

Popular Mechanics

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CHEAPER
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**How to choose one
for home, school
or business**

Page 70

**We show you how to
build a colonial pine
trestle table and
benches for \$70**

Page 92

Gifts you can make:

- Toy racetrack
- Lazy Susan server
- Wine rack
- Cutting board
- Artist's sketch bench

**Trucks: How
they've solved the
deadly jackknife**

Page 82



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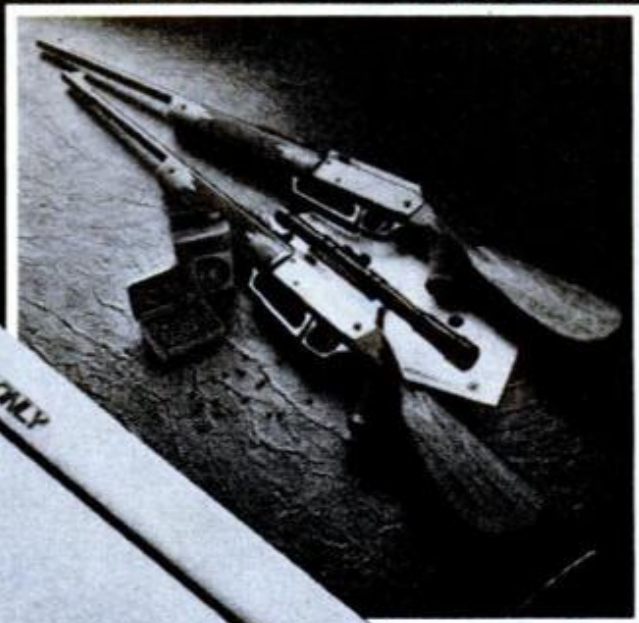
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ON THE COVER: Calculators get smaller, smarter and cheaper. But just how did the photographer, Ben Rose, manage to get all those numbers to leap right out the window? A laser helped. [See Photo hints, page 38.](#)

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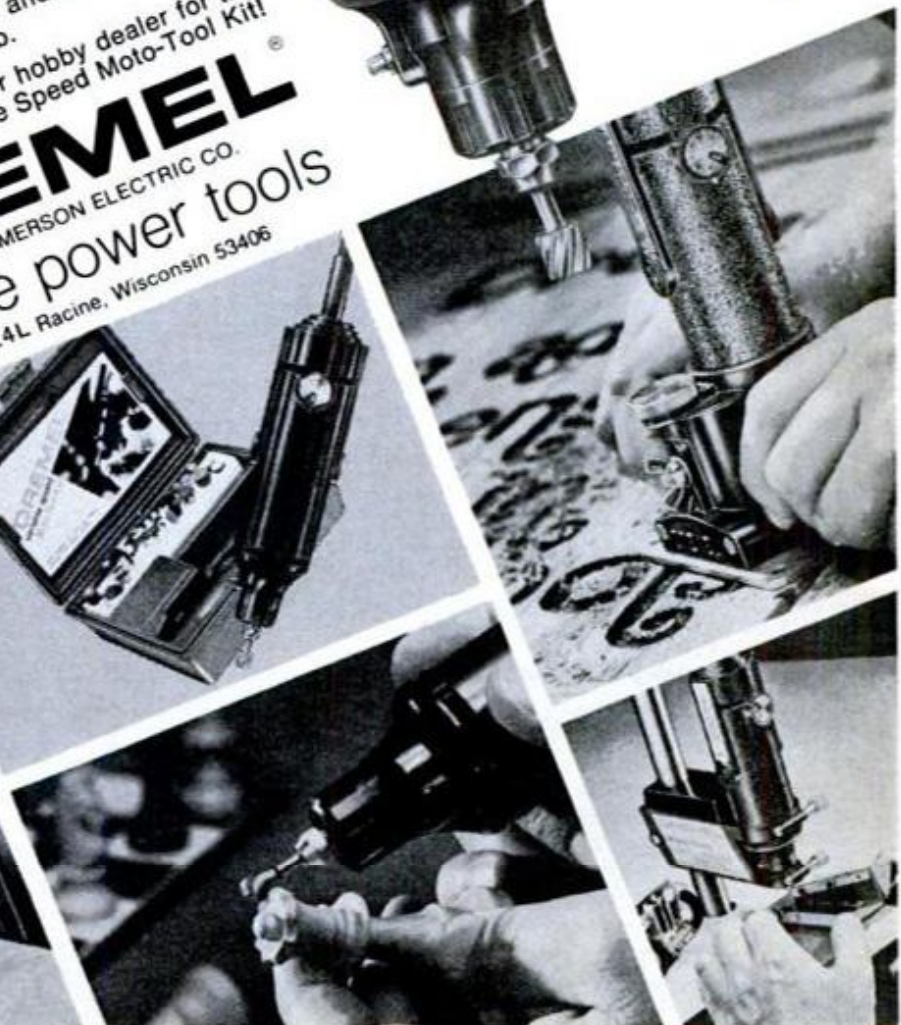
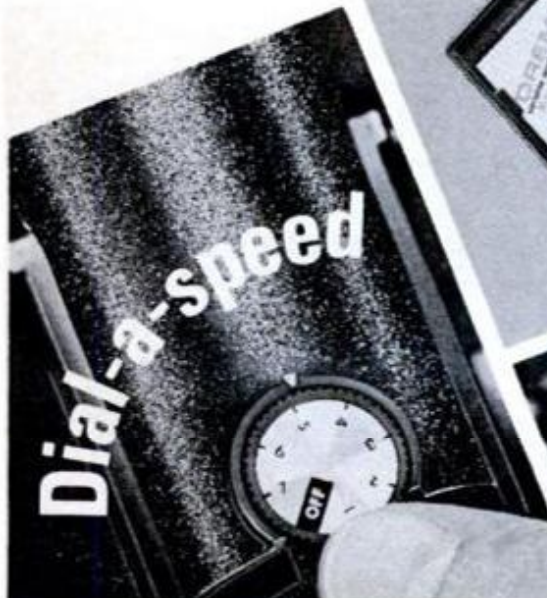
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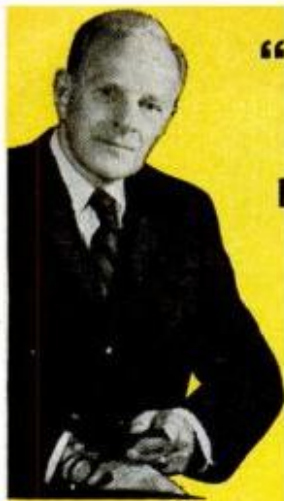
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LETTERS

TO THE EDITOR

Back home again—in Indiana

While thumbing through my new October *PM*, I was pleasantly surprised to see a scene from my home town in *The Bean That's Making Meat Obsolete* (page 84). It has been 12 years since I moved, but a home-town boy never forgets. In fact, I would have been willing to wager my paycheck that the view on page 87 was taken on North 2nd St., Decatur, Indiana, and that in the background are the McMillan Feed Mills.

You can imagine my second shock when I read the caption and was informed the location is Illinois. Is it really?

COCOA, FLA.

DAVID OWENS

Read on. Your paycheck is safe.

The picture on page 87 was taken in Decatur, Indiana. We have the largest soybean processing plant in the world here in Decatur, Indiana. We are proud of it, and if you are going to print a picture of our plant, our bean bowl outside storage and our soybean trucks in line, then we want proper credit.

DECATUR, IND.

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LETTERS

(Continued from page 8)

to the course offered in Elwood, Ind. (*They Learn Construction by Building Houses*, page 54H, Sept. PM), but we utilize other groups to enhance our program. Each student in our two-year drafting class draws a complete set of original house plans, complete with separate diagrams for electrical, plumbing and heating aspects of the home. Another group is the housing and home furnishings class which chooses color schemes, carpeting and other floor covering, kitchen cabinets and other furnishings. The landscaping and gardening class puts finishing touches to the house by completing the grading, fertilizing, seeding and planting of shrubbery.

TOWNSHIP HIGH SCHOOL
MURPHYSBORO, ILL.

TIMOTHY BOWERS
PRINCIPAL

Equals are not equal

You have picked up Ford Co.'s advertising gimmick showing the *measurements* of the Ford Granada being almost the same as the Mercedes 280, and, by inference, making the two autos comparable in quality (*Detroit '75: In Search of the Sensible Car*, page 110, Oct. PM). This ploy, even to one as unknowledgeable about automobiles as I am, is enough to make one gag. I am surprised!

PHOENIX, ARIZ.

CHESTER B. NORRIS

We agree that 195 inches of car A really doesn't make it the equal of 195-inch car B. But all we really said was that Ford admits it copied the Mercedes—including the measurements.

Let's have peace and quiet

Ever since my boyhood days in the mid-Twenties in China, I have read and enjoyed PM. It taught me much, and I am grateful.

But now, in my retirement years, I seek peace and quiet. Not only have my own desires changed, but the national scene has altered beyond recognition.

The "wide open spaces" of America no longer exist; they are crawling with people on weekends, on the ground, on the water, in the air. The (seemingly) limitless supply of fossil fuel (gasoline) is a thing of the

past. Our way of life must change—and you can help this change.

America's love affair with the automobile is passé. What we need now is practical transportation, free of pollution, economical and long-lasting—not annual renewals of tin and tinsel, overpowered gas hogs.

The particular object which prompted this letter is a small airplane (*It's Not Much to Look At*, page 134 Oct. *PM*). It has no muffler system at all and so is going to be a cone of noise pollution to hundreds below. And with gasoline in short supply, who needs an inefficient, polluting two-cycle motor?

