywood edges.

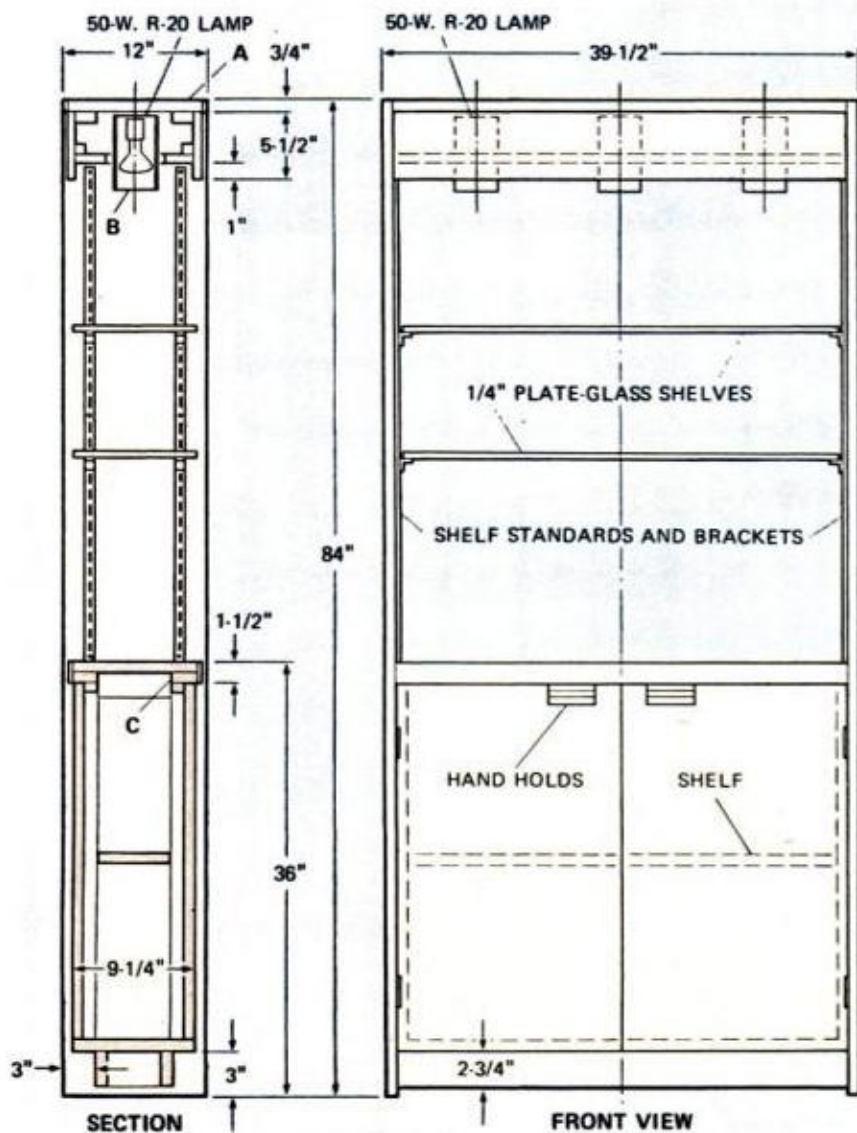
# A modern hutch

The room divider can be used as a breakfront by simply parking it along a wall. Because the shelves are of glass and the unit has three 50-watt reflector lamps, it can serve handsomely to highlight decorative objects or favored family collections. The storage space below is a bonus sure to be welcomed in most households. The beauty of the modular concept of construction is that the pieces all have the look of custom built-ins, yet, should you ever move, you can take the furniture with you. Wires from the lights exit through small holes in the top and are held fast to the back of the piece with insulated staples.

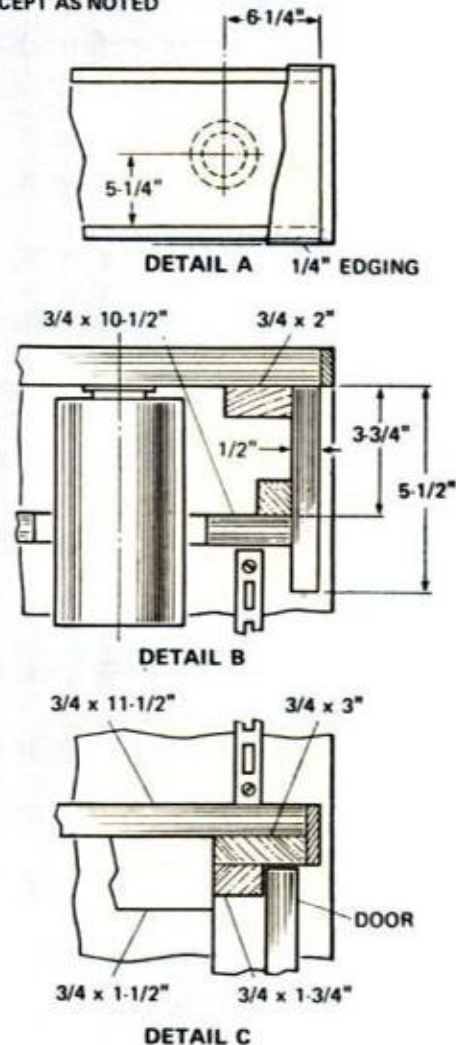
For a neat job, measure the length of the extension cord you will need and cut it to suit. Then attach the extension cord to the baseboard using insulated staples.



Modular unit makes handsome breakfront, is accented by three reflector lamps at top.



USE 3/4" PLYWOOD THROUGHOUT EXCEPT AS NOTED



# Compact sewing center

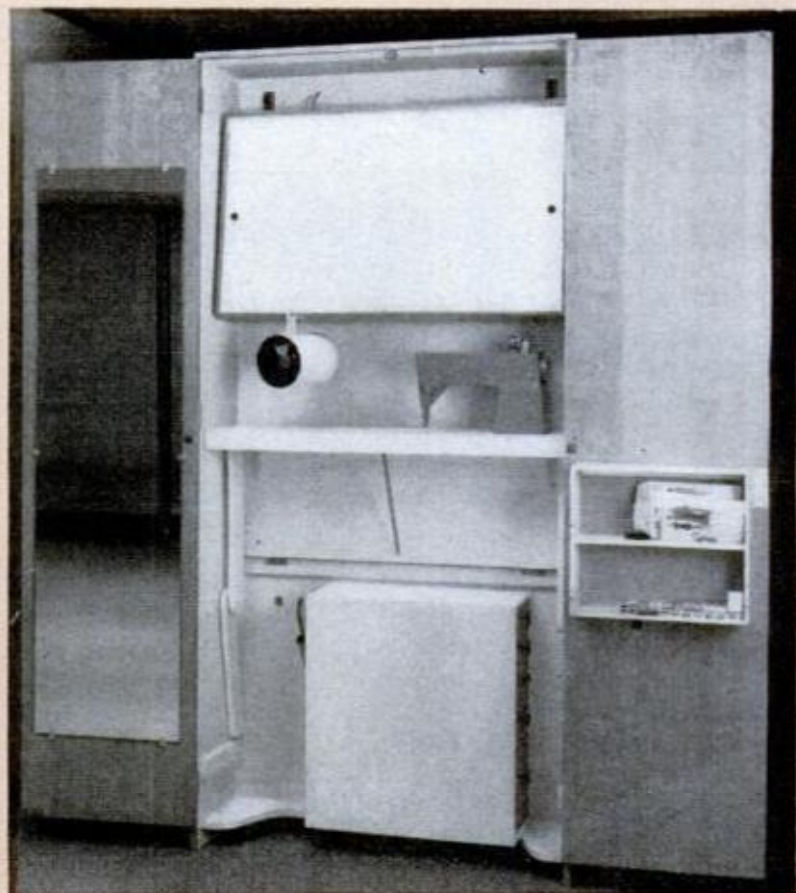
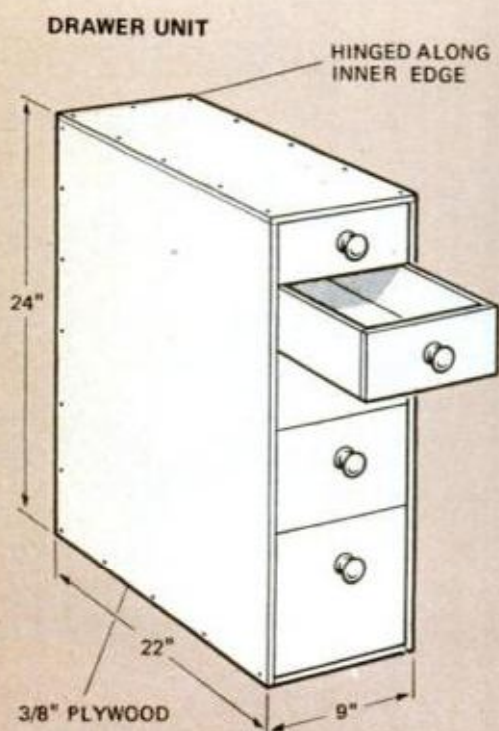
What appears to be a handsome wardrobe here actually becomes an efficient sewing center when opened for use. The design is intended to solve the problem for those who want such a facility and have no place to put it except in the bedroom.

When the doors are opened, a full-length mirror is revealed on the left door, and storage for all the accessories a busy seamstress likes to keep close at hand is at the right. There is also additional storage available in the pull-out drawers.

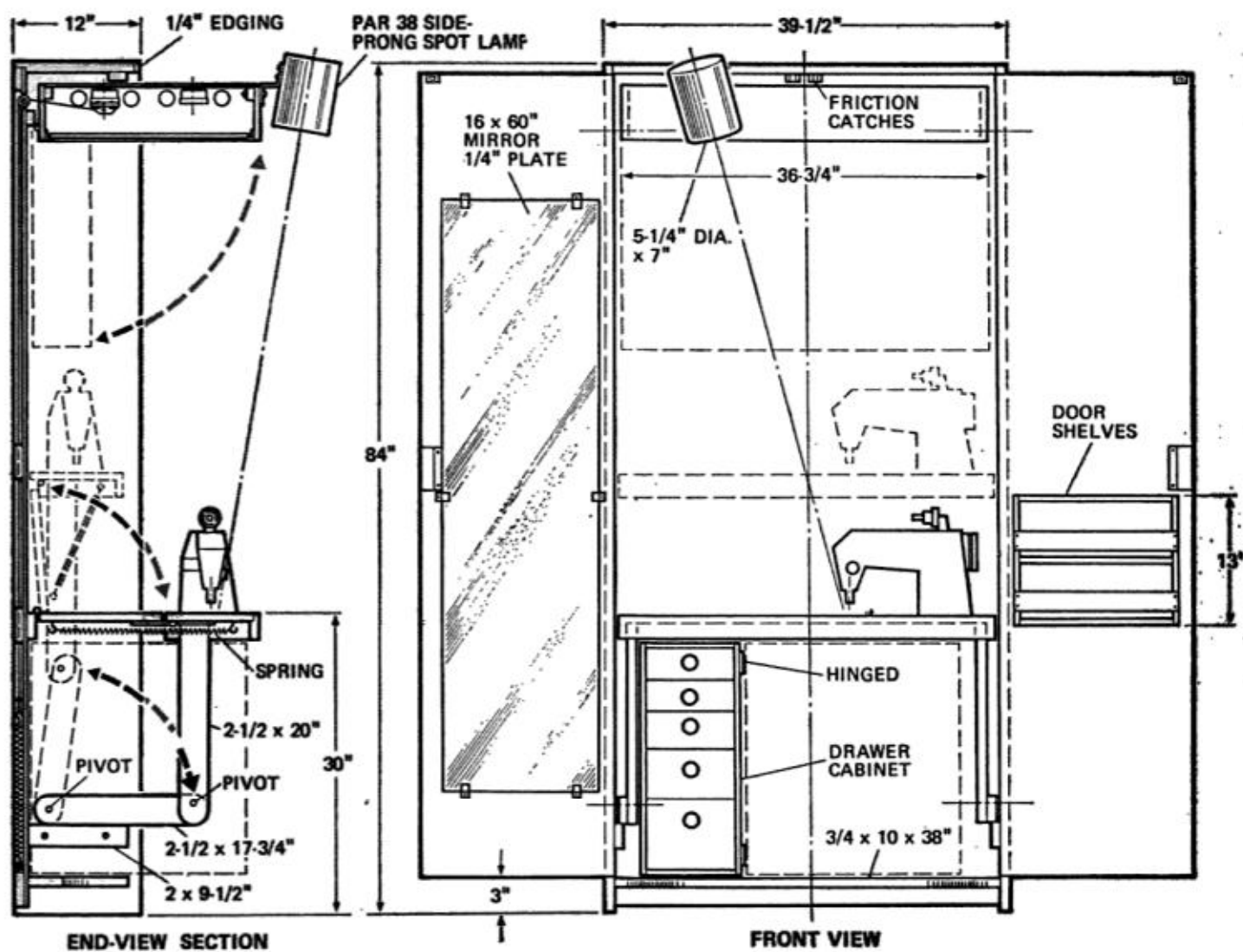
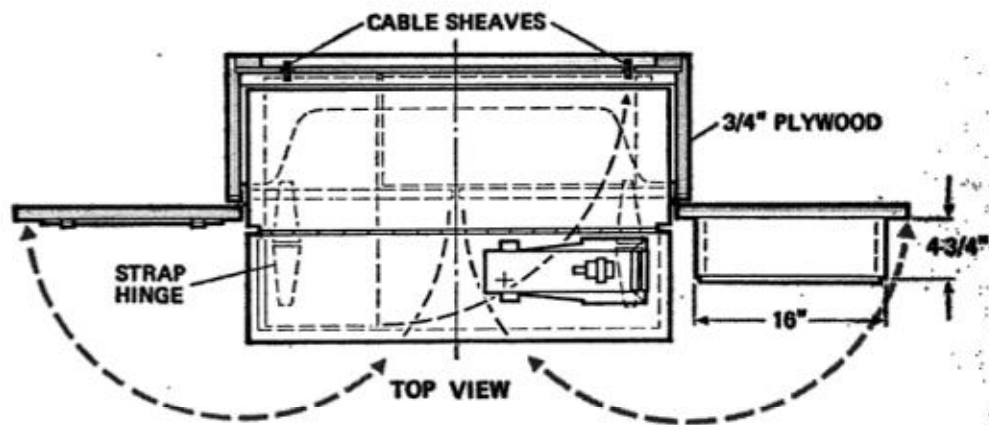
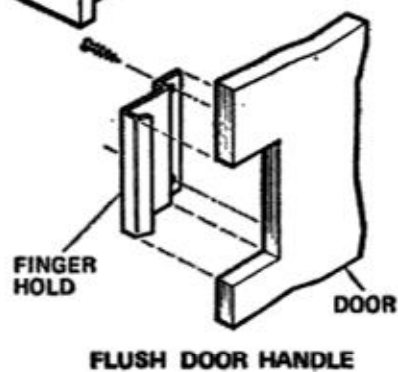
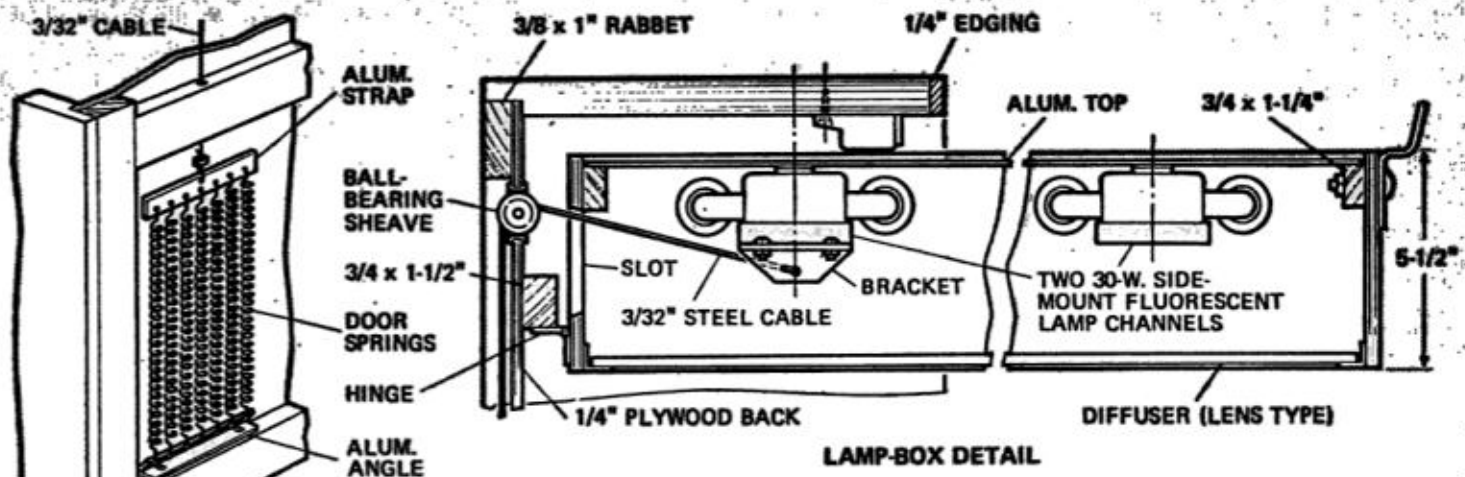
The sewing-machine counter pulls down to create a full 24-in. depth. The panel then swings up on a spring device, allowing for an extra-deep lighting fixture to fit into place. Four 30-watt Deluxe Warm-White fluorescent lamps provide general lighting, while the spotlamp—angled toward the machine's needle—provides the pinpoint light necessary to see thread against fabric without causing squinting and eyestrain.



As practical as it is pretty, sewing center has a generous-size—24 in. deep—work counter, pull-out drawer and shelf unit.



Four-drawer pedestal (drawing, left) is built using basic construction techniques, becomes focal point in finished piece.

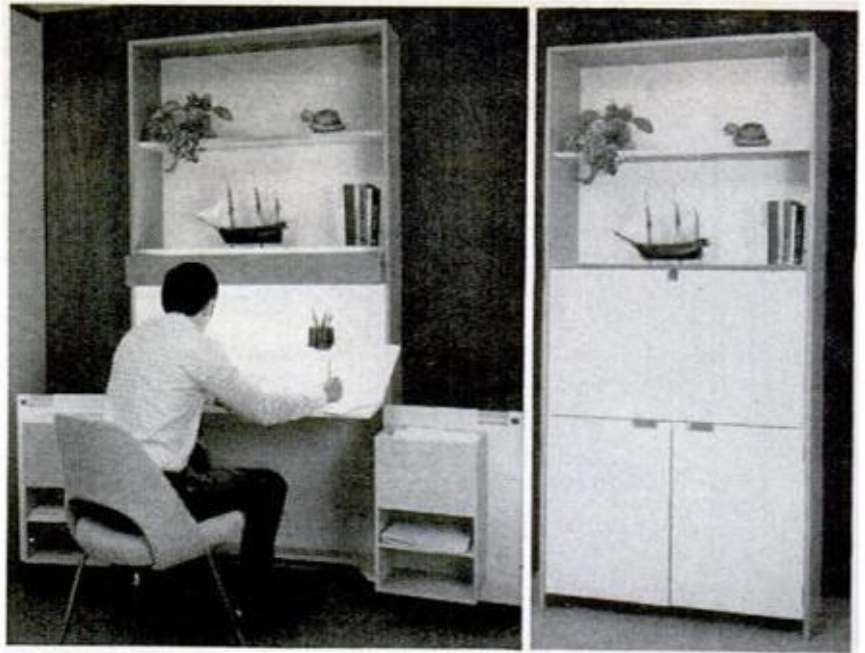




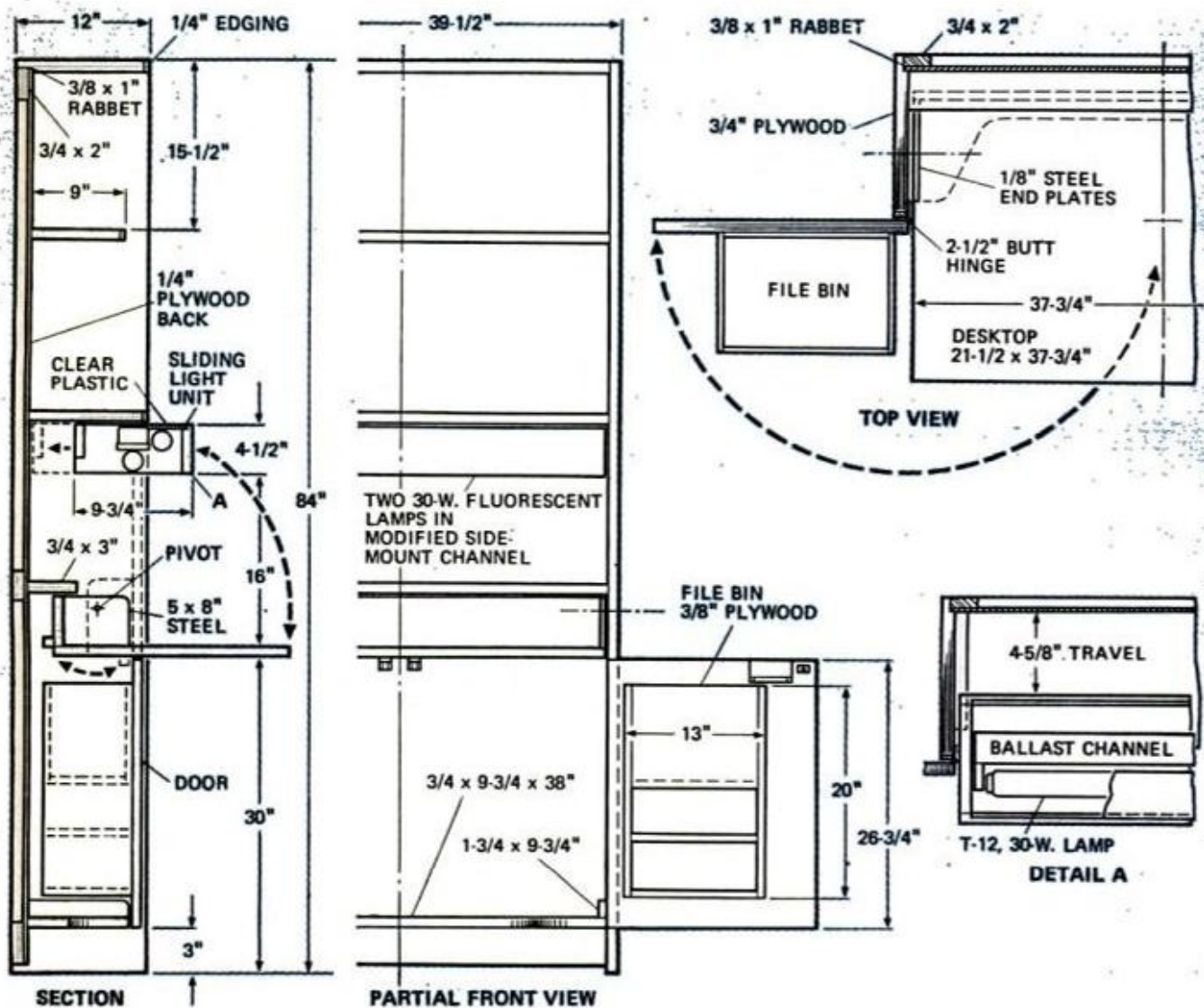
# Versatile work or hobby desk

At first glance—see photo far right—the desk appears to be a shelf-storage area. However, when you open the lower pair of doors, a counter flips down and becomes a 2-ft.-deep desktop. The lighting element pulls out so light is distributed both down on the desk work area and up toward the shelves where reference books and knickknacks can be stored.

For work surfaces such as the desktop (and the sewing center on page 68), a plastic laminate should be used for durability and to keep maintenance to a minimum.



Would you believe it's a desk? When closed (right photo), unit seems to be something it's not—a breakfront. For the man of the house, the simple structure provides all the record-keeping room he needs.

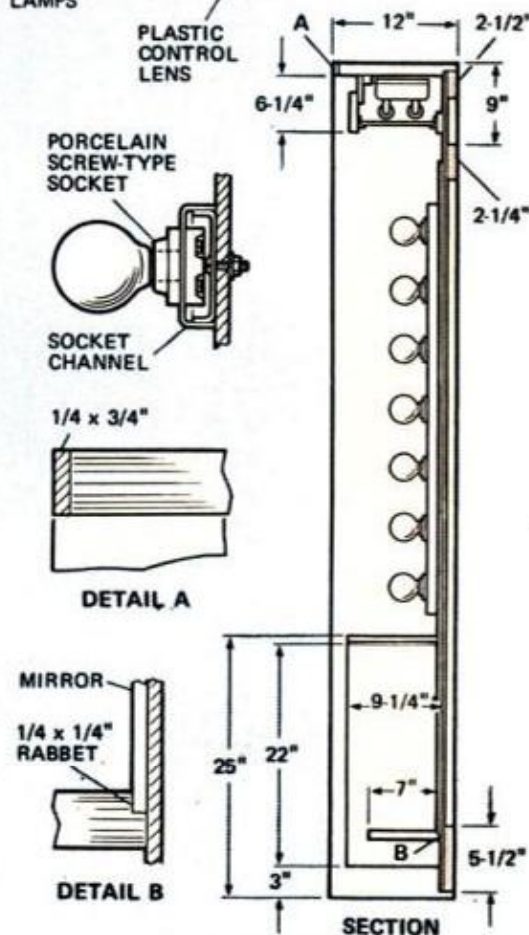
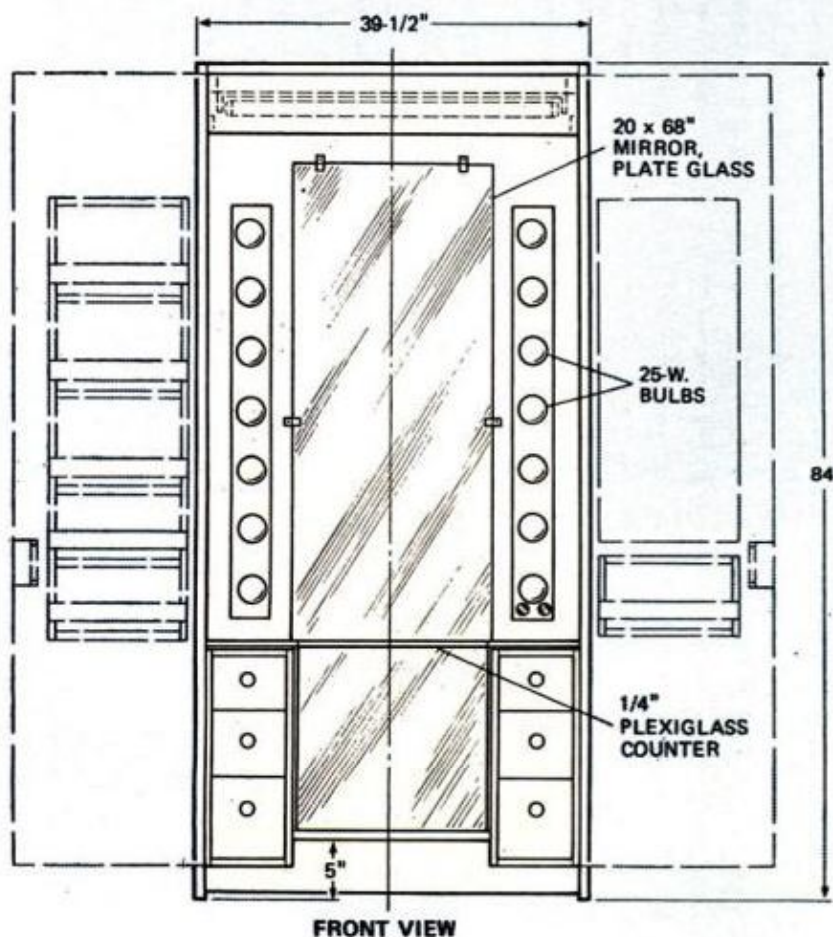
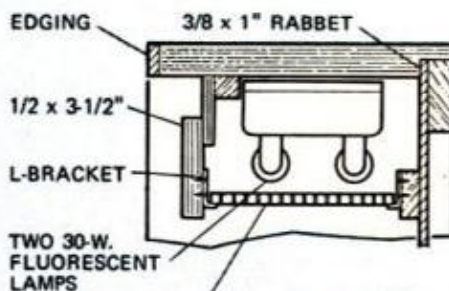
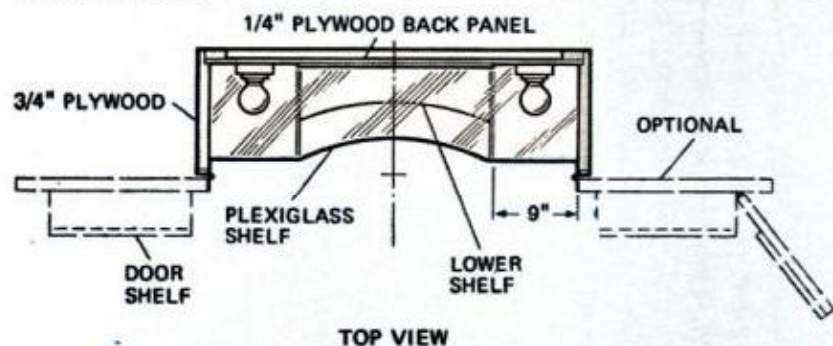


# Or build a vanity

The vanity center is planned for personal grooming and can be used either sitting down or standing. Since the top surface (shelf) will not be exposed to rough treatment which might scratch or mar it, it is of 1/4-in.-thick clear sheet acrylic plastic (such as Plexiglas or Lucite) so it is possible to utilize the full-length mirror. The lighting is a combination of decorative incandescent globe-shaped bulbs (14 25-watt No. G 18 1/2 lamps) on both sides of the mirror and a pair of 30-watt deluxe fluorescents in the hood overhead (see detail in the upper right corner of drawing below).

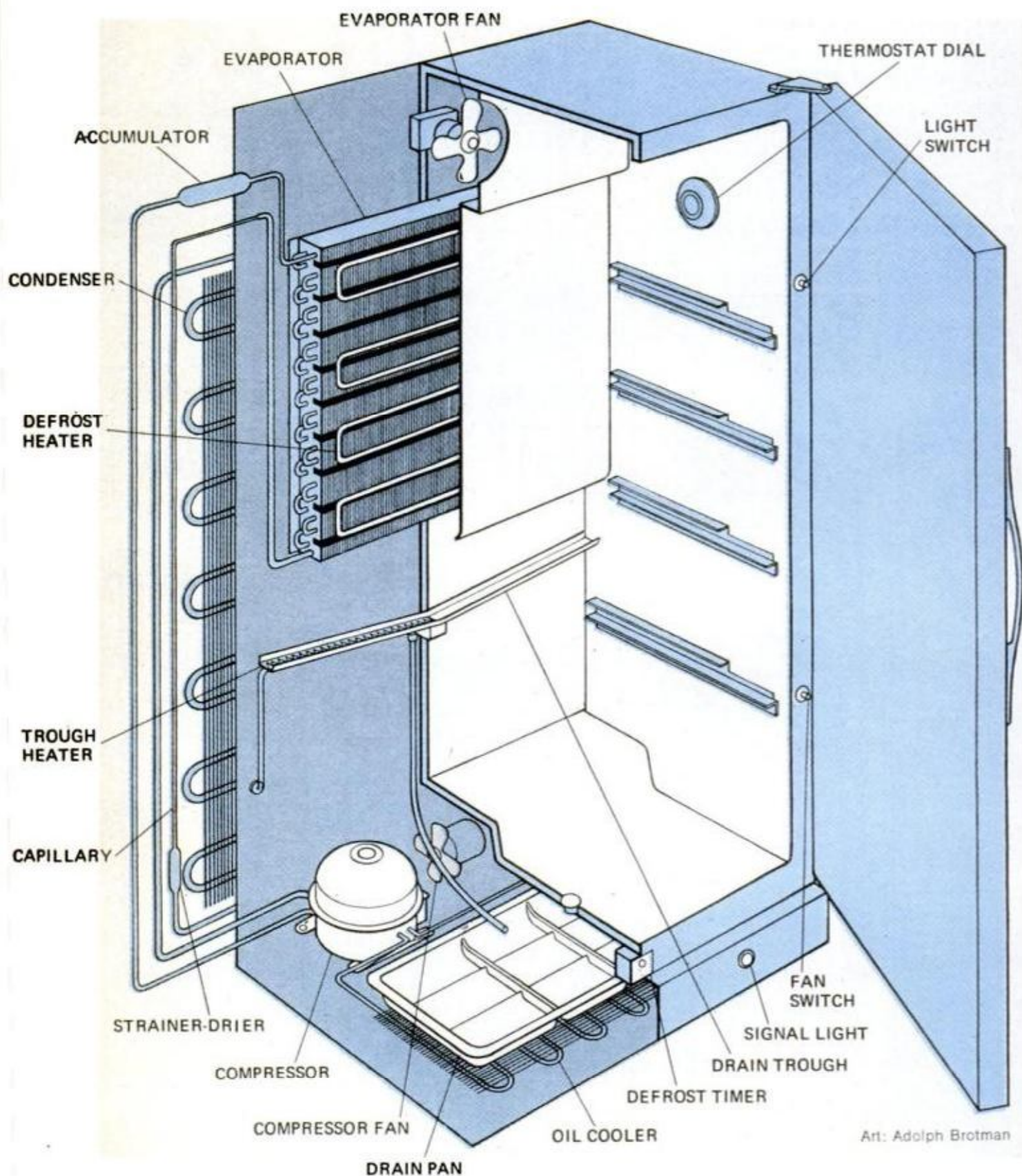
*(Please turn to page 178)*

Light where you need it—at a makeup table: Two Deluxe Warm-White fluorescents overhead and 14 incandescent bulbs do the job.



# How to fix a freezer

## Typical freezer components



**M**any of the problems that may arise with home food freezers can be dealt with by consulting the 12 troubleshooting charts on this page and the following four pages. Troubles that involve the sealed refrigeration system should be left to a qualified serviceman, but it will be helpful if the homeowner can recognize the symptoms when they occur.

In a normal system, refrigerant in a gaseous state is pumped by the compressor into the condenser, where it cools and changes into a liquid. It then passes through the extremely narrow capillary tube that leads to the evaporator. The change to larger tubing diameter at the evaporator inlet reduces the pressure on the refrigerant, allowing it to boil at low temperature, absorbing heat from the area surrounding the evaporator as it does. The vapor that results is drawn into the compressor to begin a new cycle.

During normal operation, the condenser will feel warm, the evaporator cold and the

suction line from evaporator to compressor will be cool or at about room temperature. To work properly, the system must contain a specific amount (charge) of refrigerant and its lines must be unobstructed.

When a system is undercharged, the freezer lacks normal frost accumulation on walls or evaporator coil. The compressor runs continually or for longer periods than normal, drawing less current than normal, and temperatures inside the freezer rise. Evaporator and condenser both feel warmer than in normal operation.

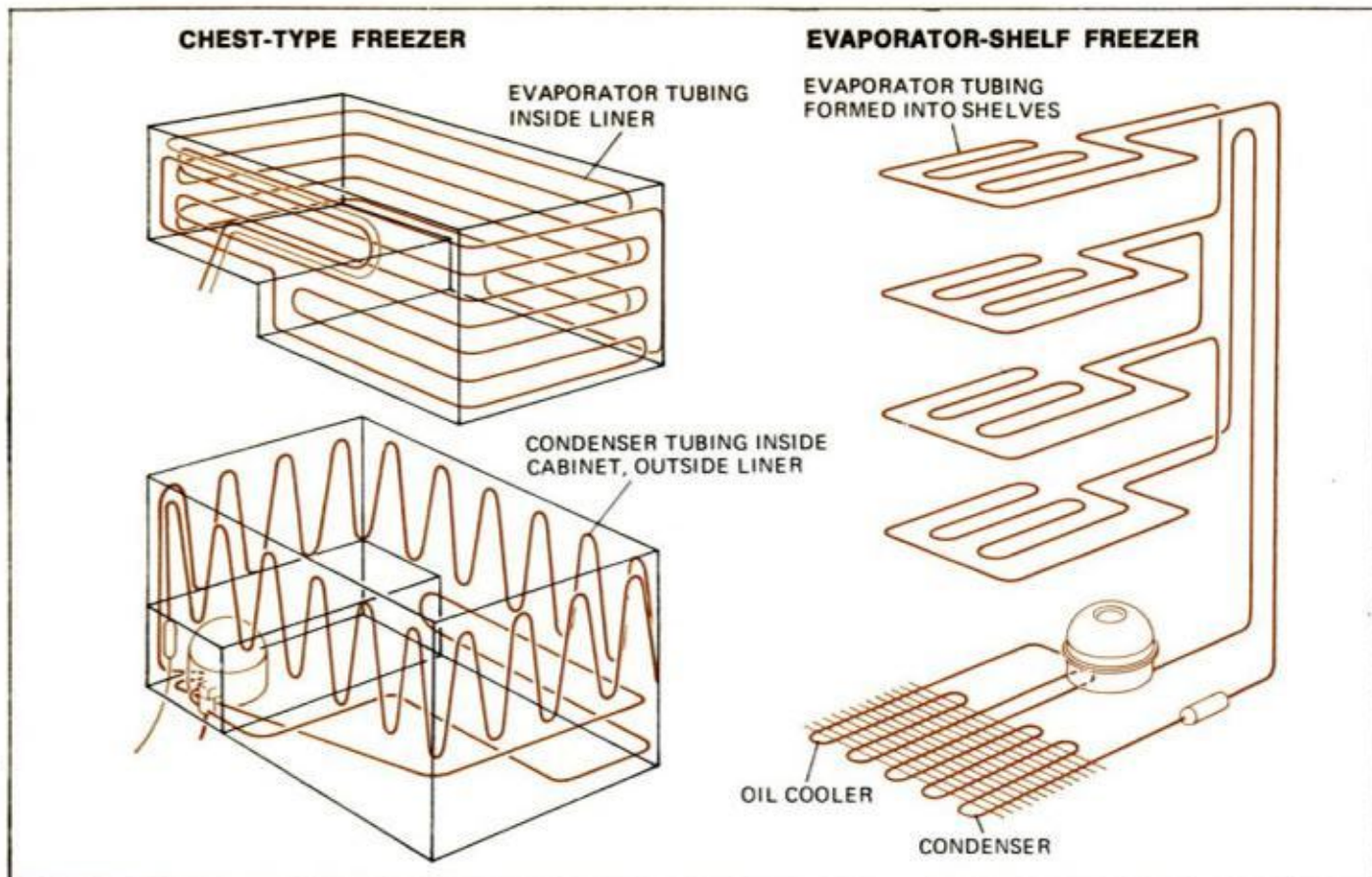
Undercharge is most commonly the result of a leak. Oil stains around a joint will indicate a leak. Test for leaks by brushing a soapy water solution over joints on the system's high side (compressor, condenser, capillary) while the freezer is running, over joints on the low side (evaporator, suction line) while it is off. Any sign of bubbling at a joint indicates a leak.

When a system is overcharged, frost accumulates on the suction line between evap-

*(Text continues on page 77)*

### Compressor does not run

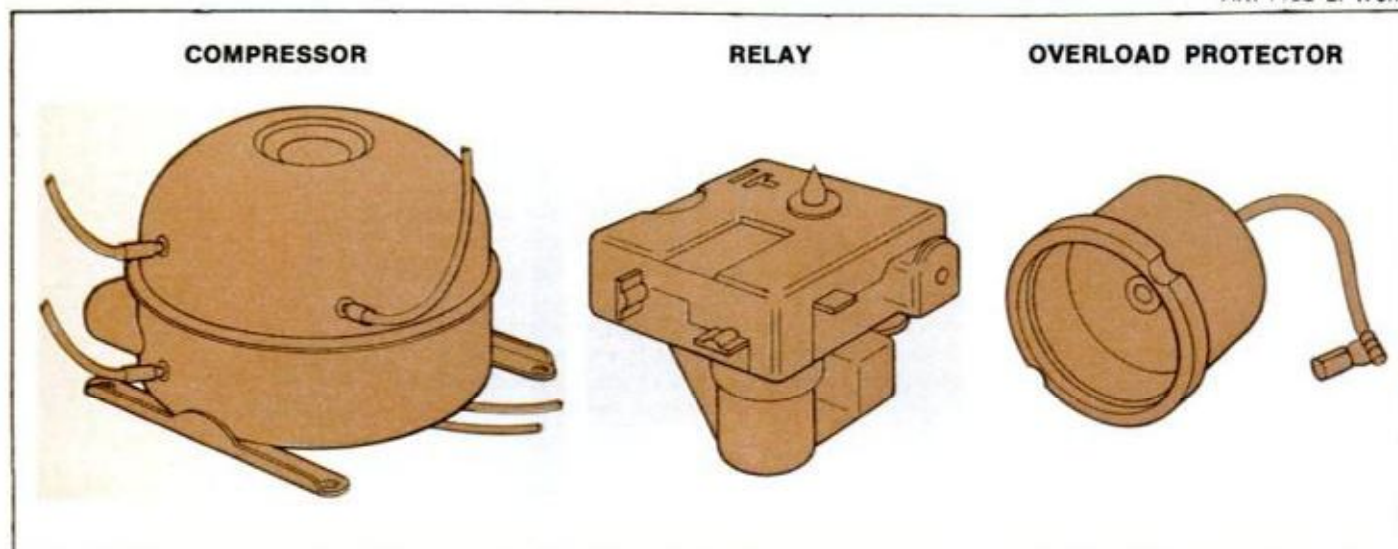
POSSIBLE CAUSES	WHAT TO TRY
1. Blown fuse or tripped circuit breaker.	Replace fuse or reset circuit breaker.
2. Defective relay.	Test for continuity between terminals L and R, S and L. Replace relay if there is no reading between L and R, or if there is a reading between S and L.
3. Defective overload protector.	Remove wires from overload protector and test for continuity across terminals. Replace overload protector if there is no reading at room temperature.
4. Defective temperature control (thermostat).	Remove wires from thermostat, turn control to coldest setting and test for continuity across terminals. Replace control if there is no reading.
5. Defective defrost timer.	Remove wires from defrost timer, and test for continuity across terminals for timer motor, defrost and compressor circuits (refer to unit's wiring diagram). Replace the timer if a circuit is open.
6. Defective compressor.	Direct-test compressor with test jumper. Have it replaced if it fails to operate properly.



### Compressor cycles on overload protector

POSSIBLE CAUSES	WHAT TO TRY
1. Low voltage.	Test voltage at wall outlet with a voltmeter. This should be within 10 percent of normal. If it's low, call power company.
2. Poor air circulation over condenser.	If condenser is dirty, vacuum-clean the coil and surrounding area.
3. Defective relay.	See No. 2 in chart titled "Compressor does not run" on page 73.
4. Restricted system.	If signs of restriction ( <a href="#">see text, page 77</a> ) are present, contact a qualified serviceman.

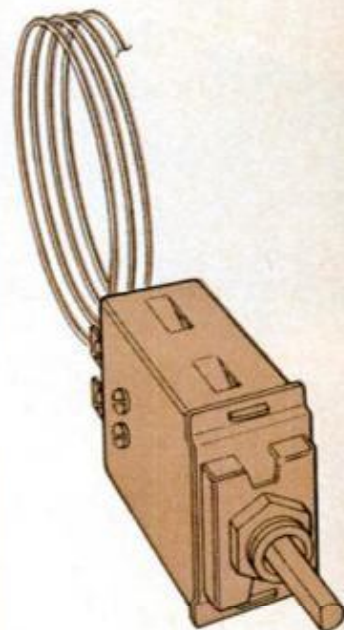
Art: Fred L. Wolff



## Compressor runs too much or constantly

POSSIBLE CAUSES	WHAT TO TRY
1. Thermostat is set too high or feeler bulb has worked loose.	Adjust thermostat to a warmer setting. Make sure that feeler bulb is secure in mounting.
2. Poor air circulation at condenser.	If condenser is dirty, use a vacuum cleaner on the coil and surrounding area.
3. Poor door seal.	Close the door on a dollar bill; there should be a slight tug when the bill is pulled out. If not, check the door and hinges for warp—if present, loosen the door-liner screws, push the door in until it seats against the gasket and retighten liner screws.
4. Undercharged or restricted system.	If signs of undercharge or restriction are present (see text, page 73), call a qualified serviceman.

THERMOSTAT



## Freezer compartment too warm

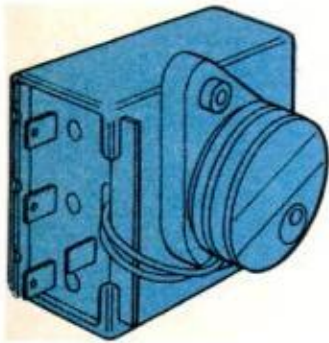
POSSIBLE CAUSES	WHAT TO TRY
1. Poor door seal.	See No. 3 in chart titled "Compressor runs too much or constantly" above.
2. Defective freezer fan.	Disconnect wires from the fan and direct-test fan motor. Replace the motor if it fails to operate properly.
3. Defective defrost heater.	Disconnect wires from the heater and test it for continuity. Replace heater if no reading can be obtained.
4. Door opened too often.	Limit the number of door openings to reduce the amount of air at room temperature that can enter the freezer.
5. Defective defrost timer.	See chart titled "Compressor does not run" on page 73.
6. Freezer overloaded with unfrozen food.	Add no more than 10 percent of freezer capacity at one time; remove some food or add dry ice.
7. Interior light on.	Push light-switch button in; the light should go out. If it does not, remove switch and test it for continuity. There should be a reading with button out, none with button in. Replace switch if defective.

**Caution:** Be sure power is turned off before you handle components. Make all continuity tests with power off. When using a test lamp, keep power off while connecting and disconnecting the lamp. Use your manufacturer's manual to locate components, and use only replacement parts that meet his specifications. Do not open refrigerant system.

## Freezer does not defrost

POSSIBLE CAUSES	WHAT TO TRY
1. Insufficient time allowed for defrosting (manual).	Normal time to soften frost is 10 to 15 minutes. Repeat defrost cycle.
2. Defective defrost timer.	See chart titled "Compressor does not run" on page 73.
3. Defective defrost heater.	See chart titled "Freezer compartment too warm" above.

## DEFROST TIMERS

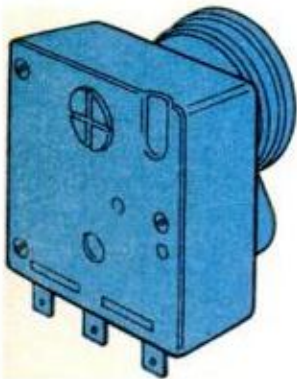


### Freezer fan does not run

POSSIBLE CAUSES	WHAT TO TRY
1. Freezer defrosting.	Normal. Check again later.
2. Defective fan switch.	Remove wires from switch, test for continuity. There should be a reading with button in, none with button out. Replace switch if defective.
3. Defective fan motor.	Disconnect wires and direct-test fan motor. Replace it if it fails to operate properly.
4. Defective defrost timer.	See chart titled "Compressor does not run," page 73.
5. Loose or defective wiring.	Check wiring against manufacturer's diagram. Tighten any loose wires.

### Water freezes in drain trough

POSSIBLE CAUSES	WHAT TO TRY
1. Defective drain-trough heater.	Remove wires and test heater for continuity.
2. Defective defrost timer.	See chart "Compressor does not run," page 73.
3. Loose or defective wiring.	Check wiring against manufacturer's diagram. Tighten any loose wires.



### Moisture condenses on cabinet or door

POSSIBLE CAUSES	WHAT TO TRY
1. Poor door seal.	See chart titled "Compressor runs too much or constantly," page 75.
2. Defective door heater.	Disconnect wires from door heater and test for continuity. Replace it if there is no reading.
3. Door opened too often.	Limit number of door openings to keep air at room temperature out of freezer.
4. Thermostat setting.	Thermostat left on too cold a setting for too long a time. Turn to warmer setting.

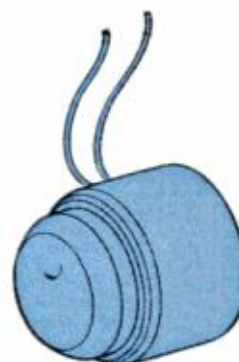
### Freezer short cycles

POSSIBLE CAUSES	WHAT TO TRY
1. Low voltage.	Test voltage at wall outlet with a voltmeter. This should be within 10 percent of normal. Call power company if it's low.
2. High room temperature.	Lower the temperature or move the freezer to a cooler place.
3. Freezer overloaded with unfrozen food.	Add no more than 10 percent of freezer capacity at one time; remove some food or add dry ice.
4. Defective relay or overload protector.	See chart, "Compressor does not run," page 73.

## Excessive current draw

POSSIBLE CAUSES	WHAT TO TRY
1. Door opened too often.	Limit number of door openings to keep air at room temperature out of the freezer.
2. Heavy warm-food loads.	Do not overload freezer. See manufacturer's instructions for correct freezer capacity; do not exceed it.
3. Thermostat set too low.	Move thermostat to warmer setting.

DEFROST THERMOSTAT



## Noisy operation

POSSIBLE CAUSES	WHAT TO TRY
1. Freezer not level.	Level freezer.
2. Tubing vibrating.	Adjust tubing slightly so that it does not rub against cabinet.
3. Loose compressor mounting.	Tighten leg mountings of compressor.

## Door does not open or close properly

POSSIBLE CAUSES	WHAT TO TRY
1. Freezer not level.	Level freezer.
2. Latch mechanism worn or out of adjustment.	Examine latch mechanism. If worn, replace it. If not, adjust it according to manufacturer's specifications.
3. Hinge mounting screws loose.	Realign and retighten mounting screws. Replace any worn bushings.
4. Door vacuum.	Normal. This occurs when there is a brief interval between door openings; inrush of air at room temperature contracts when cooled to create partial vacuum.

LIGHT AND FAN SWITCH



erator and compressor, and the compressor may run longer than normal or continually. Overcharge will exist only when the sealed system has been broken into. In the case of either undercharge or overcharge, the system must be evacuated and recharged with the correct amount of refrigerant. Any leaks, of course, must be repaired first.