Gentlemen, your magazine has done much to help the mechanically minded youth of America and the world. I submit a new evaluation to the material you will publish in the future, tailoring it to today's needs and not those of the wasteful past.

JACUMBA, CALIF.

NOEL KIRK

This once was a . . .

It seems every time I am in need of help with a project, the answer appears in the

next issue of *PM*. Lo and behold, it has happened again. Your article *This Once Was a Garage* (page 162, Oct. *PM*) is just what I am looking for. The only difference is that I am planning to build a small house which I can later convert to a garage.

MASSAPEQUA PARK, N.Y.

AL FROMMELT

Glad we're so timely with helpful articles. You do realize, though, that this could go on forever: garage to house to garage to house . . . Maybe we should try a title like How to Live With Your Car in the Dining Room.

Flywheel key is the key to the problem

How to Keep Your Power Mower Purring (page 78, July *PM*) was excellent, but one tip was left out. The mower is running fine when you hit a piece of debris (which should have been cleaned up) and the engine stops and won't restart. You check fuel and it's okay; pull the plug and there's a spark. It should run but it won't. The problem will

(Please turn to page 12)

HERMAN SURVIVORS[®]



We build Herman Survivors[®] to do two things well: Cover a lot of territory in great comfort. And stand up to the kind of punishment outdoorsmen give them. In any kind of weather. That's why we build the uppers of soft, durable burgundy full-grain glove leather, line them with Ensolite[®] for warm feet right down to -20° , then line the whole upper and soft padded cushion insole with saddle tan full-grain cowhide for even greater comfort. After that we stitch the boot down to resilient, oil-resistant Neoprene[®] crepe soles and heels. These Hermans come in two styles: 8" insulated boot, #7192, and 6" insulated shoe, #7192-6. They're tough. And they're comfortable. Like all our boots. When you're looking for quality in an outdoor shoe, hunt up a pair of Hermans.



J. M. HERMAN SHOE COMPANY,
DEPT. 34, MILLIS, MASS. 02054

That sounds like my kind of boot
Send me your catalog and the name
of my nearest Herman dealer.

PM-BGL-4-12

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LETTERS

(Continued from page 11)

most likely be timing. The blade clutch was too tight, and when it stopped, the inertia of the flywheel sheared the flywheel key. This can be checked easily by removing the flywheel nut and visually checking the flywheel and crankshaft slot. They should be lined up. When replacing the key, be sure to use a factory replacement as it is designed to shear and thus eliminate crankshaft breakage.

GREENDALE, WIS.

DOUGLAS MOORE

A little (invisible) light on the subject

Your description of black light on page 12 of the October *Letters* is erroneous. "Black light" is a popular term that refers to ultraviolet only—not to infrared. Ultraviolet and infrared are at opposite ends of the visible spectrum. To substitute infrared for ultraviolet in the bug trap (as you suggest) would diminish its effectiveness.

MASPETH, N.Y.

R.A. PARKER

Yes, only ultraviolet should be used in a

bug trap. "Black light," an engineer tells us, "is seen only when it reaches an object." (But two current dictionaries here define black light as "invisible ultraviolet or infrared light.")

More heat-saving ideas

The ingenious Mr. Gene Feeney (*Fireplace Furnace: Heating Your House Instead of Your Chimney*, page 154, Oct. *PM*) is to be congratulated for using his fireplace for something more useful than an incinerator for firewood. May I suggest further:

Sealing the fireplace opening with a carefully fitted glass-door "firescreen" (I used asbestos cement around the door frame) and furnishing combustion air from outside through a duct into an ashpit offers advantages: 1) No loss of heated air to combustion or up the flue. Less wood used. 2) No smoke stains on the masonry or in the house. 3) No sparks on the rug. 4) Opportunity to regulate fire through damper in combustion air duct. This makes fuel last longer.

(Please turn to page 14)

Jock itch (or chafing, rash, itching, sweating) shouldn't be treated lightly.

If your groin, thighs, or buttocks suffer from redness, rash, chafing, soreness, excessive perspiration, or Jock Itch (*Tinea cruris*), then you need medicated Cruex®.

Cruex soothes itchy, inflamed skin. Absorbs perspiration. Helps cushion against further irritation. And medicated Cruex helps prevent fungous infections that can develop.

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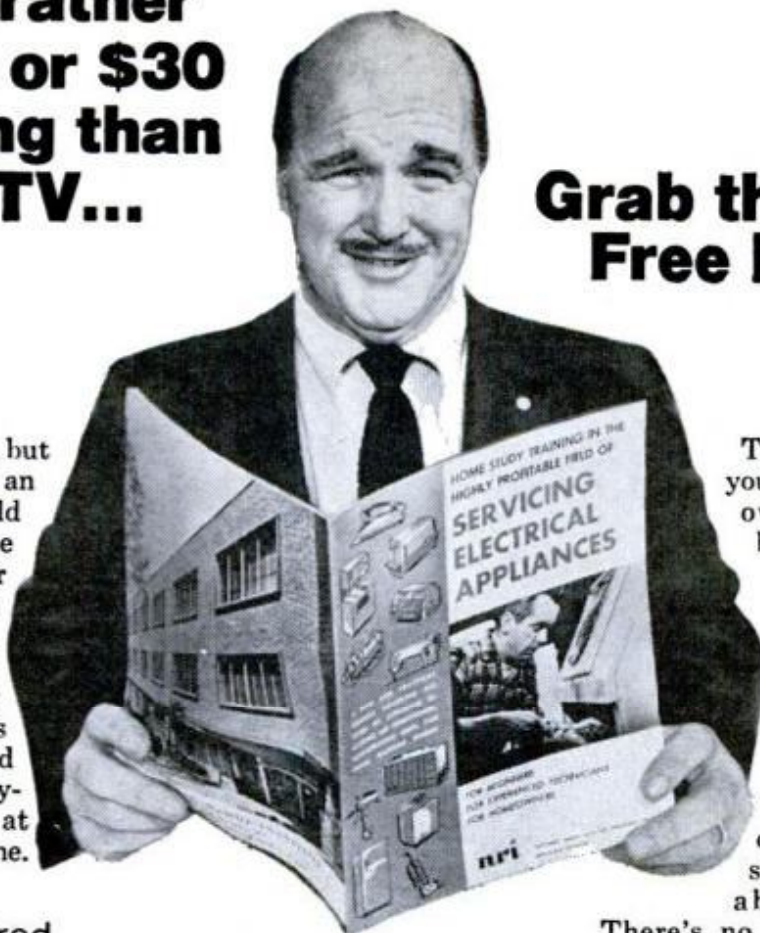
Cruex. Guaranteed to work or your money back.

TOM McCAHILL says:

**"If you'd rather
earn \$25 or \$30
an evening than
watch TV..."**

**Grab this
Free Book!"**

I'm not against the tube, but I'd hate to pass up \$5 to \$7 an hour just to catch those old movie reruns. You can make that kind of money in your spare time by being the man in demand: an Appliance repairman. Guys who can keep appliances going are wanted in more states than the FBI's top ten. And NRI can teach you everything you have to know... at home... in your spare time.



Think of the money you'll save when your own appliances go blooie!

The important thing is to make up your mind that you really want to get ahead. Do yourself a favor and send in the coupon below. You'll get back a colorful catalog that spells out everything about the course.

There's no obligation and no salesman will call... NRI doesn't need any with this course. All you invest is an 8¢ stamp, and you've got nothing to lose, except that empty feeling in your wallet.

So you've never wired a plug... NRI can show you how.

Even Edison had to do some studying. And there's no easier way to learn than the low-cost, home study course put together by the Appliance Division of NRI Home Training. All the lessons are fully-illustrated and easy to understand. Thousands of guys like yourself have learned basic electricity and how to use test instruments. The course covers the electrical and mechanical operation of every type of appliance from toasters and coffee makers to dishwashers; from vacuum cleaners and automatic laundry equipment to air conditioning and refrigerators. They even show you how to fix farm and commercial appliances and small, one-lung engines. Their staff of experts works with you every step of the way. NRI includes a professional Appliance tester in the low tuition. Almost a million men have studied with this great school,

so you know they've got this home study business down pat.

Hang onto the job you've got; learn in your spare time.

There's no need to give up your present job in order to learn a skill. With NRI, you study in your spare time, at your own rate. Many of their students have more than paid for the tuition fee within their first couple months servicing electric Appliances.

Tom McCahill

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LETTERS

(Continued from page 12)

Disadvantages include the need to clean the glass every week or so, some loss of direct radiated heat and an added installation cost of about \$100.

My system does not yet use Mr. Feeney's grate idea, but does heat the whole house—with warm air. Using a Heatilator jacketed firebox and a squirrel-cage fan, we pull air into the bottom of the jacket and through it, then push it out through a 4-inch duct pipe to opposite ends of the house. Since the fireplace is centrally located (not on an outside wall), the heated masonry contributes to total heat input, and the temperature remains constant within one or two degrees from end to end. The main furnace supplements the fireplace when outside temperature is below 10° F.

TUNKHANNOCK, PA.

WILLIAM F. SILL

The timer-controlled thermostat is already available (*Save Fuel With This Thermostat Timer*, page 148, Oct. PM). On my Honeywell clock thermostat I turned the timer cam plates so that the furnace operates for about two hours in the early morn-

ing, goes back to the night setting until late afternoon and then remains at the higher temperature until bedtime.

CORNWALL ON HUDSON, N.Y. W.E. FINNIGAN

Plywood and hammer

The paneling shown in *This Was Once a Garage* (page 162, Oct. PM) was erroneously tagged as part of the U.S. Plywood Weldwood Collection. Though *Ranchero Nevada White* is made by U.S. Plywood, it's not part of that particular line.

And in *Soft-Faced Hammers* (page 117, Nov. PM), hammer B does not come "with four interchangeable rubberlike faces." Its hollow head is partially filled with metal shot to prevent rebound, and is fitted with faces of aluminum, not rubber. What's more, it sells for \$2.75, not \$5.95.

When writing to this column, please type your letter if possible and keep it short. In any case, please print your name and address on the letter. Address it to: Letters to the Editor, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.

The little Pocket that's quick as a wink.



The Pocket 40 is a clever little camera. In bright sunlight, its 1/225-second shutter speed can give you beautiful stop-action pictures. Its $f/8$, 3-element lens focuses as close as 3 feet.

Its CdS electric eye and automatic exposure control give you the right exposure for the right picture. It's less than \$68 for all that. Other Pockets start from less than \$23.

Prices are subject to change without notice.



Kodak pocket Instamatic® cameras.



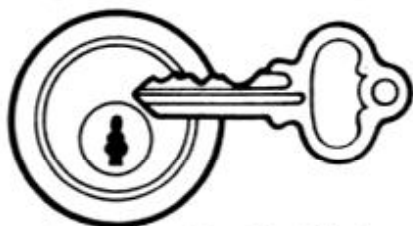
COMING NEXT MONTH: A BIGGER, BETTER POPULAR MECHANICS

Popular Mechanics is always open to new ideas. Since 1902 it has been a forum for the idea men of the world. Even the simplest suggestion from a young reader gets careful consideration here. And we are always looking for new ways to improve the magazine.

In June, 1973, we began a systematic updating of PM with the introduction of new, more legible type faces and better graphics. Rather than choke you with the dust of our remodeling, we did it gradually. Our goal was to do justice to what we had to offer, to make the whole "book" brighter and easier to read. We made a lot of progress but weren't satisfied. We then decided to take full advantage of exciting new photography and technical art by enlarging PM's page size. Though our page size has been approximately 6½ x 9½ inches for 72 years, next month Popular Mechanics will grow to 8 x 11. Bigger—and better. We're for change if it makes for a better magazine. We can assure you that in the new size PM not only looks great—it's off to a great new start in its long, exciting history. Here's just a *small* sampling of what awaits you in the big January issue:

HOW TO BURGLARPROOF YOUR HOME

Simple, inexpensive electronic equipment and better locks can end your worries about burglars



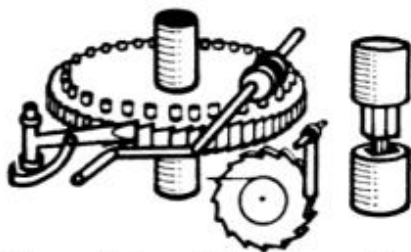
and vandals. Popular Mechanics' electronics editor shows you how to install readily available off-the-shelf hardware.

DETROIT'S SMALLEST CARS YET

The AMC Pacer leads a small parade of American mini cars. Right behind it (in exclusive sketches) we show what General Motors and Ford have coming for '76.

LEONARDO DA VINCI'S LOST NOTEBOOKS

"Lost" in the National Library of Madrid until 1965, Da Vinci's technical notes and sketches reveal that he invented—among other things—the ball bearing (reinvented in 1772), and a two-wheel, chain-driven bicycle, and designed functional gears, transmissions and machines.



The painter of the Mona Lisa would have been at home in our technological age—as an engineer and inventor.

HEADLINE: ANDREA DORIA SINKS AFTER COLLISION

For those who do, and for those who are too young to remember the tragedy, this dramatic account of the events preceding

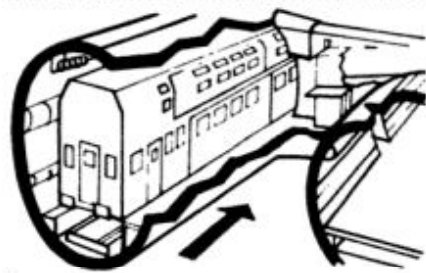


the collision of the Italian luxury liner with the *Stockholm* the night of July 25, 1956, recalls it all vividly. A companion article, *The Andrea Doria Today*, describes what divers found when they penetrated the eerie

hulk 240 feet below the surface. "Headline," a new series, will recreate the events recorded in famous headlines of the twentieth century.

THE ENGLISH CHANNEL TUNNEL

Some day England will be linked with France by the "Chunnel," a twin-tube railroad tunnel under



the English Channel. While the work inches forward, the writer supplies a hilarious description of the British procrastination that keeps the project from moving "too fast."

FIREPLACE-BAR

Like a fireplace for your family room? A small bar for recreation room or apartment? PM brings you both in one of the cleverest projects we have ever offered. And for good measure, this ingenious piece includes a stereo center. You pull on two knobs . . . open a very realistic fireplace . . . and there's the bar, the stereo and the speakers. (And this is a fireplace you can take with you when you move.)

ONE MAN'S REMODELING

Wish you could buy a new home but can't afford it? Roger Wothe was in the same spot and decided to remodel. His amazing transformation of a little cottage with an "impossible" roof line will give you ideas you can use to get your "new" home.


EDITOR

25 technical careers you can learn in 2 years or less.



How far can you go without four years of college? Here's what the U.S. Government says about it in a booklet shown above:

"A lot of people think that careers are meant for college graduates — jobs are for everybody else.

"Ten years ago, they may have had a point. But something's happened recently to change all that. A revolution in science and technology...

"You can break into any field — from medicine to computers to engineering to the space program — with only a year or two of education.

"Just become a technician."

You don't need to read the government booklet. (Its main message is

printed above.)

But you do need some guidance to pick a field you'd enjoy working in.

Free Guidance Materials

To help you select the technical career field that's right for you, we've listed opportunities in the special coupon, at right. And you can find out what you should know about the field you like best by simply checking off your choice and mailing the coupon today.

Free Guidance Booklet

By return mail, you will receive a free ICS Career Guidance Booklet that describes the opportunities, income and job security you might expect in your newly chosen field. It will also explain how ICS can help you get the training you need to break into this new

career field...right in your home...during your spare time...without losing a single day's pay from your present job...and without ever setting foot in a classroom.

Free "Demonstration Lesson"

In addition, you'll receive a free "Demonstration Lesson" that lets you see for yourself why picking up the job skills you need — the ICS way — may be easier than you think.

More than 8,500,000 men and women have turned to ICS for career training since 1890. Some 2,000 American firms and government agencies are using ICS training programs to upgrade their employees. (Among these firms are such names as Ford, U.S. Steel, Chrysler, Mobil, 3M Company, Alcoa, Pan Am, GE, Motorola, RCA.)

Take advantage of these U.S. Government facts and get started in a big-income career.

"...you no longer need four years of college to start out on a scientific or technical career.

"You can break into any field—from medicine to computers to engineering to the space program—with only a year or two of education. Just become a technician." *U.S. Office of Education*

ICS career training is approved for veterans training, and is Accredited by the Accrediting Commission of the National Home Study Council. Just mail the card or coupon for your free guidance materials. (Gov't. booklet is not included.) Mail to: ICS, Scranton, Pennsylvania 18515.



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HOMEOWNERS' CLINIC

BY W. CLYDE LAMMEY

Settling fireplace

My masonry fireplace—only 5 years old—appears to be settling, leaving a crack between the lower horizontal member of the mantel and the vertical course of bricks. The opening is nearly 1/2 in. wide and how to close it is my problem. Any suggestion?—Percy Gibson, Macon, Ga.

The chances are good that the fireplace's settling will stabilize, but neither you nor I know just when. In the meantime, I would fit a strip along the lower edge of the horizontal mantel member. A strip about 1 in. wide with a beveled or molded edge would conceal the opening and might be attached without removing the mantel; use finishing nails or long screws of a small wire size. Or it might be possible to remove the mantel, saw off the vertical facing members at the lower ends and reinstall the mantel.

Perspiring windows

Why do our windows sweat on the inside? We have storm sash and storm doors; the house is insulated and the clothes dryer is vented.—John Cvercko, Campbell, Ohio

Your storm sash are leaking cold air into the space between the storms and the inner sash. If you seal the storms with self-adhesive weatherstripping, you will likely solve this problem—certainly minimize it to the extent that it is no longer objectionable.

Fireplace cleaning

How can I clean the smoked-up interior of my fireplace? Although it has apparently been used for years, I've just moved to my present address and do not need it for heating.—Randall Wolff, Springfield, Ill.

You can look forward to a messy, tiresome job done in a most awkward working position—with the final issue in some doubt, if you're looking forward to spanking-clean

firebrick. Of several procedures, the best I've tried is the use of a strong solution of trisodium phosphate—most household cleaners contain it—applied with a stiff-bristle scrubbing brush, or bristle brush and wire brush. If the coating is old and hardened, it may take several applications to get down to the bricks. Rinse after each scrubbing, wear rubber gloves and goggles to protect your eyes from spatters.

When the fireplace has been cleaned, you can then do as many interior decorators do and paint the inside black, using a special fire-resistant paint that is sold by most fireplace supply stores.

Tipping foundation walls

In winter one side and one end wall of my basement seem to tip inward, one more than the other. They appear to straighten in summer, but the horizontal crack near the center of the longer wall is widening progressively—last winter it was nearly 1/2 in. where the concrete blocks join. What's happening and what's the remedy?—L. Carson, Buffalo, N.Y.