A partial or complete restriction in a line interrupts the normal flow of refrigerant through the system. It may be caused by moisture frozen in the capillary tube, by wax resulting from a breakdown of oil in the compressor or particles of dirt or lacquer from compressor windings.

A partial restriction produces symptoms like those of an undercharged system, plus

frost buildup between the restriction and the suction line. It may clear itself when the compressor shuts off but reappear when the compressor starts again.

With a complete restriction there is no refrigerant flow at all. Evaporator and condenser remain at room temperature, the compressor refuses to start and cycles on the overload protector.

The compressor itself may be subject to shorting, grounding, jamming or open windings (it will hum with one open winding). Continuity tests, using the manufacturer's wiring diagram, can isolate these problems, but compressor repair or replacement should not be attempted by the homeowner. ★ ★ ★



# How to hang wallpaper

Thanks to the many "fabric"-backed wall coverings now available, wallpapering is easier than ever. Since these newer materials come in a wide variety of attractive patterns, they are especially desirable for a first venture in applying wall coverings.

There are several good reasons. First, these wall coverings are easier to work with than ordinary wallpaper. You can correct mistakes by peeling off strips already in

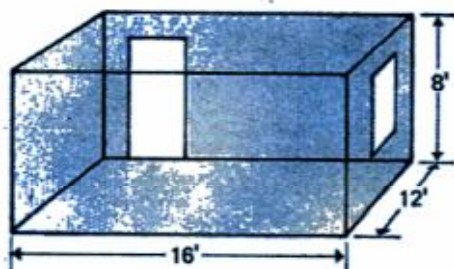
place, without fear of ripping the material. Ordinary wallpaper, once pasted in place, usually cannot be reused. Second, any adhesive on the surface can safely be washed off after the covering is in place.

Finally, wall coverings of the cloth type can be moved in position on the wall until they match perfectly with strips already in place. This maneuverability is extremely limited with ordinary wallpaper.

## Tools needed

- Carpenter's square
- Spirit level
- Cutting board, ¾ x 24 x 72-in.
- Clean sponge
- Yardstick
- Stepladder
- Plumb line and chalk
- Large scissors or shears
- Two plastic buckets (one for paste and one for washing)
- 4-in. brush for applying paste (for unpasted wall covering)
- Plastic water tray (for prepasted wall covering)
- 12-in. smoothing brush
- Wall covering trimmer, utility knife or single-edge razor blades
- Dropcloth
- Corner and seam rollers
- All tools required for wallpapering are available at well-stocked paint and wall-covering stores.

## How to measure



A standard wall-covering roll contains 35 sq. ft.—narrow rolls are longer than wide ones. To allow for waste and matching, figure on covering 30 sq. ft. with each roll.

1. Measure the distance around room at baseboard.
2. Measure wall height from baseboard to ceiling.
3. Find number of rolls you need in chart (right). For example, if room is 8x12x16 ft. with a door and window (as sketched above):
4. Add room dimensions around baseboard:  
 $12+12+16+16=56$  ft.
5. Find 56 in first column of chart.
6. Find number opposite 56 in applicable wall-height column (8 ft.): 14 rolls are needed.
7. Compute square feet of window-door openings and trim, deduct proportionate number of rolls; in this case, deduct one roll for door and window—13 rolls are needed to cover the walls.
8. Before you paper a ceiling, use column at far right to estimate the number of rolls needed—eight in this case.

ROOM ESTIMATING CHART

Around Room (ft.)	Rolls for Walls in Room With Height of			Border (yds.)	Ceiling (rolls)
	8'	9'	10'		
28	8	8	10	11	2
30	8	8	10	11	2
32	8	10	10	12	2
34	10	10	12	13	4
36	10	10	12	13	4
38	10	12	12	14	4
40	10	12	12	15	4
42	12	12	14	15	4
44	12	12	14	15	4
46	12	14	14	17	6
48	14	14	16	17	6
50	14	14	16	18	6
52	14	14	16	19	6
54	14	16	18	19	6
56	14	16	18	20	8
58	16	16	18	21	8
60	16	18	20	21	8
62	16	18	20	22	8
64	16	18	20	23	8
66	18	20	20	23	10
68	18	20	22	24	10
70	18	20	22	25	10
72	18	20	22	25	12
74	20	22	22	26	12
76	20	22	24	27	12
78	20	22	24	27	14
80	20	22	26	28	14
82	22	24	26	29	14
84	22	24	26	30	16
86	22	24	26	30	16
88	24	26	28	31	16
90	24	26	28	32	18

## Types of wall coverings and adhesives

Prepasted wall coverings are popular with do-it-yourselfers because they save time and create considerably less mess. They are available in most of the same designs as unpasted wall coverings.

Unpasted wall coverings offer a slightly greater selection of patterns and finishes, including both flocked and foil coverings. Different types of unpasted wall coverings require different types of adhesive. Use the chart at the right to determine the kind you need.

It is important to mix wheat paste or stainless paste at least one hour before you use it. Allowance for this setup time makes it easier to eliminate dry lumps. Properly mixed, the paste will be lump-free and have the consistency of heavy cream.

ADHESIVES CHART				
	Wheat Paste or Stainless Paste	Liquid Strippable or Wheat Paste	Vinyl Adhesive	Stainless Paste
Regular wallpaper	X			
Strippable wallpaper		X		
Vinyl wall covering			X	
Foils			X	
Burlap with backing			X	
Burlap (porous)	X			
Cork with backing			X	
Silks and fabrics				X

**Flocks, murals, hand prints, borders** Use adhesive appropriate for wall covering's backing



## Dealing with old wallpaper

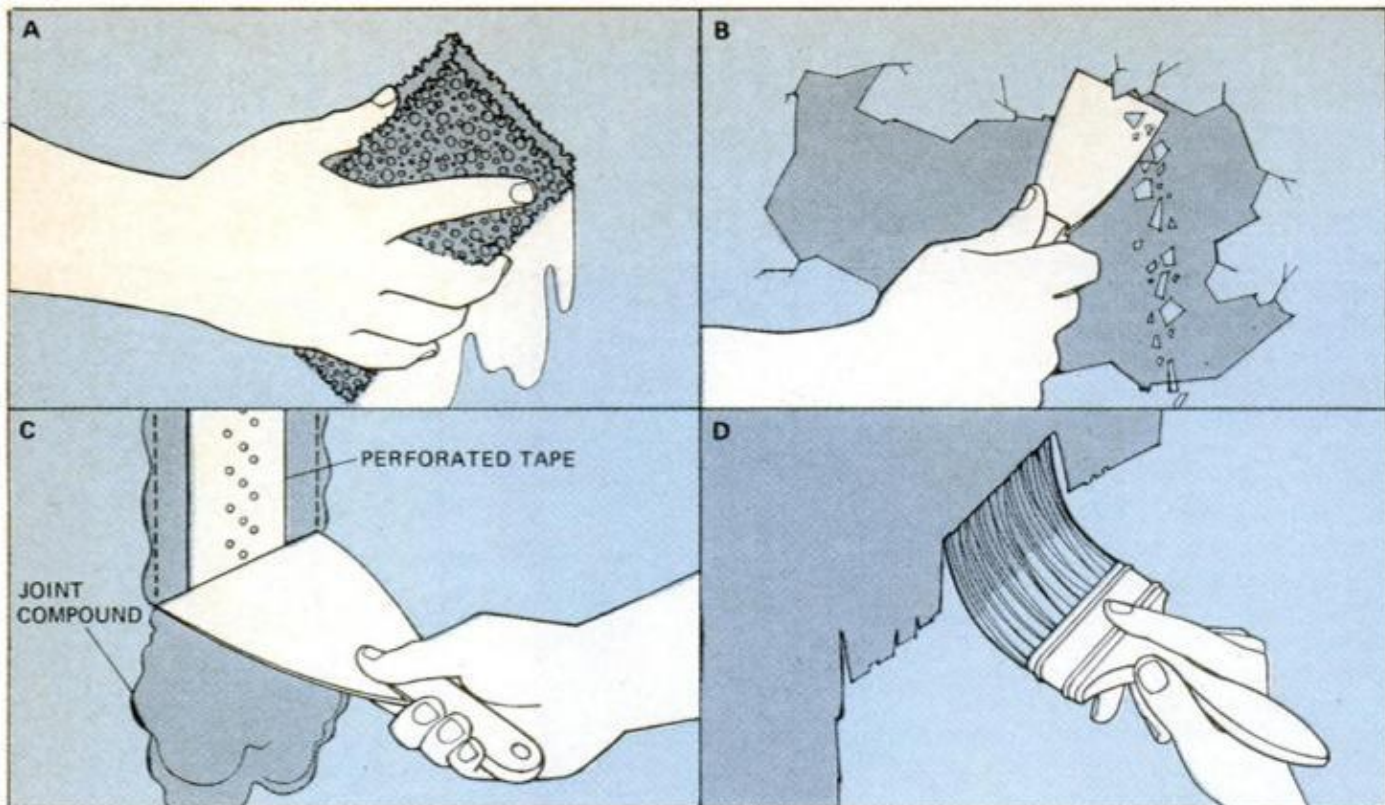
Don't underestimate the importance of properly preparing the walls to be covered. A professional generally removes an existing covering as there is always the possibility that it may work loose and ruin the new job. If you do cover existing wallpaper, make sure it's tight and smooth.

Cut an X in any air bubble and glue the paper back with white glue. Corners should be cut from floor to ceiling and reglued. Uneven spaces—where paper has pulled off the wall in spots, for example—should be filled with spackling compound and sanded. Check the joints of existing paper, fill with spackling compound and sand smooth where necessary—otherwise they may show through a new covering.

If there are two or more layers of paper on the walls, remove them. The best way is to rent a

steamer. It's easy to use and you will have no trouble if you follow instructions. Another way to remove paper is by sponging the walls with hot water and using a scraper. Keep in mind that the wetter the paper is, the faster it will come off. When removing paper from drywall, take care not to get under its layer of finish by mistake.

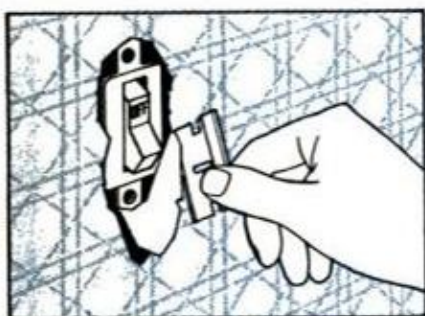
Some extra tips to make the job easier: Before starting the soaking operation, spread many layers of newspaper on the floor—remember that the paper that comes off the wall will have softened glue on the back, which can adhere to the floor, necessitating another soaking and scraping. Lightly score crosshatch marks over the paper with a utility knife (carefully so you don't damage the wall beneath); this will break the surface so that hot water will dissolve the old paste faster.



### Preparing plaster and drywall surfaces

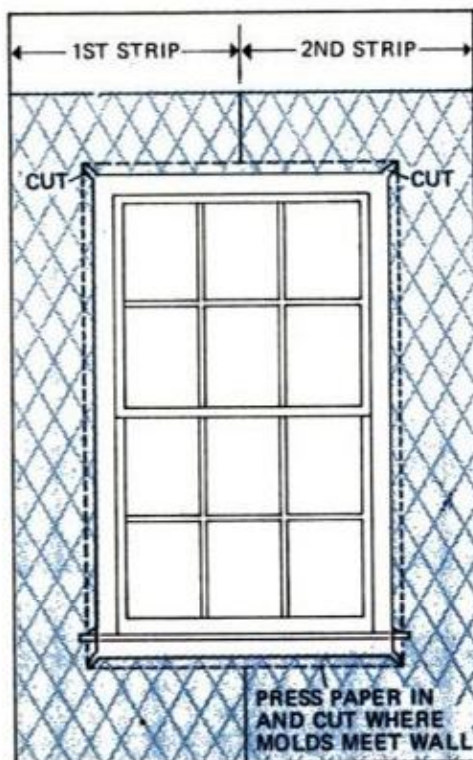
On unpainted plaster, make any needed repairs, scrape out loose cracks and fill with spackling compound (joint compound). Then apply a coat of wall size. Painted plaster should be thoroughly washed with detergent and water, rinsed with clear cold water. Make sure no soapy residue is left to dry on the surface. If necessary, remove peeling, chipped or cracked paint with a wide putty or joint knife and sand the surface smooth. Repair cracks or holes with spackling compound, sanding when dry. Dull a gloss or semigloss finish

on existing paint with a strong soda solution or coarse-grit sandpaper; slick walls will not satisfactorily accept wall covering adhesives. On new plasterboard, tape seams and apply compound according to maker's directions. Set nailheads without breaking paper (dimple with hammer), cover with compound. Sand surfaces smooth when dry. Use two coats if necessary. Prime walls with oil, alkyd or latex primer-sealer; with latex, be sure to allow curing time. Sizing surfaces lets you slide covering in position, assures better adhesion.



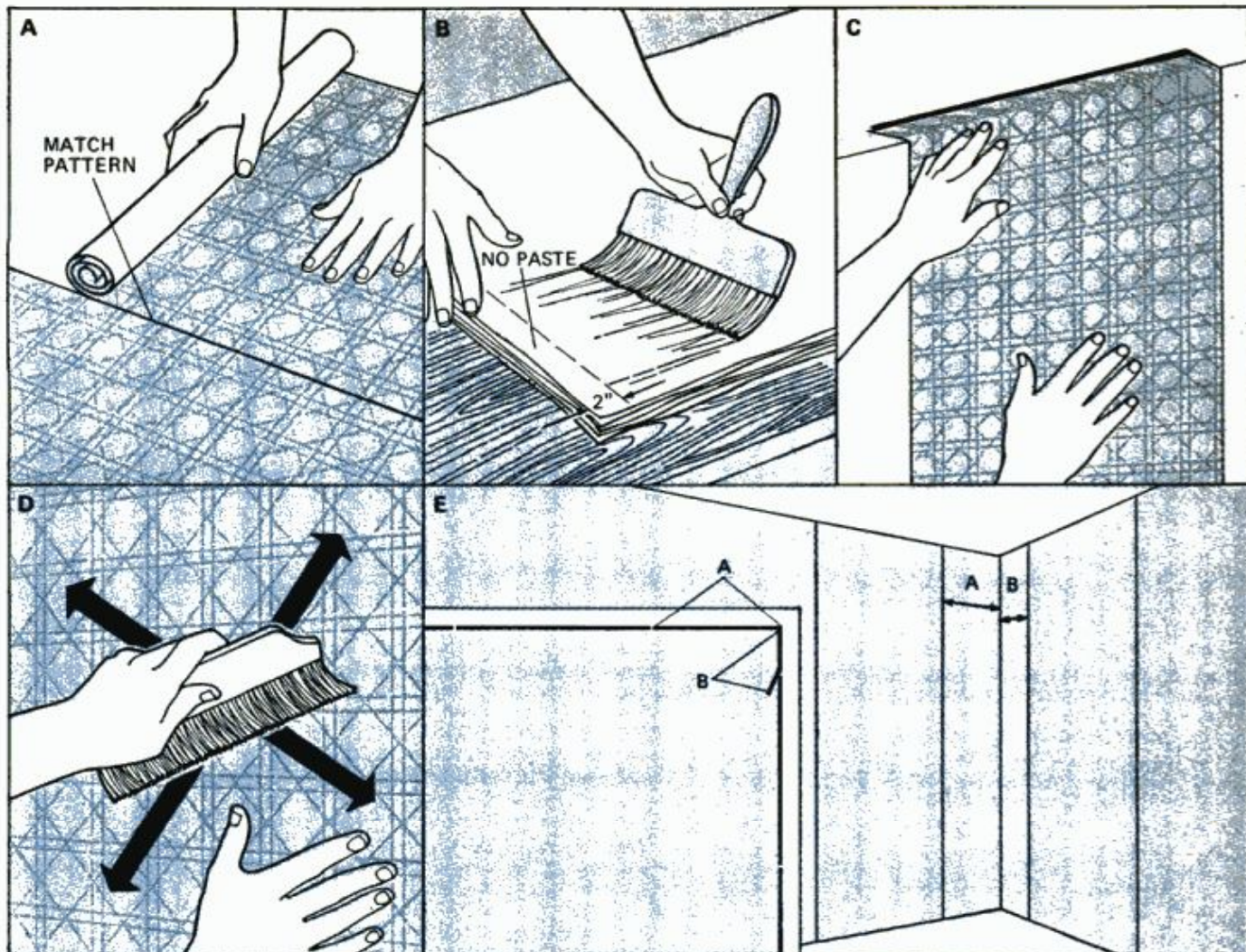
### Switches, fixtures

Before wall covering is applied, all switch plates and outlet covers should be removed and wall fixtures loosened and pulled away from the wall. Remove fixture wall brackets *after turning off power at service panel and then disconnecting wires*. When the wall covering is in place, cut an area slightly smaller than wall plate so that plate covers cutout completely.



### Papering around windows, doors

Doors and windows are handled exactly alike, except that a window means extra wall to be covered below it. Make a rough cutout by measuring from the last strip to the window casing and add  $\frac{1}{2}$  in. Measure the same way from ceiling and baseboard to trim. Remove the cutout before applying paste. Hang the strip, press in around casing and roll the joint with the seam roller, trim excess paper. Measure cutout size for the second strip as for the first and hang it, butting the first strip, in the same manner. Press and roll at joint with casing, trim. If you have taken care in cutting strips, pattern-matching at doors and windows will present no problem.



### Preparing and hanging the wall covering

Two rules of thumb: If you plan to paper all the way around the room, hang the first strip along the edge of a door or window. If there is a fireplace in the room, center the first strip over it and work in both directions from there.

On an ample-sized table—a 2x6-ft. piece of 3/4-in. plywood on sawhorses is fine—unroll the wall covering and lay it face up. Measure out wall height and add 6 in. allowance for trim. Lay the second strip next to the first, match the pattern and cut it to the same length. Lay the second strip on top of the first and continue matching and cutting strips in this manner.

When all strips are cut, turn over the stack of paper. Apply adhesive evenly with a large paste brush. Start at the center and brush toward the bottom. For easier handling, leave a 1-in. strip at the bottom unpasted. Allow about three minutes for the paper to expand before you handle it. Now fold the bottom half of the strip toward the center, paste to paste, without creasing the paper. Stop short of the center so that the fold you later make from the top will be slightly longer than the bottom one. Align the edges carefully. Apply paste to the top half of the strip as to the bottom, wait for paper to expand, and fold the top over to the center. The 1 in. unpasted strip at the top should overlap bottom edge folded up to the center.

To hang the paper, unfold the top section and place the strip high on the wall, overlapping the

ceiling-wall joint by approximately 2 in., and aligning its edge with a vertical snapped with your chalked plumb line. Give the upper section a couple of strokes with your smoothing brush to hold it to the wall. Then open the lower section. When you are satisfied with the paper's alignment, brush the entire strip smooth. Always brush from the center toward edges to get rid of air bubbles. Trim off excess paper at baseboard and ceiling joint and around doors and windows.

To hang the second strip, use the first as a guide, matching the pattern and butting—not overlapping—the seams. Repeat the smoothing procedure, then roll the seam with the seam roller. On flocked or embossed wall covering, seams should not be rolled—instead, tap along the seam with the tips of the smoothing-brush bristles. Clean strips with a damp sponge immediately to remove any paste on the surface, ceiling or baseboard. Hang remaining strips the same way.

To prepare a corner, measure from the last strip to the corner at ceiling level, midpoint and baseboard. Add 1/2 in. to the widest measurement, cut a strip to this width, and hang it in the usual manner; it will overlap the corner by 1/2 in. Snap a plumb chalkline over this overlap for use as a guide in hanging the first strip on the other wall of the corner. This technique will give you a true vertical even if the corner is not perfectly straight.

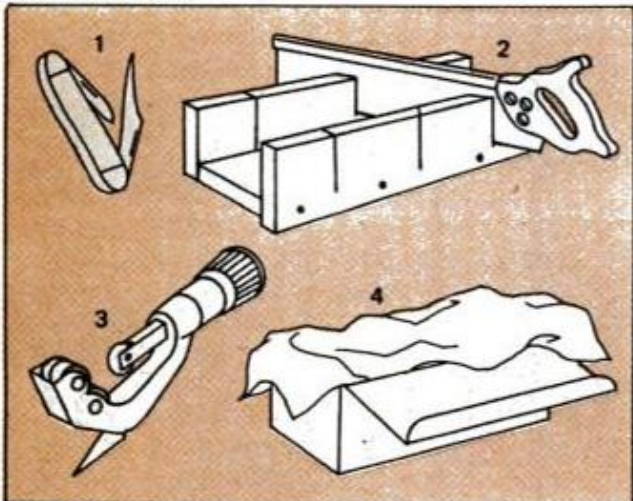
★★★

# How to work with plastic pipe

Plastic pipe is made from rigid thermo-plastic materials that are, in many cases, stronger than metal piping. Though plastic installations are now accepted in many localities, it is best to check with local building authorities in advance. Some local codes *forbid* the use of plastic pipe for water pressure lines.

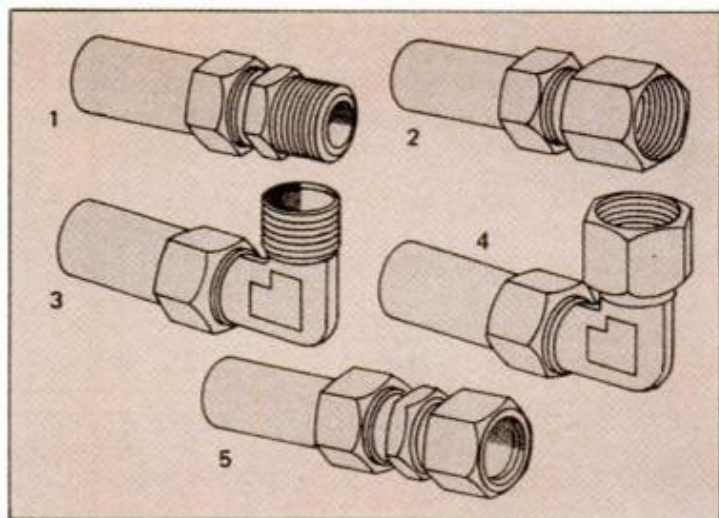
The most popular plastics for household plumbing are ABS (acrylonitrile butadiene styrene), PVC (polyvinyl chloride) and CPVC (chlorinated polyvinyl chloride). PVC and ABS are used mainly for DWV (drain, waste and vent) systems, water and gas distribution and as underground electrical conduit. CPVC can be used for distribution of hot and cold water under pressure. All plastic piping systems have fittings made of the same material as the pipe. These are "welded" together with a brushed-on solvent. As the cement dries rapidly, work one joint at a time—and always test-fit first. *Do not mix* two types of plastic in one installation, and when cementing, always read and follow manufacturers' directions.

Art: Harold Johns



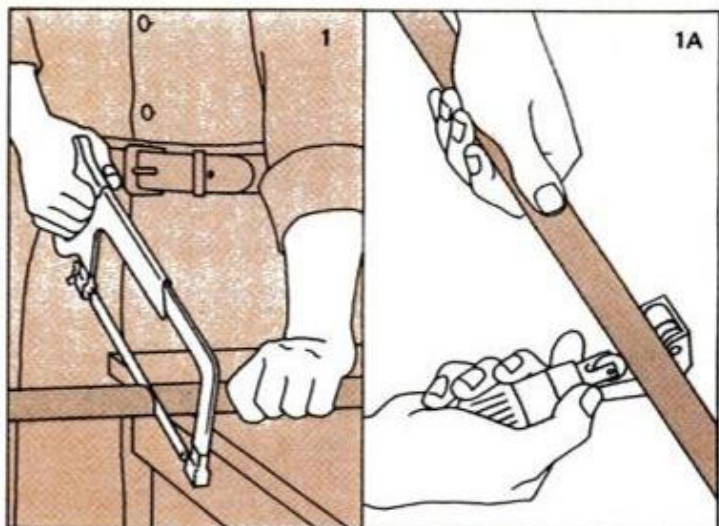
## Tools for working plastic pipe

You probably have most of the equipment you need to work with plastic pipe. Basic tools include: 1) pocketknife, 2) miterbox and backsaw, 3) tubing cutter with cutting wheel recommended for plastic pipe and 4) clean rags. *Do not* use paper products to wipe solvents.



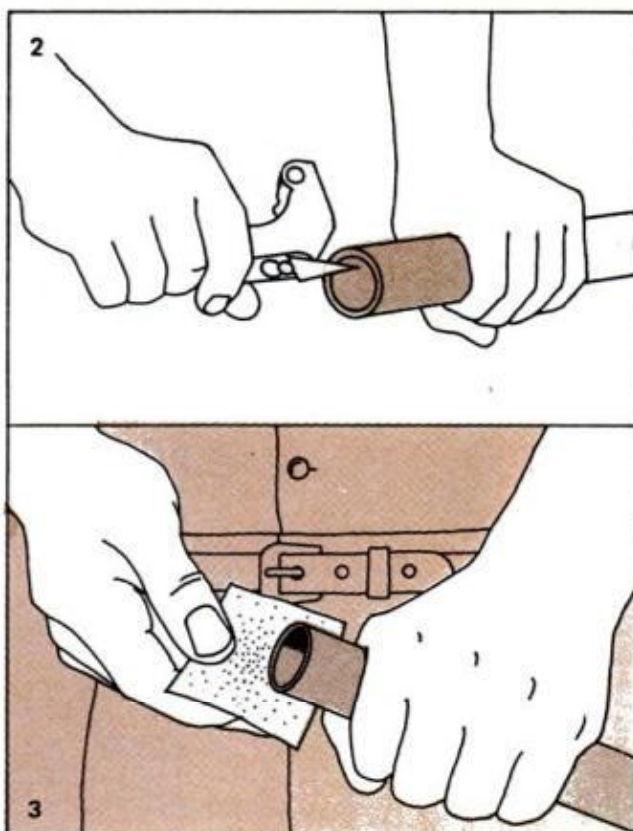
## Typical pipe adapters

Adapters permit transition from metal pipe and tubing systems to plastic pipe. Nos. 1 through 4 are for use with threaded iron pipe—1 and 3 for connection to female fittings, 2 and 4 for connection to male fittings. Elbow adapters, 3 and 4, are designed for close angle connections and help where space is tight, as is the case with in-the-wall plumbing. The copper tubing adapter, No. 5, is nonthreaded.



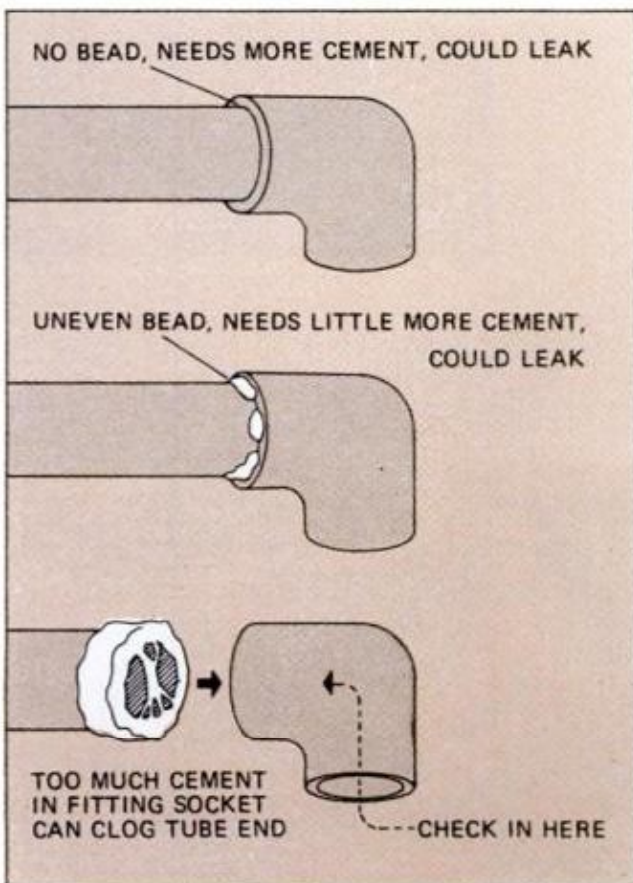
## Cutting plastic pipe

After measuring the length (or run) of pipe needed, cut pipe to proper length, *allowing for the distance it goes into fittings*. Though miterbox and backsaw or tubing cutting are neatest, pipe can also be cut freehand with hacksaw (Fig. 1) if your eye and hand are steady. Tubing cutter, Fig. 1A, is rotated around the pipe and tightened after every few revolutions until the cut has been completed.



### Deburring the pipe

Burrs and ridges from cutting must be removed with knife or tubing reamer (on cutter) so that ends are smooth inside and out. Check fit next. Pipe should enter fitting socket, but fitting should not fall off when pipe is pointed downward. Next, remove surface gloss from both pipe end and inside of socket with either fine sandpaper or a cleaning solvent made specifically for the type of plastic pipe used.



### Applying solvent cement

Using a narrow brush—width equal to  $\frac{1}{2}$  pipe diameter—apply thin coat of cement on pipe end. Dip the brush again and apply a thin coat to the socket. Dip once more and recoat the pipe end. Push pipe and fitting together and give joint a quarter turn to spread cement evenly; adjust for proper angle immediately. Hold together for at least 15 seconds, then wipe off excess cement.

Three cementing faults are depicted at the left. Wait an hour—overnight is better—before filling system with water. Check new work for leaks immediately.

# Still safer than driving?

Ignorance helps to keep 100 million Americans grounded, says this airline pilot. You're 13 times safer riding in his plane than in your own car.

by Robert Ford

**I**n terms of airline safety, 1972 gave promise of being an outstanding year. Then came December.

Early that month, a Boeing 737 crashed during approach to Chicago's Midway Airport, with a loss of 45 lives.

Two weeks later, a DC-9 lifting off in dense fog from Chicago's primary airport, O'Hare, struck a taxiing Convair 880. Nine passengers were killed.

Then just after Christmas, a brand-new Lockheed 1011 crashed into a swamp while making an approach at Miami. Fatalities totaled 101.

The 155 lives lost in these three crashes brought the year's fatalities to 160. Even so, 1972—the most recent year for which complete figures are available—turned out to be one of the safest on record.

There are several ways to measure airline safety, but no single satisfactory way. You can base a rate on the total number of passengers flown, on the number of fatalities per 100 million passenger-miles flown, on the number of trips safely completed, or on the revenue plane-miles logged.

All types of operations by all scheduled airlines must be included—from a Frontier Airlines hop between Durango, Mexico, and Alamosa, Colo., to a Pan Am nonstop from New York to London. The National Transportation Safety Board is the government agency that keeps these records.

The numbers involved are unwieldy. In 1972, some 192,770,000 passengers were carried on 5,049,000 flights; 160 passengers were killed in five separate accidents.





**Firemen remove victims** from the gutted wreckage of a DC-9 jet that clipped the tail of another plane on takeoff from Chicago's O'Hare Airport. Nine died in the accident.



**A landing attempted** in dense fog brought disaster to a DC-9 coming into Boston last July. Pieces of the jet (left) were scattered along seawall. There were 88 fatalities.

**Forty-five persons died**—two on the ground—when a Boeing 737 (far left) crashed into a Chicago residential area. Investigators said the probable cause was pilot error.



## Modern airliner is designed to be safe and to fail safely



Pilots are trained and checked out in simulators such as this one used by American Airlines. Simulators can duplicate every type of flight condition. Realism is enhanced by system that projects images of runways and terrain on screen in front of windshield.

If you figure the number of safely completed passenger trips as a percentage of total trips, you get a safety figure for '72 that's close to perfect—99.9999.

Perhaps a more meaningful measure is the rate of fatalities per 100 million passenger miles (a passenger-mile is one passenger carried one mile). In 1972 this rate was 0.10, down from 0.12 in '71.

This gauge shows that airline travel in the Seventies (so far, at least) is three times safer than it was in the Sixties, four times safer than in the Fifties, and 24 times safer than in the Forties.

All well and good, but how does air travel compare with other ways of getting there when it comes to the mathematical chances of arriving intact? On the whole, the bus and train remain the safest forms of intercity transport. During the 1960s they were about twice as safe as the airliner; in 1970 the airline rate was better than those for rail or bus.

But plane-bus-train comparisons require dealing with numbers carried to four decimal points. With the fatality rate so close



One of the latest to be put in service is this DC-10 simulator, shown here soon after installation at National Airlines' Miami facility. Current simulators, controlled by digital computers, are more versatile than earlier, simpler models.

to the vanishing point, a single accident can upset everything.

But since 1940, the airliner has been a far safer vehicle than the automobile. In 1972, for example, it was about 13 times safer.

These days people tend to be leery of statistics—even those collected by a government agency with nothing to gain or lose by the results. The conviction that flying—all of it—is dangerous is in part the reason why half the American population has never been off the ground.

Airline crashes tend to receive far more attention in the press than the bare facts deserve. An accident causing a dozen passenger deaths can be front-page material for days, while car accidents claiming ten times the number of lives do not make much of a splash. When 155 people died in air accidents during 22 days of December of 1972, no newsman—to my knowledge—tried to keep matters in perspective by noting that 2100 lives had been snuffed out on highways during the same period. It may be that auto deaths—over 50,000 a year—have become a

mere commonplace while air crashes are still dramatic events.

Within the industry, such inequity is viewed with indulgence. So are the score of books published in recent years which claim that air transportation is sitting on a powder keg with a short fuse. The authors write about our antiquated airways system, take the Federal Aviation Administration to task and make dire predictions.

It is not so much that the revelations in these books are untrue but that the recommended safety proposals are unrealistic. To bring about the changes and improvements demanded by these writers would cost billions. Where's the money to come from, not to mention public support? New airports and updated radar do not rank high on the average taxpayer's list of national priorities.

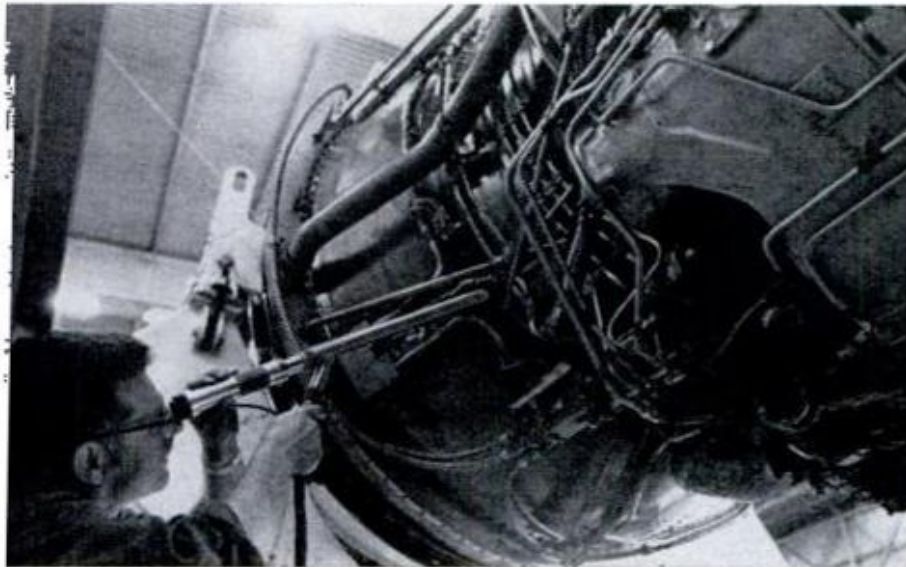
The layman who fears flying and finds no comfort in statistics may be ignorant of the many reasons why air travel is safe. It's not luck, as he often imagines. The modern airliner is designed to be safe, and to fail safe-

ly. This "fail safe" approach anticipates that every system and component of an airliner will eventually fail in service, no matter how carefully built and maintained, and provides one or more alternate ways to continue flight.

The failure of an engine during takeoff, the most critical time of every flight, is no cause for alarm. The ship can climb to a safe altitude, no matter what its load, and fly to a point 1000 miles away, if necessary. The complete loss of power from a jet engine is so rare that the average pilot never experiences such an emergency except during the routine checks when he must prove his ability to handle an "engine out" at lift-off.

Hydraulic and electrical systems are designed to overlap in the event of a failure. Should all hydraulic fluid leak out of a Boeing 707, for example, wing flaps can be lowered electrically and the landing gear manually. Normal engine reversing should provide sufficient ground deceleration; if not, emergency air braking is available. The

*(Please turn to page 184)*



**A Pan Am technician** uses an electronic borescope to probe the internal workings of a turbofan engine used on the Boeing 747 superjet. Each such engine has several borescope points to allow mechanics to make an inspection without taking the engine off a wing and disassembling it.



**Test cell** allows Pan Am technicians to "runup" engines that have been overhauled. The test cell can simulate various aircraft conditions and insures that an engine that's reinstalled is ready for flight. This eliminates need to put the engine on an aircraft and test it in actual flight.

# The 'Outback': Build-it-yourself camper for compact pickups

Your imported pickup, whether it be a Datsun, Toyota, Courier, Mazda or Luv, no longer need serve as just a compact truck. Thanks to the "Outback," it can now pinch-hit as a sporty weekend camper when you fit it with this lift-on-off cover or shell which you can build yourself from full-size

patterns or a kit of parts. The nifty little camper is shown here on a Courier pickup.

You have a choice of a 20 or 28-in.-high model. The 20-in. one is cab high, while the 28-incher is perfect for overnight camping or extended carrying capacity.

The least expensive kit, called the Basic

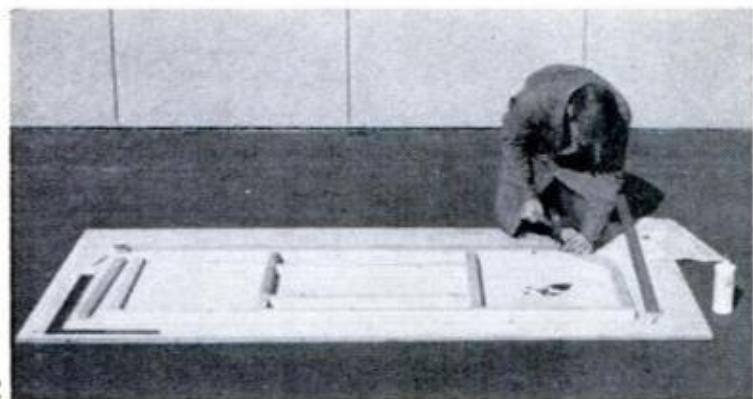


**Low-cost pickup camper shell** designed especially for the popular import trucks is available in kit form. How-to-order information is included in the text.



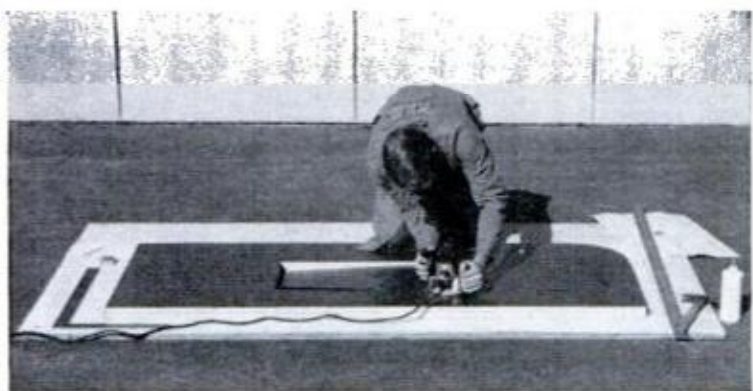
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**1. Walls are framed** with 1-in. members over full-size patterns. The various structural members are joined together using corrugated fasteners included in kit.



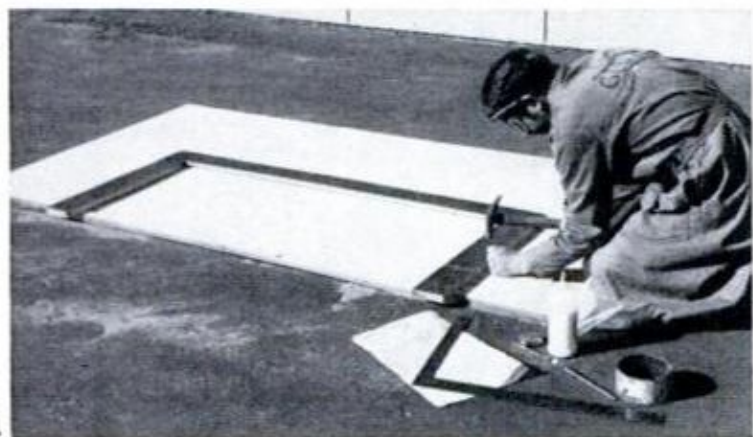
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**2. The opposite sidewall** is assembled directly on top of the initial one to assure their being exactly alike. At this stage, it's easier to work on the ground.



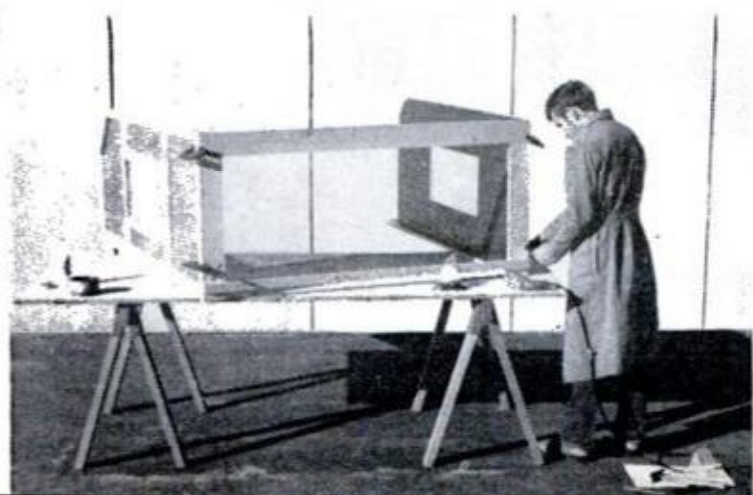
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**3. After cutting** prefinished interior paneling to fit, surfaces are coated with glue and panel is permanently applied using drive-screw nails that come in the kit.



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**4. Back wall** of the pickup shell is also framed with 1-in. pine and then covered with prefinishing paneling. Opening is for the door which is a full 54 in. wide.

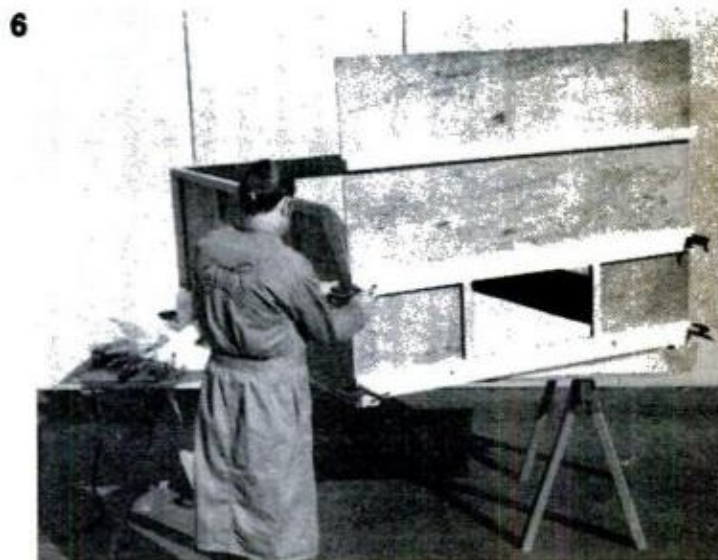


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**5. To assemble the back** and sidewalls, transfer the work to a pair of sawhorses fitted with several planks. Screws are used to fasten these parts together.

**6. Front and roof** are framed for openings, necessary beams are fastened in place before assembly to cover. Roof is fastened at bottom, gradually bent over top.

**7. Solid blocking** is installed between the beams. At the front, a contoured block is used, cut to the curve at the forward portion of the pickup cover.



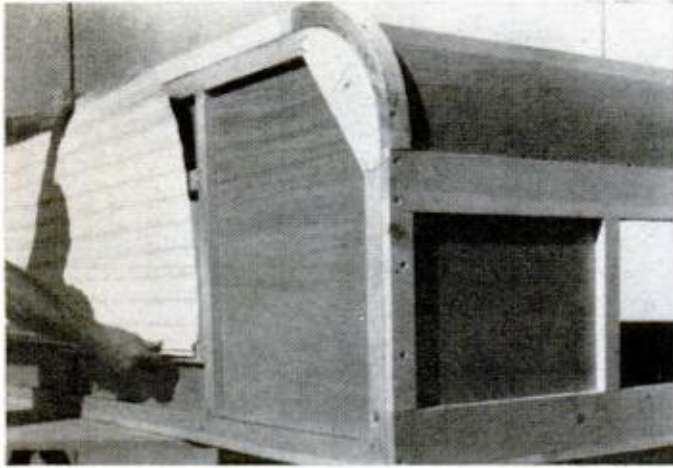
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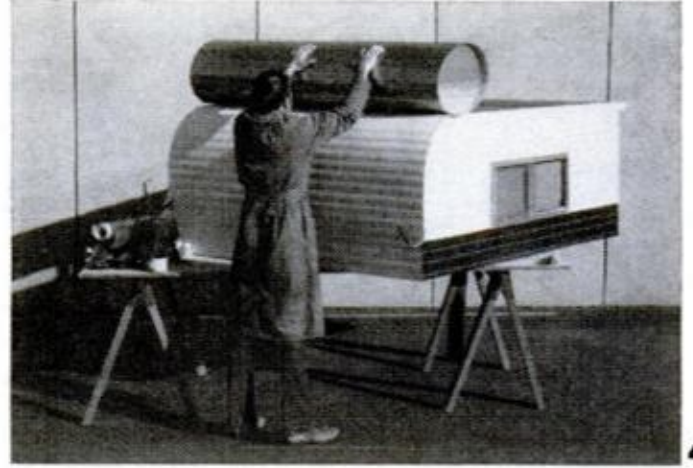
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Bargain, includes aluminum-skin parts pre-finished in gleaming white, roll-formed with all "Pittsburgh" seams installed, drip moldings predrilled for easy installation, putty tape and plated skin fasteners, plus corner beading (gimp) for all interior wall joints. The 20-in. model sells for \$60, the 28-in. for \$69 f.o.b.

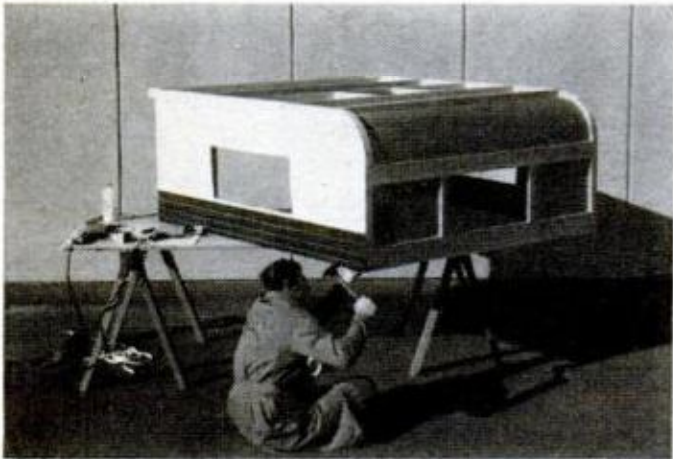
The Complete Kit provides window frames and additional parts—everything you need for building the cover except the wood and glue. The 20-in. version sells for \$110, and the 28-in. is priced at \$119. Available as an optional extra is a full-width custom door. Plans and patterns sell for only \$6.95 post-paid.



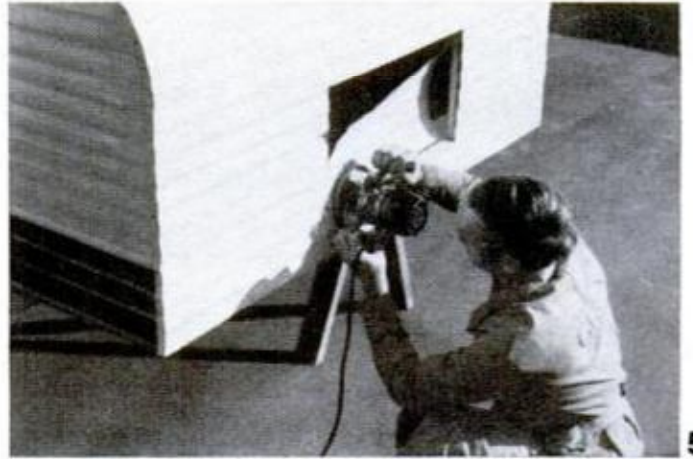
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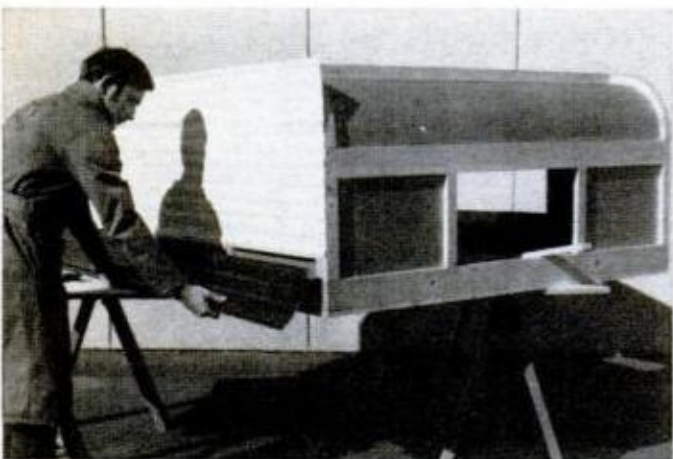
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1. The aluminum covering is pre-finished patterned sheets. The first sheet applied is the uppermost one. 2. The lower piece of aluminum inserts into a "Pittsburgh" type seam in the initially applied piece. 3. The aluminum is fastened only around the outer extremities with the lower portion bent under the cover at the bottom. 4. The front and top aluminum is in a continuous factory-joined roll and is started at the base

of the front wall and rolled back over the top. 5. Openings can be cut out with a router equipped with a panel bit or a sabre saw fitted with a metal-cutting blade. 6. Trim molding in the form of an aluminum drip strip covers the lapped junction of the side and roof aluminum covering. All required metal parts are prefinished white. On the 28-in. model, there is a dark wood-grain lower band.