There must be inadequate drainage, as the usual cause of such a condition is water collecting outside the wall below grade and freezing, forcing the block wall inward. Although there appears to be little danger of collapse at present, I'm afraid you will have to have the wall rebuilt eventually and provide a cinder fill outside down to the footings. If there's drain tile at the footings, it's possible the tile has filled or collapsed at some point and needs to be replaced. ★ ★ ★

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. For more home repair and maintenance help, get PM's Home Care Guide, \$4.45 postpaid. Send orders to PM, Dept. HL4, Box 1014, New York N.Y. 10019.

Smoking a menthol
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Get the taste of
extra coolness.

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up to KOOL.



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IMPORTS AND MOTORSPORTS



Whole-new Honda

The GL-1000 looks like a Japanese BMW. In the competition to design and produce the best big touring machine, Honda stuck with the reciprocating engine rather than go the rotary engine route of Suzuki and

Yamaha. We'll have more on this great-looking new bike after we ride it. For now, note that it's a water-cooled, horizontally opposed Four, with driveshaft and discs front and rear!



Weatherproof scooter

Do-it-yourselfers can start out with a stock Lambretta scooter and convert it to the slick missile shown here. This one is the design of engineer Jim Wilkinson. It has front and back seats, doors and a low cg for good stability. For more information on plans and construction, contact Jim at 17655 Lemay Pl., Van Nuys, Calif. 91408.



Two-stroke roller skate

If this vehicle were any smaller you'd have to hang 10 to ride it. There are three wheels underneath and a 49-cc engine for a top speed of 25 mph. Since its dimensions are 44 in. by 36 in., the designers call it "Square Meter." The 140-miles-per-gallon transporter can also be enclosed for foul-weather

(Please turn to page 24)

A winner never stops proving it. Presenting the Poulan SUPER XXV.

It's a quieter, more powerful version of the most successful lightweight in history. Beefed up to cut an 8" log in just under 4 seconds.

And even quieter than before.

Of course, it's still got all the features that made it a winner to begin with: an all metal housing, not plastic.

14-inch hard-tipped cutting bar, not 12". Chromed cutters on the chain. And a Tillotson all-position carb. All for \$139.95*.

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IMPORTS AND MOTORSPORTS

(Continued from page 22)

"driving." This ingenious solution to the urban transportation problem is from



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A product of Benjamin's sound workmanship and insistent use of high grade materials, it also has a walnut Monte Carlo stock and Pump Handle to make it your best buy. Safe, quiet, odorless. It has adjustable power for all uses — indoors or out. BB, 177 or 22. At Sporting Goods Dealers.

Use Benjamin H-C Pellets—Sized & Lubricated for greater accuracy. 177 & 22. 250 or 500 per can.

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896 Marion St., St. Louis, Mo. 63104

YOU CAN DEPEND ON BENJAMIN

Long live the double-decker!

Soon, New Yorkers will again be asked, "Please step to the top of the bus"—not that they'll need any entreaty to do so! Eight of the practical and fun buses are on the way from the British Leyland factory for use on regular runs. They'll carry almost twice as many passengers and take less road space than the current models. I'd love a used one (new, they're \$83,000) for a duplex motor home! ★ ★ ★



Model 340 BB, Model 342 Cal. 22 Pellet, Model 347 Cal. 177 Pellet.



"IT'S IMPORTANT TO HAVE A VEHICLE RUN FOR US...OUR DELCO BATTERY HAS BEEN RELIABLE AND STARTED IN GOOD WEATHER OR BAD."

Carl Weil is sold on Delco. In fact, he's so proud of the service he got from his Delco battery he decided to tell us about it.

"We live about an hour out of Denver. To us, a vehicle that starts is very important. And our vehicle with a Delco battery has given

us extremely good service."

And the Weils put their Delco battery through some rough tests throughout the years they had it.

"We have some pretty severe weather... it's very important to us to be able to get into town whenever we have to

... when our son was born it was in the winter... it was important to have the battery start. And our Delco battery did."

Service like that is what Delco batteries are all about. GM installs them in almost half the cars and trucks built in the U.S. And

Delco sure made Carl Weil happy.

"You definitely get your money's worth with Delco...."

Your Delco battery may never experience a Colorado winter.

But you will get dependable starting power almost anywhere you are.

DELCO BATTERIES
IN MORE CARS. ON MORE CORNERS.





**“Ace Hardware
has the gift
for her.”**

Carrie Stevens

A. The “Original” Rival Crock Pot. This 3½ qt. electric stoneware cooker cooks all day while the cook’s away. Flame Red or Avocado. Model 3100. Sale priced at 16.99

B. Oster Kitchen Center. A complete food preparation center... 3 appliances in one versatile unit. You can blend, mix and grind with this compact counter top appliance. Model 986-04. Sale priced at 109.87

C. Proctor Silex 4 Slice Toaster. Automatically adjusts toasting time to provide the exact shade of toast desired. You can toast either 1, 2, 3 or 4 slices at a time. Model T505W. Sale priced at 18.87

D. National Hand and Nail Brush Set. Just what you need for keeping your hands and nails beautiful! The handle of the nail brush is designed to act as a cuticle stick. Model 1110. Sale priced at 55¢

E. Sunbeam Hand Mixer. The “Burst of Power” mixmaster gives you extra mixing power at the touch of a button. 5 speed thumb tip switch with extra power on each switch. Model H-7. Sale priced at 16.99

F. Toastmaster Oven Broiler. This “continuous cleaning” family size oven broiler bakes pastries, breads and casseroles plus broils and roasts meat and poultry. Model 5242. Sale priced at 43.88



Due to physical size and merchandising policies some stores may not have on hand all items illustrated in this advertisement. Sale prices effective at participating stores through December 31, 1974. Check your Yellow Pages for your nearest Ace Hardware Store.



“The Helpful Hardware Man”

DETROIT LISTENING POST

Five new wagons in the works

There are a lot of new station wagons coming next year. Two from Chrysler, a Valiant and a Dart; two from Ford, a Monarch and a Granada and, later on, a Monza wagon from Chevrolet.

LaSalle adding a two-door

Cadillac's small car, LaSalle, will become a two-car line in 1976. The four-door coming in February will be followed by a two-door next fall. There is talk in GM that the smaller Cadillac could become the standard Cadillac by 1977. If that's true, it could mean an even smaller Cadillac than LaSalle down the road.

Improving the improvements

It's no great secret that everything out of Detroit is obsolete before the product goes on sale. Right now, while the companies are extolling advancements in the '75 cars over the '74s, the '78 cars are taking shape and they will be improved over the '75s. They will be safer, more durable cars and require less service than the '75s.

If such is the case, why not skip the next two years and jump right into the '78s? That's not possible because there's always a lag between development of an idea and the time it takes to put it in production. (This is true of all manufactured products—refrigerators, boats, aircraft, cameras—you name it.) If there was a way of jumping directly from the '75s to the '78s, the production line would still be behind the development labs. By the time the tooling was ready to put the '78s on the line, someone would have found a way of improving the improvements.

There is just no way of getting around the crawl-before-you-walk method of making cars. For instance, GM is now deep into a second-generation rotary engine. It

will be smaller, lighter, more powerful and more economical—use less gas—than GM's first edition of the engine. That version, incidentally, has been postponed again. Even if GM could afford to abandon the investment it has in its first generation Wankel, the realities of lead time being what they are, there is no way the company could leapfrog to the '78 engine.

Rotary no gas hog, says AMC

Speaking of GM's Wankel, the company has apparently turned samples of the engine over to American Motors for evaluation, although this has not been confirmed by either firm. But it's obvious from talking with AMC people that they have had "hands on" the engine and their knowledge goes beyond what they might have picked up via the grapevine. AMC executives are quick to defend the GM rotary against charges of low fuel economy. "Those charges (low mileage) just aren't true," according to an AMC v.p.

Both companies have confirmed that GM will supply AMC with the engine when GM attains volume production. AMC wants the engine for its Pacer. This is a good deal for both sides. It will give American Motors a Wankel without the enormous expense of setting up a research/development program and then tooling to build the engine. GM stands to benefit because it won't have to go it alone in selling the engine to the public against criticism from Ford and Chrysler, both of whom are highly critical of the rotary. It's always easier to sell a new idea if you have back-up support from another company.

New Cat coming from Canada

First it was Astre, next the Bobcat. Astre is Pontiac's make-over of the Chevrolet

(Please turn to page 28)

Help!

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DETROIT LISTENING POST

(Continued from page 27)

Vega. GM has been selling it in Canada for more than a year, but the car was just put in production in the United States with the start of '75 model production. Bobcat is the name of a spiffed-up Pinto Ford builds in Canada. Ford will take out U.S. citizenship for it early next year and sell Bobcat through Lincoln-Mercury dealers.

Pontiac polling buyers

The auto companies have been saying for years that they build cars to public demand. You tell Detroit what you want and that's what it makes. Baloney. The way the system really works is by seat-of-the-pants and cross-your-fingers. The carmakers try to guess what they can sell and that's what they build. The only real voice the customer has is when he goes in the showroom, when he buys or walks out. But he does not have a voice in advance of the building of the car, as the auto firms claim.

Pontiac says it is going to change that and give the buyer a real voice in the way the car is built—what's good and bad about it, the way it's serviced, priced, how the dealer treats or mistreats you—the whole ball of wax. Pontiac is going to survey every buyer of every '75 model. No company has ever surveyed every buyer of every car. Pontiac says it will use the information to build better cars, to give people what they want in automobiles and to correct faults found with dealers.

If there's something you don't like, Pontiac wants you to yell about it. This is the first time an automobile company has given the customer an honest, unrigged opportunity to vote on what he wants in a car before the car is put on the line. Obviously, this isn't going to help the buyer of a '75 car who gets a lemon. He's stuck with it. But he can influence the way Pontiac builds them in the future.

To keep things straight, this in no way implies an endorsement of Pontiac by myself or *PM*. We aren't suggesting that you hightail it out and buy one on the promise of receiving a questionnaire from the factory. That's your decision. But if you do buy a Pontiac and don't hear from the factory, let us know about it. We'll take your complaint to the company and follow-up to make sure you receive a reply. ★★

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PM'S PICTURE-TOOLS are a great new idea to take the confusion out of *what goes where* on workshop and tool panels.

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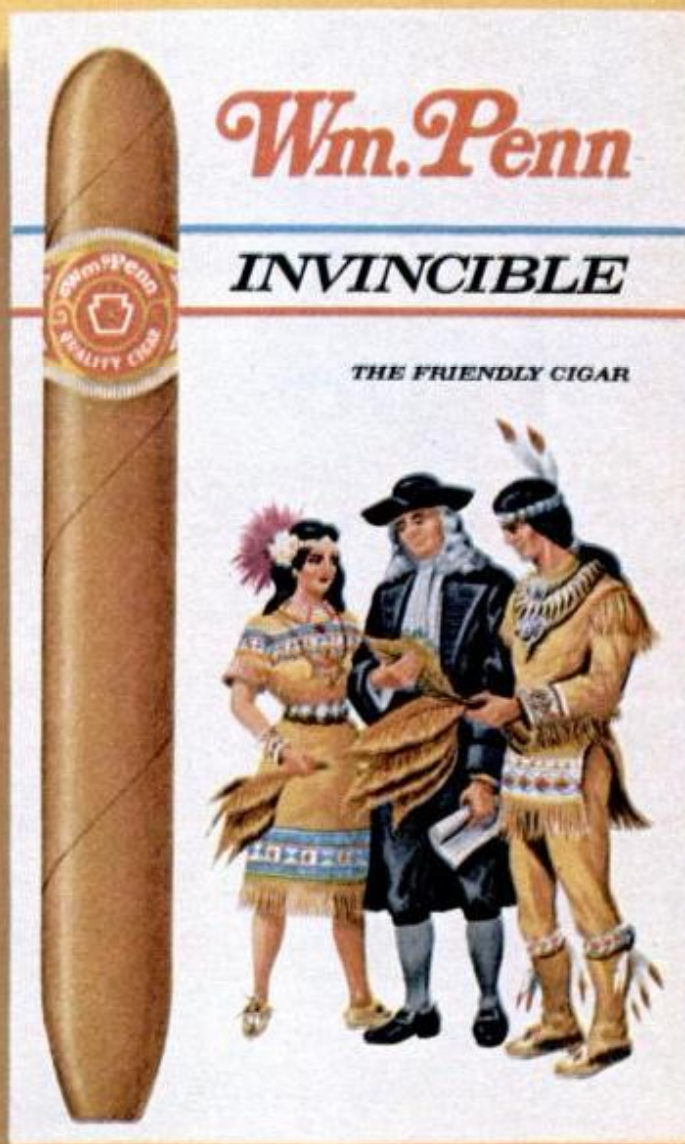
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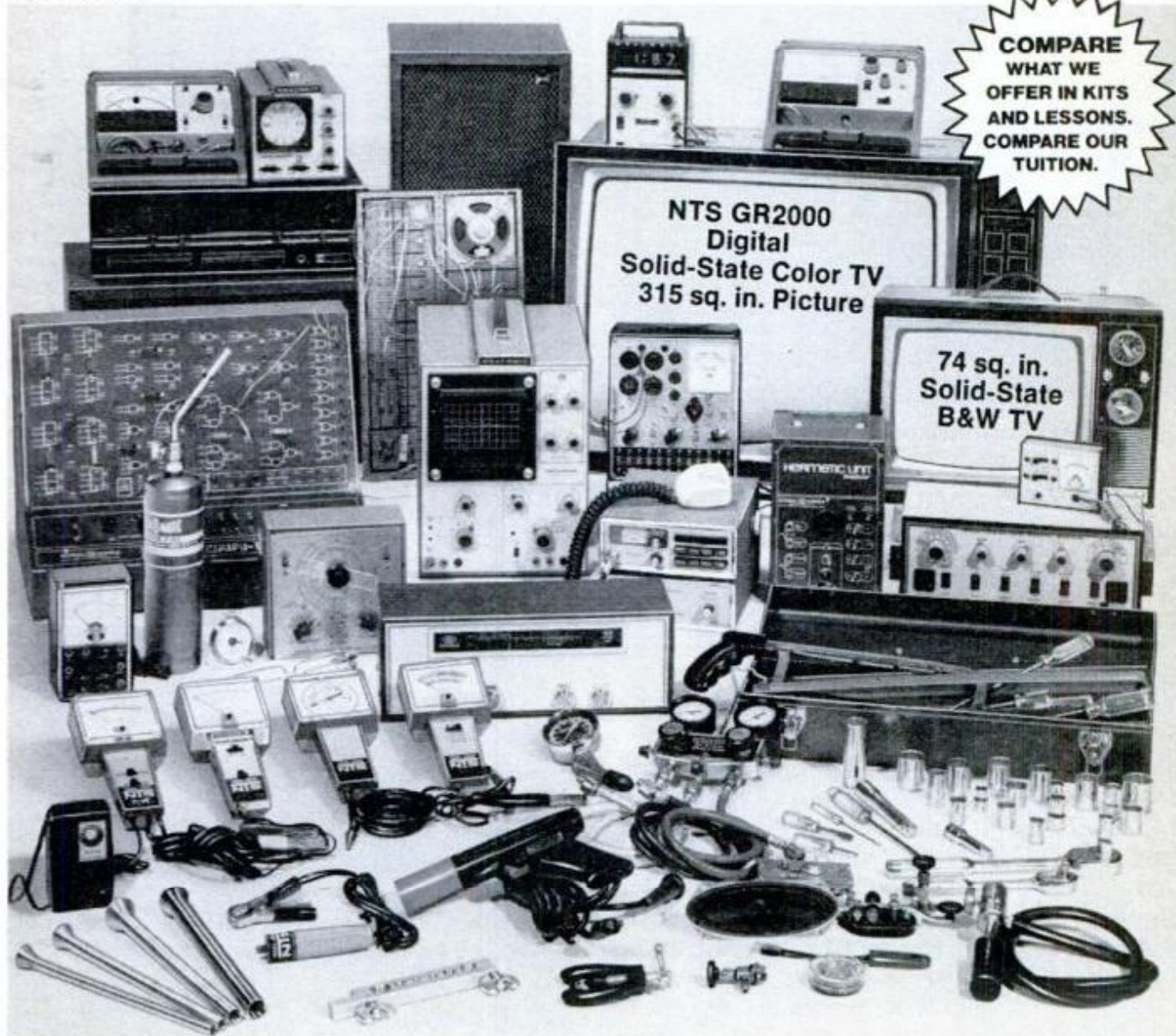
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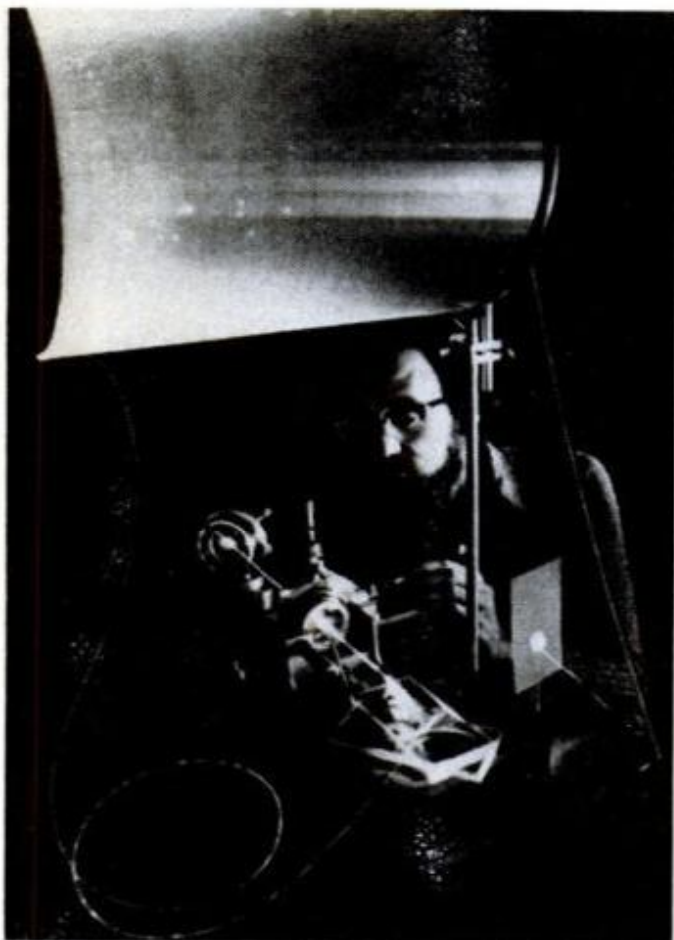
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SCIENCE WORLDWIDE



Light conversations in future

Light waves moving through glass fibers may be an important method of communication in the future, according to scientists at the Bell Laboratories, Murray Hill, N.J. Systems using light would have a greater signal-carrying capacity than existing radio and electrical transmission systems, and would be potentially cheaper.