The wood required can be bought at any lumberyard, and the step-by-step instructions which come with the plans will make the assembly relatively simple for any handyman. Plans and kits can be purchased from Glen-L Recreational Vehicles, Dept. PM, 9152 East Rosecrans, Bellflower, Calif. 90706. ★★

### 'Outback' Specifications

Length (overall) .....80-in. maximum  
Width (overall) .....62-in. maximum  
Height, interior .....20 or 28 in.  
Height, exterior .....22 or 30 in.  
Weight .....100 to 200 lbs.

Vehicle requirements: Any standard imported pickup truck with nominal 6-ft. bed. Variations can be made with plans and pattern package to suit virtually any similar size or type of truck.

Prices mentioned in the text are f.o.b.



**7. Windows** are bedded in putty tape to prevent water leaks. Excess putty is pushed into the window surround; and excess remaining is scraped off for neat appearance.



# Hot, new homebuilts for '74



The build-your-own-aircraft movement is growing by leaps and bounds. Here's a sampling of some of the latest examples—sleek, sporty and surprisingly sophisticated.

by Sheldon M. Gallager and Howard Levy

**Unusual fuselage design** gives this trim, two-place, enclosed-cockpit biplane low drag, high-speed. Called the Hiper Biplane, it cruises at 160 mph, lands at 55 mph, is fully aerobatic.

Twenty years ago private flying was supposed to be dead, killed off by growing commercial aviation, crowded airlines, soaring costs and the general impracticality of owning your own airplane on a 50-foot suburban lot. Then a startling thing began to happen. Sport aviation took off like a

rocket to the moon, and today it's become one of the hottest new hobbies around. Largely responsible for the booming interest in flying-for-fun is the rapid growth of the homebuilt movement, spurred on by the Experimental Aircraft Assn., an organization of do-it-yourselfers dedicated to pro-



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**1. Nostalgic reminder** of the old days is this perfectly scaled-down replica of a Curtiss P-6E Hawk, an Army pursuit ship dating back to the mid-30s. One of many biplane designs to show up this year, it's powered by a 130-hp Lycoming, cruises at 120 mph, has overall length of 16 feet and wingspan of 17 feet. Called Tiny Hawk, it was built by John S. Hill of Enid, Okla.

**2. One of hottest new homebuilts**, sleek low-wing monoplane at top right cruises at 220 mph, can hit up to 300 mph all out. Fully aerobatic, tandem two-seater features retractable tri-gear, is powered by 285-hp Continental. Length is 22½ feet; wingspan, 20½ feet.

**3. Souped-up Skybolt** has more power, shorter wings than prototype, giving it a faster roll rate for agile aerobatic maneuvers. Engine is 200-hp Lycoming; cruise speed, 135 mph; rate of climb, 1600 feet per minute. Wings span 22 feet—two feet less than original—and sport four ailerons for quick control. Modified design is the work of Dick Blair of Vincentown, N.J.

**4. Peeling off in smart bank**, flashily painted "Dude" is slightly modified version of popular Stephens Akro. Fully aerobatic, midwing single-seater cruises at 180 mph, climbs 3000 f.p.m., is hot competition performer.

**5. New Formula Vee racing class** is spawning a growing number of VW-powered midgets like two sporty jobs at bottom right. In background is Sonerai I, a slicked-up rework of Jeanie's Teenie built last year, showing what a little imagination can do. New this year is Sonerai II (front), a two-place tandem "stretched" version with VW power and cruise speed of 135 mph.

**6. Twin-tailed Mini Coupe** has 60-hp VW mill, low stall speed of 43 mph for barnyard landings and takeoffs. Complete kit, less engine, is \$1795 from Chris Tena Aircraft, 3700 24th Ave., Forest Grove, Ore. 97116.



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Photos: Howard Levy



moting safe, low-cost aircraft construction within the scope of home shop tools and skills.

Every year the EAA holds an air meet in Wisconsin called the "Oshkosh Fly-In." At the first Fly-In, held in 1953, some 20-odd homebuilts showed up. By the time of the most recent meet, the number had skyrocketed to 1120. EAA members now exceed 80,000, with 450 chapters in 53 countries all over the world.

So fast has the hobby grown that more than 4000 homebuilts have been completed and flown in just the past few years, and another 10,000 are under construction. A



**Believe it or not**, war-surplus aircraft wingtip tank forms fuselage of this tiny 65-hp single-seater—same tank used in PM's *Two-Man Sub* (page 94, June '71 PM). Sporting flaps and speed brakes, the Hawk is 15 feet long, has wingspan of 20½ feet, can hit 146 mph.



**Midget Mustang** incorporates such sophisticated features as folding wings (right, above) for road travel and electrically operated retractable landing gear. Powered by 100-hp Continental, it cruises at 160 mph,

has top speed of 230, can climb 1200 f.p.m. Length is 16 feet, 10 inches; wingspan, 18 feet, 10 inches. Built by Lloyd Butler of Norwalk, Ohio, it won Grand Champion Custom-Built Award at last Oshkosh Fly-In.



**It's a Sidewinder**, but if you don't recognize it it's because this latest version features retractable gear, giving it a slick new racy look as well as upping cruising speed 20 mph to 180. The side-by-side two-seater has 25-foot wingspan, 125-hp Lycoming powerplant.



**One of easiest to fly** is this low-stall, spinproof Zenith with electric flaps and all-moving one-piece rudder and elevator. Dual controls have novel single centered stick shared by both pilots. On 100-hp engine, ship cruises at 130 mph, lands at 53 mph, climbs 800 f.p.m.



**Needle-nosed beauty**, still under construction, will soon be available in kit form for home assembly. Dubbed the "Eos," it comes with 55 or 70-hp engine, can hit up to 200 mph, climbs more than 2000 f.p.m., has retractable tri-gear, is a "hot" performer.

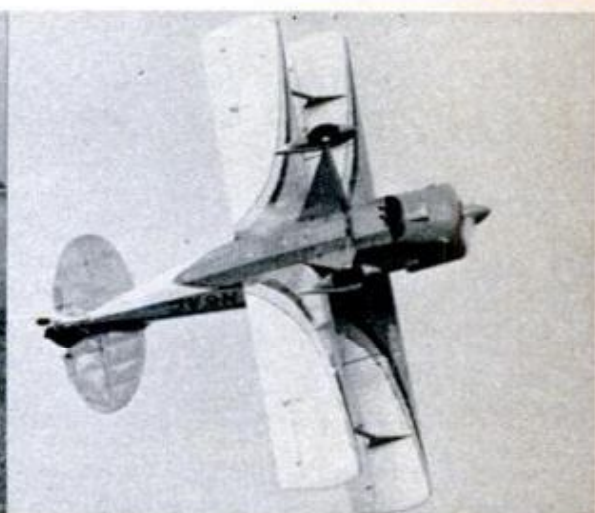
sampling of the newest and most exciting is shown on these pages. In future issues, *Popular Mechanics* will bring you more detailed information on many of them. Some can be built from available plans, some from handy kits sold ready to assemble into finished planes.

The reason for the success of the home-built movement is that for any do-it-yourself activity—you get something by doing your own work that would otherwise be impossible to obtain. The average home-built costs no more—and in many cases less—than what most people spend on a

*(Please turn to page 176)*



**Super-aerobatic sport plane** above is an original design by members of the Experimental Aircraft Assn. intended for advanced competition performance. Called Super Acro Sport, it's an outgrowth of EAA's earlier



Acro Sport, boasts a faster airfoil and added power—200 hp against 180 for the Acro. Like the Acro, the newer, speedier Super Acro is a four-aileron, single-seater biplane. Plans for both are available from EAA.



**Latest Bede homebuilt** is BD-6 (upper left), a low-power, more simplified version of the BD-4 and 5 designed for easy construction and handling by beginning pilot-builders. With 55-hp engine, the high-wing single-seater cruises at 140 mph, has flaps and low stall speed of 50 mph for short-field operation. Kit, with engine, sells for \$2200. Imp (lower left) is radical new design with inverted V-tail giving it strange "upside down" look. Intended for road towing on its own wheels, it has folding wings, retractable tri-gear, pusher prop with 120-hp engine. Unusual "shoulder-wing" craft (bottom) has high-level forward cockpit for good visibility in all directions. Called Whistler, the little 70-hp, VW-powered "pea patch" plane has a cruising speed of 90 mph, lands at 42 and seats two side by side.



# New boats for '74



Preseason previews and boat shows indicate that spring waterways will sport new craft that are more powerful, colorful—and costly. Larger hulls, 15 feet and up, will be of fiberglass; smaller fishing craft and cartoppers likely of aluminum or plastic. Well-made inflatables will grow in popularity.

The outboard horsepower steeplechase will take on new heat once expected changes are made by race-sanctioning groups to allow big (over 100-cu.-in.-displacement) development motors to compete again in unlimited classes. Small mills are enjoying big acceptance as added power for bass boats, trolling, emergency extras plus all-around push for smaller craft. Water-jet drives are an option in many boats as more enginemakers introduce somewhat improved squirt models. Stern drives lead the power parade in colder waters, but there is a swing to V-drive inboards down where the seas are salty, warm and corrosive.

We predict growth of twin hulls



Chris-Craft's neat fiberglass 25-foot Express Cruiser (above) has seakindly offshore hull, sleeps four, draws only 27 inches, offers 200-hp inboard engine, many options.

**Flashy mini-runabout, Hydro Stream Hustler** (at top) from W.E. Pipkorn Industries, is an 11-foot tunnel hull rated for 25 hp that can do over 28 mph with a Merc 20. Glasspar G3 (above) can take up to 95 hp pushing her 14 feet. Favored for towing water skiers, the speedster can also carry a load of 1150 lbs.

**Fancied up for fishermen**, this 14-foot john-boat from MonArk's new line is one of 35 aluminum flat-bottoms, semi-Vs, canoes, workboats and runabouts, plus 10 fiberglass models from the Monticello, Ark., firm.





**Glastron's biggest** so far, the handsome new V-254 Caribbean Command Bridge model has choice of single or twin I/O engines. Dual control stations, on flying bridge and in cabin provide big-boat maneuverability in a trailerable model. The craft sleeps two, has optional galley/dinette. Other models are V-250 Cruiser, V-253 Hardtop.

**Inflatables**, like new Sears Ted Williams six-man Super Strong being tested by Ted, are growing in popularity. Sears also has two, four-man-size models. Boston Whalers keep growing bigger. Newest is Revenge 21 (below) with open cockpit for fishing and cuddy cabin forward. Similar is Revenge 19.



**Tunnel-hull look** is feature of Dolphin Corinthian from Dolphin Sport Craft, North Chicago, Ill. The 17-footer has been timed at 40 mph with 85-hp outboard. Runabout is rated for 150 hp.



for sail and power alike. Catamarans add to planing speed for windjammers, though they can be more tricky to bring about. Tunnel hulls with twin sponson keels tend to reduce water friction and are showing up in pleasure craft as well as racing designs. But offshore where waves can lump up, deep-Vs still appear to be best. ★★★



**Wellcraft's Nova 21** is new slightly smaller model of style leader Nova 24. A deep-V offshore hull but with twin bunks forward, craft is rated for twin 140 I/Os.



**Convincer Model U** is Ouachita's name for 16-foot family and fishing boat. Rated for up to 95 hp, it comes in five colors and assorted fixture options.



**Silverline Nantucket**, designed by offshore racing champion Jim Wynne, provides seakindly hull, deluxe instruments, low engine placement, high performance.



**Deep-V with a cuddy cabin**, this new Glasspar V231 is a 23-footer with 8-foot trailerable beam, offshore capabilities and power from a stern-drive 188 Merc.



**Commander Express Cruiser** with fiberglass hardtop from Larson, new 21-footer with dinette, bunks in forward cabin can mount 225 OMC I/O, carry 2100 lbs.



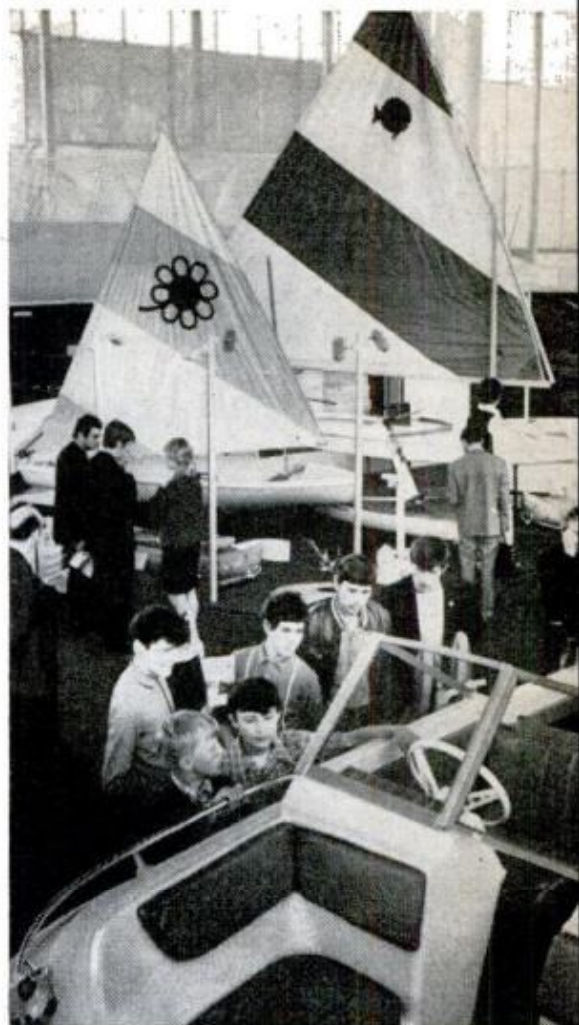
**Sizzler catamarans**, from Great Lakes Sports, Cleveland, Ohio, are now available in Ski-16, Super-16 and Seafire 18-foot models that also offer platform-power action.

# Outdoors America ... inside Russia

**G**ear we take for granted is collecting crowds in the Soviet Union. An exhibit titled "Outdoor Recreation—USA" is making a year-long Russian tour sponsored by the U.S. Information Agency and 187 cooperating American firms, government agencies and individuals.

A good look at a real ATV, sailing surfboard, snowmobile, scuba regulator, hang glider, backpacker's freeze-dried food assortment or a motor home should make U.S. recreation more understandable. Brand names like Chris-Craft, Voit, Coleman, Thermos, Bernzomatic, Cypress Gardens, Remington, Winchester and Evinrude are among the many represented. Displays include sports of all seasons, National Park tours and even the computerized reservation systems of motels. And equally important, according to U.S.I.A., are 22 Russian-speaking young U.S. guides who help explain our sports.—*Bill McKeown*

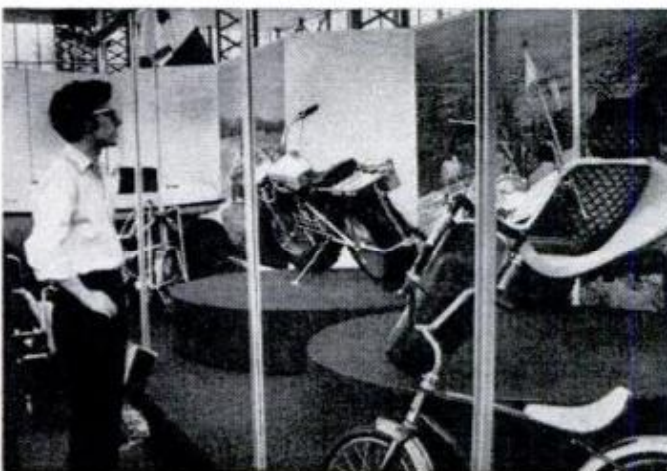
**Sailboats**—Snark Sunflower, AMF Alcort Sunfish (right)—and Chrysler 154 Courier runabout are examined by young Russians. More water exhibits came from Old Town, Hobie, Mad River, Stowboat.



**Recreational vehicles** showing our way of traveling are Winnebago Chieftain (above), Ford LTD and Pinto wagons, Dodge convertible, Playpac travel trailer, Skamper folding hardtop camper, Jeep Wagoneer.

**Winter action** displays have Arctic Cats (above left) and Skiroule snowmobiles, skis, snowshoes, sleds, iceboats, plus the latest in cold-weather gear from Sears, L. L. Bean, Hecht, Arctic Cat and others.

**Pedal and power bikes** attract attention in Russia just as they do here. Alspott Tri-Sport three-wheeler, a Rokon Trail-breaker, Attex ATV, Raleigh and AMF Wheel Goods bicycles prove popular.



# A long way from popping wheelies!

In the wide world of motorcycle competition you can choose to run any conceivable kind of race—slow, fast or up to your hubs in mud—but you'll need more skill than it takes just to lift a front wheel on your neighborhood street.

by Charles R. Self Jr.

In motocross competition, a rider must beat a long, hard, dusty trail to victory. This type of racing is fast becoming one of the most popular spectator sports in the United States.



Forget baseball. Motorcycling is the national pastime in the United States. Twenty million bikes are the proof. With the astounding growth of the motorcycling population in this country has come an equally astonishing growth in the popularity of motorcycle competition of all kinds. More than half the riders are unlicensed and do not use the roads at all—many competition riders never bother to get road licenses. Many noncompetition riders just don't want to ride on the roads—over 50 percent of the motorcycles sold this year will be off-road models, only minimally if at all suited to road use.

So the huge numbers of interested people are there. And a great many of these riders, whether expert or novice, go to races which are sanctioned by the American Motorcycle Assn. (AMA). Many people who wouldn't ride a motorcycle on a bet also go to races.

The variety of competition is staggering. Road racing. Mile. Half mile. Short track. Motocross. Desert racing. TT (steeplechase). Enduros. Observed trials. Hill climbs. All are increasing in popularity. And each differs markedly from the others (with the exception of mile, half mile and short track) unlike auto racing in which the major difference is often the size and power of the cars.

Equipment differences are important in motorcycling, too. Gone are the days when a National Expert could take his BSA 500 to Daytona, change the gearing and have a shot at winning—sans fairing, almost dirt tracking the corners, longhorn handlebars clanging against other machines. Now the sliding machines are saved for the dirt tracks, and the road racers are sophisticated 100-hp bombs, weighing in at about 350 pounds and frightening to listen to and watch. Top speeds are now touching



170 mph, and lap speeds over 100 mph on tight tracks are common.

Yet, for all this, road racing takes up only about one-fourth of the two dozen or so Grand National Trail races each year. Dirt track—mile, half mile, short track—requires high horsepower, too, but a different machine must be used. The rider will be broadsliding the corners, not usually topping 130 mph in the mile, and fairings are not important. What matters is having a good amount of steering lock and long, high-leverage handlebars. Now each type of racing requires a different motorcycle. Gone also are the days when a top rider, AMA No. 1 for the year, was lucky to take \$10,000. Now the total for No. 1 is almost sure to top ten times that amount.

Some motorcycle competition doesn't involve high speeds at all. Observed trials—the art form of motorcycling competition—seldom requires speeds over 10 mph. The

art is in getting over the worst ground in the world without ever stopping or putting a foot down for support!

### The Grand National Trail

Basically, three types of racing make up the American Motorcycle Assn. Grand National Trail: road racing, flat track (both mile and half mile) and TT races.

### Road racing

This is the worldwide motorcycle sport most familiar to the average nonrider and one of the most colorful and exciting because of the grace, power and speed involved.

Road racing under AMA rules is in two classes: up to 250 cc (360 cc with four-stroke engine or two-stroke single); and up



Road racers wind down through the "corkscrew"—a series of quick esses in the Laguna Seca circuit.

to 750 cc. Novices are limited to the light-weight class; national experts run the big machines. Fairings are used to cut down wind drag and extreme angles of lean are the order of the race as riders jockey for position in and out of turns. Most such road races (all in the United States and Canada) are now held on special courses. Soon, all open-road courses will disappear. The Isle of Man is the site of a Tourist Trophy race over 36 miles of its roads (per lap!) each year.

Horsepower figures are not generally



available, but the big machines can produce 90 to 110 hp, with top speeds around 175 mph in the straights—often not much slower in banked curves! Smaller bikes will run over 145 mph flat out, depending on gearing. Mistakes can be painful—Mert Lawwill, 1969 Grand National champ blew a tire at over 140 mph on the banking at Daytona during tire tests. The resulting crash did a fair country job of messing up his left arm and hand. He's back now, ranking No. 4 for the 1973 season, but the fight for AMA No. 1 plate for 1974 is over: Kenny Roberts on a Yamaha sewed it up.

Great brakes—usually dual discs in front and a single disc in the rear—have made the monster racers safer than ever. So has the great advance in suspension art. Muffling is not yet required for road racers. So engine tuning to the nth degree is the rule. AMA-sanctioned championship events must be 50 miles or more in length—all are at least 75 now. Expert and Junior riders can also ride in the combined lightweight race. Novices must run only the lightweight class, but get a separate race.

The AMA National Championship standings for the season determine riders' plate numbers for 1974. Here are the top 20: 1. Kenny Roberts, 2. Garry Scott, 3. Gary Nixon, 4. Mert Lawwill, 5. Don Castro, 6. Rex Beauchamp, 7. Dave Aldana, 8. Dick Mann, 9. Jim Rice, 10. Ken Carruthers, 11. Gene Romero, 12. Yvon Duhamel, 13. James Evans, 14. Gary Fisher, 15. Scott Brelsford, 16. Randy Scott, 17. Chuck Palmgren, 18. Steve Baker, 19. Dave Sehl, 20. Terry Dorsch.

Roberts set a new high with 1959 points; previous high was Mark Brelsford with 1483 in 1972. Mark has been recovering from a bad spill he took early in '73.

The top five bikes and points are: Yamaha, 2746; Triumph, 1633; Harley Davidson, 1460; Kawasaki, 1132, and Suzuki, 741.

### Flat track

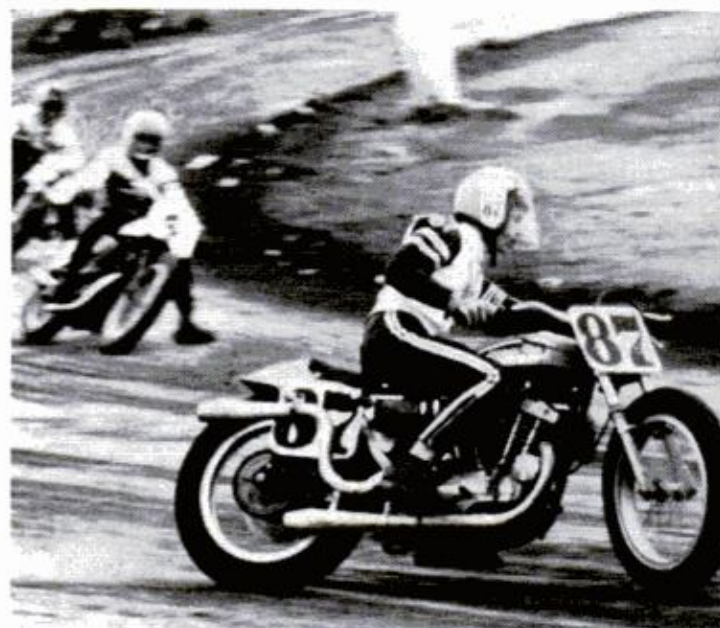
Mile and half-mile racing on dirt flat tracks is the heart of the Grand National scene. It's also a heart stopper for the spectator with its screaming, thundering slides and high speeds—especially in the mile. The riders are on 750-cc machines (or over 251-cc according to the rules). Novices are limited to 250-cc multis (two-stroke) or 360-cc singles (two-stroke) and multis (four-stroke).

All machines must be muffled to 92 decibels on the A scale—still loud enough to

make the noise part of racing, but not so loud as to wreck the ears of riders, spectators and neighbors.

Speeds in these races, as in all others, depend on the courses. Some courses are a great deal faster than others, while the others are more spectacular because of the styles they allow. A "blue groove" track can be boring—or as boring as any race can be where the rider is touching 100 mph in the curves with a concrete wall on the outside! Riders on groove tracks usually have to stay pretty close to a single line or they lose speed badly in the corners.

On the looser surface tracks, spectacular slides are more usual, with more passing in the curves, since there is little difference in speed up high or down low on the curves. It's this passing in corners that make the looser surface tracks more exciting for spectators. The riders ram down the short straights in a wind-cheating crouch, suddenly sliding forward on the seat as the corner comes up. The left leg goes down and the racer rams the handlebars to the left,



Fancy flat tracking is an easy exercise for Mark Brelsford, who ran the AMA No. 1 plate in '73.

throwing the machine into a thundering, dirt-throwing slide at 100 mph, with another man right beside, possibly with that other rider's handlebar grip almost in his belly!

No fairings. Minimal brakes (not used except to set up for the corners). Fantastic skill. Edge-of-the-seat racing for the spectators. That's at least part of the reason that half of the 24 Grand National races for 1972 were miles or half-miles. Eight of the 19 events for 1973 followed the pattern

and even more—back to the 50 percent mark or better—are scheduled to go on in 1974.

### Short-track racing

This is similar to flat-track racing except that the machines and tracks are shorter. The courses must be no longer than 2250



**Short tracking indoors** at Houston, almost laying down his Yamaha, is Kenny Roberts, No. 1 plate for '74.

feet measured from the pole. All two-stroke multis are limited to 250 cc and other equipment can be no larger than 360 cc.

### TT racing

TT racing again demands slightly different configurations in the machinery: Expert and Junior riders are limited(!) to machines up to 900-cc displacement. Novices face the 250/360-cc restrictions otherwise imposed. Experts may run in lightweight (0-250-cc) or heavyweight (251-900-cc) classes, though if a lightweight class is not scheduled, the event must be held as an "open," which allows any size motorcycle up to 900 cc. The course will have both right and left-hand turns, and a hill or jump if at all possible (I've never seen a TT course without a jump). Course width must be no less than 15 feet at any point.

Speeds in TT races will vary, possibly more than in any other Grand National racing. Slow corners must be negotiated, sometimes at 15 or 20 mph, while high-speed straights can see 100 mph or more depending on class and length. Good brakes and smooth gearboxes are essential as strong slowing action and fast up and downshifting



**Scrambles TT jump** at Schenectady is all in a day's sport for Gordon Kirby on a 175 Ossa Stiletto.

are very important in staying upright and winning. Most TT courses are hard-surfaced dirt.

### Motocross

One of the fastest growing sports in the country is motocross. Five years ago, the purses were in the \$800 range, and there wasn't an American rider around who had any chance to whip even the mediocre Europeans at MX (after all, they invented this particular form of punishment). For 1973, the AMA sanctioned motocrosses with prizes up to \$18,000.

The purses still aren't in the range of motorcycle road races, but they soon will be. When Marty Tripes, 17-year-old Honda team rider, won his second Los Angeles Coliseum of Motocross this year (his first win was also his first race as a pro—at 16!), he did it in front of 40,000 spectators. From the days of Barry Higgins in the East and John DeSoto in the West, factory teams have grown much larger and stronger: Brad Lackey (top 500-cc American for 1973); Jim Pomeroy (the first, and to date only, American to win a European Grand Prix—Barcelona, Spain, Apr. 8, 1973, and it was his first 250-cc Grand Prix ride!); Jim Weinert; Mike Runyard; Gary Jones (top American, 250 cc) and many others now—as well as Barry and John who are still riding.

Motocross is a relatively simple sport: A course of about one mile is laid out over the terrain available. There will be hills, jumps, potholes, washboard ripples, off-cam-

ber turns, possibly one high-speed straight, much mess and a lot of dust or mud. The guy who gets around fastest in either two

good spot may provide a view of as much as 75 percent of what's happening.



**Motocross champion**, Roger de Coster of Belgium, hangs ten on uphill bend with thousands of fans watching.

or three heats wins overall. That's it. The heats are called motos and will be 30 minutes long if there are three and 45 minutes long if there are two (which is the usual international Grand Prix style).

The motorcycles have close-ratio gearboxes, powerful yet relatively flexible engines, immensely strong frames and good brakes. The bikes are narrow at the tank and seat—it's always necessary for the rider to clamber around to maintain control and the narrowness makes the clambering easier. Tires are huge knobbies. Total weight of most competitive MXers is about 215 pounds or less. Many are now down in the 190-pound range and grinding out a reliable 30-34 horses. Acceleration is startling to say the least! Top speed isn't unusually high—low gearing is needed to get around wet, steep, messy courses.

Actual top end is no more than 80 or 85 and the bike may hit that speed in about one race out of five. The thrill is in the superb action at what we today consider low to moderate speeds. But don't fall off at 50. Bones still break, no matter how distorted our sense of speed has become since 10 mph was thought frightening—not all that long ago. Motocross is one of the most rewarding styles of competition from the spectators' viewpoint: You can get within a few feet of the action and a single

## Enduros

Motorcycles which ape motocross bikes in looks are used in another off-road event: enduros. The bikes seem similar but there are differences: Transmissions are no longer close-ratio, but develop long leaps between gears. Engines are detuned, with 250-cc bikes rated at 24 to 28 hp. The bikes are heavier, because skid plates under the engine cases have been added, as have lights, a larger tank and seat and, usually, wider handlebars. Considering engine tuning, though, it needs remembering that a detuned Ossa SDR (enduro bike) grinds out 24 hp, while the soon to be available Ossa Phantom (motocross) has about 33 ponies. Both engines displace 244 cc, or a shade under 15 cu. in.

An enduro is laid out over backwoods trails, through swamps and other types of mire, down what seem to be sheer cliffs and up the other side, over logs, boulders, shale, sand and what-have-you. All the while a rider maintains an average speed of 23 to 26 mph, making all the correct turns needed to stay on course and not crashing badly enough to put either himself or the motorcycle out of contention. Time checks are spotted at certain areas along the course and you're off your medal if you drop 60 seconds off your "key" time. Key time is the time you started, plus the correct number of minutes to hold your average speed to that particular check.

Enduros are probably best for the beginner, next to observed trials. You basically compete against yourself and a clock. If you wear out, it's easy enough to pull up and rest. If you do crash—and almost everyone does, including Malcolm Smith and Charlie Vincent, two of the best enduro riders in

**Enduro path** through the thicket is a challenge to an unflinching coordination between man and machine.



the world—you're not too far from help.

Most enduros for novices are scaled down versions of the experts' torture runs. Motorcycle preparation is not as rigorous, nor is the physical conditioning necessary. For the tough ones like the Berkshire Trials and the International Six Days Trial, riders will prepare as much as eight months in advance (particularly for the I.S.D.T.). Charlie Vincent runs two miles each day, does more exercises than I want to count and then goes out and rides the difficult woods areas for several more hours. The beginner will be happier—and less sore—if he gets at least part way in decent shape, but the sharp tune isn't essential right away.

For those interested in motorcycle competition in the United States, it is essential to join the American Motorcycle Assn. For noncompetition riders, it's a good way to keep up with what's happening on the road and for the competitor. The AMA is the sanctioning body writing the rules.

### **Trials**

For the slowest motorcycle competition, this is the way to go. Observed trials has yet to sweep the country, but it's getting a rolling start and the sweep is coming.

It's a simple sport: a course of several sections is laid out in the roughest of terrain. Turns and climbs are made barely possible—sometimes just barely for even World Champion Mick Andrews. If there's a two-foot log, a three-foot boulder and a five-foot sheer drop in the path, they remain. The object of the meet is to get through each section without stopping or putting a foot down or going out of bounds. The rider with the fewest points—one for each dab, more for going out of bounds or stopping—wins.

For those who enjoy incredible feats of control, trials is it. Many experts can pull up to a stop, shut the bike off, climb over the front wheel and back into the seat, restart and drive away without touching a foot to the ground. Or they can loft that front wheel and hold that wheelie until you get tired of watching.

Trials bikes are excellent for the beginner, since they have very tractable power (most are detuned 250s with about 17 or 18 hp and gobs of low-end power) and are very light in weight (mostly 201 to 205 pounds). Yamaha has Mick Andrews advising it on trials-bike design and it even has a mini version for the small fry to start on. Kawasaki has hired Don Smith, the

British champion, as its designer. Suzuki has a new beauty called the Exacta RL-250. Three small Spanish factories reign supreme, but whether Ossa, Bultaco and Montesa can hold the line now that the big bucks are arriving is problematical.

Requirements for a good trialer are well known, but not that easy to put in practice. Weight must be minimal. Frame geometry and footpeg placement must make it easy to loft the front end and to clear obstacles, but the machine must retain enough stability to prevent backflips every time

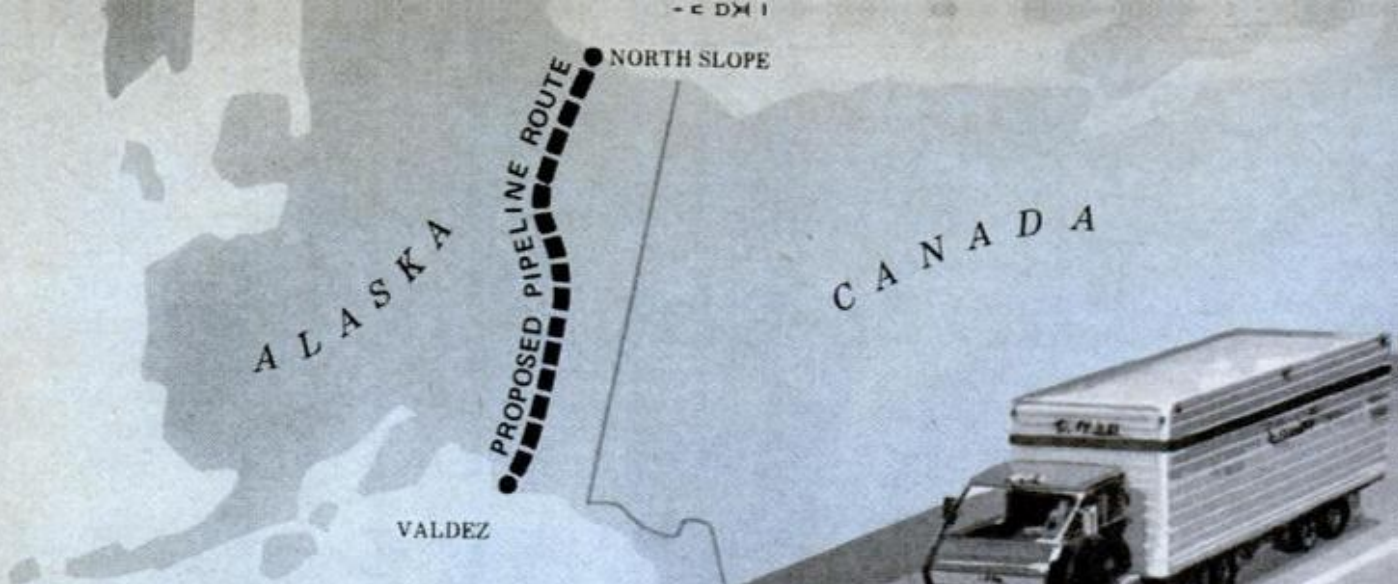


**Observed trials** champion, Mick Andrews, puts a foot down as log unexpectedly crumbles under his machine.

the throttle is snapped open. The seat can be small and hard, since most riding is done standing up. Tires are block pattern, carry only five or six-pound pressure to increase traction over wet rocks and the like.

Frame tubes can be very small as the machine won't have to take a high-speed pounding, but for falls the frame must still be sturdy. Steep fork angle and lack of trail make turning circles tiny, but the bike is also just about totally unsuitable for use of 40 mph since the quick steering becomes excessively twitchy then.

That's the major world of U.S. motorcycle competition today. Not all sports are included because some aren't spectator sports (desert racing), others are mostly confined to one area (speedway) and others are hard for the average person to locate (hill climbs) without really getting to know some people in the sport. To get involved and meet some of those people, contact the American Motorcycle Assn., Box 141, Westerville, Ohio 43081. ★★★



300-FT. PRECAST SECTION  
HIGHWAY



RAPID-TRANSIT SYSTEM

WINDOWS



SUSPENSION CABLES

OIL PIPELINES

CONCRETE PIER

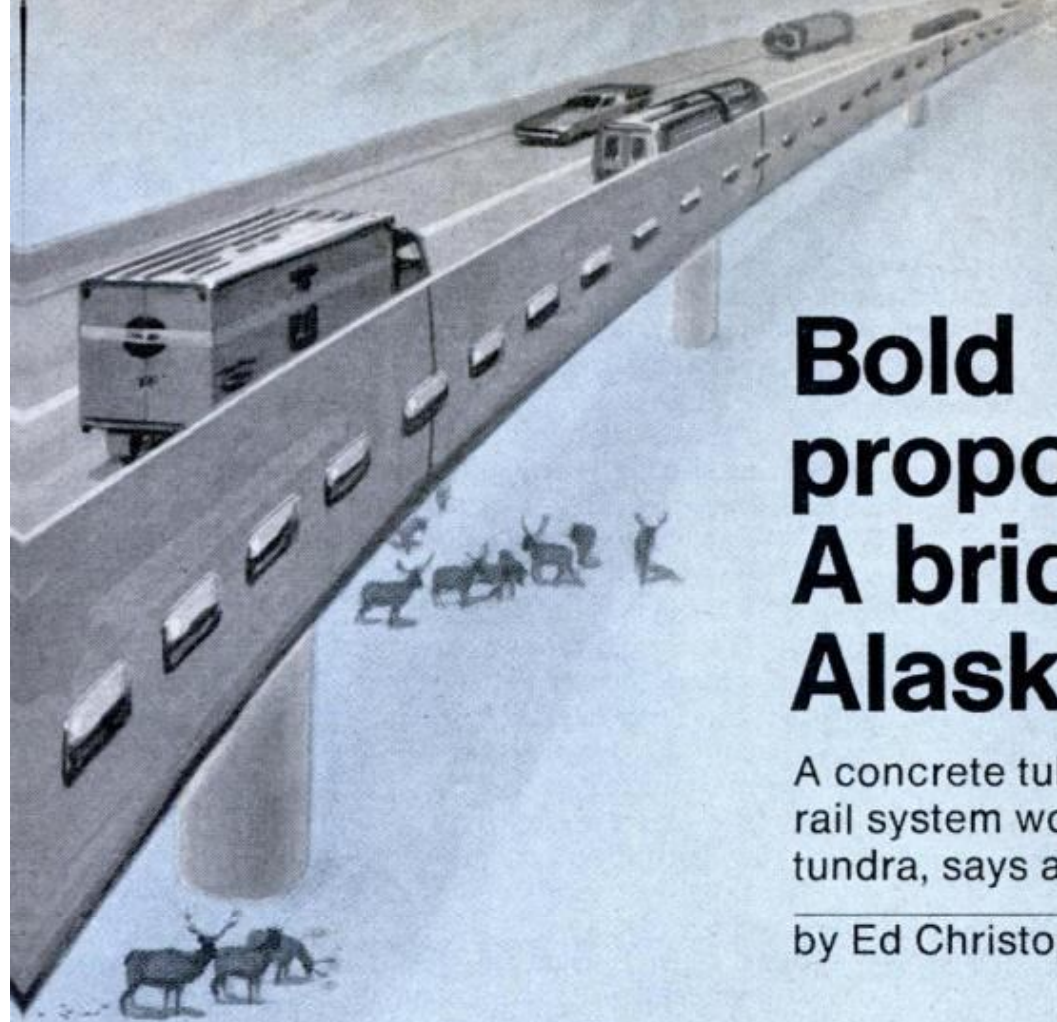


ENERGY-ABSORPTION PAD

AGGREGATE FILL



*R. Grinnell*



# Bold proposal: A bridge for Alaskan oil

A concrete tube for pipelines and rail system would save the arctic tundra, says a noted engineer.

by Ed Christopherson

The huge oil reserves on Alaska's North Slope—estimated at from 10 to 30 billion barrels—have bred controversy since their discovery in 1968.

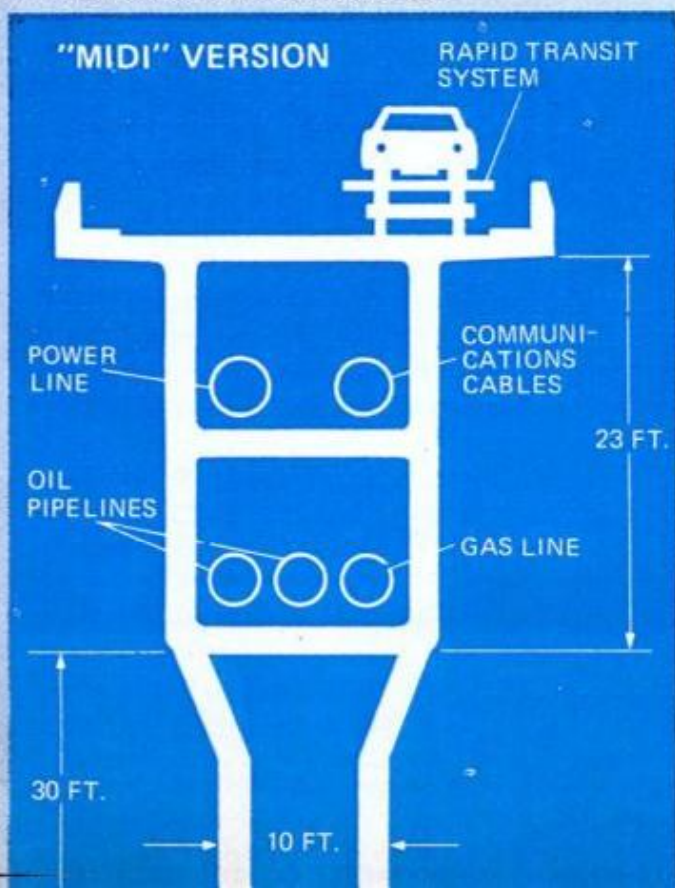
Because Prudhoe Bay is icebound for most of the year, the oil can't be taken out by conventional tanker. Thus, the oil companies developing the area plan to build the Trans-Alaska Pipeline System (TAPS) to move the crude across the state's landmass from Prudhoe to the ice-free port of Valdez—on the Gulf of Alaska about 100 miles east of Anchorage. From there it would be shipped to the lower 48 states.

For years, oil men and ecologists have been at loggerheads over the proposed pipeline. At this writing, it seems the oilmen, with an assist from the energy crisis, have all but won the battle. Bills to permit the building of a pipeline have passed both houses of Congress.

By the time you read this, it's likely that the President will have signed a bill into law.

But that won't keep the environmentalists quiet. They warn that the pipeline could damage the permafrost through heat transfer, cause further pollution through oil leakage and obstruct the migration of the caribou. The relatively unfouled Alaskan en-

Two levels of traffic would be accommodated in the "Maxi" configuration of the Integrated Pipeline Transportation system. Top-level highway could be converted to a second rail system. More modest version of the IPT is shown below in cross section.



## 789-mile bridge . . . 30 feet above ground

vironment could be seriously affected—and not for the better.

Is there an alternative?

Perhaps the most imaginative and comprehensive proposal is the Integrated Pipeline Transportation (IPT) system, the brainchild of T.Y. Lin, a Chinese-born civil engineer recognized as one of the world's leading designers of prestressed concrete bridges and buildings. Lin is on the faculty at the University of California, Berkeley, and a busy consultant.

The TAPS approach represents conventional engineering and, to Lin, is "yesterday's way to build an oil pipeline."

According to the Department of the Interior, which has the responsibility of okaying the pipeline, about half the length of the 789-mile TAPS pipe would be buried, the other half supported above ground at heights of from two to eight feet.

In contrast, the IPT would be a tubular concrete structure supported at 300-foot in-

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**Big tube could accommodate as many as six pipelines and also function as a transportation artery.**

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tervals by bridge-type piers. The big tube could accommodate as many as six pipelines and could also function as a transportation artery. Its upper deck, or decks, could be used by autos, trucks and/or an electrified rail system.

In effect, the IPT would be a 789-mile bridge from Prudhoe to Valdez 30 feet above ground along its entire route.

If you ignore environmental aspects, a conventional pipeline seems the cheapest and best solution to the need of getting Alaskan oil to market. But when the land is the Alaskan Peninsula, and the route crosses three mountain ranges, 350 rivers and streams, and runs through permafrost and across earthquake faults, the project becomes an engineering nightmare.

The climate is hostile. In the extreme north, the sun is not seen for almost two months a year. Temperatures can drop to minus 80°F. in interior areas and winds of 40 mph are common.

Permafrost is the name for soil and sedi-

ment, often with a high water content, which in the arctic becomes perpetually frozen ground. At the northern oil fields the permafrost is some 2000 feet thick but thins out further south, eventually disappearing.

Permafrost is stable but, environmentalists say, will melt from the heat of the 140°F. oil pumped through a pipeline such as TAPS. (The oil must be warm to keep flowing.) In that event, sections of the pipeline would eventually be floating in a slurry instead of being supported by anything solid.

Ice wedges—massive vertical veins of ice which form tight polygonal networks invisible from the surface and difficult to delineate through borings—are another widely distributed permafrost hazard. The thawing of ice wedges, according to a U.S. Geological Survey study, could also cause settling, resulting in shearing stresses in the pipe.

Shearing stress—a term for forces that can snap a pipeline—also can result from earthquakes. Seismic vibrations could cause loosely packed sands and silts to liquefy, leaving stretches of pipeline unsupported.

This possibility becomes a serious threat to a pipeline with a route that crosses seven fault zones, three of which are highly active. Hundreds of earthquake shocks are noted in Alaska every year. Much of the \$300 million damage of the 1964 Alaskan quake occurred in the vicinity of Valdez, the southern terminal of the TAPS line.

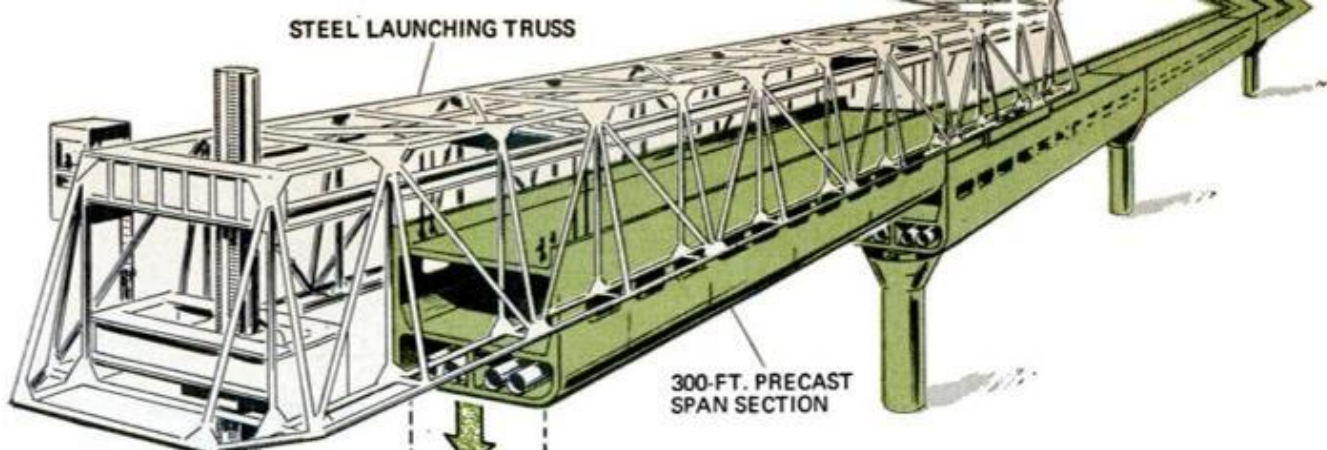
In an attempt to limit the size of possible oil spills, TAPS engineers have included a system of check and block valves so no more than 64,000 barrels of oil are likely to escape from any point in the system.

In spite of elaborately detailed contingency plans to staunch and clean up oil spills, pipeline leaks could do serious damage to vegetation and streams, and destroy important fish spawning grounds hundreds of miles downstream.

Lin's IPT system is designed to avoid or contain the various hazards. Permafrost is no obstacle to IPT construction because in its frozen state it provides a solid, rock-like bearing. Fifty-foot pier holes would be sunk with rock-drilling rigs with 10-foot-diameter bits. When a hole is ready, the pier—a

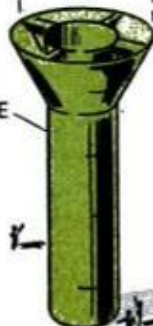
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### STEEL LAUNCHING TRUSS

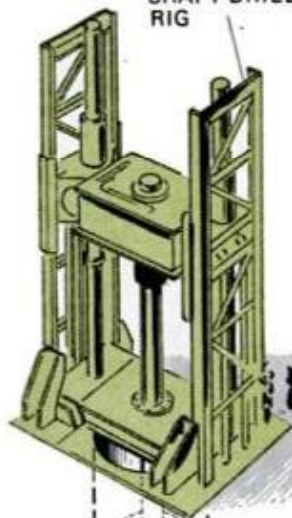


300-FT. PRECAST SPAN SECTION

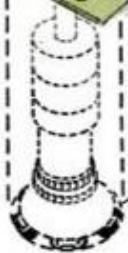
PRECAST CONCRETE PIER



SHAFT-DRILLING RIG



LARGE-DIAMETER BIT

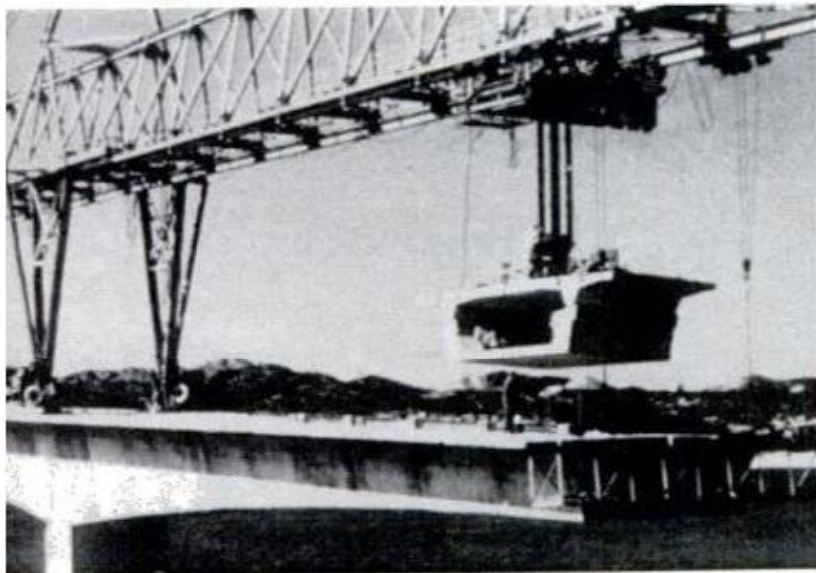


### CONSTRUCTING IPT SYSTEM

A method similar to that used in launching bridges over rivers would be employed. A cantilevered steel truss moves forward as construction progresses, dropping piers into 50-foot holes and easing precast span sections into position. Both piers and span sections would be fabricated at plants located at 40-mile intervals along the route. The launching truss and the fabricating plants would be weatherproofed for year-round operation in Alaska's rugged climate.



Special drilling rigs such as that shown in drawing could be used to dig the holes required by the big piers. In soft ground, large-diameter holes can be drilled in a single operation, though this would not be the case in Alaska. Shaft shown above was cut with a 10-foot-diameter auger. The bridge-launching method the inventor proposed for his IPT system is seen in operation (left) during the construction of a river-spanning bridge in Italy.





# IT'S NEW NOW



## Waterborne 'motorcycle' hits speeds up to 30 mph

You skim along the water at speeds up to 30 mph in this new one-man recreational craft called Power-Ski. Capable of exciting banking turns and wave-hopping jumps, the 7-foot-long fiberglass hull is powered by a 20-hp engine and planes on two stern fins plus a steerable front ski. A 3½-gallon gas tank gives the 195-pound midget racer a two-hour fuel supply and 50-mile range. Novel waterborne "motorcycle" is \$1395 from Power-Ski Corp., 5500 North Northwest Hwy., Chicago, Ill. 60630.

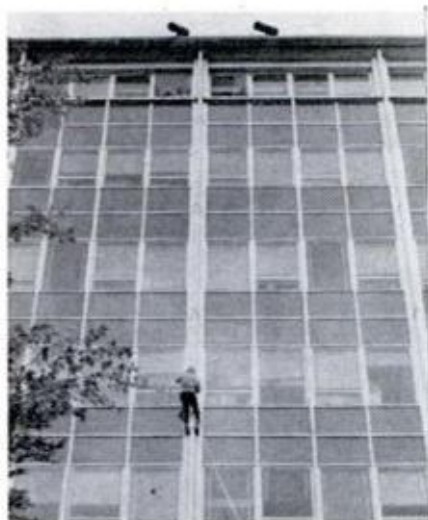
## A daring young man on his flying ice machine

While other skaters plod along on their own leg power, 18-year-old Sebastian Heinsdorff of Irschenhausen, Bavaria, breezes past them in his homemade prop-powered "skatemobile." The unusual machine was constructed from an old bicycle frame with two rear runners and a third welded to the front-wheel fork for steering. The pusher prop, enclosed in a circular shroud for safety, is driven by a motorcycle engine. Heinsdorff hasn't devised a way to clock his speed, but says his ice flier sure beats pedaling on land and skating on foot.



## 'Flying' Rolls-Royce

It's made of Rolls-Royce parts but doesn't look like any Rolls-Royce you've ever seen. John Dodd of London put an 1800-hp war-surplus Rolls-Royce Spitfire engine in a Rolls chassis to get this 200-mph hybrid. Cost: \$36,000.



## Portable fire escape for personal use

In the wake of recent tragic skyscraper fires comes an emergency escape device designed to let trapped occupants lower themselves down the outside of a burning building when inside exits are blocked. This device consists of two spring-loaded braking rollers through which a line runs and a sling to sit in. The roller brakes automatically lower the sling at a fixed rate of two feet per second. Being inexpensive, the slings could be stored on each floor like life jackets in a boat, ready for instant use. They're the invention of New Orleans architect Albert C. Ledner.



## Have gas, need car

California college student Nancy May has found a surefire way to get lifts home or to school. When hitchhiking, she always carries a can of gasoline and a sign "Have Gas." Gas-nervous motorists getting low on fuel rarely pass her by, she says.



## 'Feelie' money

Three raised dots tell a blind person by touch that this bill is a Dutch 10-guilder note. The system is being tried in Holland, the first country to introduce paper money the sightless can "see." If it is successful, other denominations of bills will be similarly coded.



## Phone call tracer

Tracking down phone calls usually takes too long to be of much help in catching persons making obscene calls, bomb threats, kidnapping ransom demands and the like. With this new electronic tracer, however, a caller's number shows up on a lighted display the instant you answer the phone, revealing call's origin. Device can be used with any phone, is made by Telident, Inc., 304 South Broadway, Los Angeles, Calif. 90012.



## Amphibious camper for road or water

You can lead this camp trailer to water, then make it swim, too. Towable on its own wheels, the amphibious camper can be rolled right into any lake or river you come to to double as a family houseboat. The 16-foot-long, 1600-pound Caraboat has sleeping quarters for four, galley and bath facilities, built-in stern drive and forward pilot cockpit. It's made by Carabot, Ltd., Sutton-in-Mansfield, England.

## Tape player for home or car

You can enjoy your stereo car tapes at home as well as on the road with convertible system sold by Montgomery Ward. Home unit (right) has a bracket to hold the tape player, two built-in speakers and a power supply for use on house current. Complete system includes player, home adapter and extra bracket and speakers for car, is \$99.95.



## Formation of homebuilts

You rarely see a sight like this—five homebuilt Thorp T-18s in an impromptu get-together at a Midwest air meet. (If their formation isn't quite as perfect as it might be, it's because it's the first time this many homebuilts have attempted simultaneous flight together.) Since first published in *PM* (*Thorp's Two-Seater*, page 91, Feb. '73 *PM*), the T-18 has become one of the most popular build-it-yourself aircraft with 200 completed or under way. Plans for the sleek little two-seater are \$150 from Thorp Engineering, Box 516, Sun Valley, Calif. 91352.

## Safe, flameless heat speeds home and shop jobs

Electric heat gun provides temperatures up to 1000° F. for such jobs as softening, thawing, drying, curing and shrinking—wherever safe, flameless heat is needed. Two models—with ring stand for \$62.15 and without stand for \$52.15—are sold by Eddy Products, 15255 Watertown Plank Rd., Elm Grove, Wis. 53122.



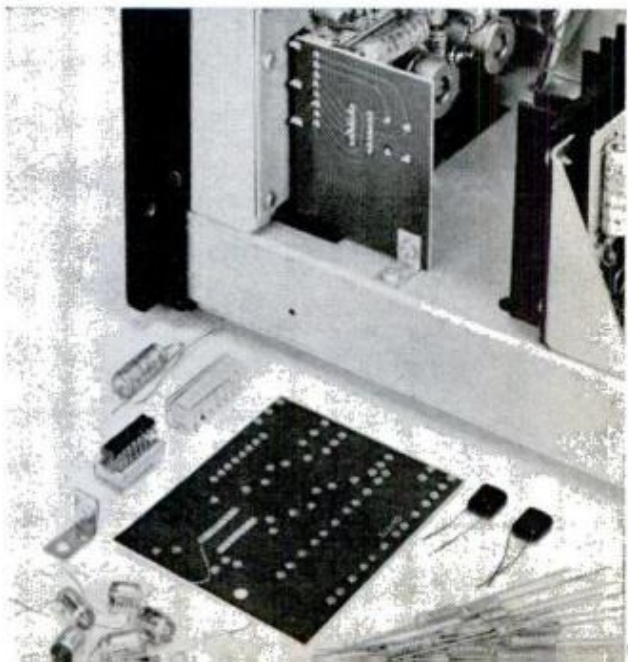
## Updating Heath's decoder to SQ

If you own one of the earlier Heathkit 4-channel amplifiers (AA-2004) that did not include the newer SQ decoder circuitry, you can add it now. A replacement decoder board incorporating the latest decoder circuitry is available in kit form from Heath Co., Benton Harbor, Mich. 49022. The current model—the AA-2010—already comes with the new circuitry built in.



## Versatile shortwave receiver kit

If you like to listen to shortwave, but don't want a strictly ham-type receiver, this versatile Heathkit set is a good choice. It provides standard commercial AM reception and international shortwave broadcasts on nine switch-selected bands from 3.5 to 21.8 MHz. Accessory filters let you receive CW and SSB. Model SB-313 kit is \$339.95. A matching-style speaker (top photo) is \$19.95. Heath Co., Benton Harbor, Mich. 49022.



# NOW

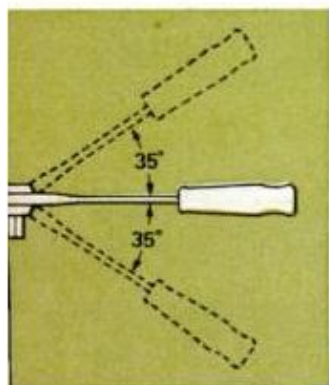
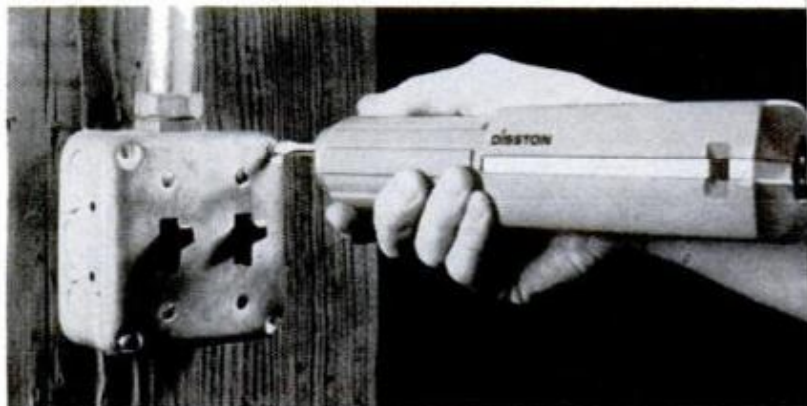


## Noiseproof earphones

High-style headphones for radio communications are said to insulate out distracting outside noises, making it easier to hear faint transmissions without having to turn volume above comfortable listening levels. Ideal for short-wave listening, two-way communications and aircraft use, Quiet-Com monaural phones are made by ILC Industries, Inc., 350 Pear St., Dover, Del. 19901.

## Cordless electric screwdriver

This handy electric screwdriver goes with you anywhere, trails no power cord and operates on a self-contained rechargeable battery. The tool, complete with battery, charger and interchangeable bits for slotted and Phillips screws, is \$29.99 from Disston, Inc., 601 Grant St., Pittsburgh, Pa. 15219. It also is reversible for removing screws.

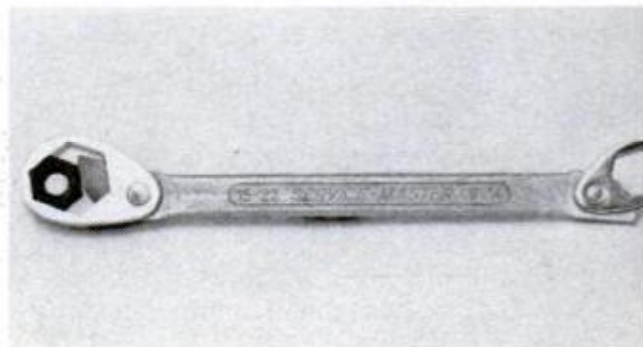


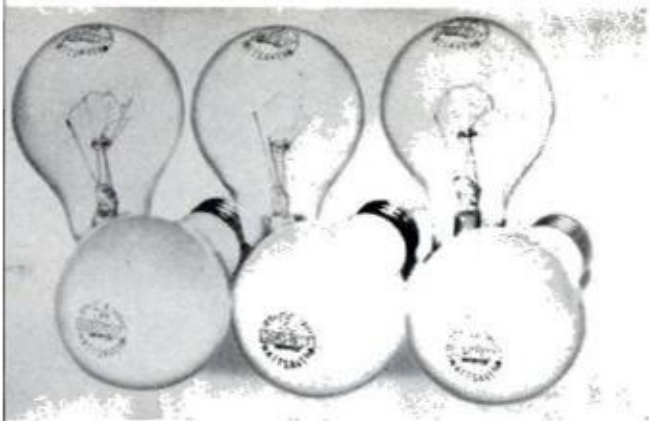
## Swiveling socket wrench

Swivel-handle ratchet wrench tilts up or down for added clearance when working in cramped space. Takes all standard sockets—in 1/2-inch drive for \$24.20, 3/8-inch for \$24. E-L Tools, Box 89, East Patchogue, N.Y. 11772.

## Ratcheting box wrench grips any-size nuts

This single box wrench handles a wide range of hex-nut sizes and provides a ratchet action as well. A cam-locking arrangement automatically adjusts to nut size and takes a fresh grip each time the wrench is turned. Its jamming action holds even burred or rounded nuts. \$7.95 from E-L Tools, Box 89, East Patchogue, N.Y. 11772.



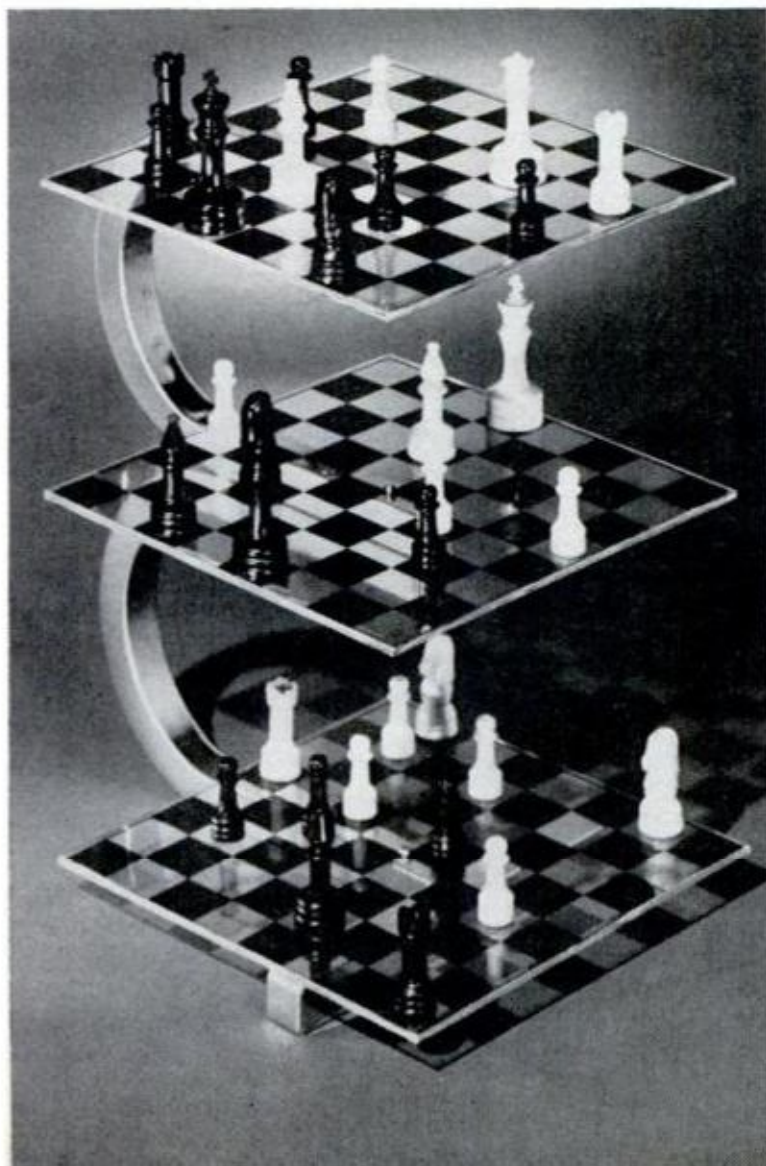


### Brighter bulbs on less power

In line with the current push to save energy consumption, these new "WattSaver" light bulbs are said to burn eight percent less electricity than regular lamps of equivalent light output. Clear or frosted, they come in 55, 92 and 138-watt sizes designed to match the illumination of standard 60, 100 and 150-watt bulbs respectively. Priced at 99 cents to \$1.09 from Duro-Lite Lamps, Inc., 17-10 Willow St., Fair Lawn, N.J. 07410.

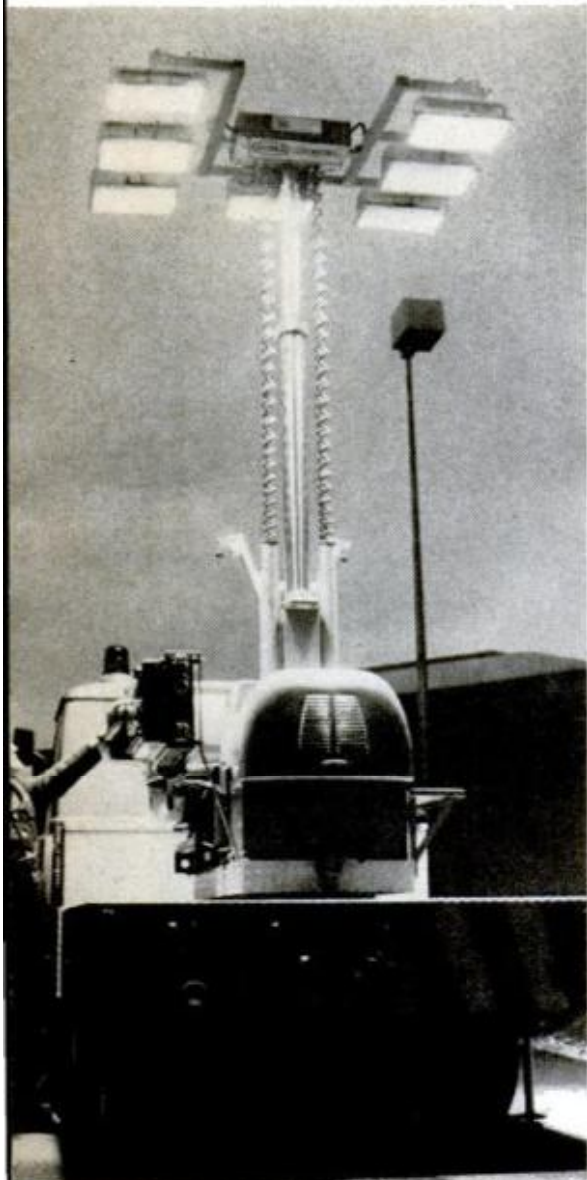
### Three-dimensional chess for the multidimensional mind

As if chess weren't hard enough to learn in its conventional form, you can stimulate your mind with this challenging three-tiered, three-dimensional version sold by Montgomery Ward. Price, including chessmen, is \$10.95.



### Three feeders—for the birds

Colorful self-dispensing bird feeders are now available in three styles for \$5.98 each from Rubbermaid. The feeders have see-through plastic sides, hold five pounds of seed and channel the feed into troughs at the edges. The three models, all measuring 9 x 13¼ x 10¾ inches, offer a choice of shed, barn or tile roof. They can be mounted on a pole or wall shelf or suspended from a tree branch. Parts disassemble for easy cleaning. Rubbermaid, Inc., Wooster, Ohio 44691.

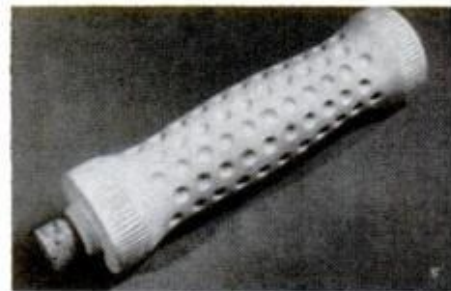


## Mobile 'lamppost' rolls to emergencies, turning night into day

Like a giant lamppost on wheels, this mobile emergency lighting tower can be rushed in to illuminate highway accident scenes or other disaster areas at night. Used by the police in Berne, Switzerland, it generates its own electricity, requiring no connection to an outside power source, and is so bright it can light up a space the size of a football field. Unlike low-mounted searchlights that tend to blind workers with their glare, the tall tower throws its light downward and outward from overhead, keeping it out of the rescuers' eyes.

## Rolling the aches out of sore feet

Rolling your feet back and forth over this specially contoured roller is claimed to relieve aches and pains and promote good circulation throughout your bloodstream. The roller is filled with hot water to provide warmth, and perforations along its length are said to create an alternate suction and pressure action to stimulate blood flow. Reflexizer is \$14.95 ppd. from Dr. Knoll Products, Box 2336, East Liverpool, Ohio 43920.



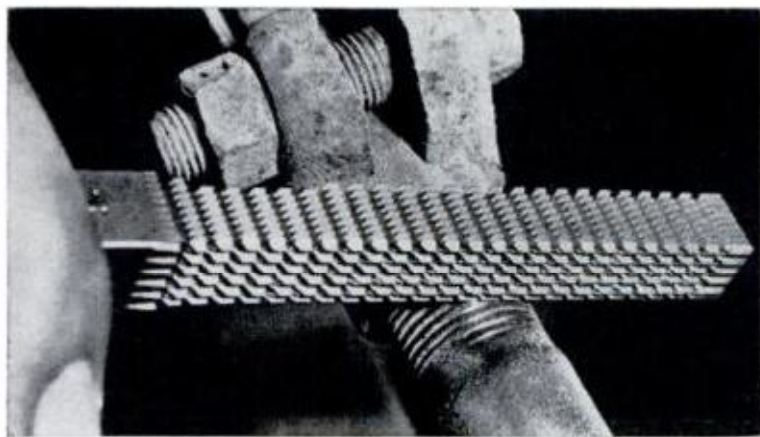
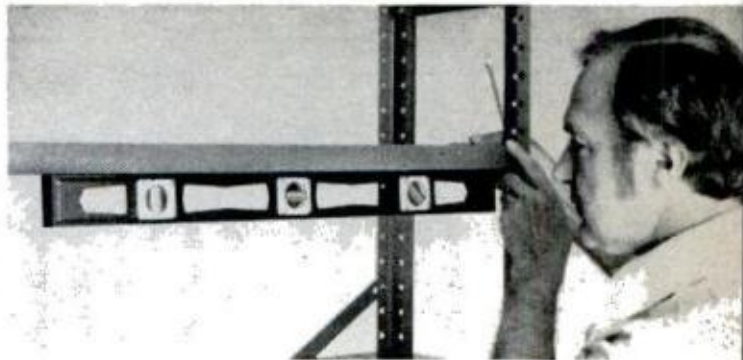
## 'Soapbox' racer you build from a kit

Soapbox racers aren't made from soapboxes anymore. This smartly designed speedster can be built from a kit of parts sold by Montgomery Ward. All you supply is the lumber. The kit includes wheels, axles, steering linkage, full-size patterns for easy cutting of pieces and decorative decals. Price is \$9.88. The racer sports front and rear airfoils, air scoop, hand brake and footrest, is 49 inches long.



### Magnetic level reads angles, too

Leveling steel shelves or other metal objects is easy with this magnetic-edged aluminum carpenter's level that sticks to any metallic surface, leaving your hands free to work. Sold by Sears, Roebuck, the three-vial tool not only checks plumb and level surfaces, but measures any angle through a full 360°. \$7.99 for 24-inch length, \$17.99 for 48-inch model.

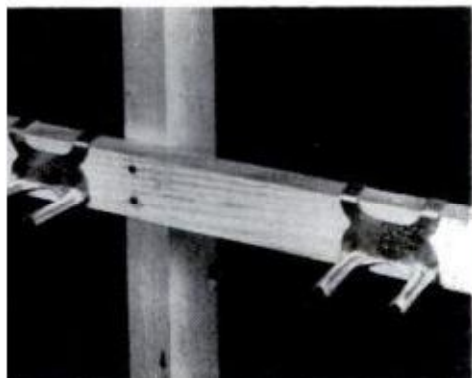
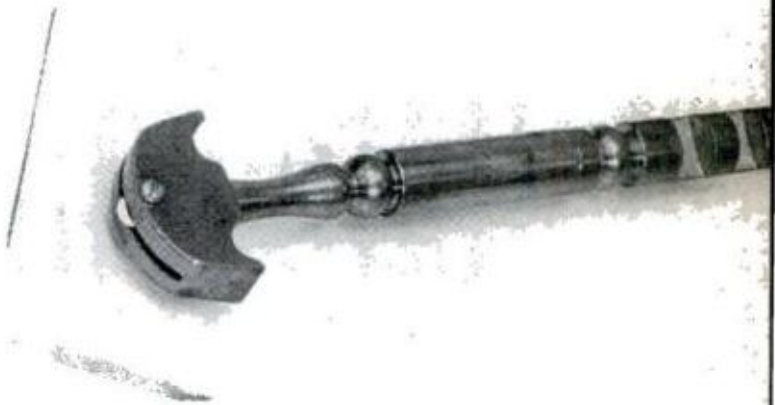


### File renews metric threads

This four-sided file will restore damaged threads on any of eight metric pitch sizes from .75 mm to 3.00 mm. Handy for repairing foreign cars and machinery, the file has hardened teeth for removing corrosion or reshaping mashed threads on shafts, bolts, studs and other threaded fittings. Sold at tool dealers, it's made by Jaw Mfg. Co., 39 Mulberry St., Reading, Pa. 19603.

### Old-style glass cutter improves on new

Patterned after early-style glass cutters, this finely made all-brass reproduction has features not found on modern cutters. Unscrew the end of the hollow handle and you'll find three spare cutting wheels together with a small screwdriver for changing wheels quickly. The tool sells for \$1.65 plus shipping charges from Brookstone Co., 15 Brookstone Bldg., Peterborough, N. H. 03458.



### Simple tool hangers for stud walls

These tool hangers hook over a one-by-two or similar wood strip nailed across studs to organize tool storage in a garage or unfinished basement. They slide for desired spacing, are \$1.98 for six plus 60 cents postage. Beeco Products, Box 5366, 7-Oaks Station, Detroit, Mich. 48235.





## Stick-on trouble light for roadside repairs

Trouble light for roadside car repairs has suction-cup feet that let you stick it anywhere on hood, trunk, roof or fenders without marring finish. The 12-volt lamp simply plugs into cigaret-lighter socket for power, can also be used inside car for map-reading or snacking on trips. \$6.50 postpaid from Glen-Bel Enterprises, Rt. 5, Crossville, Tenn. 38555. Battery-clip version is also available.



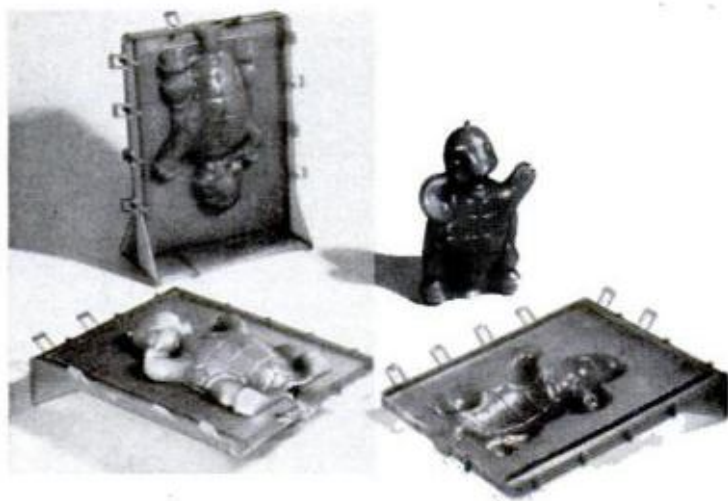
## Big-capacity drill at a bargain price

Latest Craftsman drill from Sears, Roebuck has  $\frac{3}{8}$ -inch chuck capacity, powerful 1/3-hp motor and continuously variable speeds up to 1100 rpm. It's also reversible and takes a variety of screwdriving, sanding, grinding, polishing and other attachments. The Model 9GT1145 drill is double-insulated for safety, sells for \$39.50.



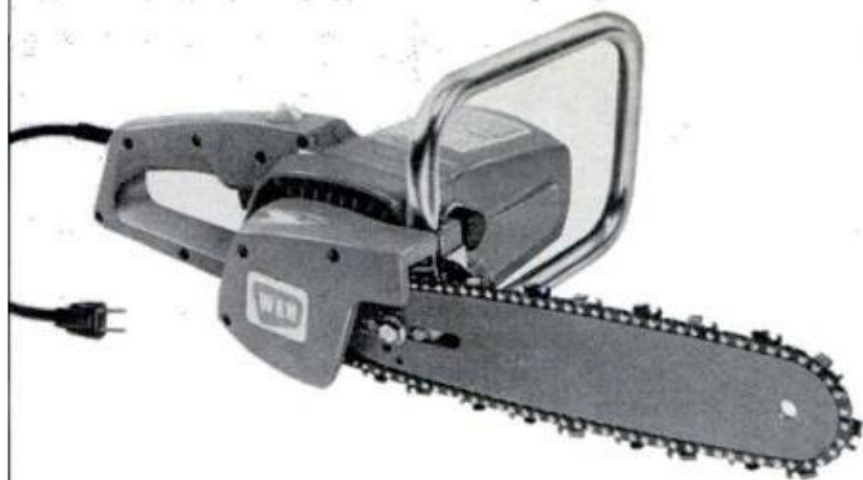
## New high-speed pad sander with steady two-hand grip

New housing design on this Rockwell orbital sander features two-hand grip—rear handle plus auxiliary front knob—for easy guiding, firm control. The  $3\frac{1}{2}$ -pound Model 96 develops 12,000 orbits per minute, said to give smooth, swirl-free results. \$29.99, Rockwell, 400 North Lexington Ave., Pittsburgh, Pa. 15208.



## Snap-together molds make candle-forming a snap

Candlemaking is easier with these molds that have built-in stands to keep them upright, automatic wick-positioning guides and self-locking clips to hold the two halves together without clamps, rubber bands or other fasteners. Snap-It molds come in many shapes for \$1.50 to \$2.50. Information on types can be obtained from Evercoat Co., 6600 Cornell Rd., Cincinnati, Ohio 45242.

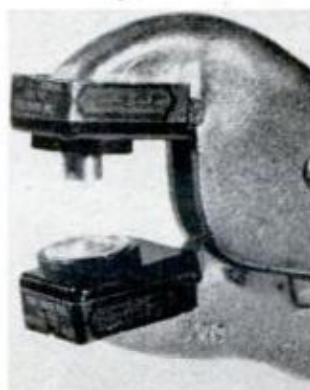
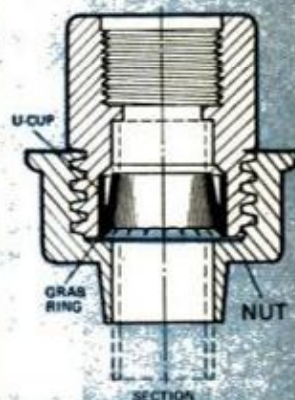


### Low-cost electric chainsaw with high-quality features

This lightweight 10-inch chainsaw, priced at \$59.95, is said to be the lowest-cost double-insulated electric-powered model on the market. Weighing only 8 pounds, the Wen saw has such features as 2-hp, 11-amp. motor, gear drive, anti-kickback clutch and built-in chain oiler and oil level indicator. Wen Products, Inc., 5810 Northwest Hwy., Chicago, Ill. 60631.

### Slip-on connectors make plumbing simple

New slip-fit connectors for copper tubing and plastic pipe require no solder or cement. When you push them on, a U-shaped retaining cup and grab ring form a pressure-tight, waterproof joint. Connectors are available to fit common types and sizes of pipe. For information, write Mobile International, 16291 West Fourteen Mile Rd., Birmingham, Mich. 48009.

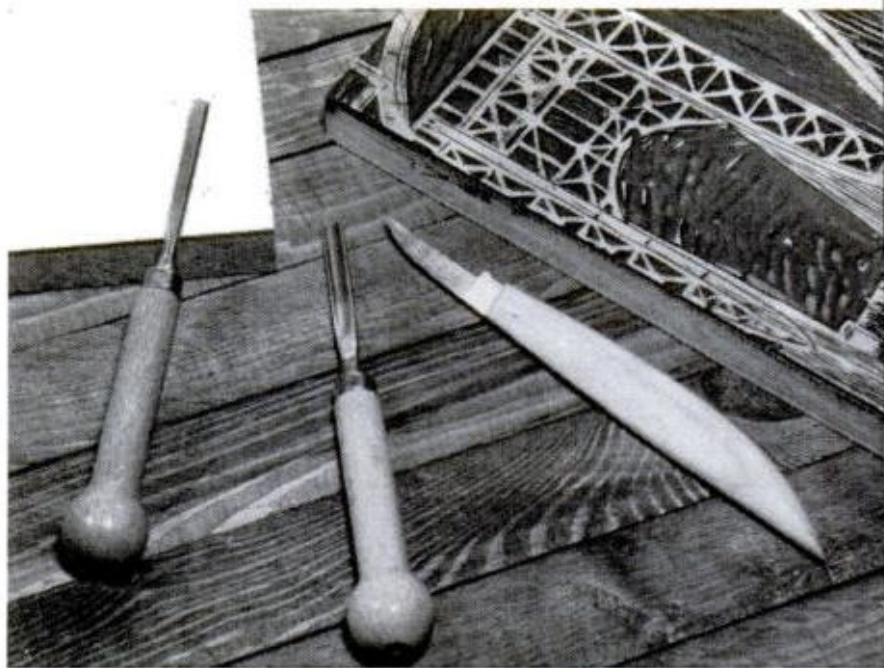


### Handy accessories for vise-type pliers

Interchangeable inserts for vise-type pliers let you install snaps, grommets and rivets, punch holes and clamp soft, fragile materials. Kit includes 14 slip-on jaw attachments, 368 assorted fasteners and a 10-inch vise plier. Attachments also fit Petersen Vise-Grip plier and Sears No. 45341 plier. Kit is \$29.90. Time Saver Tool Corp., 7006 Indianapolis Blvd., Hammond, Ind. 46324.

## Three-tool carving set lets you work in soap or linoleum

You can carve either soap or linoleum blocks with this double-duty carving set. The inexpensive three-tool set, intended mainly for the casual or beginning carver, includes gouge, V-parting tool and chip carving knife. The instruments, shown in the photo at right, are made of polished German tool steel and have smoothly rounded hardwood handles. The three types are all you need to perform basic carving operations in soap or linoleum. No. 15S01-AW set is \$8.55 ppd. from Woodcraft Supply Corp., 313 Montvale Ave., Woburn, Mass. 01801.



## Wide-angle safety goggles for a better view of your work

You get a broader field of view with these new "wide-angle" safety goggles designed for use in grinding, drilling and other shop-tool operations. Unlike most eye protectors that are straight, these curve slightly, producing a "wrap-around" effect for greater peripheral vision. Perforations around the edges provide ventilation to prevent the goggles from fogging. \$9.98. The Stanley Works, New Britain, Conn. 06050.

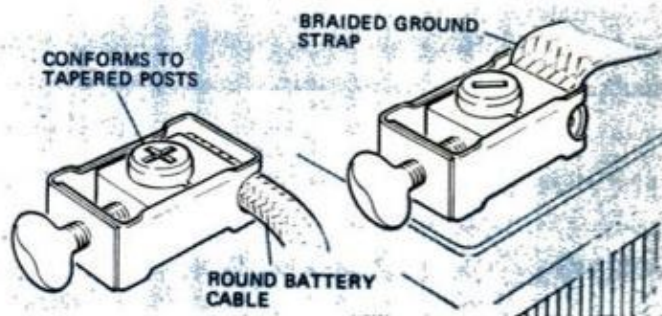
## Quick way to make a plumbing fix

Now you can make plumbing repairs without shutting off and draining the whole system. With this "Cool Tool" outfit, you quick-freeze a plug in the line on each side of the affected area, then you can cut the line and solder in new fittings without any water flow. Freon gas is used as the refrigerant with collars slipped over the points to be frozen. Each unit is \$19.20. Flomatic Corp., North Hoosick, N.Y. 12133.



## Quick-change battery clips take any cables, fit any post shapes

Attaching and removing battery cables is simply a matter of turning a thumbscrew with these new easy-on, easy-off connectors. The clips have noncorrosive stainless-steel frames with soft lead inserts that snugly grip tapered battery posts when the thumbscrews are tightened. They take both rounded cables and flat braided straps, require no tools for installation and fit all car, boat, RV and yard-equipment batteries. By reversing the sliding lead inserts (left in photo at top), the connectors will even fit the rectangular-type battery posts found on many electric-start riding mowers. Zip Adjustable Terminals are \$1.75 each from C. L. Pitnikoff, 25 Holstone Lane, Willingboro, N.J. 08046.



## Instant juices from fruits and vegetables

Portable juice extractor features a convenient carrying handle and stainless-steel parts, favored by food enthusiasts because the metal is nonreactive to organic chemicals. Powered by a 300-watt motor, the countertop appliance processes fruits and vegetables into fresh, natural juices and has an electrical braking system that instantly stops the drive as soon as the juicing action is complete. Made by Braun, it sells for \$70 at department and specialty stores.

## Direct-reading calipers

You don't have to transfer measurements to a separate scale with these self-indicating calipers. The tool takes inside and outside measurements and indicates readings directly on an attached scale calibrated in both inches and metric units. When not in use, it folds for compact storage in a toolbox (photo at near left). Price is \$28.50 from Indicating Caliper Co., Box 51, Oak Park, Ill. 60301.



# Muddy prints and how to cure them

by Ivan Berger

PHOTOGRAPHY EDITOR

Prints from readers pour across my desk each month—and surprisingly many of them, even when the contributors are professional photographers, are muddy, murky, dull and lifeless. There are mere grays where there should be blacks, and the whites appear to be seen in dim light through a dirty window. Yet the causes and cures of muddiness are easy to understand. I should know—in the years since I started printing (when I was 11), I've had to find out every cure in the book, because I've made most of the blunders.

The first step, of course, is to look closely at your prints. I'm convinced that the reason so many people try to sell or show off muddy work is because they're so carried away by the image of the picture itself that they can't take an objective look at how horribly that image is displayed. So take that look: A good print virtually always has at least one spot of pure, rich black, and one of pure, sparkling white to set off its range of middle tones. If you've deliberately broken this rule, fine—presumably you had a reason. But if your prints accidentally lack true whites or blacks, find out what you're doing wrong.

First, look at your negatives. If they don't cover the full range of tones, from a few, almost black spots of highlight to a few spots of shadow that are almost clear with a wide range of gray tones in between, you'll have trouble getting a good print.

When you take the picture,



Photos: Ivan Berger



1



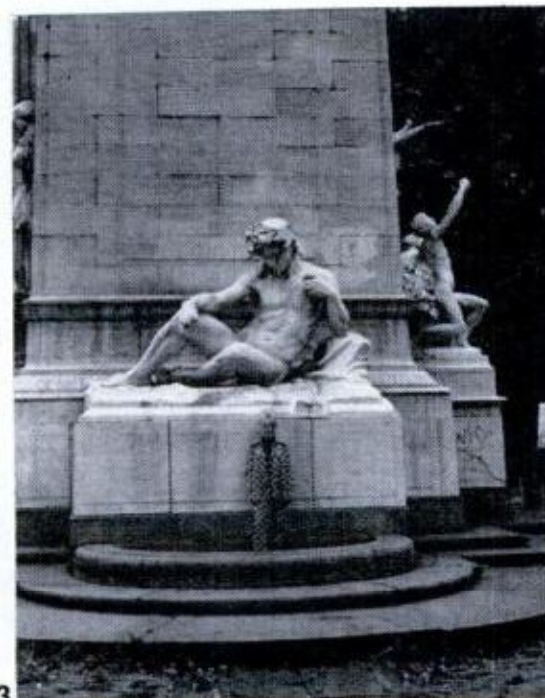
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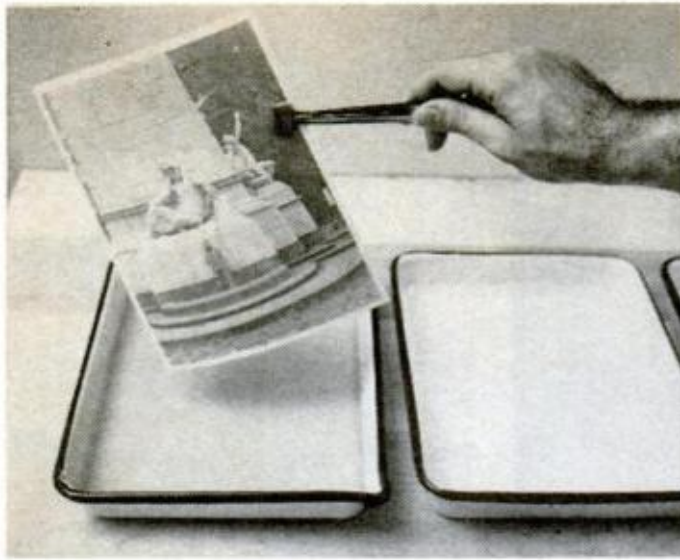


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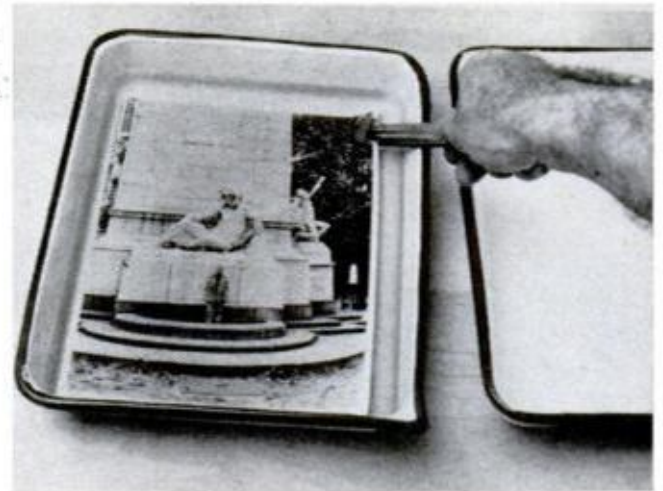
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**Good print** (far left), has wide tonal range, from white to black and all gray tones between. Muddy prints above are caused by: (1) overexposure, underdevelopment; (2) too-low paper contrast; (3) thin negative overexposed in printing for deeper blacks; (4) thin negative underexposed for cleaner whites; (5) thin negative "saved" as far as possible by contrasty No. 14 paper—but still a bit flat and muddy because of deficiencies in the negative.



**Improper inspection**—raising print from tray—lets developer run off or oxidize, causing blotchy, uneven development, contrast loss and stains. Proper technique is to hold print just below developer surface, discard developer before it becomes cloudy (indicating exhaustion).

Photos: Peter Schneider

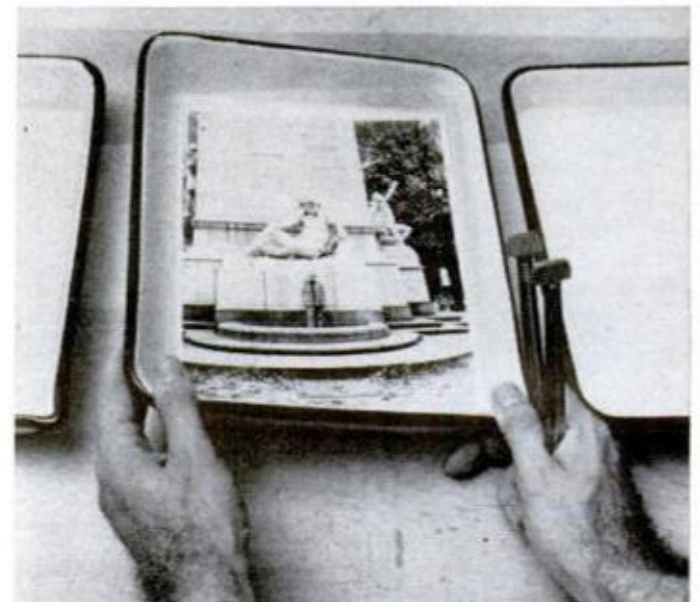


make sure you expose correctly, then follow the manufacturer's developing times and temperatures *exactly*. Adjust the exposure index setting of your light meter, setting the meter to a slightly higher than normal film speed if your films are consistently overexposed or setting it a bit lower if you normally underexpose negatives.

But most muddy prints are made from negatives that could yield better prints with better work. One of the easiest temptations to bad workmanship is to overexpose and underdevelop the print. In our impatience to see the picture, it's easy to blast a print with so much light that an image will pop into view as soon as the developer hits the paper, or to pull a print out of the developer when it begins to "look all right" under the safelight, even if the entire recommended developing time (usually about a minute) hasn't yet gone by. Unfortunately, that doesn't give the developer time to work evenly and thoroughly on the whole print. As a result, the prints are muddy and often mottled with poor highlight detail.

A second temptation—letting underexposed prints linger in the developer in hopes that they'll somehow improve—will only give you fog, stain, a lack of highlight detail, or all three at once. Never try to make up in development for a gross exposure error. If you have to change development times more than 20 or 30 seconds from the recommended time, remake the print with another exposure (stabilization printing, which gives you no leeway to fool around with processing time, is a great teacher of exposure discipline).

And make sure you have *exactly* the right exposure—often an exposure difference of only 10 or 20 percent can turn a



**Proper agitation** promotes even development. Agitate print by moving it with tongs (top), taking care not to scratch print surface, or by rocking tray (above)—easier with smaller trays, many of which are designed to rock easily, even on completely flat surfaces.

merely adequate print into a good one, or vice versa. Your goal is a print that not only contains a full range of tones, but has all the shadow and highlight details that were in the negative. Correct paper contrast will help with this.

Overdevelopment or underdevelopment can still occur when you follow the paper manufacturer's developing-time recommendations, if your developer is at the wrong temperature or concentration. Underdevelopment (and, frequently, stains) will also occur if you try to process too many prints in a tray of developer or let it get con-

taminated by stop bath or fixer (refill it with fresh developer when its level drops visibly; discard the whole tray at the first sign of discoloration or sludge).

Proper agitation and inspection make a difference, too. Swishing the paper around in the developer with print tongs (preferably rubber-tipped, to prevent print scratching) or by rocking the tray will ensure that development starts and continues evenly; agitation in the stop bath means that it will stop evenly, too. And agitation in the fixing bath for just the right amount of time will ensure prints that (if properly washed) will last for years. Agitation is the right way to handle a print—but hauling it out of the developer for inspection is the wrong way; developer drains off in spots, oxidizes in others, and that's another cause of uneven development. The best way to inspect a print is in a good white light, after it's been developed and fixed ([see Photo Hints, page 14](#)); but learn, too, to compensate for the slight differences in tonality between a processed, wet print and a dry one—what you see in the fixing bath is not quite what you'll get.

If you don't work in your darkroom very often, your chemicals and paper may hang around for months before they're finally used up, and can go stale in the meantime. To prevent this, buy small quantities of paper (even though it costs less per sheet in larger packages), and refrigerate it between darkroom sessions (let it get back to room temperature before you use it).

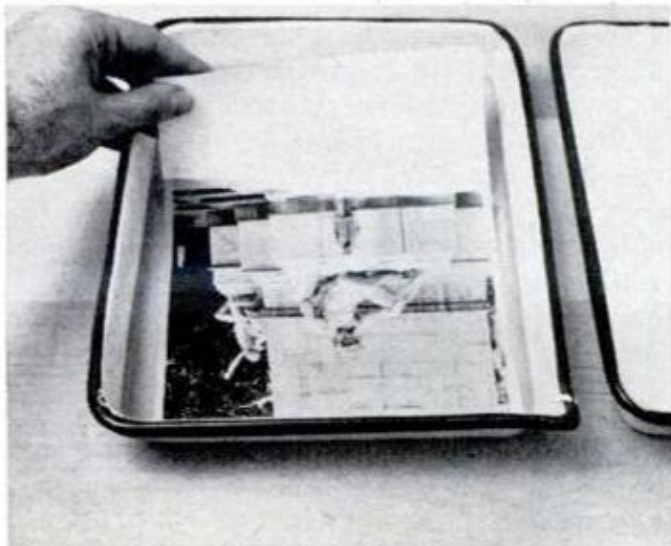
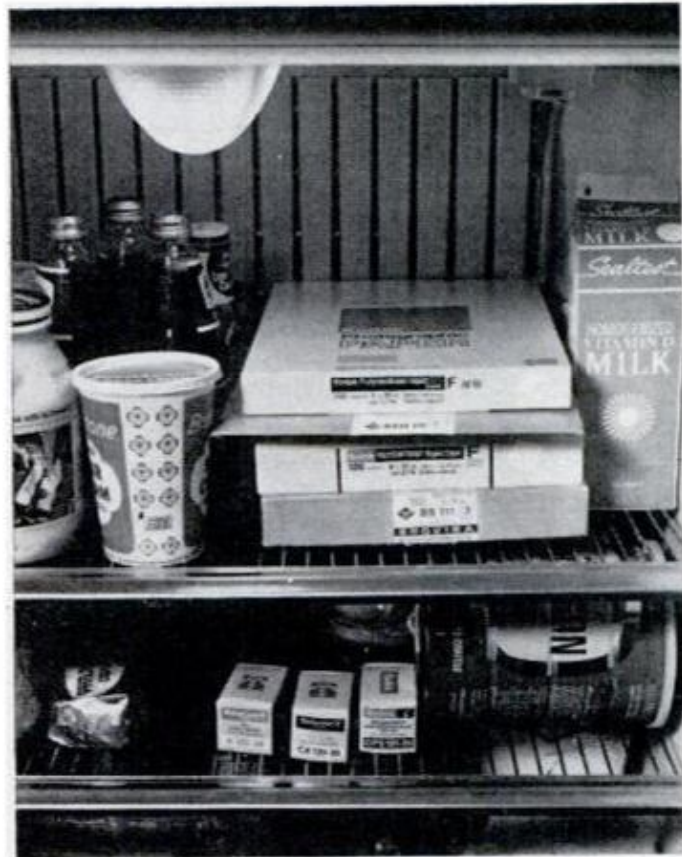
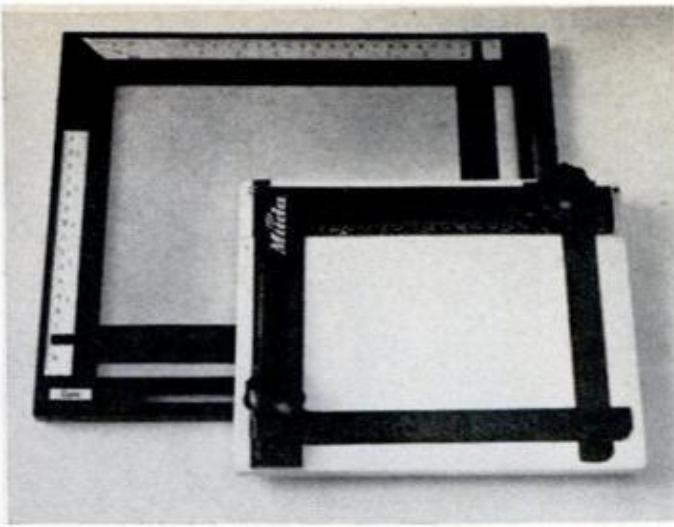
Your chemicals, especially developers, should be mixed up only in batches just big enough to fill the biggest tank or tray you use. Keep records of how much you use each chemical, discarding it when it's been used to its rated capacity; the lives of many film developers can be extended, though, by adding a "replenisher" after each use. Stale paper can sometimes be salvaged by adding Kodak Anti-Fog to your developer, but fresh paper will do an even better job.