Bell Labs scientists are working with what they claim to be the "most transparent glass fibers ever made." In one demonstration (photo above), light from a laser enters a hair-thin glass fiber in center of photo, travels half a mile on drum above, then illuminates card in front of researcher. Second photo shows how light, like water from a hose, spews from the end of the half-mile-long thread of fiber. Light waves have the capability of transmitting voice, data and video signals.



Air Force plane shatters record

Nearly three hours were lopped off the transatlantic speed record in a recent flight by an Air Force SR-71. The sleek reconnaissance plane took only 1 hour, 55 minutes and 42 seconds to cover the 3490-mile run between New York and London. Average ground speed was 1817 mph. The old record,



established by a British fighter plane in 1969, was 4 hours and 46 minutes. Carrying a two-man crew, the SR-71 zipped out of the New York "gate" at a speed of better than 2000 mph and at an altitude above 80,000 feet. It was refueled by jet tankers while en route.



Comeback for the aurochs?

The last recorded sighting of the aurochs—the extinct wild ox of Europe—was in 1627 in a Polish forest. As shown in old woodcuts, this magnificent beast sported curved horns, a black coat and stood about six feet at the shoulder.

An attempt is now being made at the Hellabrunn Zoo in Munich, West Germany, to breed modern cattle in hopes of producing a strain close to the aurochs. The bull shown above is the result of a decade of crossbreeding of many types of European cattle. Though he looks and stands like the aurochs, the modern animal has a docile temperament—not the fiery disposition of the legendary wild beast.

Jupiter has salty satellite

The surface of Io, one of planet Jupiter's 12 satellites, may be generously sprinkled with a layer of sodium chloride—common table salt—according to a report by the National Science Foundation. The satellite reflects light in the various colors characteristic of that reflected and emitted by sodium compounds. The most likely compound, say scientists, would be sodium chloride. ★ ★ ★

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The workshop set you've been wanting. Get 6 precision-engineered Irwin Speedbor® "88" wood bits with 1/4" electric drill shank, sizes 3/8, 1/2, 5/8, 3/4, 7/8, 1". Plus an all metal storage rack. Specially priced for home, farm, factory, school workshop. Bits forged from finest tool steel. Heat tempered full length. Machine-sharpened for fast, clean, accurate cutting power. Irwin 13 bit set with rack also available, 1/4 to 1". Both sets gift boxed. Buy from your Irwin hand tools dealer.

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All-plastic storm windows you assemble in minutes

by Stephen Walton

When you need storm windows quickly and at low cost, "Weather or Not" is an all-plastic storm sash you can put together without miter joints. Its manufacturer suggests use on older dwellings and second homes, and for doubling up existing storms on northern exposures.

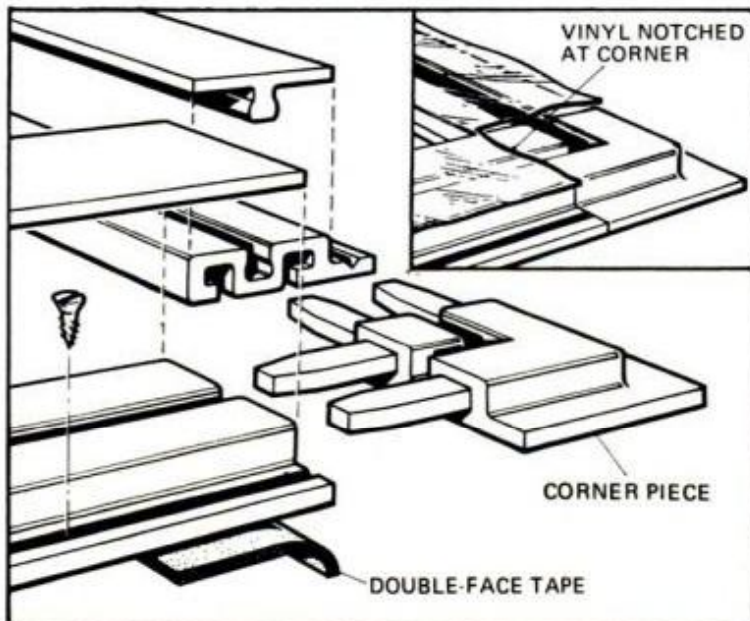
Clear sheet vinyl is clamped into extruded vinyl frames with T-shaped extrusions that snap like "pop" beads into channels. For summer use on sunny sides of airconditioned rooms, tinted vinyl sheet can be used instead. The completed sash is installed on a window frame with double-faced tape, or with nails or screws—a groove on the channel-strip flange helps locate them. The maker says storms have been manufactured for maximum clarity, long life and mildew resistance.

Retail price is about \$8 for a 30x36-in. window. Tenneco Chemicals, Foam & Plastics Div., West 100 Century Rd., Paramus, N.J. 07652. ★ ★ ★



To make odd-size frames, you merely hacksaw strips to length. No mitering is required because of the way that the corner pieces fit into the channel strips. Triple-gauge vinyl, notched at corners, is held by T-shaped strips that snap in place.

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Best wishes,
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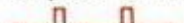
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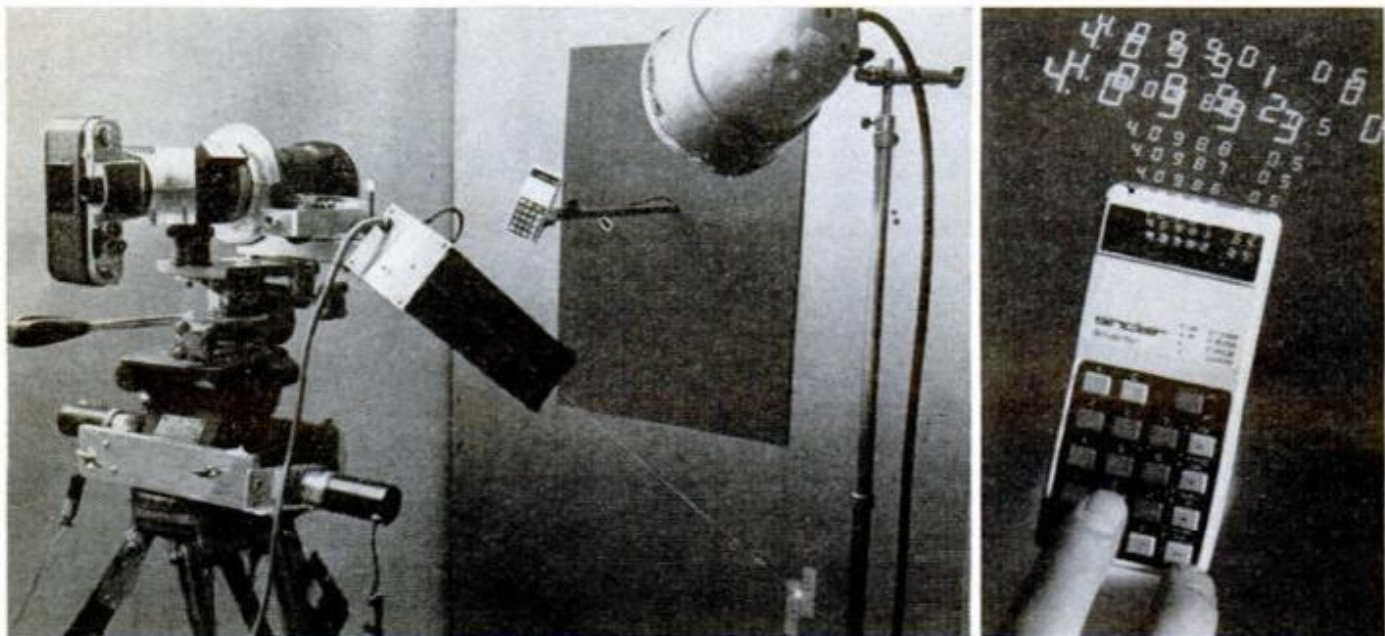
Time: car _____ model _____ year _____

12 volt negative ground required

Name _____

PHOTO HINTS

FROM READERS

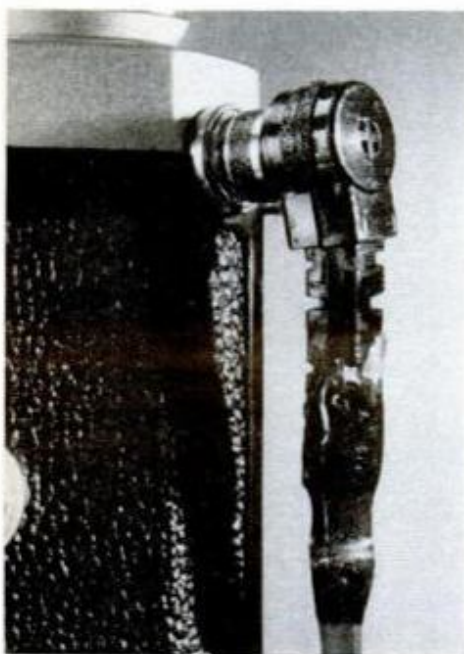


How our cover shot was made. (It only took three days)

How do you get numbers to spill out of a calculator? For photographer Ben Rose, all it took was a zoom lens, a motorized tripod and a laser.