Stale materials may cause stains, veiled

[\(Please turn to page 180\)](#)

**Highlight-veiling fog** can come from light reflected back through paper by white easel surfaces (top); tan or yellow easels are safer. Stored in refrigerator (center), film and paper stay fresher longer, resisting fog, contrast loss or color shifts. Prints that "pop up" almost as you put them into the developer (left) are overexposed; shortening developing time this way seems like a great time-saver, but developing is uneven, blotchy, with some parts developing fully while others are still dry. And contrast is very low.

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# Low-cost synthesizers: switched-on home music fun

The professional ones can cost as much as houses, but some synthesizers are now in the piano price range.

by Hans Klein



The ARP Odyssey that Roger Powell's playing here costs \$1295; the studio-type Arp 2500 shown behind him costs from \$4000 to \$20,000, according to size, complexity.



**Mini-Moog outfit** costs about \$1900, including hand-carried, ribbon-control, glide-tone "keyboard" and trigger that accompanies drum beats with notes or chords whose pitch varies according to intensity with which drum is struck. Mini-Moog alone is \$1495.

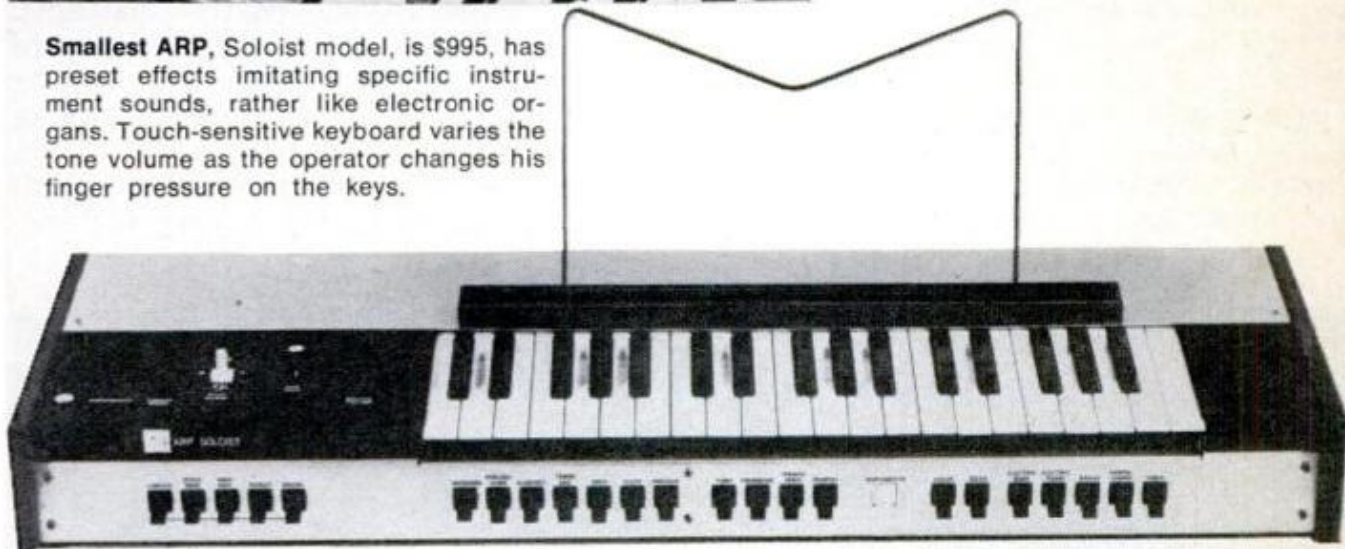
From tuba to piccolo at the flip of a switch, then to surf crashing on the shore, trumpets, cellos, barking dogs, a far-out electric guitar, a twangy washtub bass, a wailing Dixieland clarinet and hundreds of other sounds all from one little instrument? You bet—if that instrument's a synthesizer.

The synthesizer is a new breed of electronic musical instrument that gives musicians control over every aspect of a musical sound: pitch, attack and decay, timbre (or tone color) and duration. This total control over the sound makes the synthesizer far more tonally expressive than other electronic keyboard instruments, like organs. For instance, with a synthesizer you can "bend" notes sharp or flat while playing, or "slide" continuously from note to note, and even produce "unpitched" sounds like rain, wind, surf, and jets taking off. And while the most versatile synthesizers are up in the \$10,000 range, models are available for



**Bridging the gap** between organ and synthesizer, Syntha-Sound in some Baldwin organs (available separately for \$790) has some preset instrument sounds, plus control of attack, decay, wave-form and pitch. Wurlitzer has similar synthesizers in some of its organs.

**Smallest ARP**, Soloist model, is \$995, has preset effects imitating specific instrument sounds, rather like electronic organs. Touch-sensitive keyboard varies the tone volume as the operator changes his finger pressure on the keys.



\$800 to \$1500—roughly the price range of many home pianos. There's even a \$139 kit.

Synthesizers do electrically what conventional instruments do physically. As an example, let's examine the way a synthesizer creates the sound of a violin. On a real violin, a very simple motion is created at the bridge by the action of the bow on a string. The string sticks to the resin on the bow and is pulled along for a fraction of an inch. When it gets pulled too far along, the string snaps back to its original position, and the cycle is repeated. This simple motion is called a "sawtooth wave" because the stick-slip motion of the string illustrated on a graph looks like saw teeth.

These simple vibrations are transmitted to the body of the violin which gives the sound its characteristic resonances and tone color. The violin body is actually a musical *filter* which colors the harmonics and overtones of the simple sawtooth wave transmitted to it from the bridge and string.

A synthesizer creates a violin sound in a similar way, but using electrical components. A tone generator, or *oscillator*, is set up to produce (in this case) a sawtooth wave-form. (Tone generators in most organs can only produce square waves, but tone generators in synthesizers produce sawtooth waves, triangle waves, and pulse waves also.) The resulting electrical signal is then given appropriate attack and decay characteristics by an *envelope generator* and the final signal, when played through a good amplifier and speaker, will come out sounding like a real violin.

The main differences between organs and synthesizers are in the tone-generating and filtering systems. In the synthesizer, the tone generators are variable and can produce a constant gliding tone all the way from subaudio to ultrasonic. Usually, however, these oscillators are programmed to produce pitches that are determined by the synthesizer's piano-like keyboard, though

you can slide from note to note, bend the pitches of the notes, and add vibrato very easily. On an organ, all the tone generators are fixed in pitch and it is thus impossible to play anything but those fixed tones.

Similarly, the filters in an organ are fixed and generally very simple in nature; typical organ filters cannot produce complex sounds such as a solo violin.

Synthesizers, on the other hand, not only have complex fixed filters, but also have *dynamic filters* which can change their characteristics automatically. This feature helps to form good brass sounds or plucked string sounds where the timbre changes as the note builds up or dies away.

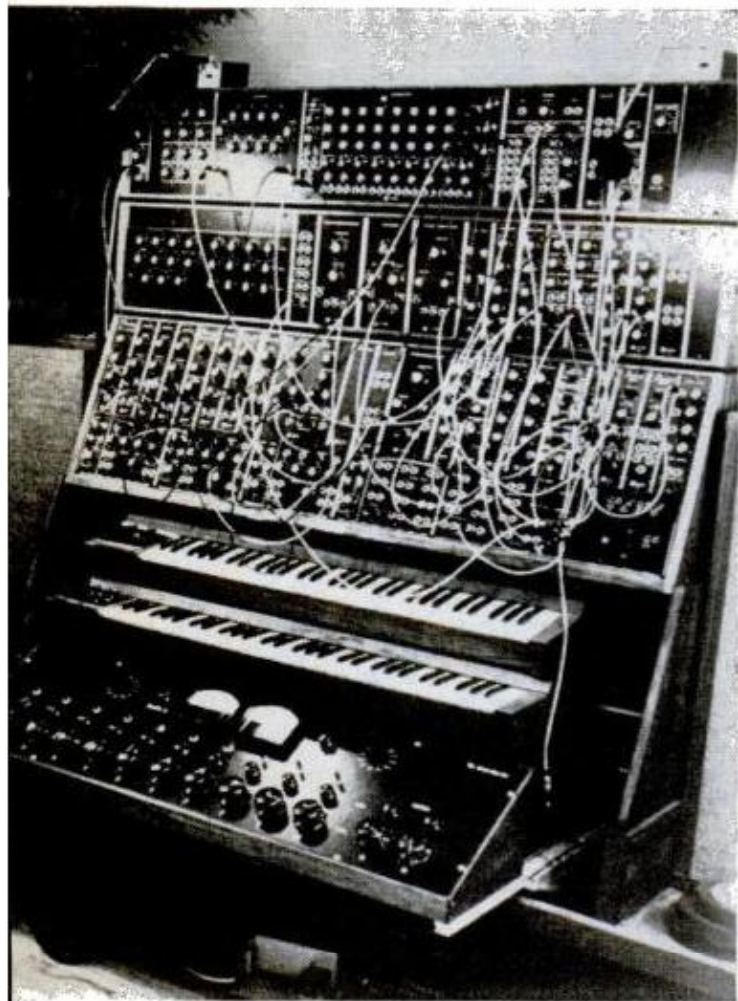
But, though synthesizers offer a wider range of *tones* than organs, organs can play more complex *tunes*. On organs, all keys are "live" at once, and can be played simultaneously in complex, polyphonic patterns; synthesizers usually can play only one, or at most two, notes at a time.

There are basically two kinds of synthesizers, *preset* and *variable*. On a variable

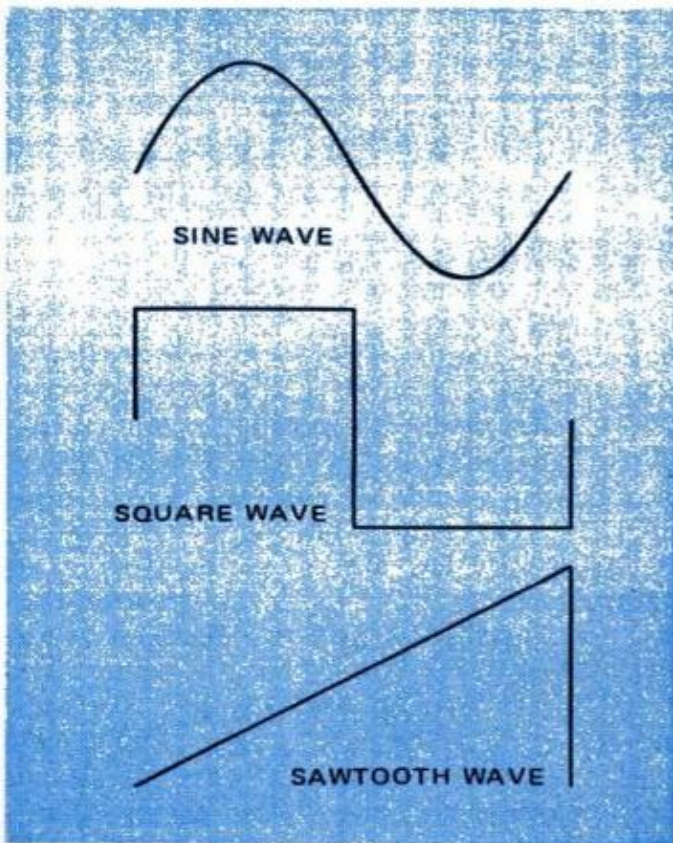
synthesizer, controls, patch cords and switches are used to adjust the various electronic circuits, such as the oscillators, envelope generators and filters. These controls are manipulated by the musician to create various instrumental sounds or to invent new sounds.

One of the biggest variable synthesizers, the ARP 2500, has over 750 switches and controls. A scientist at Bell Telephone Laboratories figured that this instrument could make seven million different sounds—more than you could try in three lifetimes. This synthesizer, in addition to an impressive selection of basic synthesizer circuits, includes digital circuitry which can be programmed so that the synthesizer will actually compose and play melodic passages and complex self-modifying rhythm patterns. At a cool \$10,000, these synthesizers are not for the weak of heart—or of budget.

More down to earth in terms of price, is the ARP Odyssey which sells for \$1295 and the Mini-Moog which sells for \$1495. Both are variable synthesizers having features



**Switched-on Bach** was "performed" ("constructed" is a better word—each melodic line was recorded separately)—on Walter Carlos's Moog studio synthesizer.



**Basic wave-forms** are mixed, subtracted, filtered or otherwise manipulated to make waves as complex as the sound waves from musical instruments (but not necessarily imitating them). Some waves may be used to control others; one square wave, for instance, can turn another into different-sounding "staircase."



**Portable Moog Sonic Six** comes in carrying case with an amplifier and speaker, costs \$1195.



**ARP Odyssey** is polyphonic, allowing two independent tones or melody lines, costs \$1295.

especially designed for live performance. The ARP Odyssey even comes with foot pedals and can make, among other sounds, an exquisitely funky "fuzz-wah" effect using a unique device called a phase-synchronized oscillator, while such accessories as a slide-wire keyboard (which can produce any pitch—including those between keys on the normal keyboard—as well as slide and glide tones) and a percussion attachment (that triggers a synthesizer note each time you strike its drum) extend the Mini-Moog's versatility.

*Preset* synthesizers are a comparatively recent innovation. On a preset synthesizer, sounds are preprogrammed by the manufacturer and are produced by simply pressing a tab labeled with the name of the sound, much like the stops on an organ. A computer-like memory remembers all the different adjustments that have to be made automatically to change from one sound to another.

Only two truly preset synthesizers are available right now, both made by ARP Instruments, the country's biggest synthesizer producer. The ARP Soloist can produce 15 instrumental voices ranging from tuba to piccolo and costs about \$1000. Its bigger brother is the ARP Pro Soloist which has 30 preset voices, some of them pretty wild. It is priced at \$1295. These instruments include a touch-sensitive keyboard which lets you control the sound by finger pressure. Considering the number of sounds that can be created, these prices compare reasonably with those of organs, many of which cost more than \$1500.

Preset synthesizers can be used by themselves in performing combos or they can be added to any home organ. Some organ manufacturers, including Baldwin and Wurlitzer, are already building small synthesizers into some of their home models. Baldwin's "Synthasound" is also available as a separate \$790 instrument. Other comparatively low-cost synthesizers include the EMS Synthi models (\$995 to \$1195), Electrocomp models from \$895 to \$995, Moog's Sonic Six (\$1195) and Satellite (\$595), and Baldwin's \$790 Syntha Sound. Paia also has a somewhat less complex and versatile synthesizer in kit form for \$139, but it's only in limited production at present.

What's the difference between a preset synthesizer and an organ? Synthesizers let you alter the qualities of a tone—it's dy-

*(Please turn to page 176)*

# Three ways to make

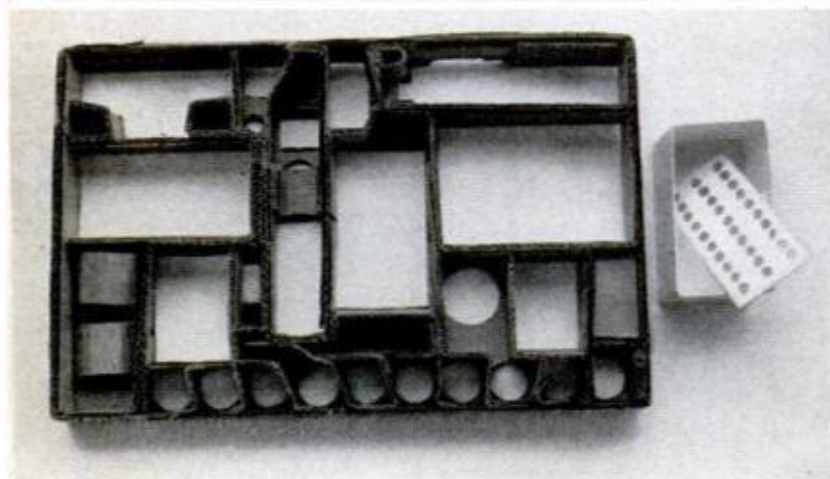
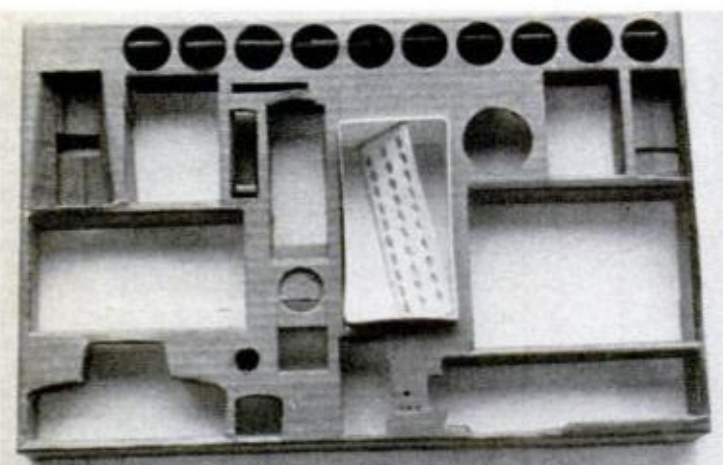
## Line an attaché case with cardboard

What does it take to hold all this gear neatly and firmly in a slim attaché case? Just corrugated cardboard. Cut a plain, flat sheet of it to form a box two inches deep, just fitting the case. Arrange the equipment as compactly as possible and mark its outlines. Then cut within the outlines, to leave some excess flap that can be turned under and glued to the partition reinforcements.

Turn the box over and partition the individual compartments with two-inch strips of the cardboard, then roll or work more cardboard into the voids between the partitions (the picture at bottom left shows the partitions before the voids were filled). For additional protection, you may want to line your attaché case, top and bottom, with foam.

If you want to carry more gear, partition both the top and bottom of a valise, with a foam-covered cardboard separating the layers.—*Glover Hendrickson*

**Tight, efficient packing is easy**, with cardboard separators trimmed into compartments to fit equipment. And it's sturdy: For three years, this bag has carried two 35-mm cameras, three auxiliary lenses, 10 rolls of film, flash equipment, 30 flashbulbs, rangefinder, light meter, filters, tape recorder, nine cassettes, five sets of spare batteries and extra power pack for the recorder.



# a custom camera bag

## Line a suitcase with soft foam

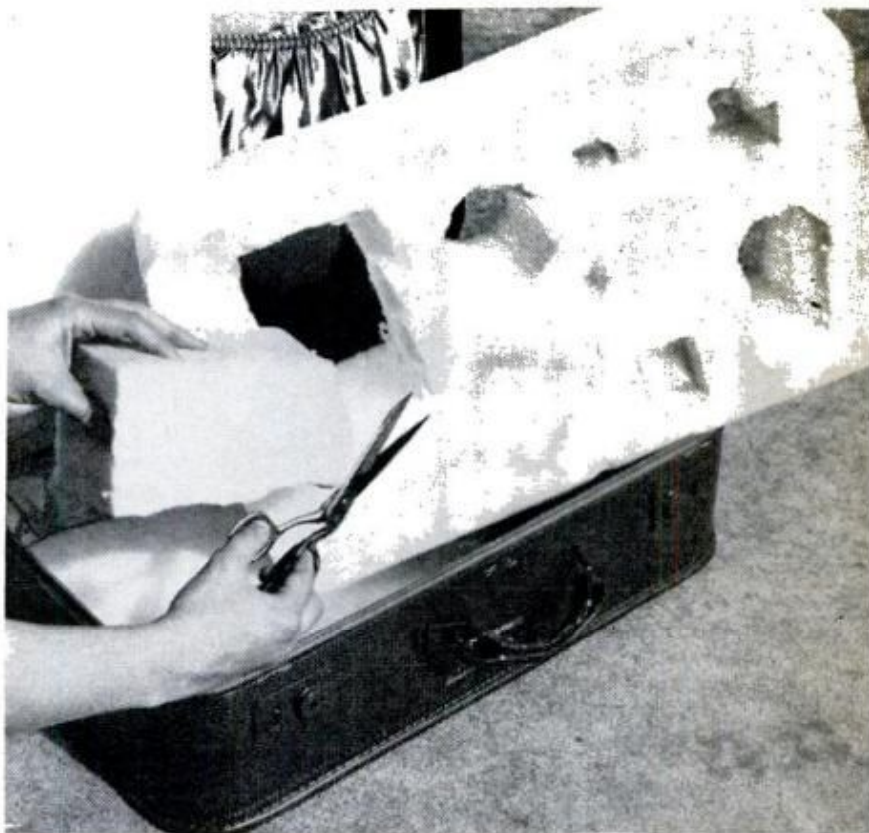
Outgrowing your gadget bag? Here is a cheap, satisfactory alternative: Just convert an old suitcase to a foam-padded carryall.

First scrounge your suitcase—most families have a few kicking around the attic. It needn't be fancy, but should be sturdy and big enough to hold all your equipment plus a fat, foam surround.

The foam comes from surplus stores and similar outlets; the dealer can cut it to the interior dimensions of your suitcase. You'll need one-inch slabs for the top and bottom of the case, plus another slab thick enough to fill the space between them (i.e., if your case is six inches deep, you'll need a four-inch center section to fit between top and bottom pads).

Arrange your equipment on this center section and trace its outlines with a felt-tipped pen. Then cut holes and indentations with a large sewing scissors. If your suitcase has pockets, you may want to leave them exposed to hold film. The finished case will protect your camera and accessories from drops and jolts—and won't advertise to thieves that it's anything but a beat-up suitcase—*Michael Lamm*.

**Foam padding is great protection** against jars and jolts of travel. Large scissors cut it easily, whether you're cutting all the way through for a big camera or just making a shallow indentation to hold light meter or strobe. Old suitcases are best—they're less inviting to thieves.



## Customize a standard camera case

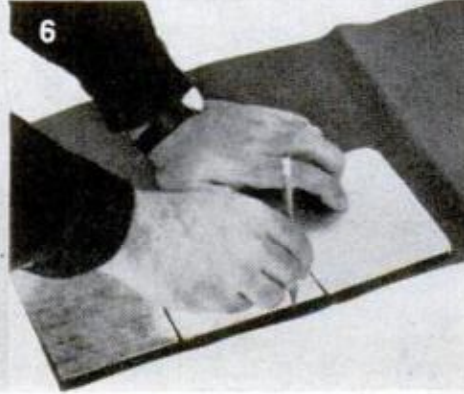
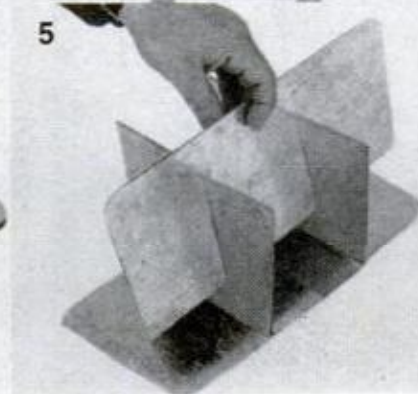
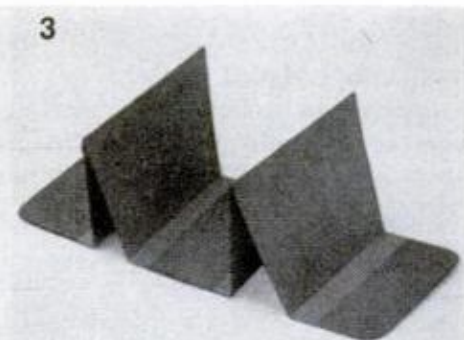
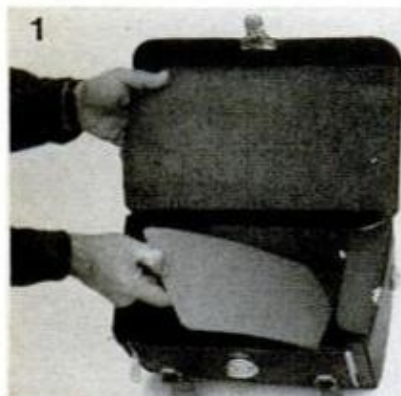


Standard camera bags are built for nobody's equipment—certainly not yours. These easy-to-make, fitted compartments let you put more into your gadget bag, yet make everything in the bag easier to find.

Figure under \$5 for materials: a sheet of galvanized steel or aluminum (flashing is okay); a sheet of adhesive-backed foam plastic for protective cushioning; some thin cardboard; and tape. The foam can be ordered from Weldit Corp., 44 West 18th St., New York, N.Y. 10011; a 12x26-inch sheet costs \$1.49; a 12x52-inch sheet, \$2.49, postpaid.

First cut away and remove your bag's stock dividers. Then cut cardboard mockups of new dividers you'll need to custom-fit around your equipment. Start with a cardboard bottom (1), then slip in the dividers (2), and mark their positions on the bottom piece. Cut the bottom along the divider position lines and tape the vertical dividers—doubled up for strength—to the cutup bottom template (3). Spread this mock-up flat, transfer its outline onto the sheet metal (4), cut the metal with shears, and bend it into the same shape as the mock-up.

Follow the same steps for the double-thickness divider running the length of the bag, then slit both pieces so they can be assembled egg-crate-style (5). Finally, trace the divider outline onto the foam (6) cut the foam a section at a time, peel away its backing paper, and press the foam onto the dividers. Trim edges with a razor, and you have a bag as neat as a factory-made job—but a lot handier, because it will be a precise fit for your equipment.—*Alexander Markovich*





## Pocket headphone amp for listening and recording

by Eugene Walters

If you've ever plugged your stereo headphones into your tape deck's monitor jack and found it lacked the power to drive your headphones as they should be driven, take heart. A headphone amplifier can give you all the signal strength you need—and you can build this one for under \$15.

It's a simple project, but it will put out enough power to drive most stereo headphones, and includes individual level controls for each channel. Power comes



from a standard 9-volt transistor battery.

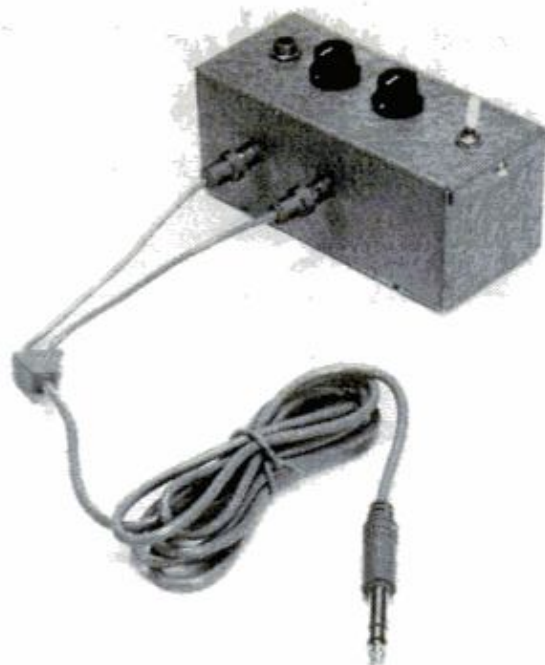
All circuitry except the switch, jacks and gain controls is built on a 2 x 4 $\frac{3}{4}$ -in. perforated circuit board, mounted in a 5 x 2 $\frac{1}{4}$  x 2 $\frac{1}{4}$ -in. metal chassis box (don't use a plastic box, or you might get hum problems). But before you start mounting components, make sure the board fits easily within the box. Trim it if necessary (any remaining excess can be filed away). Use the perfboard as a template to locate and drill four  $\frac{1}{8}$ -in. mounting holes in the metal chassis bottom. If the holes don't line up exactly, ream them slightly, or otherwise enlarge them.

Transistors are identical—general-purpose silicon audio types. You can mount them directly to the perfboard, but their wire leads are relatively short, and connections to them will have to be a bit cramped.

A better idea is to mount them in transistor sockets, thus positively preventing damage to the transistors from soldering-iron heat (you don't install the transistors until after soldering), and giving you enough lead length to let you take advantage of the perfboard's plentiful elbow room. Another good reason to use sockets is that economy-grade transistors like the ones used here may not have completely identical electrical characteristics, even if they're numbered identically. Thus, one transistor might work better as Q2 than as Q1, and so on for the other transistors. With sockets, you can switch them around until you find the best arrangement. When plugging in the transistors, spread their leads into small circles and clip them to a length of about  $\frac{3}{8}$  in. Test the leads for proper length before you clip them, though.

If you do solder directly to the transistor leads, be sure to use a low-wattage iron (10-25 watts, or 50 at the very outside) and a heat-sink tool clamped on the transistor lead between the transistor body and the connection. Go in and out *fast* with the iron; too much heat can ruin a transistor, heat sink or no. Remember to use the heat sink if you add more connections later.

Circuit layout is simple, and not too critical—just mount the components in fairly straightforward order, taking care to install the electrolytic capacitors with correct polarity (an incorrectly wired electrolytic is a ruined one, in short order). Component leads that go to ground should be near the board's edge, so you can loop a piece of bare hookup wire around the



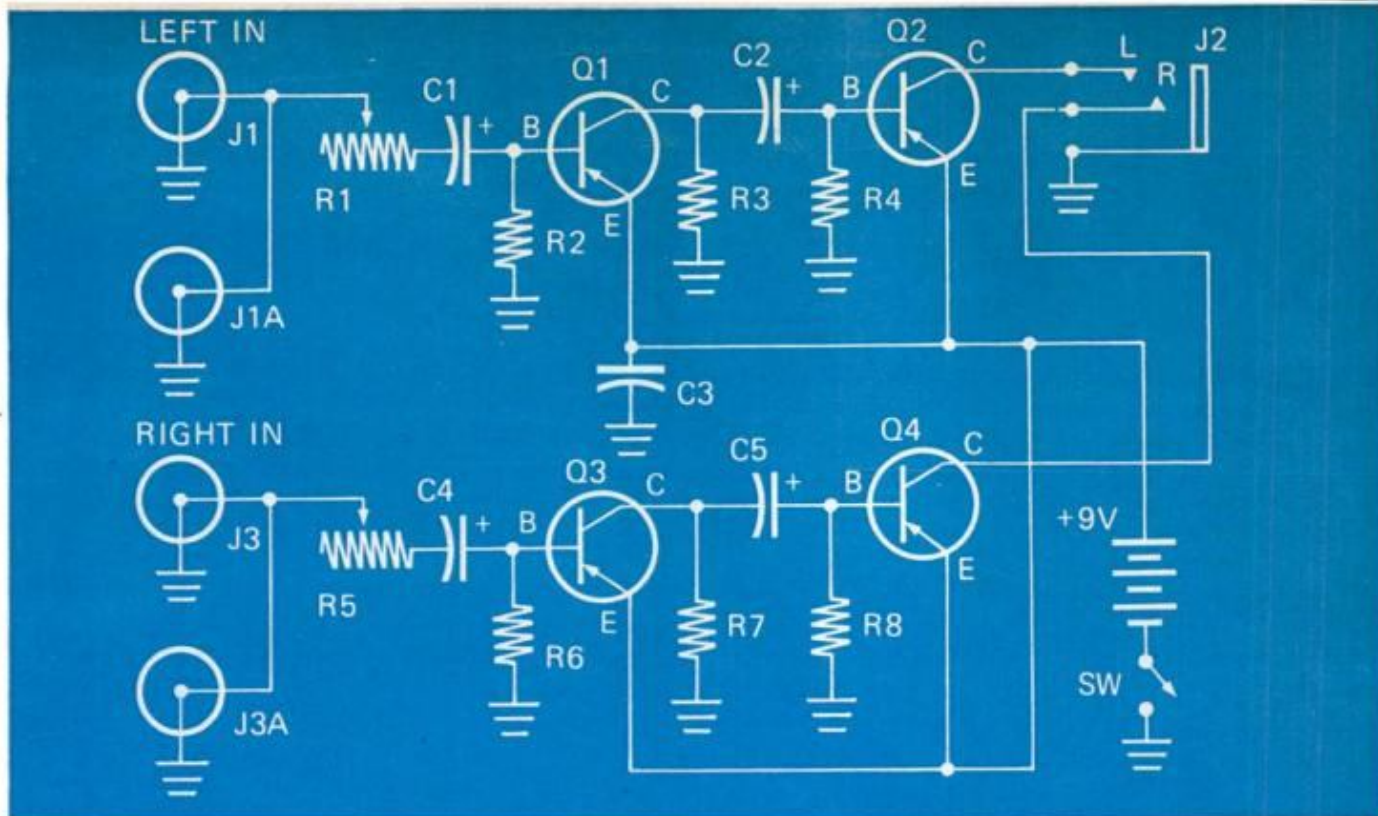
**On tape decks with headphone jack**, you can connect amp with stereo phone-phono adapter cable like this.

board's perimeter to serve as a common ground.

Attach and solder the ground wire after all the other components have been soldered into place. Where needed, the ground wire can be supported with small loops of bare wire through holes in the board. Twist and solder these loops to the ground wire; if loose, they could make intermittent contacts, causing "static." Clip soldered connections close to the board to keep them from making contact with the chassis. Where it's impossible to shorten a lead, reheat the solder and press the lead down with a screwdriver. If it still looks too long, stick a piece of plastic insulating tape on the metal chassis at the point where the lead might make contact.

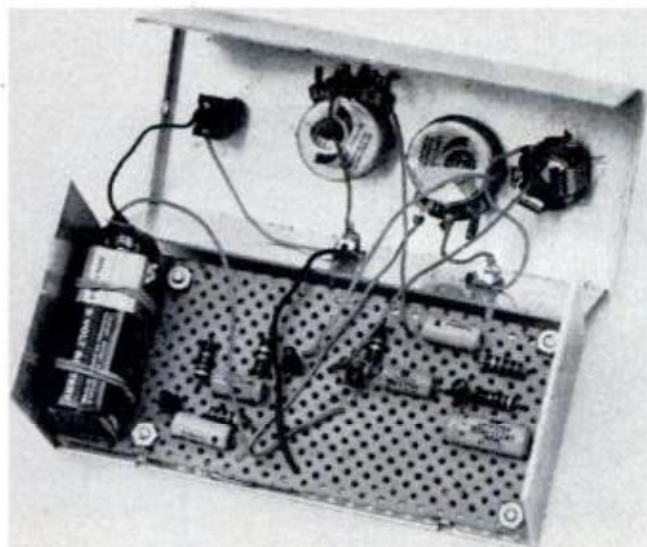
The jacks, switch and controls are mounted in the cover of the chassis box. Since the switch is relatively shallow and connects directly to the black battery lead, it's mounted right above the battery. The level controls R1 and R5 are each 1-meg-ohm potentiometers, wired in the circuit as series rheostats, to avoid the oscillation problems that might occur if they were used in the bias circuit.

The incoming signal is plugged into jacks J1 and J3—standard, single-hole phono jacks. However, if you're using the headphone amp with a tape deck and want to feed the same signal into your power amplifier, too, without a lot of plugging and un-



plugging, you can add another pair of phono jacks in parallel with the inputs. These jacks (J1A and J3A in the schematic) are for additional cables to your amp. If you don't want to install extra jacks, "Y" connectors with two phono jacks and one phono plug apiece will do the same job, but installing the extra jacks is both neater and cheaper.

When mounting the perfboard on the metal chassis, use  $\frac{5}{8}$ -in. screws on spacers to hold the board above the metal box to prevent shorts. If no spacers are handy, three nuts on each screw will do. ★★★



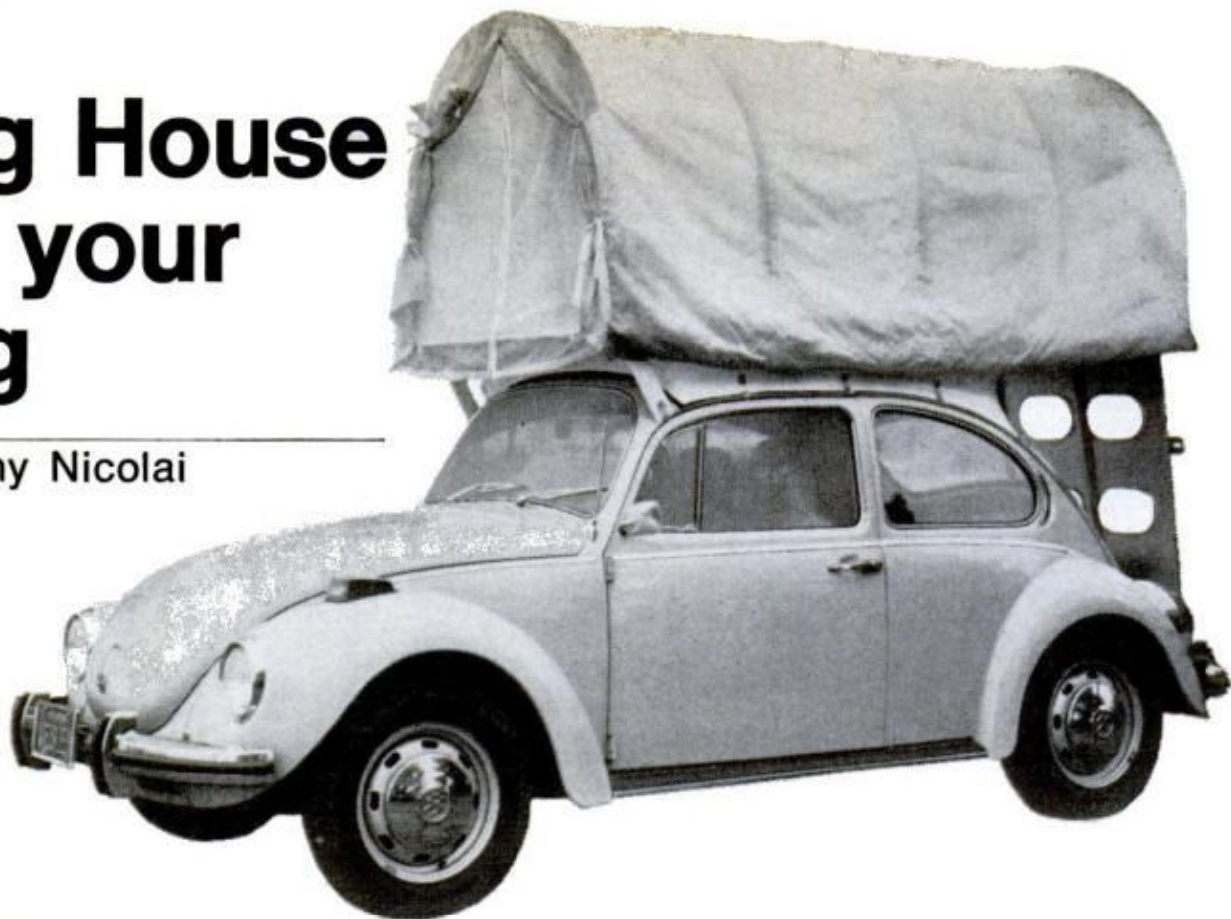
#### PARTS LIST

- R1, R5**—1 meg, linear taper potentiometers (Lafayette 33P 11537)
- R2, R6**—22 k,  $\frac{1}{2}$ -w. resistors (Lafayette 52P3105)
- R3, R7**—4.7 k,  $\frac{1}{2}$ -w. resistors (Lafayette 52P3089)
- R4, R8**—10 k,  $\frac{1}{2}$ -w. resistors (Lafayette 52P3097)
- C1, C2, C4, C5**—10 mf, 15-v. electrolytic capacitors (Lafayette 34P85463)
- C3**—100 mf, 15-v. electrolytic capacitor (Lafayette 34P85547)
- Q1, Q2, Q3, Q4**—General-purpose, audio-type PNP transistors (Lafayette 19P54676; Callectro K4-505; HEP-52, or equivalent)
- J1, J3 (optional: J1A, J3A)**—pin-type (RCA) phono jacks (Lafayette 99P62341)
- J2**—Three-conductor headphone jack (Lafayette 99P61186)
- SW**—Miniature s.p.s.t. toggle (Lafayette 34P33018)
- Misc.**—9-v. battery connector (Lafayette 99P62879),  $5 \times 2\frac{1}{4} \times 2\frac{1}{4}$ " chassis box (Lafayette 12P83886), knobs, perfboard, 9-v. transistor-radio battery, hookup wire, optional transistor sockets (Lafayette 32P42252), rubber bands, solder, machine screws, spacers, nuts.

Inside view of amp (left) shows perfboard for mounting parts, with switch, jacks and controls on the cover.

# Bug House for your bug

by Penny Nicolai



Photos: Mario Romo



**1** A Volkswagen-size penthouse unit folds down onto base mount to make neat cartop luggage rack.



**2** Hinged top unfolds back and down, after being unpadlocked, to form platform floor and rear steps.



**5** Full sitting headroom provides ample space for VW camper to finish tent erection from the inside.



**6** Shock cords hold the tent cover securely in place in breeze. Most setup can be done from inside.

Volkswagen owners do a lot of bragging, but they seldom mention sleeping inside the bug model. Only a couple of pretzels could be really comfortable.

But now Weslen, Inc., of 22771 Western Ave., Torrance, Calif., has come out with an add-on camping unit for about \$300. It has been aptly named the Bug House, can be easily mounted on any Volkswagen bug model in a matter of minutes, and the result is a cartop penthouse that erects to offer an enclosed double bunk providing sleeping accommodations for two.

Housing of the base is of fiberglass contoured to fit the VW roof. It locks into place without requiring any body drilling, and rides securely without rattles. All required parts fit inside the base, leaving the interior of your VW free for luggage and camping gear. Extra equipment can also be secured to the folded Bug House, so you can use it as a luggage rack.

Setup is quick, with two padlocks holding the cover in place. Unlock them and the cover pulls down to become a stepladder

with bottom fitting firmly inside the rear bumper. Pulling a second hinged flap forward reveals the nylon tent cover and rib bows stored in the space below.

Lifting out the four ribs, you bow them into place and insert them into socket holes along the platform edge. With the floor panel slid back in place and the nylon tent cover adjusted, the tent is ready for air or foam mattresses, sleeping bags and a good night's rest. Total time for one man to erect Bug House is about seven minutes.

Even a sleepwalker is fairly safe since the spring-steel ribs fitted into the 1/4-inch plywood base prevent rolling out of bed, and tearing resistance of the nylon tent is more than enough to hold a man's weight. Both ends of the tent are covered with full-height zippered mosquito netting under zippered privacy closures. Small screened windows in these doors are closed with pull-cords. Inside there is ample sitting headroom, and beginning campers seem to also like the cartop distance from ground-level snakes or bugs. ★★★



**3** Flooring panel slides back to reveal storage compartment in base for rib-bows and nylon tenting.



**4** Setup is simple with ribs bowed into place and fitted into hole sockets in 1/4-inch plywood floor.



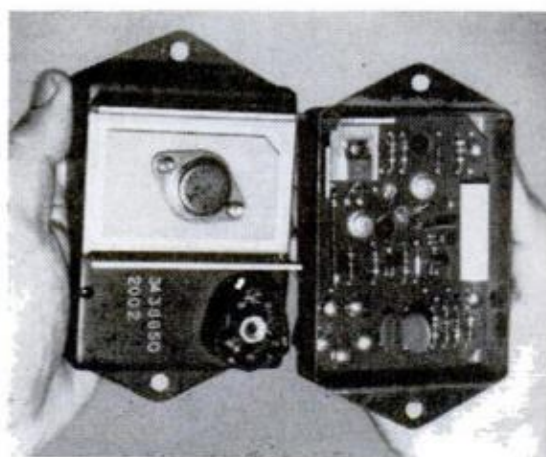
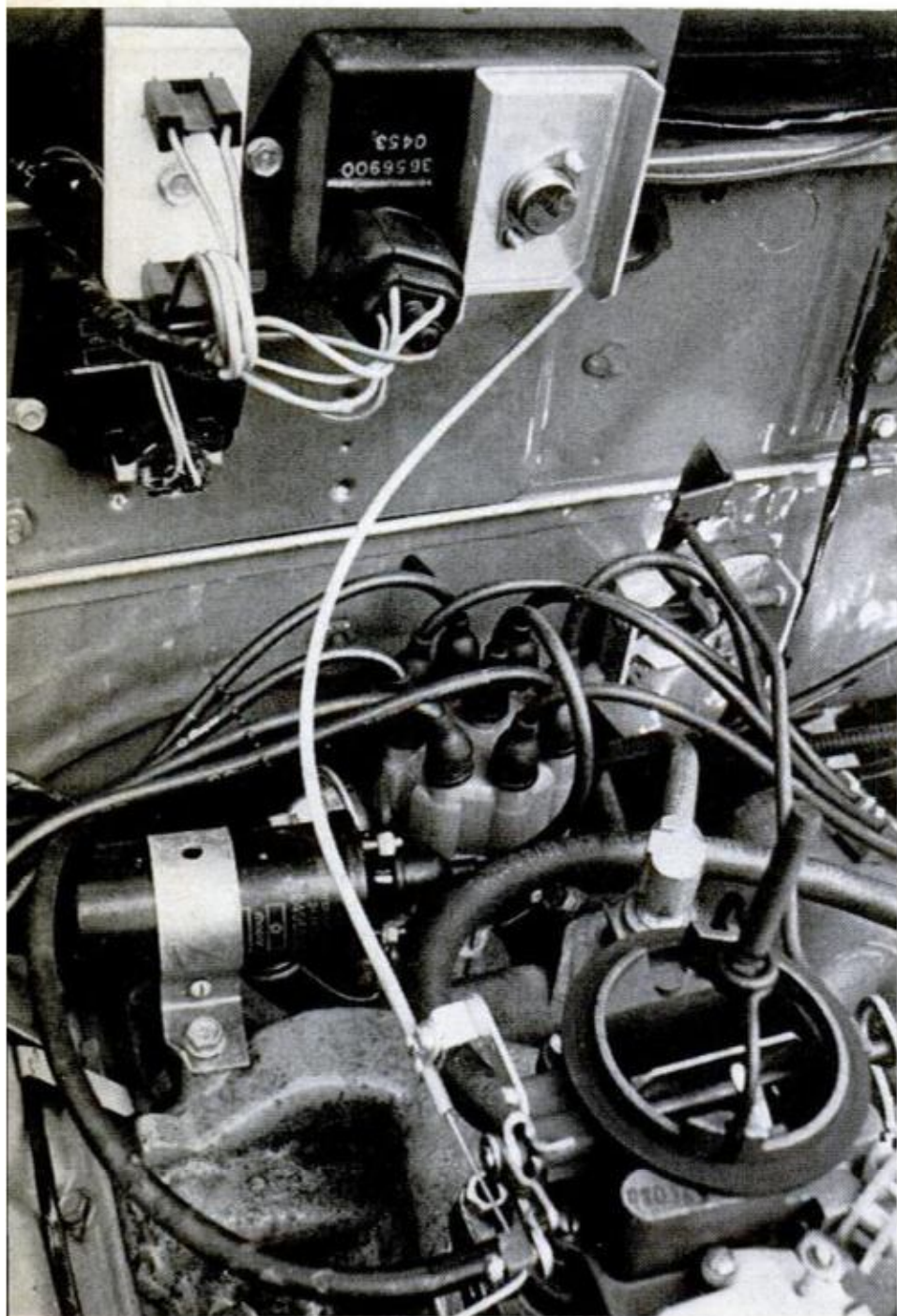
**7** Front porch for sunning, head out for sleeping, is alternate arrangement with tent partially erected.



**8** Climbing convenient ladder anchored to VW bumper, Bug Houseman enters his house-over-wheels.

# All you need to know about electronic ignition systems

by Rudolf F. Graf



**Under the hood** in the engine compartment at left is Chrysler's electronic ignition system. It consists of what appears to be a conventional distributor and electronic control unit and dual ballast resistor on the firewall. The open distributor, above, reveals the magnetic pickup unit that replaces the points. At top is the electronic control unit which contains the transistor circuits that control dwell time electronically.

**B**reaker points in ignition systems are going the way of whalebone corsets, nickel cigars and the iceman. Born 65 years ago in the famed ignition system that Charles F. Kettering designed for early Cadillacs, breaker points have stubbornly resisted retirement. But, today, advances in solid-state engineering and the tightening squeeze of governmental auto emission control regulations have combined to eliminate old-fashioned breaker points in favor of a new electronic ignition system. The change, led by Chrysler, appears to be permanent and is the spearhead of a solid-state revolution in Detroit ignition thinking.

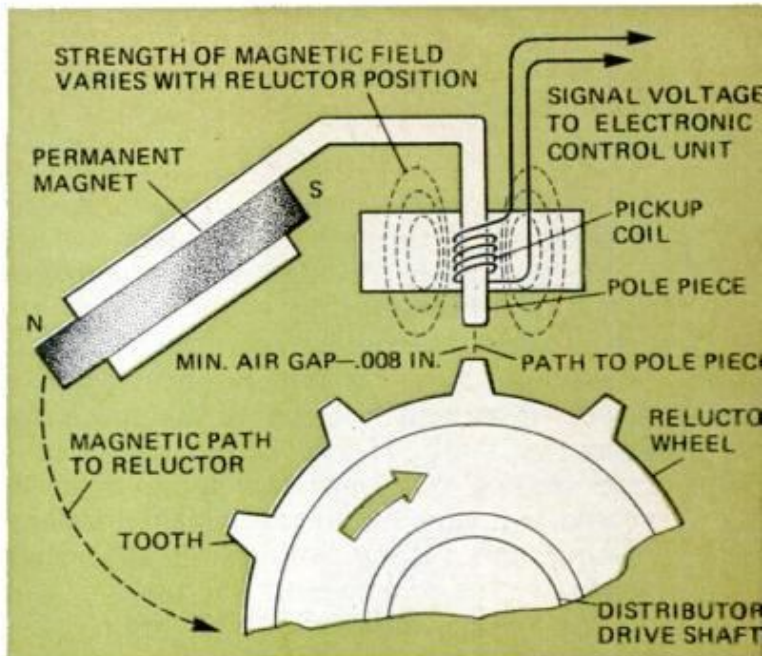
### Why electronic ignition?

The reasons for electronic ignition are simple and mighty convincing. At 60 mph in a car powered by an eight-cylinder engine with conventional ignition, a set of breaker points opens and closes more than 12,000 times a minute! With each closure, four to six amps. of current from the car's battery surge through the breaker points to store spark-producing energy in the primary winding of the ignition coil. Each opening results in an arc across the points as the inductive circuit is interrupted. Where there's an arc, there's energy loss and severe heat—that's why points are tungsten-tipped. But, even so, after about 250 hours of continuous slamming contact and searing heat, most points can't conduct full current and mechanical wear has changed timing. That means increasingly sluggish performance and misfiring. And, it's a sad fact that misfire in just one cylinder out of eight can increase engine exhaust emissions by as much as ten times!

Of course, if you're fastidious, you can keep a conventional ignition system in good shape by replacing points every 100 hours. Few of us do. That's why engineers at Chrysler Corp. chucked the points in all their 73 vehicles—to eliminate the headache of periodic breaker point replacement and to provide a system that can reliably fire every sparkplug, every time, on time, thus giving your car that "just tuned" feel and easing the burden on emission control systems.

### Something old, something new

All of the differences between the conventional and the new electronic systems are in the low-voltage primary circuit. The high-voltage secondary system remains un-



**Magnetic pickup** eliminates the need for contact points. Rotating reluctor and pole piece of pickup coil are separated by .008-inch air gap. Reluctor varies magnetic flux in pole piece, generating a signal that tells the control unit when a spark is needed. Vacuum advance shifts pickup unit position for timing change as in conventional breaker point system.

changed. There are no differences in the rotor, distributor cap, ignition coil, wires, sparkplugs, or advance mechanism. But, inside the distributor, some *big* changes have been made!

Down on the "breaker plate" (as it used to be called), you'll find a bracket supporting a rectangular magnet at one end, and an epoxy-encased coil at the other. This is the magnetic pickup unit. Inside the epoxy, a coil of fine, insulated wire is wound around the tip of the mounting bracket which extends through the case and acquires the name "pole piece" as it emerges on the opposite side. (The pickup coil terminals connect through harness wiring to the electronic control unit installed on the firewall of the engine compartment.) The old distributor cam and the "condenser" are gone. In place of the cam, a multitoothed iron wheel called a reluctor is fitted onto the distributor driveshaft.

How do the magnetic pickup and reluctor replace the switching action of a breaker-point set? The answer is, they don't exactly. Their purpose is to generate an electrical signal that rises and falls in step with mechanical rotation of the distributor driveshaft. The electronic control unit then converts this signal into a periodically interrupted flow of battery current through the ignition coil primary. Thus, it takes

both the pickup and the control unit to take over the function previously performed by the points.

### How the pickup unit works

The pickup unit magnet forms a closed magnetic path through the reluctor wheel and the pole piece. As the distributor drive-shaft turns the reluctor, coupling via this path changes, becoming strongest when a tooth of the rotating reluctor lies opposite the pole piece and weakest at the space between two teeth. If you recall how a generator works, you know that a coil of wire exposed to a varying magnetic field develops a rising and falling voltage. That's what happens in the pickup coil. The teeth of the reluctor correspond to cylinder firing points; a tooth lies opposite the pole piece just as one of the pistons has reached the peak point on the compression stroke. At that instant, voltage out of the pickup unit rises to a peak and signals the control unit that it's time for a spark.

### The electronic control unit

Packed into the sealed electronic control unit is a smart, four-transistor circuit that switches battery power to the ignition coil primary in response to the distributor pickup signal. On its own, though, the control unit sets "dwell" of the system to ensure a peak spark.

*Dwell* is an expression left over from the days of breaker points. In effect, it states how long points are closed, in terms of distributor cam rotation. This translates into the period of time that battery current flows into the ignition coil before each spark, thus providing a measure of the amount of stored flux energy available for conversion into spark voltage. Ideally, current *should* flow until the coil is "saturated" with magnetic flux. (That is, no more flux will be produced no matter how much longer current flows.) This rarely happens in conventional ignition because the points are mechanical and slow-moving. The dwell that you get is a compromise.

Not so in the Chrysler system that we're focusing on in this article. The diamond-shaped power transistor on the control unit is normally biased "on" and pumps battery current into the ignition coil primary until the distributor pickup unit signals that it's time for a spark. At that instant, the power transistor is switched "off" very briefly, the magnetic field about the coil

## Check your own electronic ignition system

The checks here refer to the wiring diagrams for the Chrysler system shown below.

**Timing**—Unless you tear down the engine for overhaul there is no need to retime. But checks can be made by triggering the timing light off plug No. 1 and using it to illuminate the timing works. As in the conventional system, the distributor clamp bolt is slackened and the distributor rotated until timing marks line up. The bolt is then tightened to lock the distributor at the correct factory setting.

**Dwell**—The measurement can be made, but it won't mean much because you can't adjust it. Hook up dwell meter (+) lead to ignition coil (-) and dwell meter (-) lead to block ground. You'll read close to 40°.

**Rpm**—Same hookup as dwell, but use tachometer. Adjust carburetor idle settings (cold and hot) to set correct engine rpm.

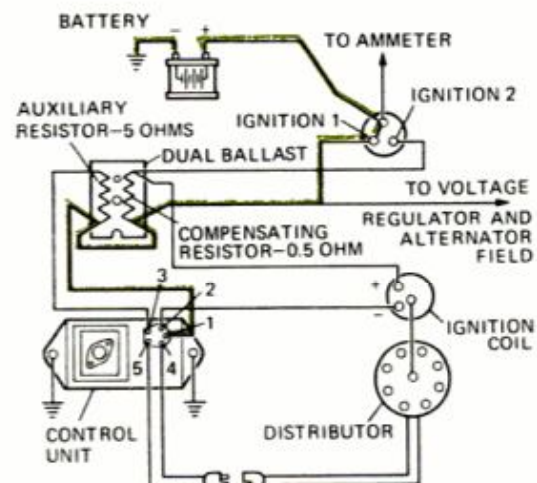
**Gap**—To check the pickup gap, a .010-inch feeler gauge should not slip between the end of the pickup coil core and an aligned reluctor tooth. **Caution:** A feeler gauge can be forced between the pickup coil and reluctor tooth when the air gap is properly adjusted, so do not use force when checking with a .010-inch feeler. If it is necessary to set pickup air gap, loosen the pickup adjusting screw, align a reluctor tooth with the pickup core and insert an .008-inch feeler between the reluctor tooth and pickup core. Tighten the pickup adjusting screw with the .008-inch feeler in place.

It is necessary to use a nonmagnetic feeler gauge because a feeler gauge that is attracted to the magnetism of the pole piece will give a false "feel" or drag. If nonmagnetic feeler gauges are not available, brass shim stock of the proper thickness can be used.

After setting the air gap, run the distributor on a test stand and apply vacuum to make sure that the reluctor teeth do not strike the pickup core during vacuum advance check.

The reluctor teeth may appear to be a little rough at the edges. Do not try to clean them up by filing the edges. You may file too much and round the edges of the teeth. A sharp edge is needed to quickly decrease the magnetic field, and induce the negative voltage in

**1. Portion of the ignition circuit to be checked** if voltage at connector cavity 1 is not within one volt of battery voltage with the accessories off.



the pickup coil. If the teeth are rounded, the voltage signal to the control unit will be erratic.

**Reluctor polarity**—There are two small arrows on the reluctor that point in opposite directions. In a clockwise distributor the arrow at the keeper pin that holds the reluctor in place should point clockwise. In a counterclockwise distributor, the arrow at the keeper pin should point counterclockwise. If the arrow at the keeper does not point in the direction of distributor rotation, remove the reluctor, turn it 180° and reinstall it.

**Plug wires**—Bare one end of an insulated length of wire. Clip the other end to engine block (ground). With engine running in darkened garage, brush bare end of wire over entire length of insulated plug lead. If you spot a spark, the lead is bad and should be replaced.

Chrysler uses silicone ignition cables equipped with a silicone rubber outer covering that is highly flexible and extremely heat resistant.

A fiberglass jacket has also been added which increases the strength and durability over the standard neoprene cables. This cable is used on the rear four cylinders of the Chrysler 400 and 440-cu.-in. engines.

The hypalon cable is used on all Chrysler 225, 318, 360, 361 and 413-cu.-in. engines and on the front four cylinders of the 400 and 440-cu.-in. engines.

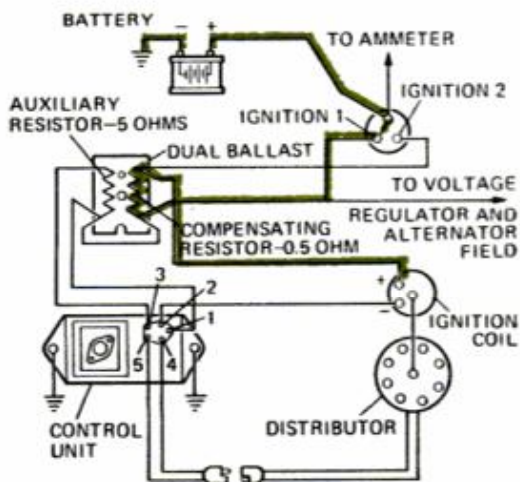
Do not use the cable as a handle and pull it from the sparkplug or the distributor cap. That's the easiest way in the world to disconnect the cable from the terminal and ruin the cable. Always remove the cable from the plug by firmly grabbing the terminal itself. The cover at the terminal is very flexible so this can be done quite easily.

## Electrical checks

1. Remove the multiwiring connector from the control unit. (Connector cavities 1 through 5 are shown below.) Turn the ignition switch on. Connect the negative lead of a voltmeter to a good ground.

2. Connect the positive lead of the voltmeter to the wiring-harness connector cavity No. 1. Available voltage at cavity No. 1 should be within one volt of battery voltage with all accessories off. If there is more than one volt difference, Fig. 1 shows the circuit that must be checked.

**2. Portion of ignition circuit to be checked** if voltage at connector cavity 2 is not within one volt of battery voltage with the accessories off.



3. Connect the positive lead of the voltmeter to the wiring-harness connector cavity No. 2. Available voltage at cavity No. 2 should be within one volt of battery voltage, with all accessories off. If there is more than one volt difference, Fig. 2 shows the circuit that must be checked.

4. Connect the positive lead of the voltmeter to the wiring-harness connector cavity No. 3. Available voltage at cavity No. 3 should be within one volt of battery voltage with all accessories off. If there is more than one volt difference, Fig. 3 shows the circuit that must be checked. Turn ignition switch "off."

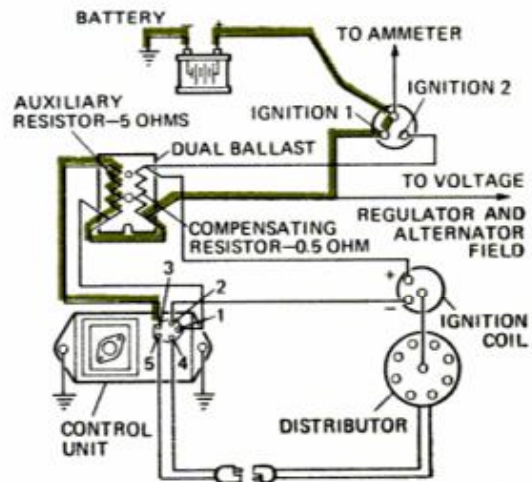
5. Connect an ohmmeter to wiring-harness connector cavity Nos. 4 and 5. The ohmmeter-resistance reading should be between 350 and 550 ohms. If it's higher or lower than specified, disconnect the dual-lead connector coming from distributor.

Using the ohmmeter, check the resistance at the dual-lead connector coming from the distributor. If the reading is not between 350 and 550 ohms, replace the pickup coil assembly in the distributor. If the reading is within specs, check the wiring harness from the dual-lead connector back to the control unit. Connect one ohmmeter lead to a good ground and the other lead to either dual-lead connector pin of the distributor harness. Ohmmeter should show an open circuit. If the ohmmeter shows continuity, the pickup coil in the distributor must be replaced.

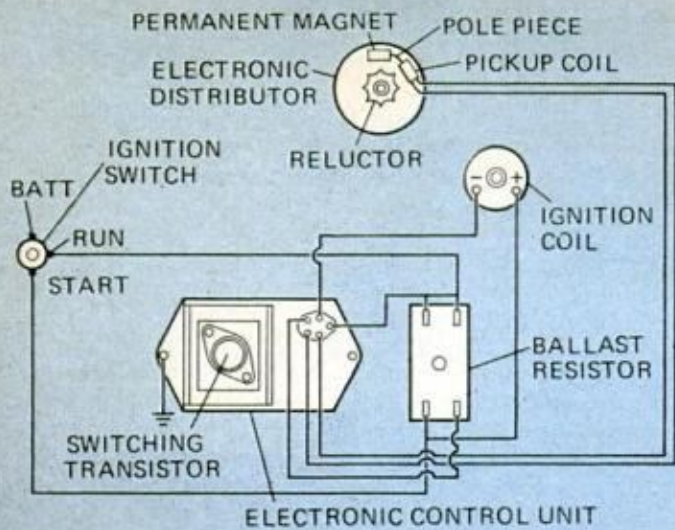
6. Connect one ohmmeter lead to a good ground and the other lead to the control-unit connector pin No. 5. The ohmmeter should show continuity between ground and the connector pin. If continuity does not exist, tighten the bolts holding the control unit to the firewall. Then recheck. If continuity does not exist, the control unit must be replaced.

Reconnect the wiring harness at the control unit and distributor. Note that whenever you remove or install the wiring-harness connector at the control unit, the ignition switch must be "off." Otherwise the control unit could be damaged. Remove the high-voltage cable from the center tower of the distributor. Hold the cable approximately 3/16 inch from the ground. Crank the engine. If arcing does not occur, replace the control unit. Crank the engine again. If arcing still does not occur, replace the ignition coil.

**3. Portion of circuit to be checked** if voltage at cavity 3 is not within one volt of battery voltage with accessories off. Ignition switch is turned off.







**Wiring diagram** of the Chrysler electronic ignition system shows all components. The dual ballast resistor replaces the single type used in conventional ignition systems. In the dual unit, separate resistors are sealed in a ceramic block. They limit current to ignition coil and the control unit. The control unit is actually sealed in epoxy, which makes it impervious to moisture, fumes and vibrations.

primary collapses suddenly and induces high voltage in the coil secondary, which causes a spark at the plug electrodes. Immediately, the power transistor switches "on" again, to recharge the coil for the next spark. In effect, the system "stretches" the dwell period well beyond that achievable with breaker points. The switch-off period is so brief that there is more than adequate time to store full energy between the sparks, even when the engine is operating at top rpm.

Operating voltage to the electronic ignition system is provided through a dual ballast containing two separate resistors: One limits current into the ignition coil primary (as in the conventional system) while the second resistor feeds the transistor circuitry of the electronic control unit. The Chrysler system interconnection is shown in the wiring diagram above.

## Maintenance

To get an idea just what kind of maintenance the owner of a Chrysler product equipped with electronic ignition might look forward to, we visited the Chrysler Training Center near Tappan, N.Y., and posed the question to Chief Instructor Bill Hamer. When we mentioned "maintenance," you might almost think we had said a dirty word.

Soft-spoken Hamer gave a measured reply: "By and large, our electronic ignition

is a troublefree system that eliminates the need for periodic points replacement." He explained that getting rid of the points did away with the need for fussy dwell adjustment, and that with the new distributor pickup unit there just wasn't anything to be done by the owner inside the distributor in the way of maintenance or adjustment. Since the reductor and pickup coil merrily whirl by each other with a clearance of .008 in. there is no wear which would necessitate adjustment. Barring a random failure in the distributor or electronic control unit, there's nothing to do in the ignition primary circuit.

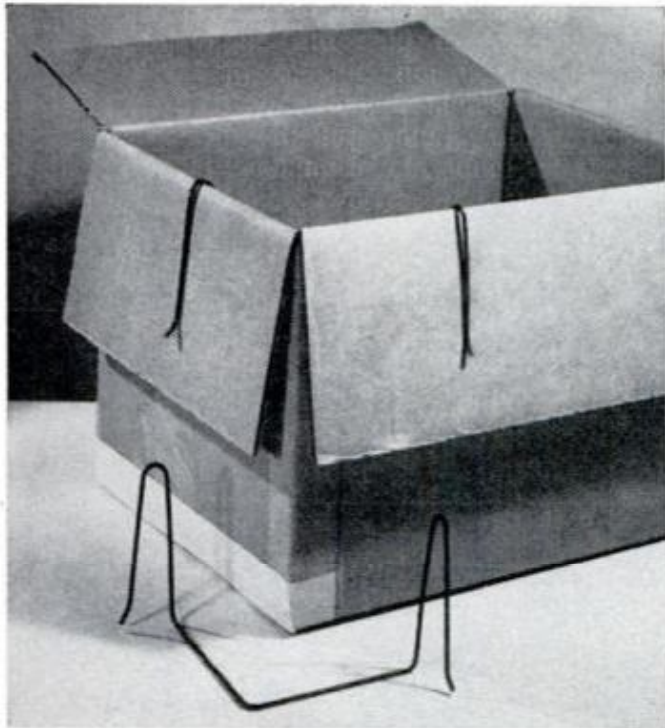
To illustrate the new simplicity of the system, Hamer hooked up a Chrysler electronic ignition tester to a brand-new 318-cu.-in. engine and ran a 30-second check on the primary circuit (these testers are standard equipment at all Chrysler dealers). Its three red lights stayed dark while two green ones glowed brightly. "If there'd been a failure in any part of the primary circuit, the defective part would be pinpointed and replaced," Hamer explained. Evidently, moving to electronics has also eliminated some costly troubleshooting time—an added bonus in these days of steeply rising dealer servicing costs.

But Hamer was quick to point out that the presence of electronic ignition in Chrysler cars hasn't done away with the need for other routine servicing and adjustments that would normally be included in a "tune-up." Because the high-voltage secondary circuit (rotor, cap, plug wires and sparkplugs) remains unchanged, checks should continue to be made for deterioration in these components. Plug life has been estimated by Chrysler at an average of 18,000 miles, although the need for plug renewal seems to be dictated more by fuel contents (lead, for example) than by the electronic system that's firing the plugs. A "healthy" plug exhibits a very light tan or gray color. While the electrode gap widens about .001 in. per 1000 miles, chances are you can clean plugs, file, regap and reinstall with good results.

Carburetor and emission controls should be checked and serviced, if need be, since foul-up in either can swiftly erase the benefits of good ignition. But don't turn off on tune-ups just because the breaker points are gone. Until they seal the hoods on cars, the maintenance-free car can't really be said to have arrived! ★★★

# HINTS

## FROM READERS



### Wire 'clamps' hold box flaps

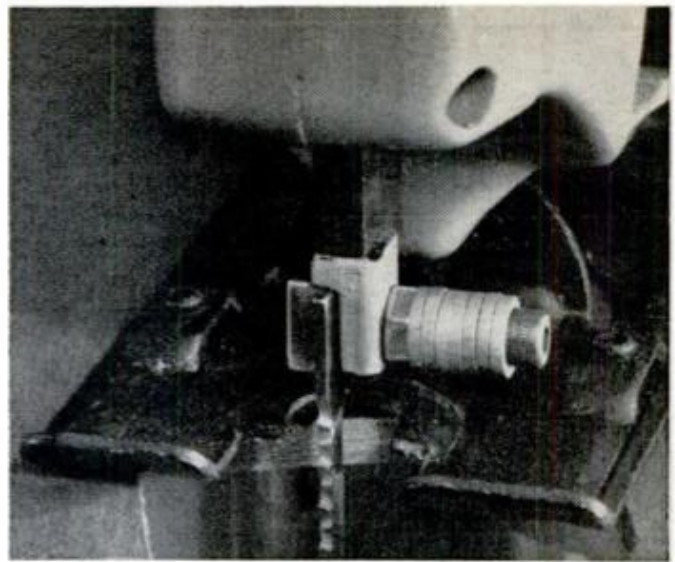
When doing a lot of packing, simple wire devices to hold the box flaps out of the way make the job easier. To make the "clamps," cut and bend coathangers as shown above.

—Marvin Duchoviner, Brockton, Mass.



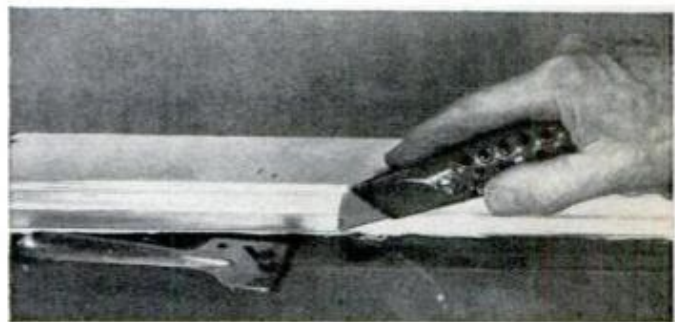
### Adapting adapters

If the hose adapter of an appliance does not fit snugly over a faucet, tighten an automobile radiator hose clamp around the rubber adapter to eliminate leaks and maintain water pressure.—P. Cryan, Newburgh, N.Y.



### More convenient sabre blade screw

To ease removal of sabre-saw blades, I replaced my hard-to-get-at short screw on the blade clamp with a  $\frac{3}{4}$ -in. one. I then "stacked" the screw with washers and a nut for rigidity.—A. Vena, Philadelphia



### Neater paint removal

When removing excess paint from the edges of window glass by scraping, first make a knife-point cut near the sash bead to separate the paint and permit a clean line in removal.—Walter E. Burton, Akron, Ohio



### Flashlight support

To support a flashlight and keep it from rolling, cut center hole in plastic container cover, clip edges to fit flashlight and cut rim of cover to provide a flat resting edge.—H. Radzinsky, Charlotte, N.C.

# You can learn to weld in minutes . . .

. . . with outfits that use oxygen sticks to generate temperatures exceeding 5000°F.

by Ronald E. Thomas

When it comes to welding, most do-it-yourselfers have been happy to leave it to the pros, and for good reason. Conventional welding equipment is pretty costly if it's just for an occasional home welding job. And the size of the big equipment will scare off most beginners.

Two outfits sized for home use have changed all that and made welding safe and simple at a price the do-it-yourselfer can afford. One pocket-sized kit called Pyro-5 sells for \$39.95; the other, called Solidox, sells for the same price.

While toylike in appearance, they are anything but. They are not designed to do the work of the pro's welder, but I was surprised with what you can do with them and how easily you can learn to weld.

Both units operate on the principle of mixing oxygen with propane to generate temperatures up to 5000°F. That's hot enough to weld a broken garden tool or mower, repair a tear in a fender or the fork of a motor bike, or to make any number of wrought-iron projects as well as cut padlocks, chains and bolts.

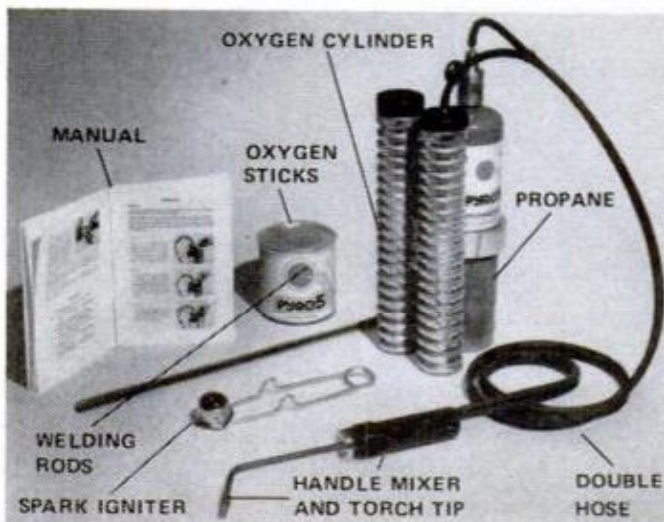
The propane comes from standard cylinders of the type you use for a Bernz-O-Matic or similar torch. The oxygen is produced from oxygen sticks which are shaped like candles and burn like cigars. After an oxygen stick is ignited with a match and secured in a special canister, it releases two minutes of oxygen flow per inch of length. The sticks are color-coded to guide selection of the right one for the job.

While these kits cost less initially than a conventional oxygen-acetylene torch, on a continued-use basis they would be more expensive to operate. They are designed and intended for the do-it-yourselfer who has only occasional light welding needs. Assum-



**Solidox torch-kit package** includes the torch itself, a 14-ounce cylinder of propane, braze rods, 90-minute supply of Solidox (oxygen pellets), safety glasses, two welding tips. For how-to-buy information, write Cleanweld Products, Inc., Dept. PM, 813 South Fremont Ave., Box 1108, Alhambra, Calif. 91802. Price \$39.95.

**Pyro-5 kit** sells for same price as kit shown above. Made by Pyronetics, Dept. PM, 10025 Shoemaker Ave., Santa Fe Springs, Calif. 90670.





**Oxygen sticks** are lit (at the red end) and dropped into canister. The canister cap is then finger-tightened because the oxygen starts to flow immediately.

**Brazing** is simpler process than gas welding procedure and good way to familiarize yourself with the unit. Melt a little of the flux off the end of the rod onto the start of the joint. Keep heating joint until flux looks like it's moving (liquid). Now melt a drop of the rod and play the torch in a zigzag fashion to cause brazed material to flow into the joint.



**Inner cone of flame** should be between  $\frac{1}{4}$  and  $\frac{3}{8}$  in. long. Hissing sound assures that torch is operating properly and under pressure. Colored glasses are a must for eye protection. Work surface should be of noncombustible material; surrounding area free of combustible material.

ing that the average professional snop would charge a \$5 to \$10 minimum for a small weld job, one of these units will pay for itself after you've used it a half-dozen or so times.

One apparent disadvantage is the short burning time of the oxygen source. On the plus side, however, this is what gives the unit its light weight—seven pounds.

You must have everything ready to go before starting the oxygen-making process by lighting the sticks. They last about five to eight minutes, causing a delay while you start another batch. However, it takes only a few minutes to start again, and the pause gives you a chance to inspect your work and make any changes that may be needed.

By using modern brazing alloys, a strong joint can be obtained without the skill and dexterity required for gas welding. The instruction book that comes with each kit contains all the information you need.

One important point: Remember that the torch flame is  $5000^{\circ}$ , and that the container for the oxygen sticks and the spent pellets and sticks are hot for quite a while after being dumped. Keep a fire extinguisher handy and dispose of expended sticks on a noncombustible material. Observe standard welding precautions regarding fire and personal safety. *Always wear colored goggles when welding. Don't let bystanders watch unless they, too, wear goggles.* ★★★

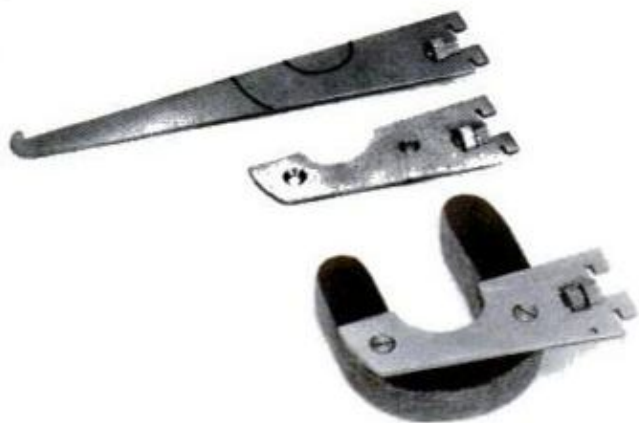
# Custom-fit gun rack adjusts for growing collection



Based on standard shelf hardware system, this rack puts your present gun collection on display, with flexibility and room for future acquisitions. Guns are supported at barrel and at stock just behind grip by blocks that are fastened to the cut-down shelf brackets.

Putting inoperative guns on display is quick work with a rack that makes use of shelf hardware for fast construction and flexibility. Each gun is fitted to its own brackets, assuring solid support and level display for best appearance. Guns can be repositioned and respaced easily and standards can also support a shelf, as shown above, for accessories.

The shelf system used here has satin-finish brass brackets, custom cut with a hacksaw blade. Support blocks were cut from  $\frac{3}{4}$ -in. pine and stained walnut. Scraps of an attractive hardwood such as walnut or birch could also be used. Blocks, used as templates for laying out cuts to be made on brackets, are shaped first to fit guns on a cut-and-try basis or, better, cut to cardboard templates fitted to gun contours. Rear (stock) supports are made first; then each gun is held in position and heights and depths of front (barrel) supports are figured so guns will be level. ★ ★ ★



Brass shelf brackets are surprisingly easy to cut with hacksaw blade in sabre saw. Wood block is first cut to fit gun, then temporarily attached to bracket as template for marking cuts. Final assembly is with  $\frac{3}{4}$ -in. No. 8 flathead brass woodscrews. Use a countersink made for metal on the brackets. Note: a locking cabinet, rather than a rack of any kind, should be used for display of all operable weapons, which should be stored with trigger locks for added safety.

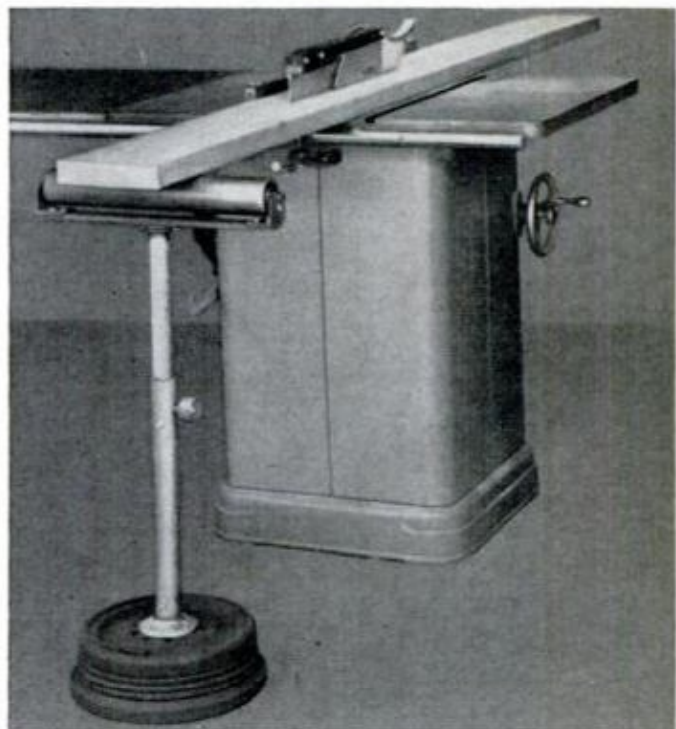
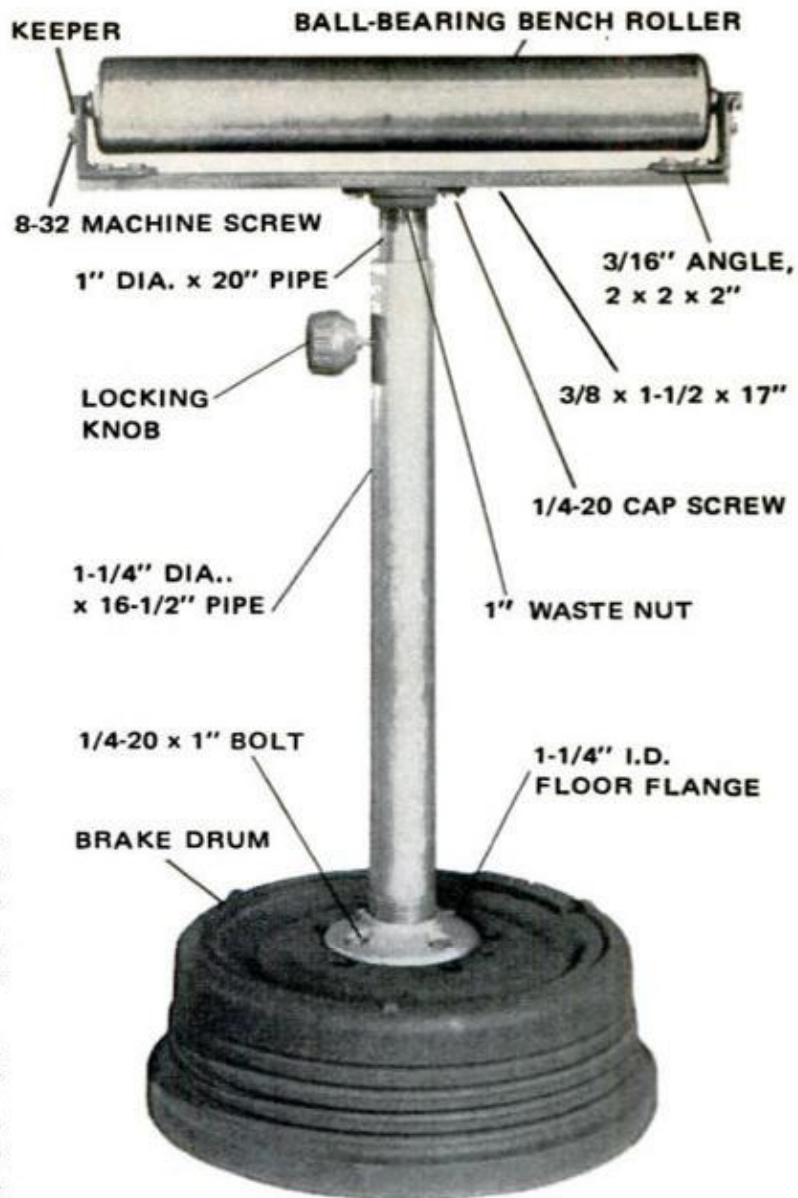
# Sturdy roller support for bench-saw work

by C. E. Banister

Here's a one-evening, easy-on-the-wallet project that will be a valuable "third hand" in your workshop. The work support boasts an adjustable roller top, which greatly simplifies ripping and crosscutting of long boards and large sheets of plywood on a bench saw.

The steel ball-bearing bench roller can be purchased from Belsaw Machinery Co., 315 Westport Rd., Kansas City, Mo. 64111 for \$6.50 postpaid. All other parts are inexpensive and readily available locally. The two lengths of pipe can be bought cut to length and each threaded at one end. A standard replacement knob for existing equipment would make a good locking device for the pipe uprights. (A piece of  $\frac{5}{16}$ -in. rod threaded at one end and bent to a  $30^\circ$  angle would also work well.) Automotive brake drums can be obtained from brake service shops or junk yards.

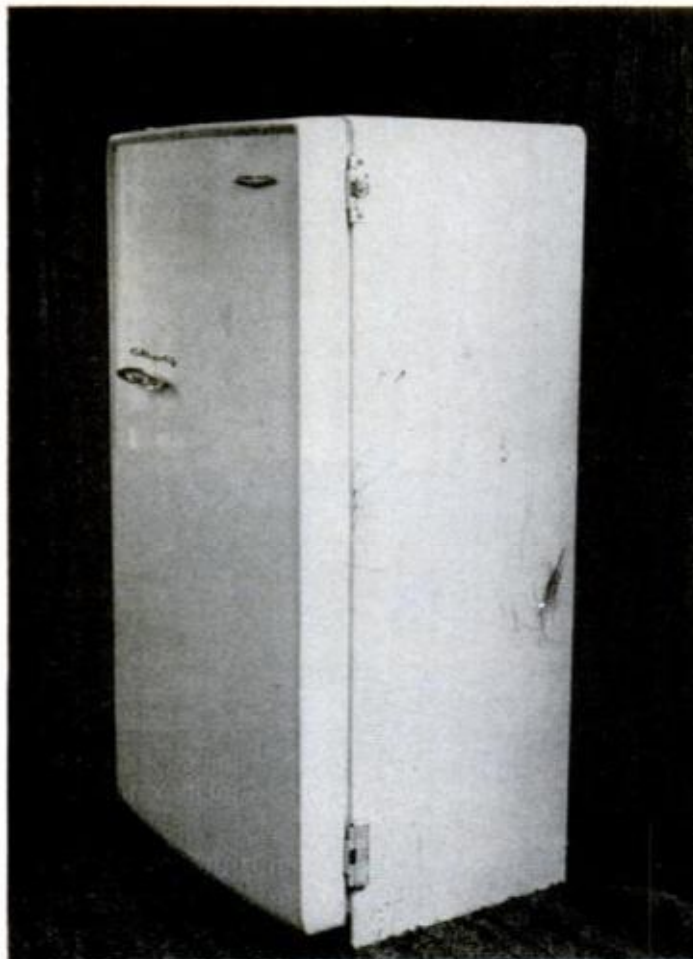
The roller cradle consists of a  $\frac{3}{8}$ -in.-thick iron bar, drilled and tapped to receive  $\frac{1}{2}$ -in.  $\frac{1}{4}$ -20 capscrews that attach the waste nut and the two angle irons. Each angle iron is notched and filed with a three-cornered file to allow the seating of the  $\frac{1}{2}$ -in. hex roller shaft. After each angle iron is drilled and tapped to receive  $\frac{3}{8}$ -in. 8-32 machine screws, two short lengths of coathanger wire for "keepers" are threaded through the  $\frac{1}{8}$ -in. factory-drilled holes in the shaft ends and wrapped under the machine-screw heads to form continuous loops and hold the roller in the cradle firmly. ★★★



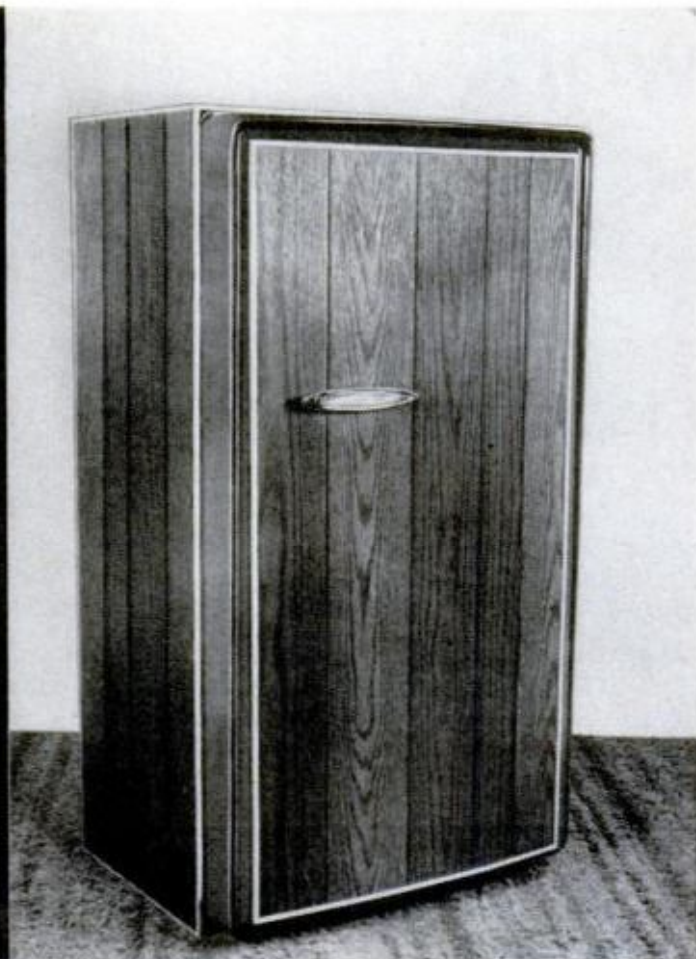
**Rugged work support**, which is tip-proof because of the design of the base, is a safety must when you are single-handedly ripping or crosscutting long pieces. (To do latter, support is repositioned at saw's side.)

# New look for an old refrigerator

by Robert Wortham



**Badly in need of refinishing**, this 12-year-old refrigerator was a good candidate for paneling-and-aluminum modernization because of its dated design.



**Dark oak panels** framed with satin-finish aluminum give the updated refrigerator a rich look. Brown spray enamel makes door harmonize where it shows.

If a recent kitchen-remodeling job has your old refrigerator in need of a face-lift, or you've bought a new refrigerator but kept the old one for the family room, you can panel it with wood for a clean-line modern look. The contrast of wood grain and narrow, satin-finish aluminum molding will take years off its appearance.

The average-size 10 to 14-cu.-ft. refrigerator will require one 4x8-ft., 1/8-in. panel (perhaps the same paneling you've used in the family room, or one that will match your kitchen cabinets), 45 lineal ft. of 3/8-in. lipped aluminum cap molding, 3/8- and 3/4-in. No. 5 flathead sheet-metal screws and a can of spray enamel (same color as the

paneling) for exposed areas of door and cabinet not covered by paneling.

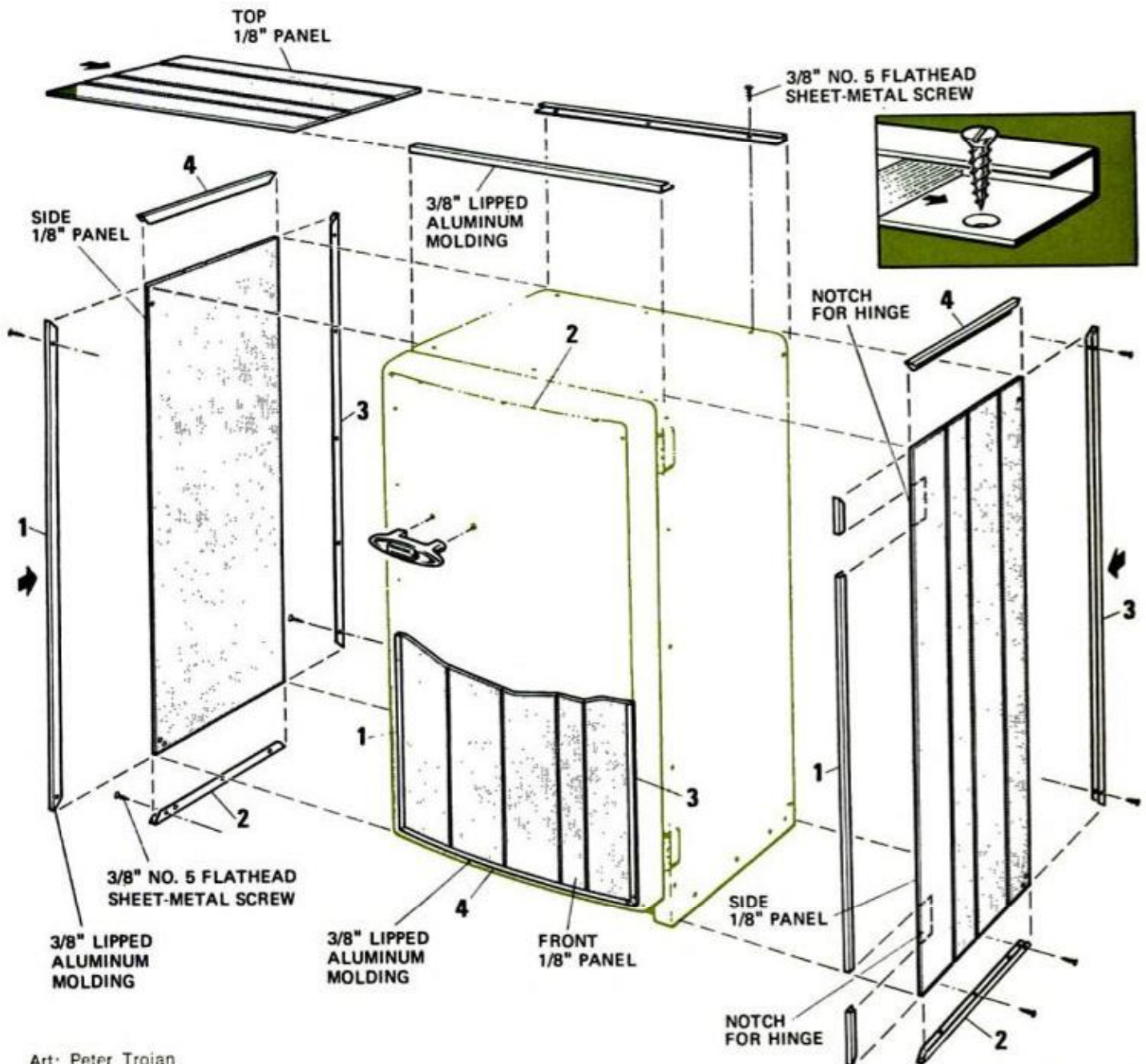
Start with a side panel, attaching front vertical and bottom molding strips through wide lip of molding with 3/8-in. screws. Slip panel into place and attach rear vertical strip with 3/4-in. screws through molding. The top molding strip, capping the top edge of the panel, is attached with contact cement—*caution*: contact cement is extremely flammable, so read and follow maker's instructions. Follow with the top, second side and door panels (the door panel and molding may bend to follow door curve). Finally, replace door handle and latch assembly, inner door and basket. ★★★



**SECTION**



Gasket and inside panel are removed so that the door handle assembly and nameplate can be detached. Door edge is spray-painted to match paneling. Except for two strips on top, which butt against strips on top edges of sides, all moldings are mitered. Top panel slides into place after the top strips and one side panel have been installed. Then the second side panel can be put into place.

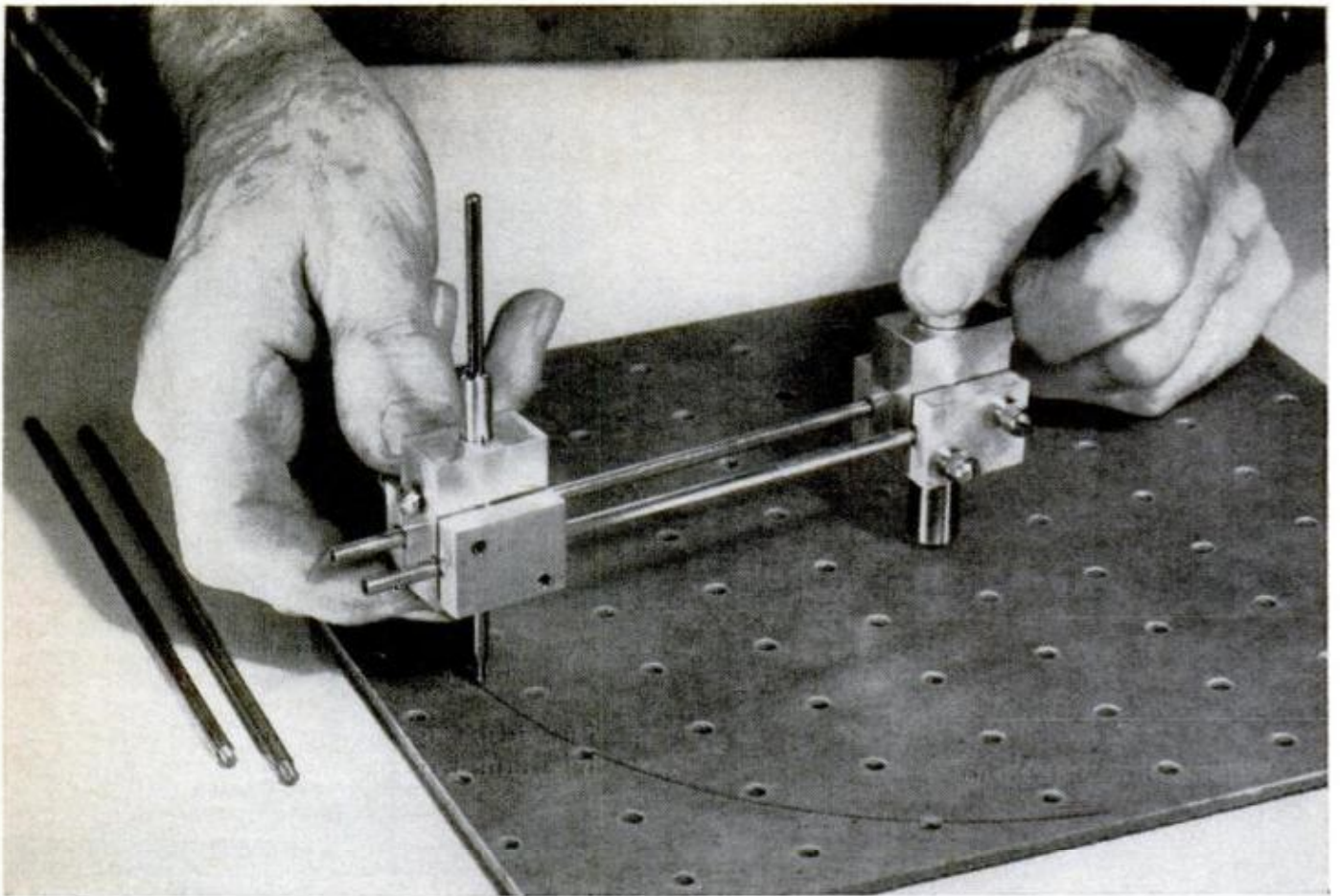


Art: Peter Trojan

JANUARY 1974

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# Shop-built trammel is on the mark every time

by Walter E. Burton

Generally, a trammel is considered to be a drawing instrument—a beam compass for example, for drawing circles and arcs of greater radii than a conventional compass can handle. The construction of a trammel outfit like the one shown above marking a circle on perforated hardboard can be a rewarding project in which a small lathe is useful. But if you lack this machine, the parts could be made entirely by hand.

The trammel "outfit" consists essentially of two steel, brass, or brass-plated steel rods approximately  $5/32$  in. in diameter, a pair of metal (or even hardwood) blocks mounted to slide on parallel rods, and various pivot centers and scribes that can be clamped in the blocks.

Lengths of the two rods will depend on the radii of circles to be drawn or distances between center marks to be made. Usually, rods 12 to 24 in. long will be desirable. Because it is not always convenient to store long rods, they can be made in sections connected by threaded couplings.