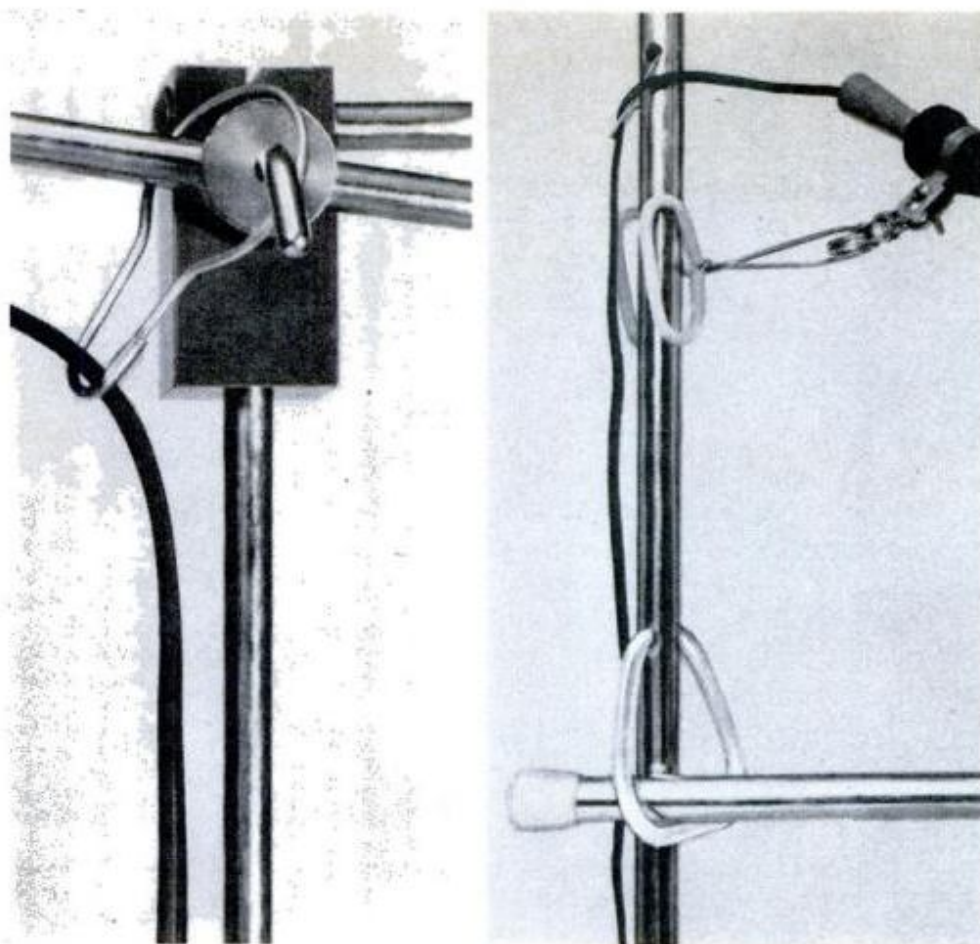
Rose first mounted the calculator (which is one-third bigger than life-size on the cover) to a rod extending from his green background board. To hold the calculator in place he used a homemade clamp pressing outward against the calculator's sides from within its battery compartment. Power for the calculator during the three days of shooting (Rose made 100 test shots) came from a lantern battery behind the background.

After first shooting the main exposure—the calculator and the finger operating it—with normal studio light, Rose took a succession of time exposures of the calculator display, with the studio's other lights off. After each shot, he adjusted his zoom lens to a slightly longer focal length to make the numbers larger (pencil marks on a tape attached to the lens barrel told him what setting to use), and adjusted the tilt of his tripod with a home-built motor drive to raise or lower the numbers' position on his film. A laser attached to the tripod head moved with the camera; the tiny, brilliant spot of light that it projected moved across a scale pencilled onto another tape strip on the background, to tell him when the camera was in the right position for each shot. The tripod was motor-driven for more precise control.



Epoxy saves flashcords

Flashcords usually break at the plug ends. To prevent this, I dip my cords in epoxy cement while they're still new, to form an extended strain relief. My cords last much longer that way.—*Steven Fay, New York*



Lighting gear from bath accessories

Spring-loaded poles take up only a fraction as much floor space as light stands—and they're cheaper, too, if you purchase them as bathroom space-saver towel poles from a department store or bath shop. They easily support small spring-clamp sockets and lightweight background support rods (near left), with no modifications needed. Shower curtain hooks (far left), another bath-shop item, work well with these or regular light stands, to keep dangling cords close to the stand pole or boom arm, where they won't tangle or trip you.—*Ed Johnsey, Dayton, Ohio*

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Try your hand at photography that moves with a Minolta SR-T. For more information, see your dealer or write Minolta Corp., 101 Williams Dr., Ramsey, N.J. 07446. In Canada: Anglophoto Ltd., P.Q.



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APPLIANCE CLINIC

BY PAUL MANN

No punch

I have a Rival Can-O-Matic electric can opener. After a period of satisfactory operation, the cutter wheel no longer penetrated the tops of cans. I installed a new wheel, but this did not help. There doesn't seem to be anything bent or out of kilter. What could be wrong?—Allen D. Gutchess Jr., Toledo, Ohio

I assume that the spring that should be behind the cutter wheel was put back into place when you installed the new wheel. If it was, then the feed wheel may be worn and due for replacement. A worn feed wheel will not push cans up far enough to allow their lids to be penetrated by the cutter wheel.

Cold storage

I go to Florida for the winter. In the past, I have turned down the heating-system thermostat to 60° F. This year, because of the high cost of fuel, I want to shut everything down and have the water drained from all units to prevent freezing. The only problem I foresee is with the water softener. The salt tank is no problem, because salt water will not freeze. But the zeolite tank is something else. I suppose it should be drained, but there is no bottom drain plug. I've been thinking I would tap a hole in the bottom of the tank and let water drain for some time before I go away. Is this practical? Would I lose zeolite during the draining period? Can you offer a better solution?—Frederick C. McMullen, Fair Lawn, N.J.

Practical? No. Would you lose zeolite? Probably. Can I offer a better solution? Yes. Shut the water off to the tank by throwing the bypass valve. Open the tank up. In most cases, this is done by unscrewing the control on top of the tank. Now siphon off the water in the top of the tank. You can use a gas-tank siphon or a length of garden hose. There will be about 6 in. of water above the mineral bed. Draw off as much as possible, but be careful not to swallow any of the zeolite if it enters the siphon as you are drawing. When the water has

been drained from the tank, just leave everything dismantled until you return from Florida.

Lone ranger

Unless you can help me, I will have to spend over \$500. I have an electric countertop range that carries the name "Suburban." It was manufactured about 12 years ago. All units except the grill need new switches and wiring, but specific replacement parts are not available here. If I could get them and a wiring diagram, I could do the job myself. If I can't, I will have to redesign the counter and install a new unit. Help, please.—Glenn F. Brewton, Norfolk, Va.

The Suburban was made by the Hedges Manufacturing Co., now the Hedges Parts Div. of Appliance Center, Inc., Riverfront Pkwy., Chattanooga, Tenn. 37402. The switches are standard parts that were made by Robertshaw Controls. You may want to write to Chattanooga for what you need.

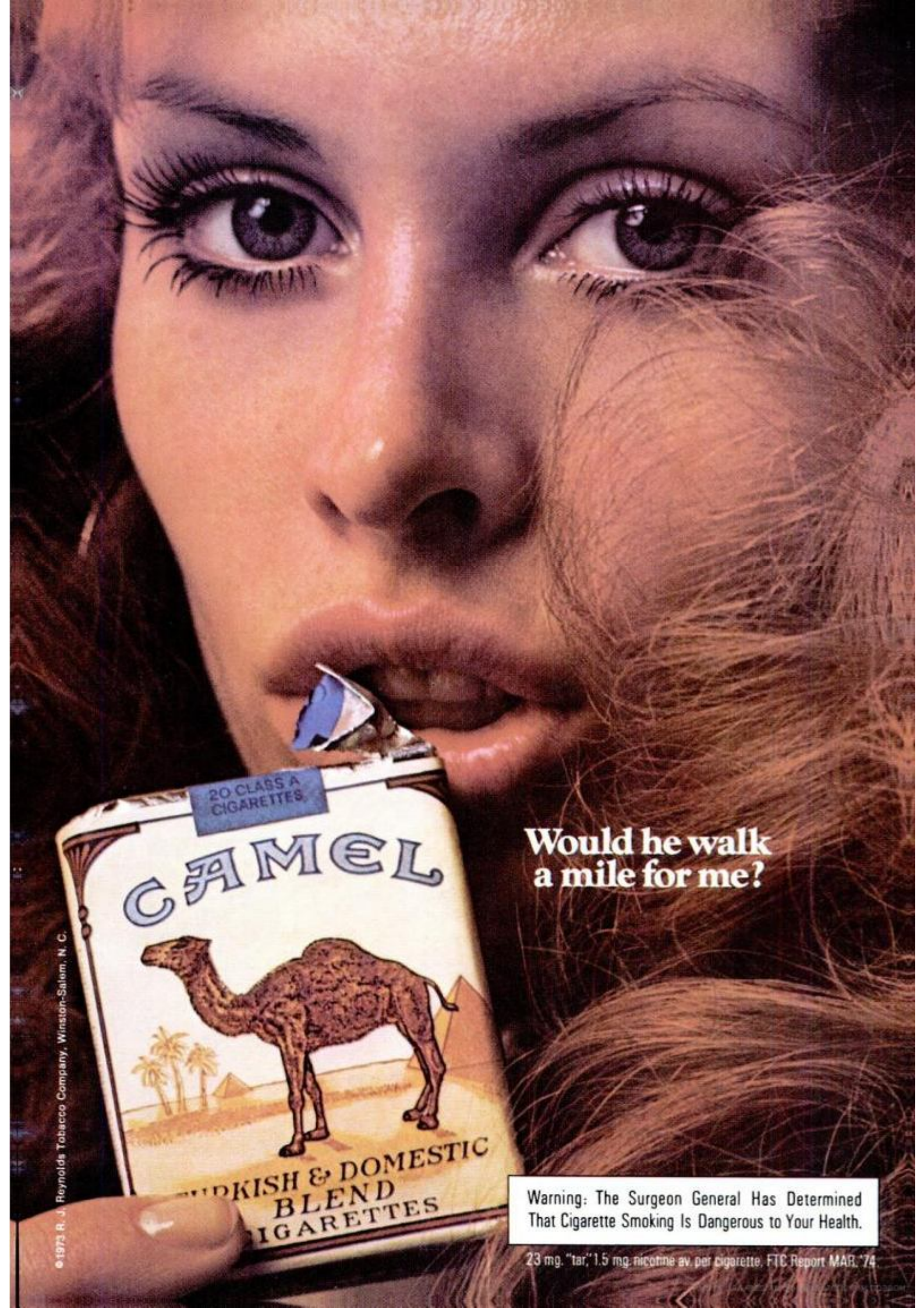
I have asked one of my local contacts—Jacoby Appliance Parts, Inc., of New Brunswick, N.J.—to get in touch with you. Jacoby informs me that the switches will cost \$6.95 each (there are four), and that the three-strand wiring needed will cost 50 cents per lineal foot. The switches come with complete installation instructions and diagrams. The cost of putting this unit back into operating condition should be far less than \$500.