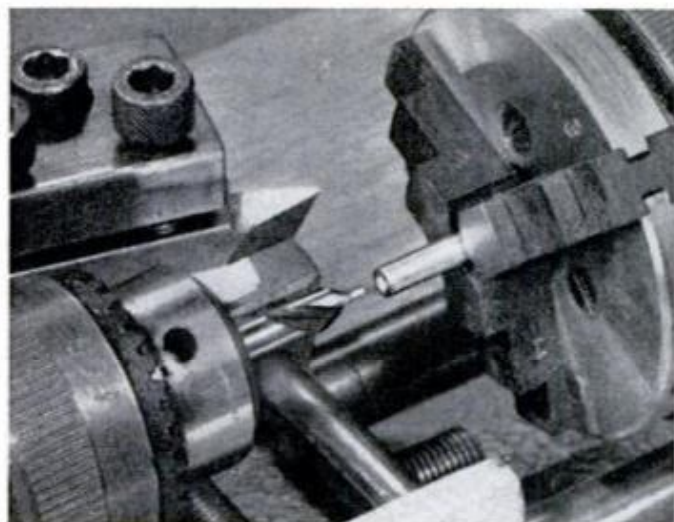
*Making rod joint (part G):* Clamp the rod in a lathe chuck or headstock collet and face off the end so it is perfectly flat and square with the side. With a center drill, start an axial hole. Using a twist drill, enlarge this to tap size to a depth of about

$\frac{1}{2}$  in. Clamp a tap in the tailstock chuck, douse it with threading lubricant, and turn the headstock spindle by hand to cut threads as far as the hole depth permits. Drill and tap both ends to be joined. Run a bolt into one of the tapped holes until it is jammed tightly with at least  $\frac{1}{4}$  in. of threads projecting. Cut off the bolt head. Bolt size is not critical, as long as the bolt and the rod metal around it have adequate strength. For the  $\frac{5}{32}$  in. rods shown, 4-40 bolts were used.

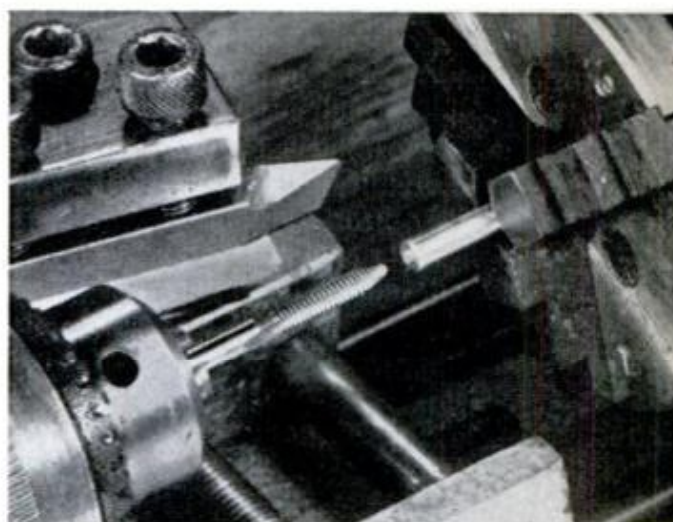
*Sliding-block units:* Each block unit consists of a central part (A) flanked by two smaller clamping blocks (B and C). When

the clamping blocks are drawn toward the center section by tightening two knurled-head 6-32 bolts, they squeeze against the rods running through parallel channels, locking the unit in position on the rods. A vertical hole ( $\frac{1}{4}$ -in. dia.) in the central block serves as a socket for such attachments as a pivot center, scriber, ruling pen, ballpoint pen, knife and pencil.

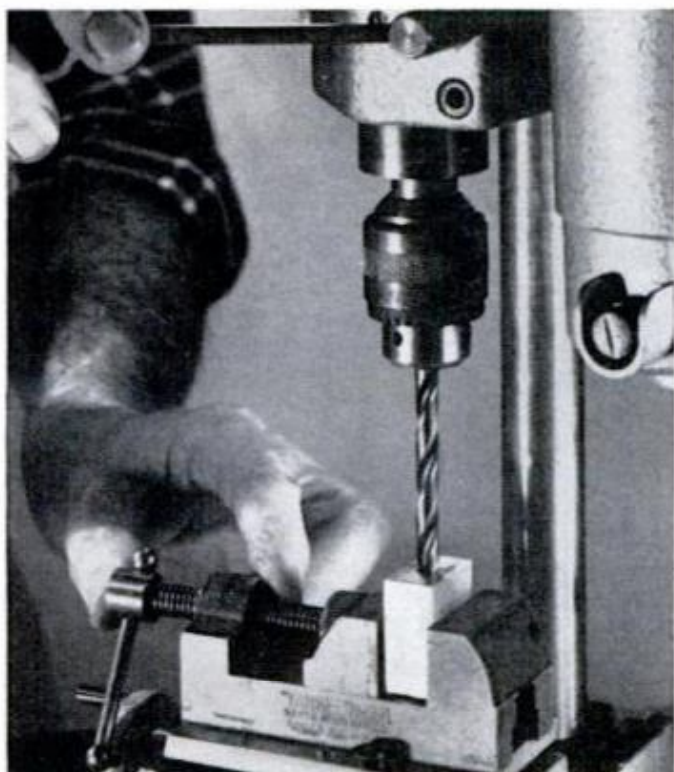
After squaring block A, drill the accessory-holding hole. Grooves for the rods can be formed by milling or by careful hand sawing and filing. Carefully align the grooves in the central block and those in the clamping blocks. Each groove, which can be



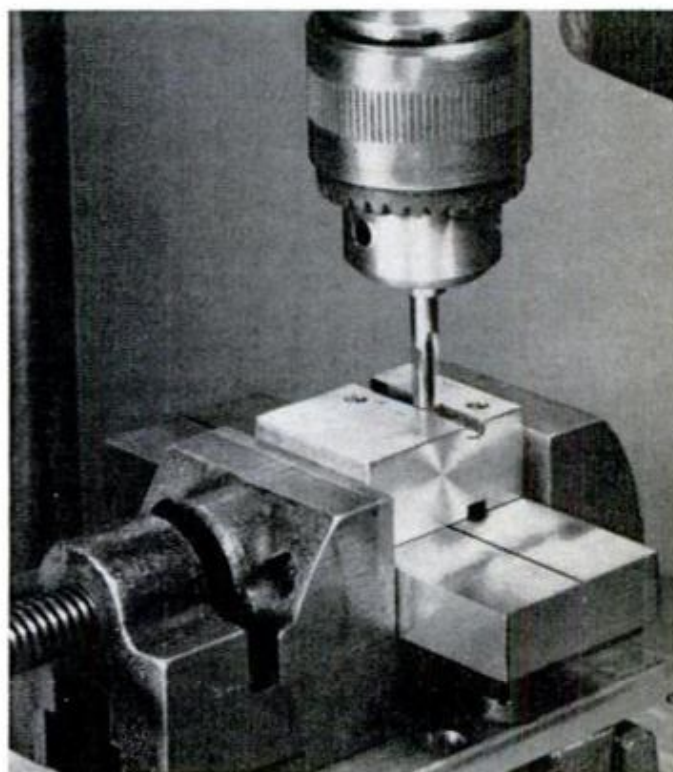
**First step** in making rod joint is to bore an axial hole in the end of  $\frac{5}{32}$ -in. brass-plated steel rod.



**Next, hole is tapped** for a 4-40 thread. Tap is held in tailstock chuck, headstock spindle turned by hand.



**A  $\frac{1}{4}$ -in. hole** is drilled in one of two adjustable (sliding) blocks which hold centers, scribes and the like.



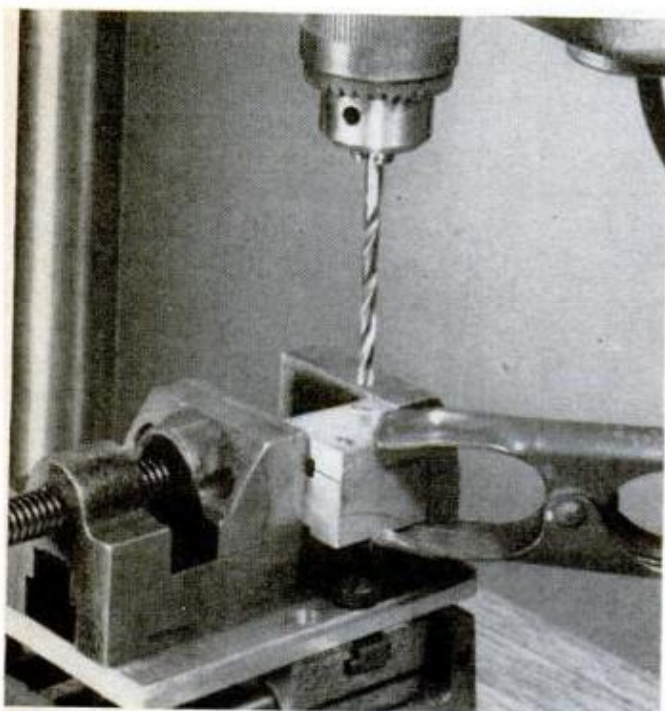
**Slot is milled** in center portion of sliding block, as well as in other side of block and clamping blocks.

rectangular or rounded in section, has a depth slightly less than half the rod diameter. If grooves should happen to be made a bit too deep, a series of punch marks along them may reduce the clearance enough to produce good clamping action. Groove width is equal to, or slightly less than, rod diameter. If necessary, file edges to produce a snug, sliding fit.

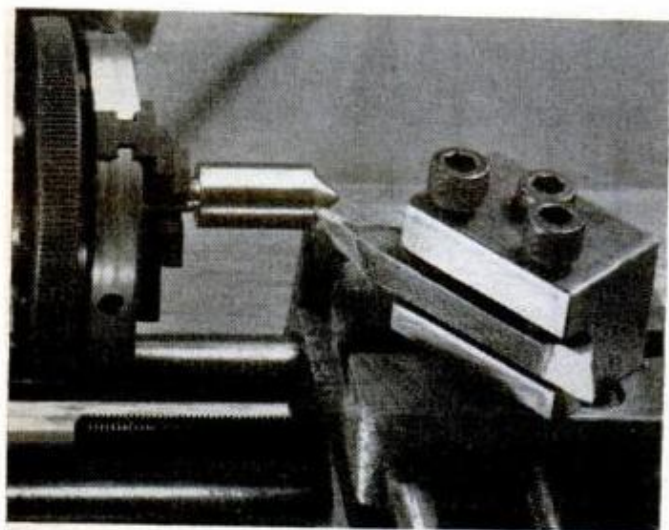
Holes for the horizontal clamping bolts can be made either before or after the rod grooves have been formed—so long as the grooves are kept in alignment. The clamping-bolt holes in one clamping block (B) and in the center block (A) are drilled to the body diameter of the bolt; the holes in

the other clamping block (C) are drilled to tap size and threaded. When aligning holes, drill through all pieces with a tap-size bit (No. 36 for 6-32 threads), then enlarge holes in the center block and *one* clamping block with a body-size bit (No. 28 for a 6-32 bolt). In one end of block A, drill and tap a hole for a 6-32 setscrew (bolt) for clamping the centers and other attachments in the 1/4-in. vertical hole.

Although the two block units are practically identical, the one ordinarily used as the pivot block is equipped with a little finger button (J) which is pressed into the top of the vertical 1/4-in. hole. This makes it easier to hold the block steady when you



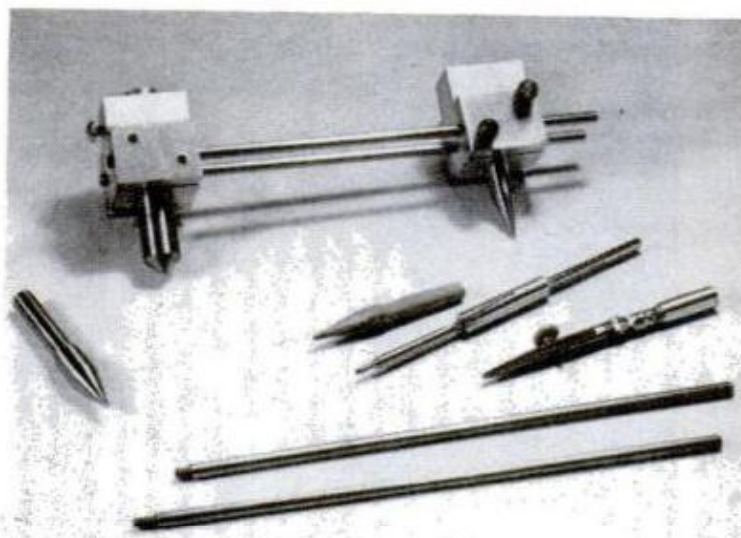
Use block cap (B or C) as a guide for drilling clamping-bolt hole through block A with tap-size bit.



Cone center made of drill rod is machined with blunt tip (90 to 100°), used when centering on a hole.



Various parts of trammel assembly include two pointed centers and a pointed scribe, a ruling pen attachment, and a ballpoint-pen refill with slotted adapter sleeve (see drawings and text) for drawing large diameter circles in ink with the trammel.



Assembled trammel with the blunt, cone-shaped pivot center and a pointed scribe in place. The stub pencil, in place of scribe, can be used for drawing circles on paper, cardboard and various woods.

scribe a circle. Because the button must project  $\frac{1}{8}$  in. or so into the hole, pivot points to be used with that block are made with shorter shanks than those of the scriber points used in the scriber-block unit. In fact, the shank of a scriber point should project slightly above its block top, so it can be tapped with a hammer if desired.

**Attachments:** For conventional use as a compass for drawing circles, the trammel is provided with a pivot point (F), having a shorter ( $1\text{-}1/16$  in.) shank, and with either a pencil, ballpoint pen refill, or ruling pen mounted in the scriber block. For scribing on metal, and punching hole locations, a

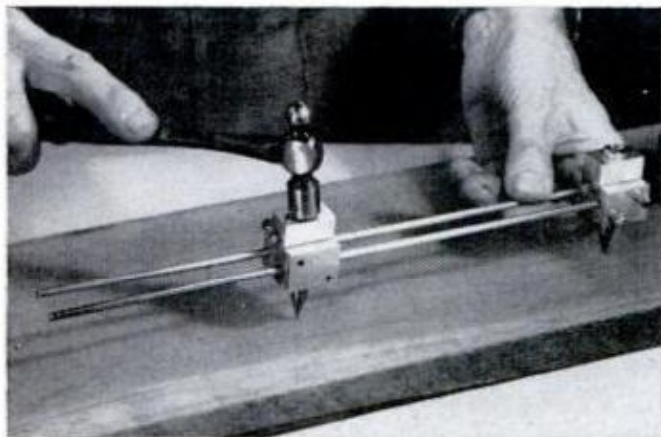
point like F should be used in the scriber block.

Sometimes you'll want to draw a circle around an existing hole. For this purpose, a pivot point (E) with a blunt conical tip is handy. Make pivots and scribes of hardenable steel (such as drill rod) and harden and temper the points to assure maximum life.

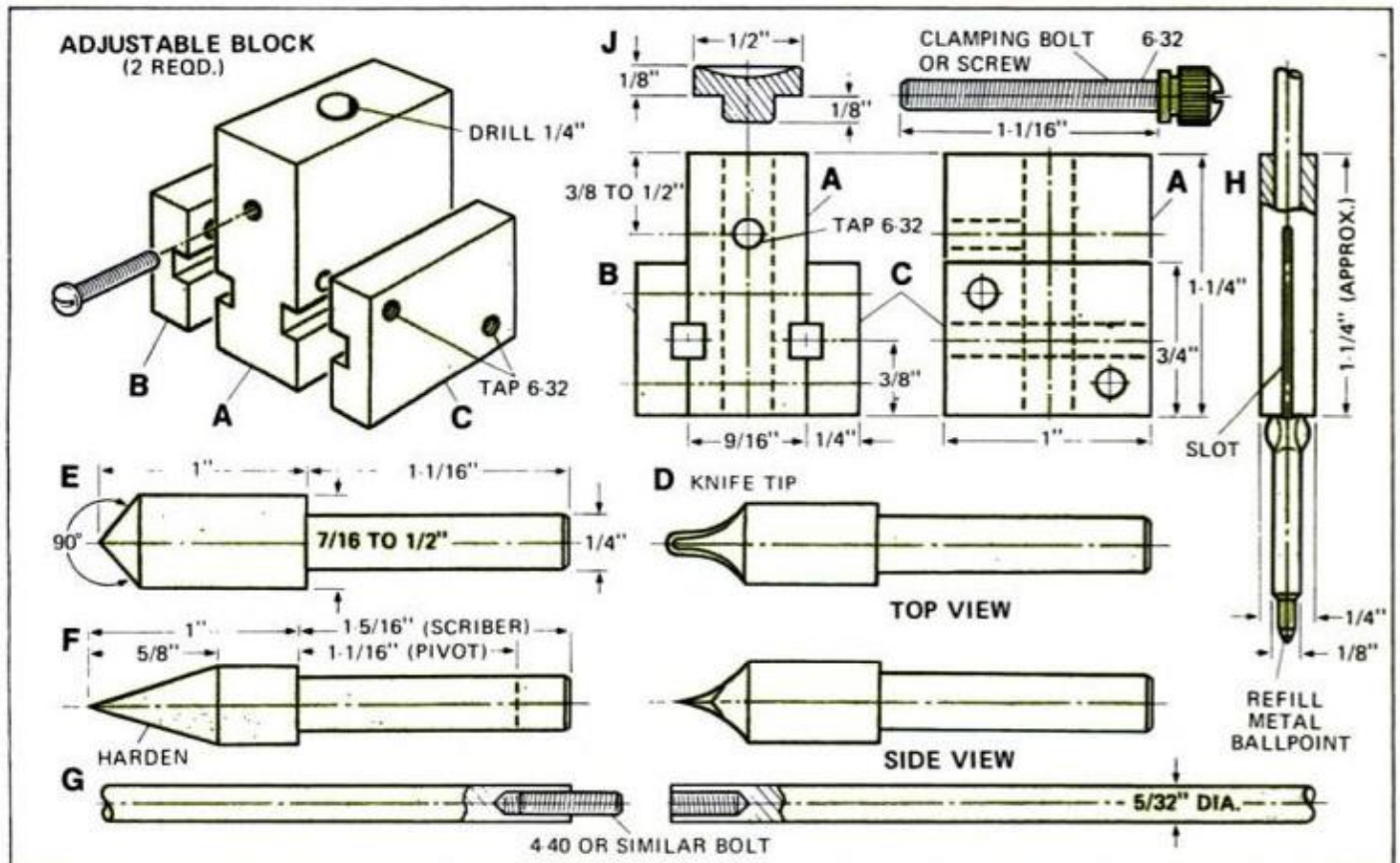
Another useful attachment is a knife-blade insert (D) for the scriber block. This can be made from drill rod and shaped generally like points E or F, but with a flattened, sharpened tip that cuts like a knife. It's useful for cutting cardboard discs.

The ballpoint pen refill should be an all-metal type; the one shown is  $\frac{1}{8}$  in. in diameter. To adapt it to the  $\frac{1}{4}$ -in. hole in the block, a brass sleeve was made (see H). Diametrical saw slots extend half its length so pressure of the locking screw squeezes the sleeve against the refill and holds it firmly.

The sleeve position is adjusted so the refill projects about the same distance as the pivot point in the pivot block. Mounting the ruling pen will depend on its construction and size, and may also require a sleeve. The knurled heads on the 6-32 bolts shown were made by jamming knurled nuts against the bolt heads.

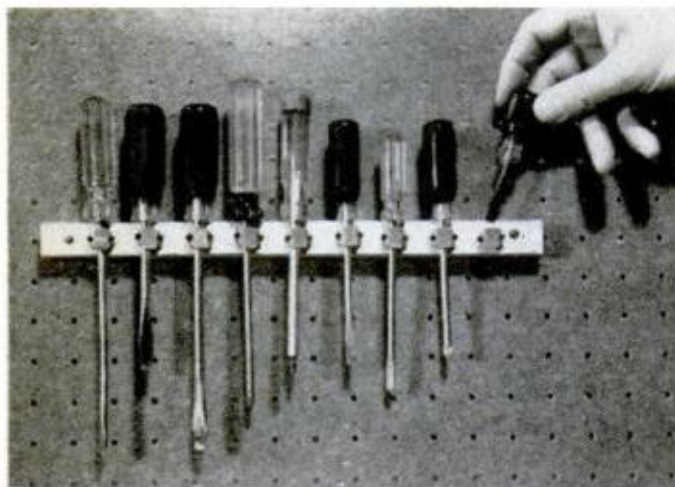


Trammel can be used to spot-punch equally spaced points on various materials. Use a lightweight hammer.



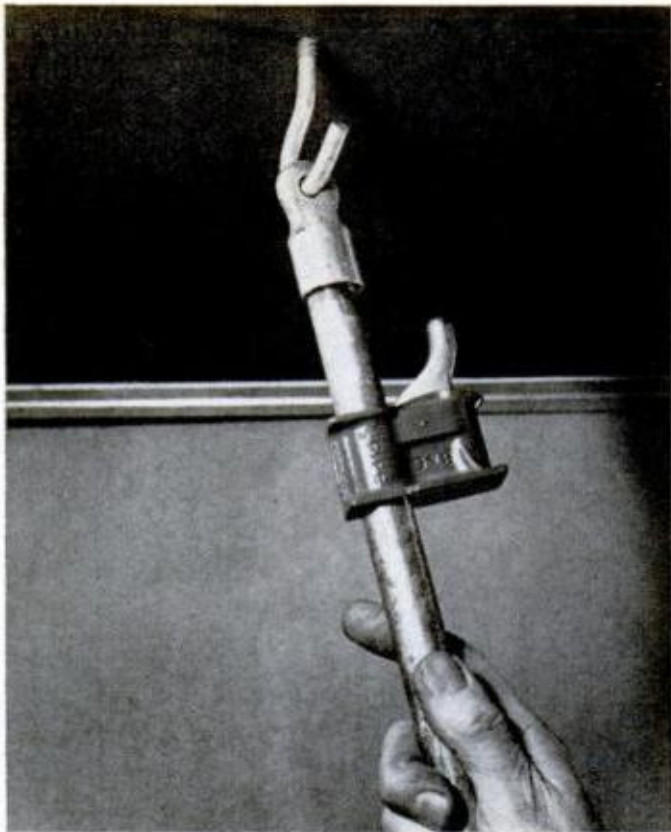
# HINTS

## FROM READERS



### Screwdrivers 'stapled' in place

A quick and easy way to build a sturdy screwdriver rack is to partially drive electrical staples into a length of 1x1. To make the rack shown, I used Handy Strap staples for "loops" and fastened the board to the wall with two hefty screws. If desired, rack could be suspended from perforated board.—*Ken Patterson, Regina, Sask.*



### Hangable gluing clamp

Gluing clamps are commonly made with black pipe threaded at one end. But if you use pipe threaded on both ends, you can screw an eye tip (for awning pipe) onto one, and the tool can then be hung from wall or ceiling—visible and out of the way. Bonus: The sliding jaw is locked on so it can't be lost.—*Andrew Vena, Philadelphia*



### Cutting paper washers

Make paper washers for shims or decoration with a sharp-edged metal washer (or one on which you've filed sharp edges) as a punch. Place washer on a metal block, place paper over, then add a rubber pad such as two or three thicknesses of inner tube and a second block. Squeeze this sandwich in a vise or strike it with a heavy hammer to make the cut.—*Walter E. Burton, Akron, Ohio*



### Double-diameter work in lathe collets

Double-diameter work with one end of uneven contour can be difficult to hold in a lathe collet. To polish the shanks of  $\frac{1}{4}$ -in. rotary files, I inserted the tools through the collets' rear openings. To polish shank sections near heads, the files were gripped with heads outward. This stunt for two-diameter workpieces is practical with some jaw-type chucks.—*Burt Web, Skokie, Ill.*

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# Driver's license

Predictions point to tests for operators. Match your skill against these sample questions and maneuvers.

by Bill McKeown  
OUTDOORS EDITOR

**H**ow much you know about driving snowmobiles and how well you run your own may soon be a legal question. Already eight states and six Canadian provinces require driver's licenses. Like it or not, all drivers may eventually be required to pass tests in writing and aboard machines out in the snow. Our survey shows, however, that many owners should be able to pass right now. Try our sample test on the facing page and see how you rate. Then read on to check your answers. Common sense should give you a good score even if you have never driven one of these winter fun machines.

The demand for licensing has been brought on by a number of careless and

**Trail skill** will be of increasing importance with the growth of the sport. Practice in proper spacing, speed selection, ability to stop and prevent overrun or collisions, knowing when and how to leave a deep-cut track to pass are essential for drivers.

**Following signs** that now mark hundreds of trails, and studying trail maps before setting out are new but necessary snowmobile lessons to be learned. Ability to follow topographical plans helps insure safe operation over terrain that is unfamiliar.

156



# for snowmobiles?

inconsiderate drivers who have ignored property rights, chased animals, collided with cars and trains, damaged tree nurseries, drowned while crossing thin ice, gotten lost and required extensive rescue missions, and disturbed the peace by running machines day and night much too near homes.

The present regulations requiring a license usually refer to an automobile driver's license or to a certificate that a snowmo driver under 18 has passed an instruction program. Minnesota, probably the most progressive in the development of legislation that has become a model for other states, has a Snowmobile Education and Training Program administered by its Department of Natural Resources. Youngsters between 12 and 18 pass a course that covers machine nomenclature, control familiarization, machine safety features, operating procedures, snowmobile and highway laws and regulations, loading and towing procedures, snowmobile code of ethics, safety hazards of operation, including possible hearing damage, environmental



**Close maneuvering** first requires wide-open, level fields with unobstructed view for front machine. Leader should have driving, first aid, sometimes avalanche knowledge.

## Sample driver test

What are the major causes of snowmobile accidents?  
(Name four)

At what time of day do most accidents occur?

Name five safety items a driver should take along.

What added equipment is needed for night operation?

What is the best way to tell if a train is coming?

Should a driver sit, kneel or stand when jumping a machine?

What is the meaning and importance of "wild chill factor"?

What are the procedures for an emergency turn on hard-packed snow or ice?

What items of cold-weather

clothing should be avoided?

What is meant by "overdriving your lights"?

What is proper procedure for driving in avalanche areas?

What should you try to do in case of blizzard or "whiteout"?

Name two tow-sled precautions.

What are at least three misuses of snowmobiles that should be avoided?

What applicable laws should be checked before setting out?

Name five ways to avoid trouble and get more fun from the sport.

### Performance check

Demonstrate starting, stopping, warm-up techniques (plus rope start of electric model).

Run a course that requires driving straightaways, up and down steep slopes, sharp turns at top and bottom of incline.

Drive narrow trail behind companion or examiner demonstrating proper spacing and emergency stops without tailgating or override.

Demonstrate proper crossing of highway with steep plowed drifts, ditches on each side.

During speed runs, demonstrate stopping before reaching obstacle, or dodging it.

Run a slalom course.

State fuel/oil mix ratio and give estimate of distance and hours of running time at average speeds with one tank of gas.

*Are you sure of all the answers? If not, read story and review owner's manual.*





consequences of snowmobile use, and performance and written tests. Upon completion, a safety certificate is issued.

To qualify for a passing grade when taking our sample test, a driver would need to know that most accidents occur at night and about three quarters of drivers involved apparently have been drinking. Collisions with cars, trains and fixed barriers cause most fatalities, with drownings a close second. Careless and reckless operation would seem to be indicated in most cases. Only stunt drivers should try jumping a machine; there is no recommended way for a driver to try this back-jarring maneuver.

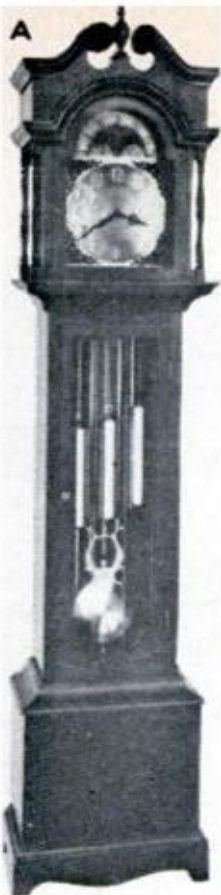
Safety aids for the snowmobiler would certainly include a companion. Heading out alone is dangerous, and traveling with a buddy on another machine, or with a group, is by far the best. Matches, first-aid kit, flares, snowshoes, blanket and rope are also recommended, and at night a flashlight and reflectorized side patches are required in some areas. Head and taillights go out in some machines when the engine is off. Night speeds should be slow enough so you can stop before striking any object suddenly seen ahead, thus avoiding "overdriving."

Operation on ice or packed snow becomes

*(Please turn to page 160)*

**Topping ridge** takes special talent (left) since ridge may hide ravine or steep drop-off, solid tree wall or busy highway and chance of collision with passing car. Speed practice (below) requires open fields with chance to graduate to steeper slope maneuvering, traversing, flat and banked-turn maneuvers, introductory racing.





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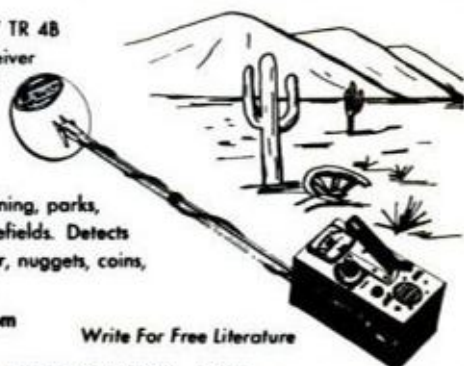
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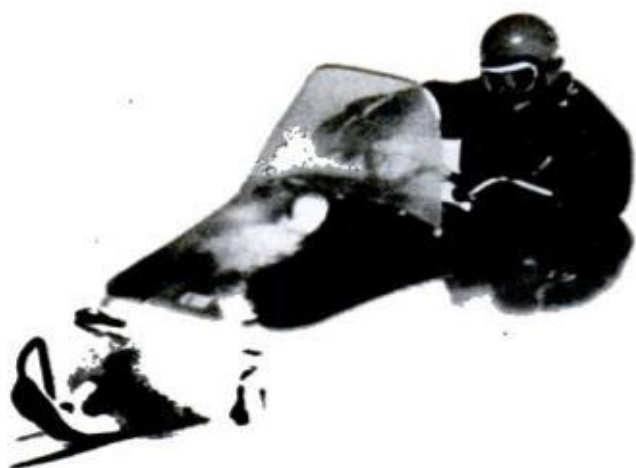
## DRIVER'S LICENSE FOR SNOWMOBILES?

*(Continued from page 158)*

more difficult because the front-steering skis lose their bite. Road-running is dangerous as a result, and highways should be crossed at right angles. Some states require an auto driver's license just to cross a highway and, as with railroad tracks, a driver should first stop and, ideally, shut off his engine and remove his helmet to listen for trains or cars. On a lake, avoid approaching any areas of thin ice or open water; the driver should roll off the machine if he can not slow it or steer it away.

Speed lowers the chilling factor of the breeze, and clothing must be properly chosen, but with no loose scarves to catch in moving parts. Avalanche areas should be avoided or traversed with long spaces between machines. In a "whiteout," an operator should turn around and try to retrace his tracks. Weather conditions, plus federal, state or provincial, and local laws should be checked before departure. When towing, use a stiff bar to prevent override.

Club membership, proper clothing, pre-study of weather and trails, choice of a companion, and a last check of local conditions plus notification of someone of your destination should insure a successful outing in the snow. ★ ★ ★



**Hanging out** to control centrifugal force of high-speed turns is only learned through practice and a developed feel for machine. Running slalom-type course helps develop skill. Knowing when to stop (below) to rest and warm up can be key to prevent frostbite and exhaustion that can lead to bad judgment, accidents.



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# HINTS

## FROM READERS



### Chain grips

Plastic electrical connectors of the Mars type make large pull grips for pull-chain light fixtures. Drill a small hole in the end of the connector and slip the chain through, then replace the end clip on the chain.

—Ken Patterson, Regina, Sask.



### Sanders from dowels

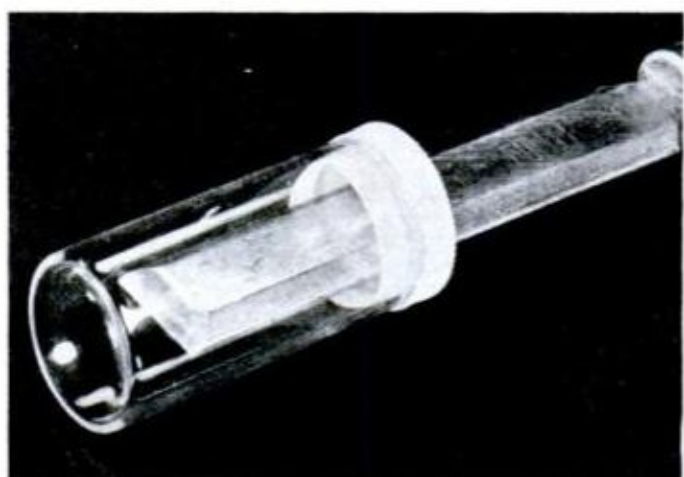
Lacking drum sanders of the correct size for some inside curves, we found that sections of dowel could be used to serve the purpose. A slot was cut in the end of the dowel and a strip of sandpaper inserted and wrapped around the dowel. We have used these sanders in the drill press and on portable electric drills. When the ends of the paper become worn, pieces are torn off and the "sanders" are like new again.—M. K. Cox and D. L. Palmer, Cambridge, Ill.



### Handy spatula

A spatula for shop use can be made from a bit of springy  $\frac{1}{64} \times \frac{1}{2} \times 4$ -in. steel strapping and a handle from a rubber stamp. A slot about  $\frac{1}{2}$  in. deep is cut in the handle and the blade inserted, with household cement to fill the space. Two holes are drilled through blade and handle, and brass escutcheon pins are used as rivets. The blade is rough-shaped before the handle is attached, then finished by grinding and polishing.

—Walter E. Burton, Akron, Ohio



### Protecting chisel edge

To protect the edge of a chisel kept in your toolbox, use a plastic prescription bottle just larger than the chisel's width. Use the chisel to cut a snug slot in the cap, then push the capped bottle over it.

—David L. Wiest, Cloudercroft, N.M.

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**FREE CATALOG**

## CAR CLINIC

BY MORT SCHULTZ

### Sunbeam parts suppliers

Hey, Jim Walery out in Northridge, Calif., and all you other Sunbeam owners having a problem getting parts (see *Car Clinic*, Aug. '73 PM): A couple of your fellow readers of this column have suggestions.

Phil Roth of Sauk Village, Ill., claims he has found "a fantastic nationwide parts source" in World Wide Import Parts, Inc., 208 North York Rd., Bensenville, Ill. Dr. D.R. South of Elkhart, Ind., advises "parts without difficulty" can be obtained from George Byers & Sons, Inc., 46 East Town St., Columbus, Ohio. Thank you, gentlemen.

### Better play it straight

*I have three four-ply conventional nylon tires on my car and one bias-belted tire on the right rear. Is there any cause to worry about handling under this setup?—William G. Vreeland, Paterson, N.J.*

The National Highway Traffic Safety Administration answers your question this way: "Random 'mixing' front and rear or on the same axle can produce unpredictable, sometimes dangerous handling difficulties." The agency contends that under various driving conditions requiring dependable vehicle control, especially cornering, mixed tire performance compares to the effect of wearing a rubber-soled shoe on one foot and a new leather-soled shoe on the other.

The "dos and don'ts" regarding mixing of tires are as follows:

Wherever possible, fit your car with tires of the same type—all conventional (bias), all bias-belted or all radial ply.

If you have a "mix," do not use two different types in front or rear. Place tires of the same type on the same axle. In your case, it would be best to get a new conventional tire to replace the bias-belted on the right rear, but if you had another bias-belted you could use it in place of the conventional tire on the left rear.

If you are "mixing" bias with bias-belted, mount the bias tires in front and the bias-belted in the rear for best handling.

Do not mix radial ply or "60 series" tires with any other type or sizes on the same car. Use the same type all around.

### Blues in the night

*The horn of my 1971 Plymouth has stuck a half-dozen times since the car was new. It's like a toothache coming only in the middle of the night. My neighbors are ready to form a lynch party. Help.—C. Harlan Dunn, Owasso, Okla.*

Your letter is one of several describing this trouble received recently from owners of Chrysler Corp. cars. The reason for the unwanted concert seems to be the material used in the horn switch. The switch consists essentially of a thin strip of copper shrouded by rubber insulation. High air temperature in the car causes this rubber to deteriorate, which enables the copper to make contact. Fortunately, rubber insulation presently being supplied to parts departments of Chrysler Corp. dealers seems to be sturdier than that originally used. I suggest you have it installed.

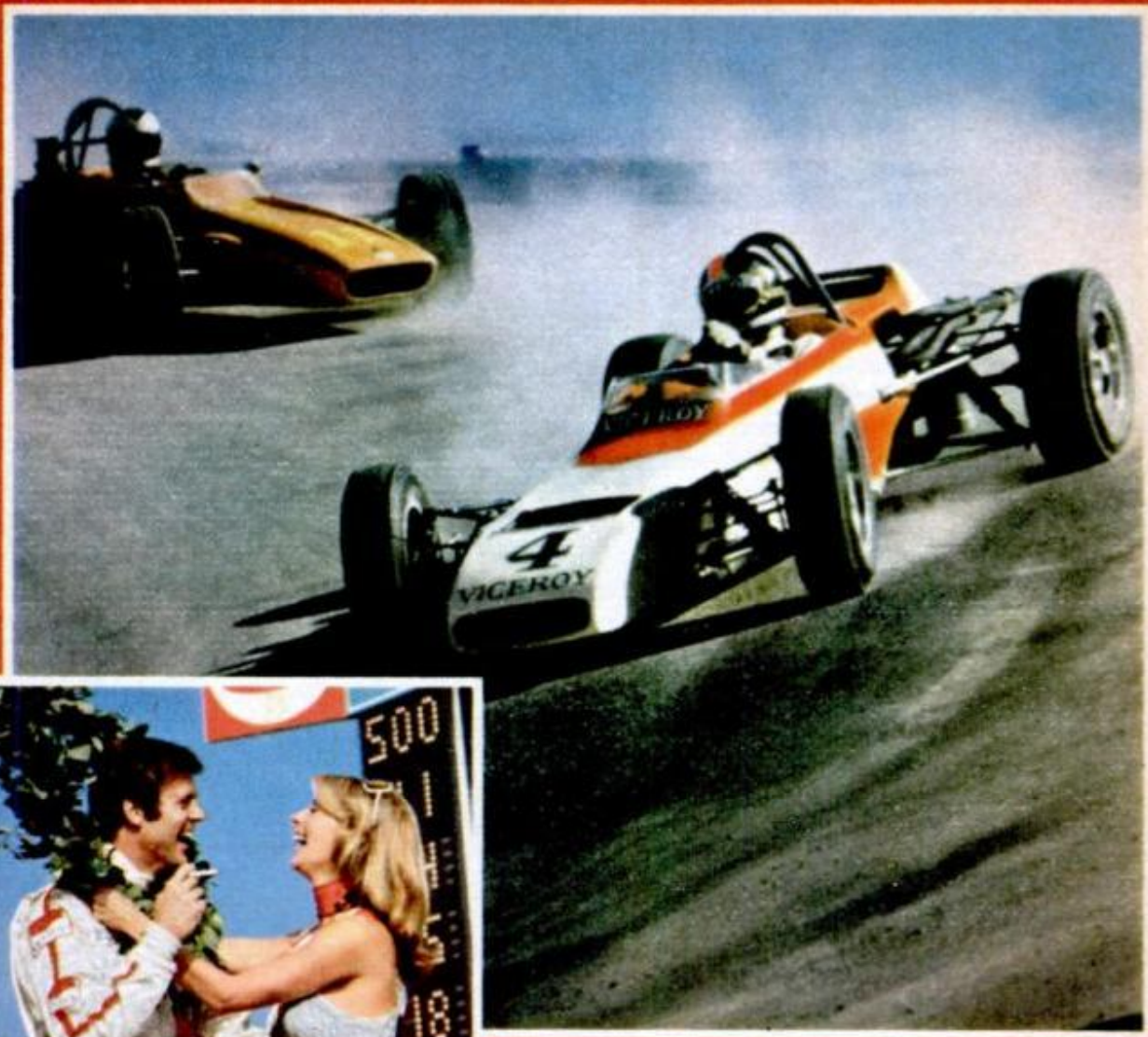
### Dueling Datsun's duals

*Recently, I tried to tune up a Datsun having the L-16 overhead-cam engine with dual-pointed distributor. I was baffled although I followed instructions that directed me to block off one set of points while setting dwell of the other set. However, when I tried to set the second set, they were completely dead, and with the first set blocked off the engine wouldn't fire. Can you help?—Werner W. Mosman, Midway City, Calif.*

Yes. Here are the instructions you need:

- Equip yourself with two jumper leads made of 16-gauge wire about six inches long. One jumper should have a female connection on one end and a male connection on the other. The second jumper should be fitted with alligator clips.
- Work at the wire junction block behind

(Please turn to page 162D)



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av. per cigarette, FTC Report Sept. '73



## CAR CLINIC

(Continued from page 162B)

the relay on the left front side of the car, practically to the rear of the headlights. Separate junction block and note color coding of its leads from the wiring harness:

Black—normal ignition (primary) wire, which is "hot" at all times. The terminal of this wire provides the current for setting the points.

Black with yellow trace—from retarded point relay. The terminal of this wire isn't used when setting the points.

Note color of the leads of the wire going from the section of the junction block to the distributor. They are as follows:

Black—goes to primary (advance) points.  
Yellow—to secondary (retard) points.

□ Connect jumper lead having female and male connectors between terminals of the two parts of the junction block that service the black (primary) wires. With a dwell meter, set primary set of points to 50°.

□ Disconnect jumper wire from the black wire terminal on the section of the junction block on the point side and connect it to the terminal serving the yellow (secondary point) wire. Set point dwell to 50°.

□ Hook up the jumper wire having alligator clips so that one end is clipped to the "hot" terminal while the other end is clipped to the terminal to which the other jumper is not connected. Both sets of points will now be energized.

□ Set total dwell for both sets of points to 50-55° by moving the distributor face plate.

### Adding notches

*My 1973 Vega, with a Holley two-barrel carburetor, stumbles and stalls when first started cold. Your suggestions would be appreciated.—Louis Haver, Ithaca, N.Y.*

The automatic choke may not be set properly since the original specification has been changed. If you have manual transmission, set choke 2½ notches rich rather than two. Some earlier-model carbs have only two notches on the rich side, making it necessary to add marks for proper adjustment. Score each increment on housing 3/32 inch from the last one.

### Puddle of woe

*I've taken my 1965 Chrysler Newport to several mechanics, but there is always a puddle of transmission fluid on my garage floor. Mechanics tighten bolts around the transmission pan and add transmission sealer without success. What else should be done?—David Rosenstroch, Brooklyn.*

Three likely reasons for the leak in the order you should tackle them: Failure of speedometer cable housing seal, failure of transmission pan gasket and distorted transmission pan.

### Hose job

*My 1973 Pinto, which has a 2000-cc engine and airconditioner, stumbles and gives bad performance at high speeds. There is nothing wrong with the fuel pump or carburetor as far as my dealer can tell. Any ideas?—John Franklin, Chevy Chase, Md.*

Pintos and Capris, too, of the model you describe have been giving this trouble—traced to a kink in the fuel hose between fuel pump and carburetor. You can probably pep up high-speed operation by repositioning the hose to get some slack between fuel pump and hose-support bracket.

## SERVICE TIPS

□ **If the steering column rattles** in your 1973 Dodge Coronet or Charger when you drive over bumps at low speed, you'll want to see your Dodge dealer about a new "securing" service package: part No. 3685635. Installation instructions are in service bulletin 19-02-73 D.

□ **Battery tells all.** Did you know that Delco Remy has a new "Delco Eye" battery that not only tells at a glance the electrolyte level, but also indicates state of charge in respect to specific gravity? When the Eye is dark with a green ball visible, specific gravity and electrolyte level are okay. When the Eye is dark, but a green ball is not visible, specific gravity is low and the battery should be charged. When the Eye is bright yellow, electrolyte level is low and water should be added.

□ **Pulling to one side** may be a problem affecting your 1971-1973 Capri. If so, take the car to your Lincoln-Mercury dealer. New instructions in service bulletin 41 tell how to compensate for the pull when making adjustments. ★★

**GOT A PROBLEM WITH YOUR CAR?** Ask Mort about it. Send your question to Car 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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Plymouth's annual troubleshooting contest:

# This race really is 'won in the pits'!

by Bill Hartford  
AUTO EDITOR



**Troubleshooting** against the clock is a sure test of what you know about car repair and how well you know it. In the National Finals of the 1973 Plymouth Trouble Shooting Contest, 113 teams consisting of two students each and representing all 50 states, went to work on identically bugged Gold Dusters lined up on Boston Common. Within an hour the quickest teams had their cars running and tuned and took the lion's share of \$90,000 in scholarships and prizes. The 1974 Nationals will be held in Dallas next June. Study to be there!

**A**nd I thought auto racing was exciting. It was just as thrilling to see the judge's red timing flag go up when two young students got a bugged car started last June. It was the National Finals of the 1973 Plymouth Trouble Shooting Contest.

A competition to get a car started—thrilling? Well, to anyone who has turned a key to find “the damn thing won't start,”

and has wondered what to do next, it sure is thrilling. The speed and skill of the 113 two-student teams from 50 states was dazzling. It really is an exciting moment when the first of the teams just gets the engine to fire. Only the fastest and most accurate troubleshooting will find the no-start conditions in the cars, all of which have been identically bugged.



For these finalists, it was a long road to the National Competition. They had proven themselves against other students in regional competitions and won the honor of participating in the Finals. Now is the time, in fact, for young auto mechanics students to start competing on the local level for the big trip to the 1974 Nationals, this year to be held in Dallas, in June.

The Plymouth Trouble Shooting Contest, which started as a small, local event in California in 1949, is open to high school seniors and students in post high school institutions such as junior colleges and vocational training centers. There are winners in both categories.

The prizes? There are \$90,000 worth of college scholarships, savings bonds and tools

to go around. Just by being at the Finals, the students had already won a million dollars worth of confidence and sense of accomplishment. All were justifiably proud to have proven their skill in the regionals and have been flown to Boston, along with their auto mechanics instructors, all expenses paid.

Just by being there they had won a complete set of tools for their schools. And teams that placed in the Finals won a new Plymouth engine and transmission for their schools, complete with accessories for instructional use in the auto mechanics shop, and a trophy.

There were lots of family and friends in Boston, too, enough to fill the grandstands around the rows of cars and give the contest the ambience of an athletic competition.

At the starting gun, members of the press received a list of the bugs planted in the 113 Plymouth Gold Dusters. The list is printed below. As you can see, it's a wicked one. It's fiendishly devised every year by the national manager for the con-



**He bugs cars** and bugs 'em bad. John H. Moore Jr., the national manager of Plymouth's Trouble Shooting Contest, each year turns up some of the meanest monkey wrenches anyone could throw under a hood. How well do you think you could cope with the seven bugs described below?

test, John H. Moore Jr. A racing buff and licensed pilot, Big John supervises and coordinates all activities of the contest.

Chrysler-Plymouth engineers and technicians implement the bugging, going so far as manufacturing specially designed defective parts to install in the cars. The Plymouth dealers of America, who share in sponsoring the contest, lend a hand providing the manpower necessary for judging and supervising the event. Also supporting the local contests and National Finals are Sun Electric, Champion Spark Plug, Holley Carburetor and Carter Carburetor. The contest is a marvel of logistics and all the people concerned with its timing, scoring and judging deserve a tip of the hat for their dedication and integrity. The students, too, know that in this contest the only way to win is by applying their ingenuity directly to the problem. There's no short cut to get an engine running smoothly if you can't diagnose a distributor that's been installed 90° retarded!

When a team is confident its car is running according to factory specs, it closes the hood and the team judge puts up the red flag for the timing stand to see. Each team judge waits at the tool stand at the front of the car. He holds a closed box that contains spare parts to replace those defective parts in the car. When the team members diagnose a part as bad, they ask him for a replacement.

Next stop for the team is the final judging bay. The team drives there and the car is checked against factory specs on professional diagnostic equipment. Points are lost

*(Please turn to page 170)*

## BUGS PLANTED IN CARS FOR THE 1973 NATIONAL FINALS

### Malfunction used

1. Fuel-inlet needle and seat in carburetor plugged.
2. Idle air/fuel mixture screw turned all the way in against its seat.
3. Curb idle screw loosened until the throttle plate closed completely.
4. Battery ground cable with a complete open circuit installed.
5. Battery positive cable with a complete open circuit installed.
6. Distributor removed and reinstalled 90° retarded.
7. No. 2 and No. 5 sparkplug wires crossed at distributor cap.

### Condition caused

- Engine will not start or run.
- Engine will start but will not idle.
- Engine will start but will not idle.
- No electrical unit on car will work.
- No electrical unit on car will work.
- Car will not run properly.
- Car will not idle or run properly.

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## RACE REALLY 'WON IN THE PITS'!

*(Continued from page 168)*

for every variation from factory specs. The time limit for the troubleshooting is 90 minutes and the fact that about a third of the teams are still working at the end of that time is an indication of how tough it is to get out those bugs.

A team's final time is determined by combining the result of the actual troubleshooting with that of a written exam. Errors in the written exam are converted to time demerits and these are combined with actual working times and workmanship quality time penalties in the mechanical competi-

tion. Lowest times determine the first, second and third-place winners.

Winning time for the high school team last year was 52 minutes, 17 seconds. The team, Steve Moorer and Steve Dietrick, represented Rancocas Valley Regional High School in New Jersey. The post-high winners, Dave McLain and Dick Pershell, represented the Vocational Technical Institute of Southern Illinois University, Carbondale, Ill.

Plymouth's Trouble Shooting Contest is often the first step for students who go on to  
*(Please turn to page 172)*

### TYPICAL TROUBLESHOOTING QUIZ (ANSWERS ON PAGE 172)

1. A squeak developed in front suspension. It was traced to an inside metal sleeve turning in a molded rubber upper control arm bushing. To correct this:
  - A. Replace the bushing.
  - B. Lubricate with silicone lube.
  - C. Lubricate with rubber lube.
  - D. Tighten the retaining bolt holding the bushing and sleeve.
2. Torsion bar suspension gets its spring action from the bar:
  - A. Compressing.
  - B. Twisting.
  - C. Bending.
  - D. Flexing.
3. A car with power steering lacked assist only when parking. This could be the result of:
  - A. The valve body is out of adjustment.
  - B. Collapsed pressure hose.
  - C. Damaged reaction springs.
  - D. A loose pump drive belt.
4. After soaking a carburetor in cleaner and rinsing it, all parts should be:
  - A. Gauged for size.
  - B. Flushed with gasoline.
  - C. Lubricated.
  - D. Blown out with compressed air.
5. Most common cause of faulty choke operation is:
  - A. An inoperative manifold heat riser.
  - B. A broken bimetal spring.
  - C. A gum deposit on choke parts.
  - D. A clogged choke screen.
6. Plastigauge is used to check:
  - A. Crankshaft runout.
  - B. Bearing journal diameter.
  - C. Connecting rod side clearance.
  - D. Bearing clearance.
7. An engine cylinder must be thoroughly cleaned after honing. The recommended method to clean the cylinder is to:
  - A. Use soap and water with a brush.
  - B. Wipe with clean rags and gasoline.
  - C. Rinse with solvent and blow-dry.
  - D. Rinse with honing oil.
8. During a valve grind, a slight crown was noted on all the hydraulic tappet body faces. This indicates:
  - A. A need for refacing the tappets.
  - B. Excessive wear on the outer edges.
  - C. Normal tappets.
  - D. New tappets are required.
9. The first indication to the driver that 1/2 of his brake system has failed on a tandem master cylinder would be:
  - A. Easy stopping requiring little pedal pressure.
  - B. A warning light on the dash.
  - C. Skidding of the part of the system that is not operating.
  - D. Pulling when the brakes are applied.
10. A brake drum turned within acceptable limits is:
  - A. Usable only with standard size tires.
  - B. Usable for slow speeds only.
  - C. Usable for normal service.
  - D. Unusable when not towing a trailer.
11. Excessive tire wear in the center of the tread could be due to:
  - A. Improper toe adjustment.
  - B. Improper camber adjustment.
  - C. Overinflation.
  - D. Overloading the tire.
12. The oil pressure that delays the 1-2 shift is called:
  - A. Governor.
  - B. Reducer.
  - C. TV or modulator.
  - D. Compensator.
13. The transmission "range" selector is attached to and controls the position of the:
  - A. Shift valve.
  - B. Manual valve.
  - C. Throttle valve.
  - D. Control valve.
14. During torque multiplication in a torque converter, the stator is locked from rotating by the:
  - A. One-way clutch.
  - B. Impeller.
  - C. Turbine.
  - D. Planetary gear set.

*(Please turn to page 172)*

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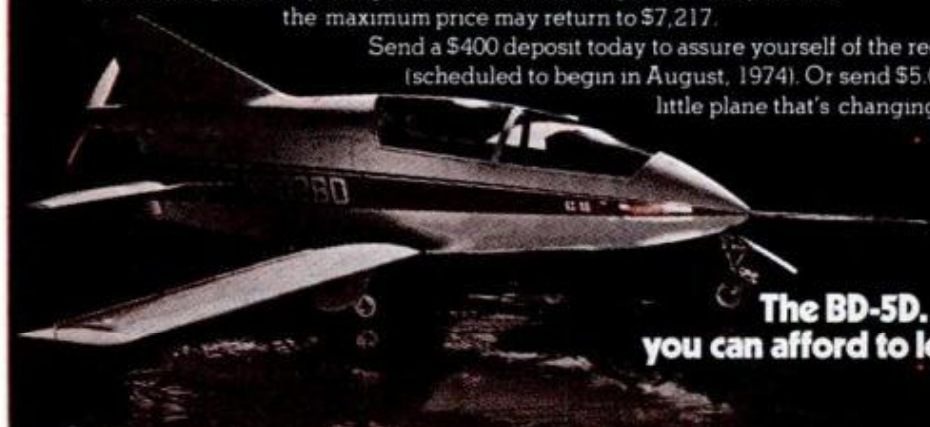
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## RACE REALLY 'WON IN THE PITS!'

(Continued from page 170)

pursue a career in auto mechanics. The shortage of trained auto mechanics and technicians is of concern to Chrysler and the contest is one way it recognizes this shortage. Another is the recent development and support of a private school in specialized automotive education, the MoTech Automotive Education Center. The main MoTech campus is in Livonia, Mich., but Chrysler is planning to open several other automo-

tive education campuses around the country.

If you're planning to be more than just a Saturday Mechanic, take a crack at the Plymouth Trouble Shooting Contest before you spend tuition money anywhere. The scholarship route is the best way to go. Check with your school, Chrysler-Plymouth dealer, or write John H. Moore Jr., Plymouth Trouble Shooting Contest, Box 2119, Detroit, Mich. 48231. ★★★

## TROUBLESHOOTING QUIZ

(Continued from page 170)

**15. The purpose of spring shackles, as used on rear leaf-type springs, is to:**

- A. Dampen spring oscillations.
- B. Help reduce road shock to the frame and body.
- C. Allow the spring to change length during operation.
- D. Absorb spring rebound.

**16. The tendency of the differential nose to tip up on acceleration is controlled on leaf-spring rear suspension cars by a:**

- A. Short, stiff front section of the spring.
- B. Spring hanger bolt on the rear of the spring.
- C. Spring shackles.
- D. Lower control arms.

**17. The pressure cap used on the cooling system:**

- A. Reduces the chance of coolant leakage.
- B. Lowers the boiling point of the coolant.
- C. Raises the boiling point of the coolant.
- D. Keeps the coolant from overflowing.

**18. Proper operation of the PCV system reduces vehicle emissions. It also:**

- A. Reduces CO emissions.
- B. Upsets carburetion.
- C. Allows the use of nondetergent oil.
- D. Reduces oil contamination.

**19. Sludge and oil contamination build up in the oil most rapidly when the engine is operated:**

- A. Occasional stop-and-go driving.
- B. On long trips at low speeds.
- C. On long trips at high speeds.
- D. With mixture of stop-and-go with high speeds.

**20. The reverse idler gear in a three-speed transmission turns:**

- A. Any time the engine is running.
- B. Any time the cluster gear turns.
- C. Only when moving in reverse.
- D. Any time the output shaft turns.

**21. A standard transmission car—sitting still with engine running, transmission in first gear and clutch pedal depressed—clutch plate (driven disc) would:**

- A. Be turning at pressure plate speed.

- B. Be turning at engine speed.
- C. Be turning at flywheel speed.
- D. Be standing still.

**22. The clutch pressure plate forces the friction disc against the:**

- A. Clutch cover.
- B. Flywheel.
- C. Pressure-plate baffle.
- D. Friction plate.

**23. Ignition point dwell increases due to point rubbing block wear. When this occurs, ignition timing:**

- A. Advances.
- B. Retards.
- C. Remains the same.
- D. May change differently due to the type of point construction.

**24. The ignition capacitor (condenser):**

- A. Prevents arcing of ignition points.
- B. Charges the coil to produce the spark.
- C. Slows down coil buildup.
- D. Keeps required voltage low.

**25. A technician connected a voltmeter from the distributor side of the coil to ground. While cranking the engine, the voltmeter would not register. The trouble is:**

- A. A grounded primary in the distributor.
- B. An open primary in the distributor.
- C. A faulty ignition resistor.
- D. An open condenser.

**26. An owner complained of short headlight bulb life. When questioned, he also said the lights brightened when he accelerated from a stop. Which of the following would most likely cause this problem?**

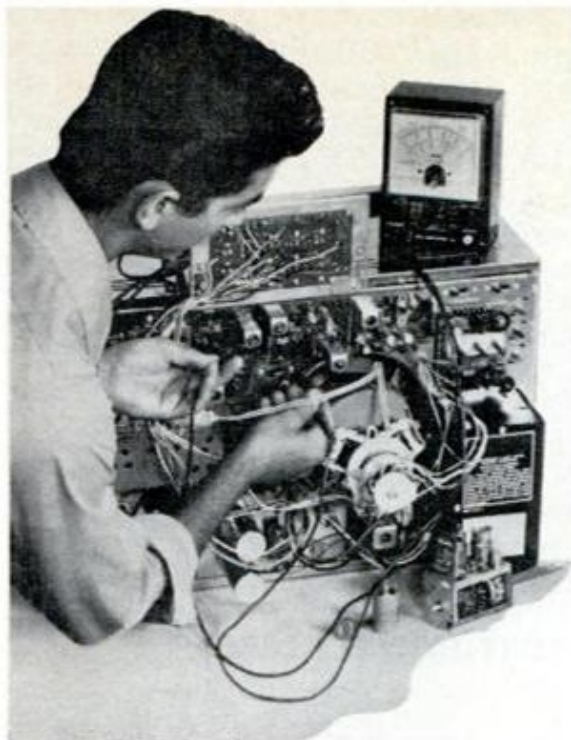
- A. Faulty alternator.
- B. Faulty battery.
- C. Faulty current limiter.
- D. Faulty voltage regulator.

**27. When testing a starter armature on a growler, a hacksaw blade vibrated when placed on top of the armature. This indicates the:**

- A. Field coils are grounded.
- B. Solenoid disc is burned.
- C. Armature is open.
- D. Armature is shorted.

ANSWERS TO QUIZ ON PAGE 170: 1-A, 2-B, 3-D, 4-D, 5-C, 6-D, 7-A, 8-C, 9-B, 10-C, 11-C, 12-C, 13-B, 14-A, 15-C, 16-A, 17-C, 18-D, 19-A, 20-B, 21-D, 22-B, 23-B, 24-A, 25-A, 26-D, 27-D

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## HOT, NEW HOMEBUILTS FOR '74

(Continued from page 95)

family car. Special design features like low stall speeds, easy handling and short-field landing and takeoff characteristics make it possible to fly out of "pea-patch"-size pasture strips, eliminating the need to use long, expensive, heavily trafficked commercial runways. Refinements such as folding wings and planes that can be towed on their wheels let you "garage" your ship at home and trailer it easily to a nearby air-strip.

These developments are what are making "back-yard aviation" practical, inexpensive and fun—and with them are coming a whole new breed of small, yet highly sophisticated, homebuilts designed especially to meet the private pilot's needs.

Among the latest and most spectacular represented here are such prize-winning performers as the Sorrell Hiper Bipe (page 92), an unusual biplane awarded top honors in the Outstanding New Design category at the most recent Oshkosh Fly-In, and Lloyd Butler's sleek, racy Midget Mustang (page 94), Grand Champion winner at the same Fly-In. Also present are new variations on such popular regulars as the Skybolt (page 93), Stephens Akro (page 93) and Sidewinder (page 94). Modifications include added speed and power, greater maneuverability and updating touches like modern retractable landing gear. Three new kit-builts are the twin-tailed Mini Coupe (page 93), the futuristic, needle-nosed Eos (page 95) and Jim Bede's latest creation, the BD-6 (page 95). The Mini Coupe kit, priced at \$1795 less VW engine, is available from Chris Tena Aircraft Corp., 3700 24th Ave., Forest Grove, Ore. 97116. The Eos is sold in a variety of kits, with and without engine, for up to about \$3500 from Airmotive Engineers, Inc., 6330 Highland Rd., Pontiac, Mich. 48054.

Bede's BD-6, not as "hot" as the BD-5 and more like the simpler BD-4 in appearance, is a low-cost, moderately powered high-wing single-seater designed for easy construction and handling by the beginning pilot-builder. A complete kit, including 55-hp engine, is \$2200 from Bede Aircraft, Inc., Newton Municipal Airport, Newton, Kans. 67114. Another dream ship to build and fly is the Zenith (page 94), a lovable little dual-control low-winger with side-by-side seating and remarkable low-stall, spin-proof characteristics. PM will be reporting on the Zenith in a coming issue soon.

For novelty and cleverness, you can't beat the tiny single-seater Hawk (page 94) made from an aircraft wing tank. For sheer spine-tingling thrills, there's the super-aerobatic Super Acro Sport (page 95) designed by the EAA itself. A faster, more powerful version of the EAA's earlier Acro Sport, it's intended for advanced competition performance. Plans for both Acros, as well as information about sport aviation activities in general, can be obtained from the Experimental Aircraft Assn., Box 229, Hales Corners, Wis. 53130. Membership in the EAA is \$15 a year, and anyone can join. The fee includes a subscription to the EAA's monthly publication, *Sport Aviation*, an excellent source of news about plans, kits, prices and construction techniques for all types of homebuilt aircraft. ★★

## LOW-COST SYNTHESIZERS

(Continued from page 129)

dynamic envelope, precise pitch, and so on, while organs sacrifice that ability to adjust (or misadjust) a tone. Some industry executives predict that synthesizer technology will ultimately replace most organ technology. After all, why settle for a trumpet stop on an organ when you can synthesize a trumpet that really sounds like a trumpet? (Though synthesizer purists argue: Why synthesize a trumpet when you can come up with a new tone that a trumpet cannot make?)

Certainly the most famous recording produced on a synthesizer is *Switched-On Bach*, made on the professional Moog shown on page 128. In a jazz-rock vein, a new release on Atlantic called *Cosmic Furnace* made by Roger Powell on an ARP is most impressive. Powell makes use of every technical trick in the book and I found this record good for hours of exciting listening. In a more popular genre, Hugo Montenegro's Quadrisc release from RCA called *The Godfather* is full of excellent synthesizer effects. And Stevie Wonder's latest two albums are exemplary for their subtle and brilliant use of synthesizers.

The key to the success of synthesizers is fun. Every hour with a synthesizer produces exciting discoveries and new sounds which can really broaden your concept of music. Amateurs and professionals alike have found that synthesizers offer the excitement of exploration, the satisfaction of creating new sounds, and pure fun of playing music like it's never been before. ★★

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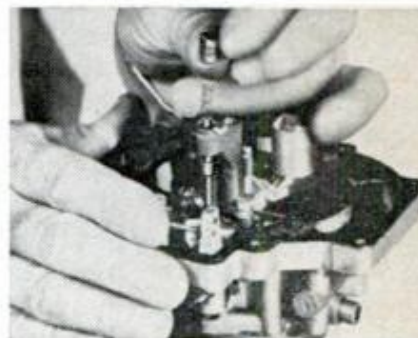
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*(Continued from page 71)*

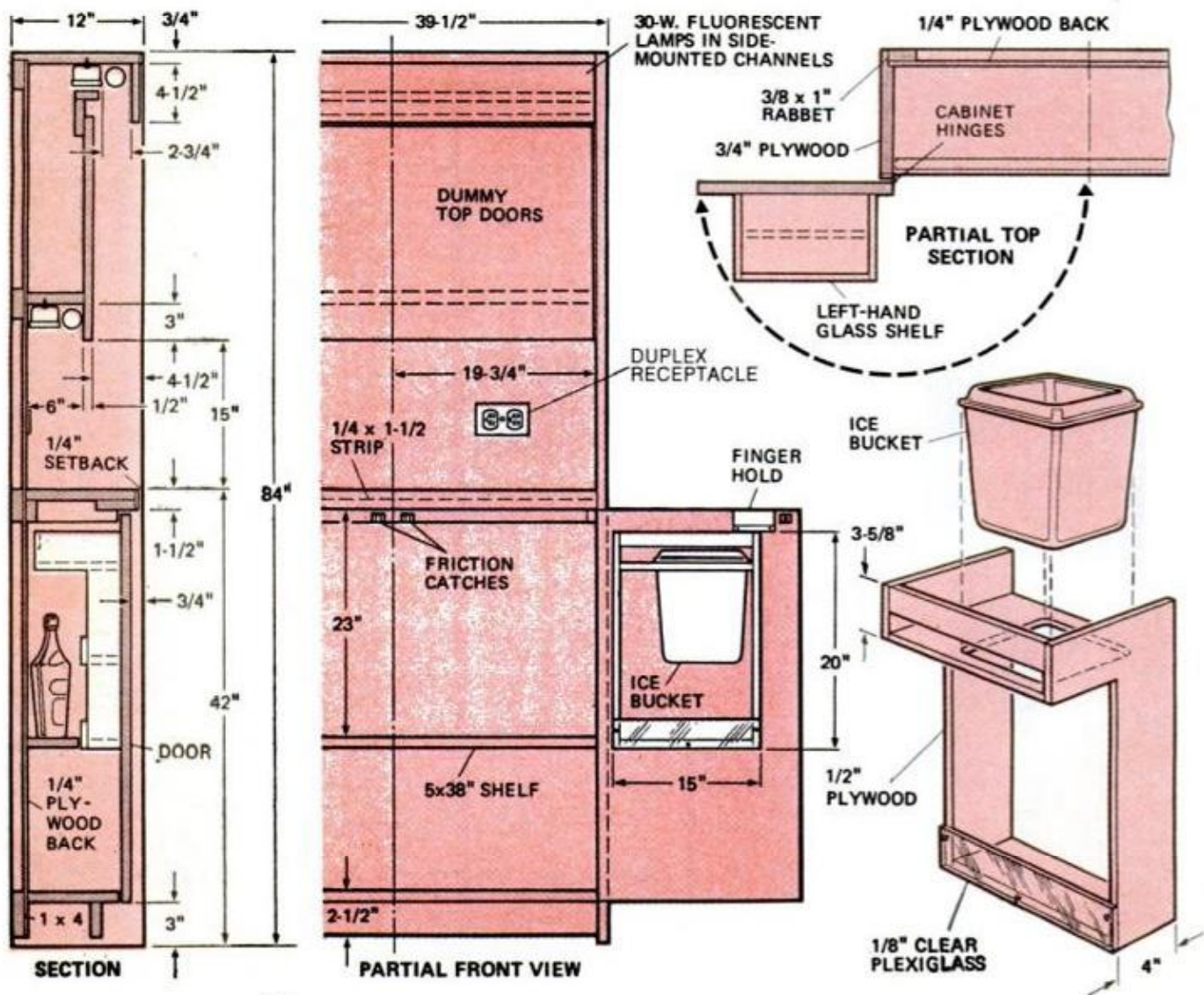
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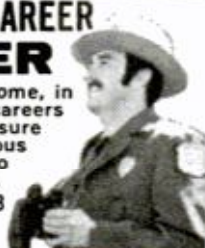
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## MUDDY PRINTS—HOW TO CURE THEM

(Continued from page 125)

highlights that never show pure whites, or fog that covers the whole paper, including borders. It usually prevents both proper blacks and whites from forming; in fact, the inability to get a proper black, no matter how much you expose the paper, is usually a sign of staleness.

But the inability to get a proper white is more often an effect of light fog. Fog that covers the whole paper visibly is usually caused by light leaks. Darkrooms that look dark when you first turn off the light may not be. A few small light leaks can sometimes be tolerated for printing (but never for film loading) provided none of them admits enough light to illuminate the darkroom (if you can see where you're going in the "dark," it's too light) and none shines directly on the paper. Check for enlarger light leaks, too.

Fog that just veils the highlights is harder to spot. Usually it comes from safelights. The easiest test is to unpack and expose a sheet of paper in complete darkness, then partially cover it with a box and turn the safelights on again. After five minutes, move the box to uncover half of the remaining area; then develop. If you can see a shadow line across the print, you have a fogging problem. Such fog can also come from light that bounces from a white easel back up to the paper emulsion.

Muddy prints are low in contrast, but not all poor contrast is due to the mud-producing errors noted above. Low-contrast subjects (often the result of shooting on a cloudy day) can explain a few "flat" prints; under or overexposed negatives that lack full tonal range will explain even more. These errors can be partially corrected (see Fig. 4, page 123) by printing on a "harder," or higher-contrast paper, such as Nos. 4, 5 or Agfa Brovira 6, just as soft papers (No. 1) can help with negatives too high in contrast. If you don't want to stock several paper grades for fear the less-used grades will go stale, use a variable contrast paper (though you'll still need graded papers for contrasts above No. 4 or so). Dust or dirt on your enlarging lens will also cut contrast, as will a cheap, low-grade lens (the difference between enlarger lenses, I've found, is less in detail resolution than in contrast). Condenser enlargers will also give a bit more contrast than diffusion-type ones. ★★★

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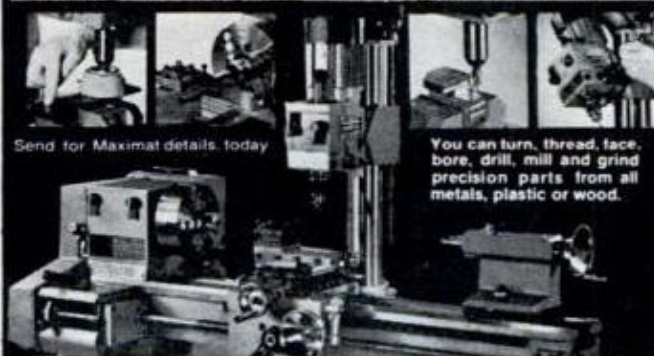
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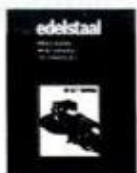
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## A BRIDGE FOR ALASKAN OIL

(Continued from page 108)

precast hollow concrete cylinder—is lowered into place from a steel erection truss.

The pier would freeze to the permafrost, according to Lin, so that it would have support from friction as well as bearing. The hollow center would be filled with aggregate from the excavation. Special insulation techniques are unnecessary because the concrete pier would remain cool and not cause any permafrost degradation.

Thick energy-supporting pads of a neoprene-like material between the pier and overhead conduit would provide resiliency against earthquake shock. The pipelines would be slung on cables inside the concrete tube so that they could swing with the forces instead of twisting and snapping.

**E**nvironmental advantages of the IPT elevated would include the following:

The concrete tube enclosing the pipelines would protect them from severe stresses caused by extreme temperature variations. The flowing oil generates heat and serves as a radiator, while the concrete tube acts as an insulator.

The concrete tube would tend to contain oil leakage and protect the pipe against possible sabotage.

The concrete tube, elevated above ground, is not in contact with tundra and permafrost, thus solving the problem of heat transfer from the pipe to the ground.

The 30-foot-high tube would not interfere with caribou migration.

The use of bridge-launching techniques minimizes access road construction to that necessary to reach production plant stations. These stations could be situated in areas picked to minimize adverse environmental effects. This contrasts with the 92-foot right-of-way TAPS needs for a permanent roadway and room for construction.

By including all modes of transport, including passenger, freight, communication, power, oil, gas, and water lines, a single artery would serve in place of the usual proliferation of pipes, lines and roads.

The IPT tube is designed to accommodate future needs. Highway lanes, for example, could be changed to rapid transit.

One of the questions Lin faces in designing IPT is just how much capacity—how many pipelines and how much roadway should the tube provide for?

A “maxi” version has a tube 40 feet wide and 33 in height. It’s designed to hold six four-foot pipelines. It includes four traffic lanes, with two lanes exposed on top of the tube, and two lanes enclosed inside. The lanes within the tube would provide all-weather transportation.

The maxi version would be sufficient for many decades to come. But higher initial investment costs and conservationists’ fears that it would overstimulate development have led Lin to concentrate on a lower-capacity “midi” version.

The midi will still have space to contain six pipes, but only two transit lines are provided for, and these run on top of the concrete tube. Snow and ice removal would be necessary. At first these two lanes would be used for highway transportation, then could be converted to electrified rail.

**T**he speed and economy of constructing IPT would be greatly enhanced by modern mass-production techniques used in concrete plants to manufacture segmental-type bridge components. These fabricating and construction plants—at 40-mile intervals along the route—would be covered to enable year-round operation. Using aggregates quarried nearby, each plant would precast the piers and the 300-foot tubular sections.

From these fabrication centers, the manufactured components would be moved over the section of IPT bridgeway already constructed and placed on piers by the cantilevered launching truss.

Lin’s estimate for building nearly 800 miles of a midi-version IPT comes to \$6 billion. The current TAPS cost is put at about \$3.5 billion.

The IPT with two pipelines is comparable in cost to two singly laid conventional pipelines. The TAPS pipeline is designed to carry a maximum of 2 million barrels of oil per day, one-tenth of the 20 million barrels consumed daily in the United States. By 1985 our oil use is expected to rise to 30 million barrels a day. This would undoubtedly create pressure for more pipelines to haul more oil from our arctic reserves.

This is all the more reason why the TAPS system should not be adopted, says Lin. “If this outmoded proposal is carried out,” he warns, “oil spill and other environmental degradation may stir up enough public opposition to prevent future needed pipelines. If the oil industry should win this battle, it will lose in the long run.” ★ ★ ★



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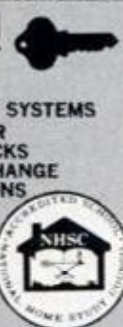
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## STILL SAFER THAN DRIVING

*(Continued from page 87)*

worst part, from the pilot's point of view, is the embarrassment of being towed to the gate by a tractor.

If hydraulics and electrical power are both lost, the gear can be dropped manually and a safe landing made without wing flaps. Every crew is trained to cope with this remote possibility, not that it is a difficult thing to pull off. In a thousand ways, problems of the past have been engineered out of modern aircraft. Aviation tries hard not to repeat mistakes.

Airliners are pampered like babies. Through a rigid schedule of "preventative maintenance," structure and internal machinery are inspected, repaired or replaced long before they can be expected to fail. An airliner will undergo hundreds of modifications during its life, from the installation of better reading lights to replacement of a fatigued rudder panel. It is in many ways a safer machine when it retires than the day it was delivered from the factory.

"Only its shadow is original equipment," jokes the mechanic changing plugs on a 60,000-hour DC-3 which still logs 250 hours a month on scheduled runs.

No airplane is better than the people who design it, build it, maintain it, fly it. In this country, the FAA monitors a plane from the time tentative blueprints are unrolled to the day the last example of its type is scrapped. Twenty years have passed since the first Boeing 707 flew, yet its operation is continuously observed everywhere. Should a BOAC mechanic in Tokyo notice a hair-line crack in a vital tail brace, the information is immediately wired to BOAC in London and Boeing in Seattle. Within hours, every 707 operator in the world has been advised to make certain inspections and repairs.

The airline pilot is perhaps the most strictly regimented and monitored technician in modern society. He takes a physical examination once a year (twice, if a captain). He undergoes rigorous ground and flight training in every type ship he flies and must prove by written and oral testing his understanding of it. By actual demonstration he must prove his ability to cope with all normal and emergency situations. A year later (six months for captains) he must again demonstrate his proficiency.

His work is observed to a degree that

would amaze his nonflying neighbors. He cannot move his "trip" from the gate without prior control tower approval. His progress to the runway is directed and observed by the tower. Every mile of his flight follows an approved plan and is monitored by ground radar stations. All radio contacts are recorded; all cockpit conversation is taped, even to a stewardess asking, "You take yours with cream and sugar, right?"

Meanwhile, a virtually indestructible device in the plane's belly—a "black box"—is tracing altitude, speed, heading and vertical acceleration on a metal disc.

And, if the recent spate of "revealing" stewardess books leads you to imagine that the girls spend their training learning to walk seductively, you have never seen a dozen of them get 370 passengers onto a 747's escape chutes in 90 seconds. Every aspect of airliner operation—maintenance, loading, flight, crew training and rechecking—is conducted in strict compliance with FAA-approved procedures.

It's not simply a matter of following rules in a book. An FAA man is often there, watching the repair work, reviewing a captain's latest EKG, sitting in on a class, riding the jumpseat during a pilot's checkride, asking a stewardess to show him emergency exits, oxygen bottles or life rafts.

While the stringent standards laid down by the world's governments are the foundation of air safety, it is the attitude within the industry that makes the structure sound. Books of regulations and government observers never kept a man from cutting corners. It's not fear of losing his license that makes a mechanic do the job right the first time; it's pride in his own workmanship and knowing what can result from a slipshod fix.

And it's not the recorder under the floor that keeps a pilot on his toes. It's his own professional pride and his own quite natural desire to see his trip completed uneventfully.

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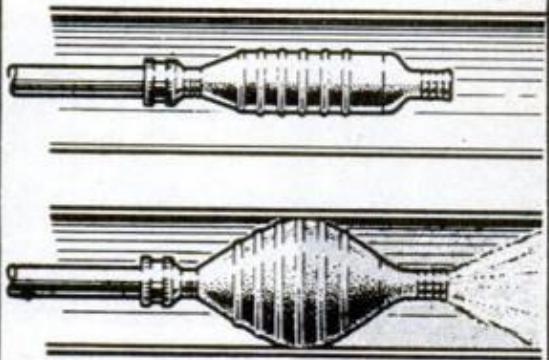
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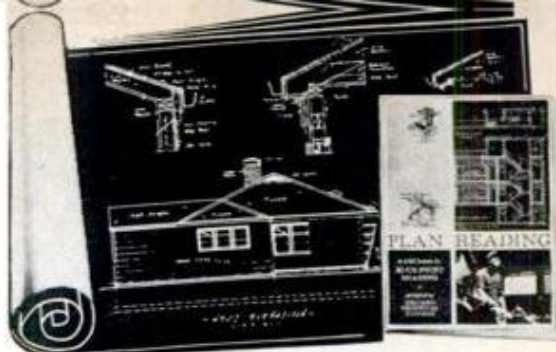
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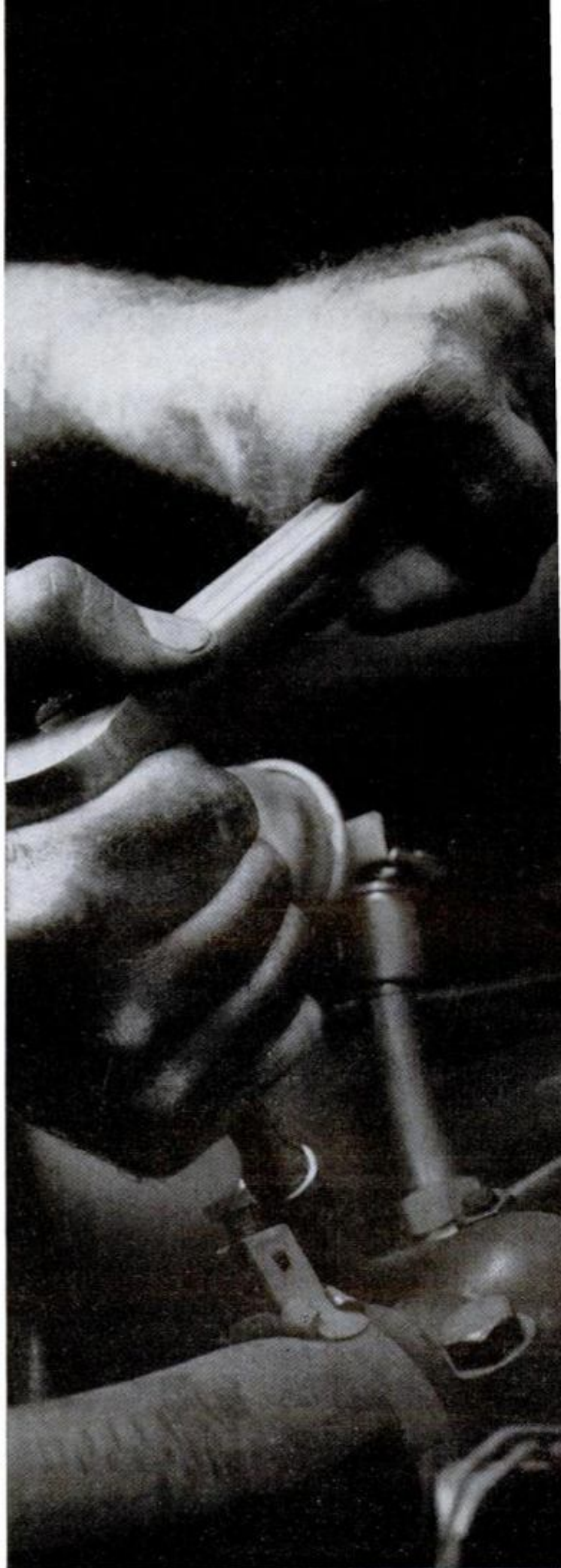
— Susan Plesko, Long Beach, Calif.



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\*Source: 1972 U.S. Labor Dept. Report (covers 1970's)

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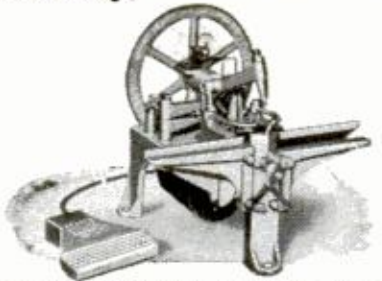
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**MAILORDER Millionaire** helps beginners make \$500 weekly. Free report reveals secret plan! Executive (1A1), 333 North Michigan, Chicago 60601.

**FREE SECRET BOOK "2042 Unique, Proven Enterprises."** Tiny businesses but huge profits! How Little Fellows beat inflation. Work home! Haylings, T29, Carlsbad, California 92008.

**\$200.00 DAILY** In Your Mailbox! Opportunity To Follow Mailorder Experts. Free Details. Associates, Box 136-A, Holland, Mich. 49423.

**ADDRESSERS. Homeworkers Needed!** Info. 35¢. Bitonti, 5225 Pattison, St. Louis, Mo. 63110.

**TAKE Catalog orders**. We drop-ship 1001 best selling specialty products. Lowest below wholesale prices. Immediate Delivery. Spectacular home business opportunity. Free Book. Specialty Merchandise, Dept. K-A, Woodland Hills, California 91364.

**HOW TO MAKE MONEY ADDRESSING, MAILING LETTERS. OFFER DETAILS 10¢.** Lindbloom, 3636 West Peterson, Chicago 60659.

**MAIL Baby Catalogs Imprinted** with your address to New Mothers for Big Profits! Details 25¢. Volz PM, Ypsilanti, Michigan 48197.

**MAILORDER BEGINNERS LIBRARY**. Learn Professional Secrets Inexpensively! Write: HOW, Box 4457-PM1, Downey, California 90241.

**HOW TO RAISE \$100.00 to \$1,000,000.00!** Write: Capital-PM, Dawsonville, Georgia 30534.

**SUBSTANTIAL PROFITS.** Own your own business. Quickly learned. Operate from your home while continuing present job. Little over \$1,400.00 starts your own nationally and locally advertised business. Investigate immediately before your territory is taken. Free Literature. Send today. Thixo-Tex, Inc., 5757 Lincoln Avenue, Dept. PM-4, Chicago, Illinois 60659.

**RAISE Capital** without collateral or credit. Unique plan assures success. Enterprises, Box 247-M, Columbus, Georgia 31902.

**1000% PROFIT** Bronzing Baby Shoes At Home. Free Literature. NBC-PM, Gower, Missouri 64454.

**FINDER'S FEES?** Turn Contacts into Cash. Two Survey Reports, Trial Membership Kit. Send \$2. FINDERHOOD, (PM-74), 15 West 38th St., New York, N.Y. 10018.

**MONEY EVERYDAY IN YOUR MAILBOX.** Free Details. Jaycee Barnes, Box 913, Glens Falls, New York 12801.

**NEED MONEY?** Stop Looking! Start small, at home, grow at your own pace. Men and Women equally successful. Details 25¢. Reliable, Dept. 101, 28 East Jackson Blvd., Suite 1204, Chicago, Ill. 60604.

**FREE Literature**—Start Your Own Mail Order Business At Home. The Tomlyn Co., Box 614 (A-3), Clifton, N.J. 07012.

**ELECTRONIC Assembly Business.** Big profits. Start home, spare time. Investment, knowledge, experience unnecessary. Free illustrated literature. Barta, Box 248GA, Walnut Creek, Calif. 94597.

**NEW, Compact fire extinguisher.** Fantastic profits. Exclusive territories. Norwich Chemical, Norwich, Connecticut 06397.

**FREE—166 Wholesale Catalogs** and FREE bookmarkers. Finest Mailorder Information!—Jay's Mail Order Sales, 2208 Hermitage Avenue, Wheaton, Maryland 20902.

**RECEIVE Mail Galore!** Your name on our national mailing lists, \$1.00. Sullins, Box 1313, Brunswick, Georgia 31520.

(Continued on next page)

## BUSINESS OPPORTUNITIES

(Continued from preceding page)

**FREE** Details and Catalog to Begin a Profitable Mailorder Business. Yvon Patraulea, 173 West 78th Street, New York, New York 10024.

**MAKE \$92.00 FROM** Square Foot Plywood (Jigsaw or Bandsaw necessary). (Proof), details 25¢. (Refundable). Woodart, Bridgewater, Mass. 02324.

**HOMEWORKERS—Mailables Wanted!** Free Information. A. Allen, 2418 Lori, Santa Ana, California, 92706.

**MAKE \$7.50 to \$15.00 hourly** building portable custom cases in your home. Huge demand. Get orders by mail. We supply materials, instructions—everything. Free details. Customcase, 6075 De Soto, Dept. X-K-A, Woodland Hills, California 91364.

**FREE COLLECTION AGENCY** Details!! \$1000.00 Monthly Possible. Master-PM, Dawsonville, Georgia 30534.

**THE FABULOUS IMPORT EXPORT BUSINESS.** Learn how to get started fast. Report reveals foreign suppliers. Ideal export items. Booklet #MO-58E, Send \$1.00. Tudor House, 26 Lace Bark Lane, Medford, New York 11763.

**MAKE 2 to 3 times your cost** on hundreds of products. Gift items, novelties, toys, carded merchandise, 1001 others/\$2.00 brings giant catalog, refundable on first order. Specialty Merchandise Wholesale, Box 37, Princeton, Iowa 52768.

**\$25 DAILY** Possible At Home. Details—Rush Stamped, Addressed Envelope. INFOMART, Box 597-T1, Lansing, Mich. 48903.

**BECOME** Notary. Free particulars. Smidts, 405 Richardt Avenue, Evansville, Indiana 47711.

**"MAILORDER Course! Home Study"**. 24 Easy Lessons. \$2.00. "Bill" Lambertson, 132 Tamiami Station, Dept. PM14, Miami, Florida 33144

**HOW To Cartoon for Money**, \$3.00 Postpaid. Superior, 2532 Superior, Chicago, Ill. 60612.

**MAILORDER** Problems? Experienced Counselling Available. Personally written Letter of Advice, Only \$5.00. Richmor, Shamokin, Pennsylvania 17872.

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**"HOW To Start Your Own Business."** Best Introductory Manual ever! Only \$1.00. Associates, 113D33 Community, Shillington, Pennsylvania 19607.

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**\$100.00 DAILY, EASIEST MAILORDER.** No Stock, Details. Smith, Box 176, Corona, Calif. 91720.

**INSTALL Burglar Alarm Systems.** Big Profit Home Business. Beginners Start Spare Time, without Mechanical Experience or Costly Equipment. Free Starter plan, Nasco, Dept. H2701, Woodland Hills, California 91364.

**STUFF envelopes.** \$300 Thousand. Free opportunity catalog. Send 16¢ stamps. NRG, Vanburger Rd., Owego, New York 13827.

**\$1,000 MONTHLY.** Addressers, Mailers possible, send addressed stamped envelope. Enterprise, Box 9826 PM, Savannah, Georgia, 31402.

**MAILORDER Catalogs.** Your Name Imprinted, Details 25¢. AM Sales, 3114 94th, East Elmhurst, NY 11369.

**REPRODUCE! CARVE! ENGRAVE!** Wood, Metal, Cheap, Easily Built Machine. Economy Enterprises, Box 23-P, Highland, Maryland 20777.

**LET Others Make Money for You.** Start Home Business. Full or Part Time. I Show You How. Free Report. Morgan, Dept. H2701, 6100 Variel, Woodland Hills, California 91364.

**STOP! \$1.00 Starts You! Own Business.** No Selling. J.A. Enterprises, 202-I Prairie, Chippewa Falls, Wisc. 54729.

**START Your Own Mailorder Business** Selling Coins To Collectors. Earn \$1,000.00 Monthly Easily! Experience Unnecessary. Complete Business Manual—\$3.95. Guaranteed. National, 204 Texas, Sulphur, Louisiana 70663.

**SECRETS!** Mail Order Success. Internationally Famous Expert Reveals How to Make Home Business Fortunes. Beginners: Get Free Report "Make Money By Mail". Discloses Free Advertising, Profitable Products. Mailco, Dept. HC701, Woodland Hills, California 91364.

**100 PRINTED** Post Cards \$1.35. Your Name, Address. Longwood, Fort Johnson, New York 12070.

**MAKE Up to \$1000.00 monthly** spare-time. Box 212, Erie, Pennsylvania 16512.

**HOME PROFITS** 100 ways! New 24-page booklet \$1.00. Cheapstakes, 210-P Fallon, Elmont, New York 11003.

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**STOP DREAMING!!!** Get on "Easy Street"! Enjoy luxury, security, independence. Proven profitable mailorder book program. Minimum initial investment; unlimited potential. Details, sample catalog 25¢. Key Enterprises, 370PM1 Wilton Road West, Ridgefield, Connecticut 06877.

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**MONEY AVAILABLE** Now! Both Personal, Business Uses . . . \$500 to Millions. Finance Anything . . . Get Rich Techniques . . . Thousands Actual Sources. Free Details. AID, Box 630-PPM, Ann Arbor, Michigan 48108.

**DO YOU Sincerely Want to be Rich?** MOA, 1148 6th Avenue, Bristol, Penna. 19007.

**GET Started in Mailorder the Simple, Easy Way!** FREE Details. E. Duke, 924 Linda Vista Drive, West Chester, Pennsylvania 19380.

**AMAZING PROFITS.** America's Easiest Mailorder Business. Make \$2000, or we pay you. Experience Unnecessary. Free Details. Volken, 746-1111 West Hastings, Vancouver 1, B.C., Canada.

**FREE Details.** Make Fantastic Profits in Mail-Order. Info-Mart, Box 1014, Brazoria, Texas 77422.

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**\$1.00 LISTS** you year sent to 1000 Importers, Jobbers, Mailers, our mailing year. Activ-Graph, Box 1252, Williamsport, Pa. 17701.

**\$500 PER MONTH** spare time. New mail order businesses. Vee Jay, 2366 17th Street, Eureka, Calif. 95501.

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**100 BUSINESSES** You Can Start For Less Than \$100. Free Report. Educational, Box 3133, Santa Rosa, California 95403.

**STUFF Envelopes.** \$25 Hundred. Immediate Earnings! Beginner's Kit \$1.00 (Refundable) MLFlores, 785-A San Pierre Way, Mountain View, Calif. 94043.

**EARN More than many professional men!** \$1000. Month Mail Order Collection Agency. Continental, Box 2023-A, Des Moines, Iowa 50310.

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## BUSINESS OPPORTUNITIES

(Continued from preceding page)

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**\$500 MONTHLY** Possible clipping newspaper items—at home, spare time. Details free. Clippings, Box 10343—PM4A, Palo Alto, California 94303.

**FREE** Descriptive List of Booklets on Money-making, Self-Improvement, Health and More! Tomar Company, 829 East 48th Street, Brooklyn, N.Y., 11203.

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(Continued from preceding page)

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(Continued on next page)

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(Continued from preceding page)

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(Continued from preceding page)

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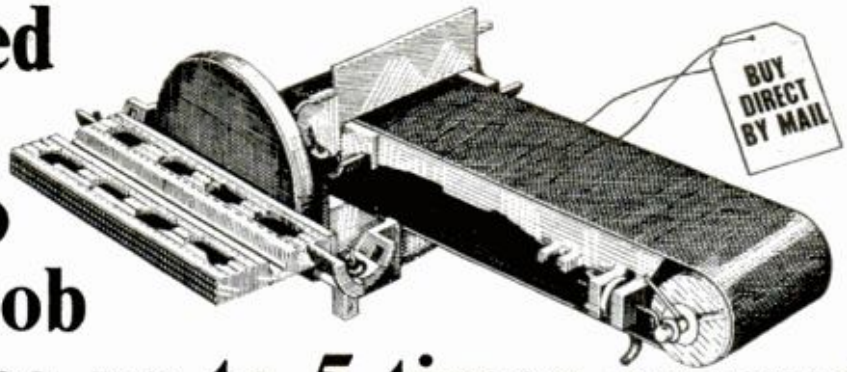
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**NEW** Miniature Fire Alarm. Protect your Property for Under \$14.00. Use Regular Outlet. Write for **FREE** Trial & Details. Londex, 3405 Seyburn, Detroit, Michigan 48214.



# Unadorned power tools ... they do the same job as tools costing up to 5 times as much.



We skipped the chrome to save you money . . . but we did not skip anything on performance. Actually, we skipped more than just chrome, we cut out every costly frill that wasn't absolutely needed.

Our tools are not exactly flashy. We are the first to admit it. But in articles covering test results on AMT tools, written by leading publications such as Popular Science, our tools have been praised over and over again. In spite of their low prices, our tools are full scale and offer full performance and precision.

**HERE'S HOW WE DO IT . . .** First, we don't claim our tools should sell for five times the price! Just that our tools do the same job . . . with the same accuracy, ease and speed . . . and will last at least as long. AMT tools cost less to make and are sold direct. They are bona fide quality power tools used by serious amateurs and professionals alike and if sold in retail stores would be much higher in price. We use no magic, let's be specific: **SIMPLICITY . . .** AMT tools are soundly engineered to eliminate every frill and gimmick—to minimize material and production costs. Machined parts are used only where they're needed. Unadorned cast iron and aluminum save you a fortune.

**DIRECT-FROM-FACTORY SAVINGS . . .** You save a bundle, yet, we offer a double guarantee backed by a 45-year-old company with millions of satisfied customers . . . and hundreds of orders pour in daily.

**LARGE VOLUME . . .** Our own foundry and large mass production facilities plus large buying power all work to keep costs down.

**STANDARD PARTS . . .** Our designs use standard hardware items wherever possible. By avoiding custom-made parts we pass on tremendous savings to you.

If you are looking for power tools that perform like units costing many times our low prices, order today and you'll be one step closer to many hours of woodworking satisfaction.

*Bill Morley*

## POWER SAW 8" tilt arbor saw . . . crosscuts, rips,

mitres, cuts compound angles, dados, coves, moldings. Completely assembled with ground cast iron table, safety guard, splitter, mitre gauge. Less blade, motor. Rip fence for easier work alignment, \$3.50 add'l. Ball bearing model, \$5.00 add'l. Takes 1/3 h.p. motor or larger, standard blades, attachments. Wt. 26 lbs., f.o.b. factory



**\$1995**



**FREE OFFER, cabinet base plans, . . .** with one piece of 3/4" plywood, convert your \$19.95 saw into a floor model with a huge 27" x 24" top. Takes cabinet rip fence, \$4.50 add'l.

## BELT SANDER A precision unit. It changes from horizontal to vertical in seconds. Heavy, sander includes 4" x 36" sanding belt. Uses 1/3 h.p. or larger motor. V-pulley drive and multi-purpose drive spindle.

Disc sander accessory, \$7.95 add'l. Mitre gauge, \$1.95 add'l. 15 lbs., f.o.b. factory



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## 3' WOOD LATHE . . . 6" swing. Same precision and speed as \$40 units. Sturdy cast iron with tubular steel bed. Lever action tail stock, two-speed pulley, fits any motor. Set of 3 high speed turning chisels, \$5.95 add'l. 4" face plate, \$2.50 add'l. 15 lbs., f.o.b. factory

Set of 3 high speed turning chisels, \$5.95 add'l. 4" face plate, \$2.50 add'l. 15 lbs., f.o.b. factory



**\$1495**

## 4' WOOD LATHE . . . 12" swing. Industrial size, does the same job as \$75 units. Tubular steel bed rails, screw action tail stock, three-speed pulley. Use any motor. 3 high speed turning chisels, \$5.95 add'l. 4" face plate, \$2.50 add'l. 30 lbs., f.o.b. factory

3 high speed turning chisels, \$5.95 add'l. 4" face plate, \$2.50 add'l. 30 lbs., f.o.b. factory



**\$2995**

## JOINTER-PLANER 4 1/8" x 22". Cast iron and steel, precision ground adjustable tables. For planing, joints, bevels. Rabbits to 3/8" depth. Fence adjustable 0° to 50°. Steel knives, dual guards. Use any motor. Precision ball bearing industrial model, \$10.00 add'l. Wt. 19 lbs., f.o.b. factory

Precision ball bearing industrial model, \$10.00 add'l. Wt. 19 lbs., f.o.b. factory



**\$2995**

## DRILL PRESS Precision 32" radial unit has standard features and many extras. Depth of throat up to 16". Head tilts and table stays level. Drills to center of a 32" circle. All cast iron and steel. Takes standard motor. 32 lbs., f.o.b. factory.

32 lbs., f.o.b. factory.



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## WOOD SHAPER KIT Makes beads, coves, moldings, tongue-and-groove joints, etc. Accurate cuts at high speeds. Sealed greased-for-life ball bearings. Less wood. Takes 1/4 h.p. motor or larger, standard cutters. Optional hold down assembly, \$2.95 add'l. 15 lbs., f.o.b. factory

Optional hold down assembly, \$2.95 add'l. 15 lbs., f.o.b. factory



**\$1995**

### TWO GUARANTEES

**10-DAY MONEY BACK GUARANTEE**  
Try any of these power tools and compare it with any similar machine at any price. If not satisfied, return it for prompt, no questions asked refund. We pay the return shipping charges.

**10-YR. FULL SERVICE GUARANTEE**  
Any part or parts of these AMT power tools (except motor which carries a one year guarantee) which become inoperative for any reason within ten years after purchase date will be repaired or replaced by the factory with no cost to the purchaser other than postage.

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4th & Spring St., Royersford, Pa. 19468

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<input type="checkbox"/> Long Cabinet Rip Fence at \$4.50	<input type="checkbox"/> Wood Shaper Kit at \$19.95
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<input type="checkbox"/> Belt Sander at \$19.95	<input type="checkbox"/> 6" Swing 3' Lathe at \$14.95
<input type="checkbox"/> Disc Sander Attachment at \$7.95	<input type="checkbox"/> 12" Swing 4' Lathe at \$29.95
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<input type="checkbox"/> Drill Press at \$39.95	<input type="checkbox"/> Turning Chisels \$5.95 (either Lathe)
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