Sides aren't the same

My refrigerator-freezer is an Admiral side-by-side. The freezer door works properly, but the refrigerator door has no spring-back action. When it is opened, the refrigerator door stays open unless closed manually. What is wrong?—Kenneth Bryant, Langhorne, Pa.

Perhaps nothing. Some models were made with an automatic door-closing feature for

(Please turn to page 45)



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APPLIANCE CLINIC

(Continued from page 40)

both doors, while others were made with an automatic closer for the freezer door only. Since you didn't specify model number when you wrote, I cannot tell which you have. Generally, though, units made after 1969 have automatic closing for the freezer door only. The automatic closer is merely a nylon cam that allows the door to roll back on its hinges. The cam is inside the inner door panel at the top hinge; the door and inner panel must be removed for its replacement. If your refrigerator door is supposed to have automatic closing, you can try to get a new nylon cam from a local Admiral dealer, or you can write to Admiral Corp., Metropolitan Div., 200 Murray Hill Pkwy., East Rutherford, N.J. 07073.

Freezer with the blahs

Our RCA Whirlpool self-defrosting refrigerator, about 5 years old, defrosts food. We can't keep ice cream, frozen vegetables, frozen juices or ice. We have tried increasing the cold to maximum, but it hasn't

helped. Can you suggest a cure?—Elizabeth Card, Binghamton, N.Y.

I assume you keep those items in the freezer compartment and not in the refrigerator, where normal temperature is 36-42° F.—slightly above the freezing point.

If frozen goods in the freezer compartment are thawing, obviously there is a malfunction. The unit is supposed to defrost every 12 hours, as determined by a defroster clock (timer). Defrosting is accomplished by a heater embedded in the evaporator coil and controlled by a bimetal thermostat switch. When the clock signals time to defrost, the switch turns on the heater. When, in 7 to 9 minutes, the temperature reaches about 70° F., the switch is supposed to shut off the heater. In your case, the bimetal switch or the defrost clock likely is at fault. If either is sticking, the temperature can soar past 100° F. Have both checked. ★ ★ ★

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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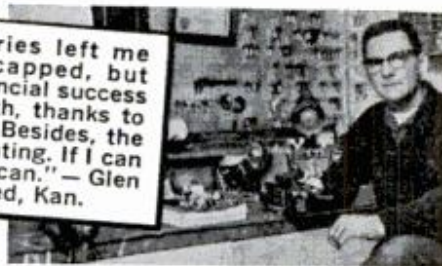


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THE BICYCLE SHOP

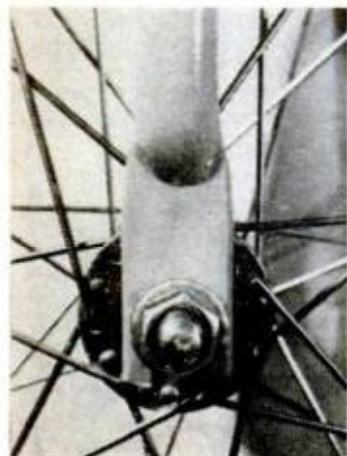
BY EUGENE A. SLOANE

On May 1, 1975, unless fairly drastic changes are made in the new Federal rules on bicycle design, most bicycles now on sale in bike shops and stores will be illegal. Millions of dollars in parts inventory will be likewise obsolete, and we can all look forward—if that is the right phrase—to an increasing shortage of bicycles and sharply rising prices.

All this because a government agency, the Consumer Product Safety Commission, looked at bicycle accident statistics provided by the National Safety Council, and concluded that many of the 2000 projected 1974 deaths and over 1½ million bicycle-related accidents of varying severity could be avoided by legislating safety into bicycle design. This is like saying other skill-related sports, such as skiing, tennis, football and even car driving for the most part, could be made drastically safer by legislating safety into the hardware involved instead of the people using their skill.

The rising incidence of bicycle-related deaths and accidents can't be blamed on the bicycle, but on the bicyclist. Instead of spending God knows how much money on research and coming up with some rather wild restrictions on designs, Uncle Sam would, in my opinion, save a lot of lives and injuries if he spent all that money and energy funding bicycle driver education in schools, colleges and at the adult level. But

Poor frames may have wheel dropouts cut into flat part of fork (left) or poor welding that comes apart.



enough of this, let's look at the new regulations.

What's good about the regulations

The new Consumer Product Safety Commission's rules are in the Tuesday, July 16, 1974 issue of the Federal Register, Part II, Vol. 39, No. 137, if you want to read all 13 pages.

There are some good rules in the new regulations. They're not all bad. For example, Section 1512.16 calls for reflectors on front, side and rear of the bicycle and on pedals. Since many bike accidents occur at night, anything that makes the bicycle and its rider more visible to the motorist will reduce the possibility of accident. There's some argument about where to put the reflectors and how they shall be attached, but they *will* be on the new bikes.

You can have either reflectors—one amber, one red—stuck on the spokes or reflective sidewall tires. You can't get tubular tires with reflective sidewalls; there's no rubber on the side to accept the reflective medium. So we will see those good bikes with tubular-tire wheels all gimmicked up with reflectors stuck in the spokes.

Frame test

A frame test must be passed by all bicycles. It involves at least a 150-pound rider

(Please turn to page 48)

Good dropouts (left) are steel, inserted and brazed into fork. Hand-brazed and lugged frame is strong.





Some people are still doubtful...

that vapor injectors really work,

but I personally guarantee the Mk-II with a money back offer.

Hello. My name is Frank Kirmss. I am president of APO of America and I have taken the unusual step of purchasing this space to bring you a personal message. The reason is simple: Many alleged gas-saving devices for cars have proven to be wishful thinking items at best and out-and-out frauds at worst. This creates a problem for the man who builds a legitimate, precision-manufactured, fully-tested economy aid.

Many people would prefer to downgrade the whole thing. "If it was any good it would come on new cars," is their argument. It is a fact that Detroit has tested devices somewhat similar to the Mk-II, but nobody—including the large car companies—has spent the money and collected data, both in the lab and in owner service, like APO of America.

And we know the Mk-II works.

It can increase mileage up to 20% or more and the critical tests devised by governmental agencies show that it can reduce exhaust emissions significantly.

Let's make one thing clear: I am not a struggling inventor battling the giant car companies trying to get something off the ground. We have sold nearly 2 million APO vapor injectors worldwide. Last year our company did \$38,000,000 in business in Japan alone. But, the United States is a new market and one which has been stung, so we are making no claims without full supporting evidence.

Independent witnesses are best, and we have many.

First, we have hundreds of letters from satisfied owners who detail their before-and-after gas mileage records. Then, we have the certified results of lab tests conducted by research organizations whose integrity is unquestioned. Finally, we have the tests conducted by car magazines such as MOTOR TREND, ROAD TEST, WHEELS AFIELD and OFF ROAD. All say that the Mk-II provides greater economy. (Reprints of this material available on request.)

Here's my offer: Send me just \$39.95 (plus tax if you live in Texas) and I'll send you a Mk-II with a 90-day supply of Econo-Mix additive. Try it. If you aren't happy, return it within 30 days and I'll refund every penny. Do it now. Don't wait for Detroit. They don't give money-back guarantees.



Frank Kirmss

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The Mark-II

VAPOR INJECTOR



APO OF AMERICA DEPT. PM

3150 IRONRIDGE DALLAS, TEX. 75247

THE BICYCLE SHOP

(Continued from page 46)

riding the bike four mph five times over 100 feet of one-inch-high by two-inch wide wood cleats. This will at least separate the poor frames (I hope) from the good ones. In the photos on page 46, the flattened part of the fork blade is weak. The next picture shows a frame that came apart due to poor welding (this is a brand-new bike). The next two photos are of a steel dropout inserted and brazed into the fork (much stronger) and a beautifully hand-brazed and lugged frame (very strong). The poor frame is made of low-carbon seamed steel; the good one is high-carbon-alloy, seamless drawn tubing of high tensile strength.

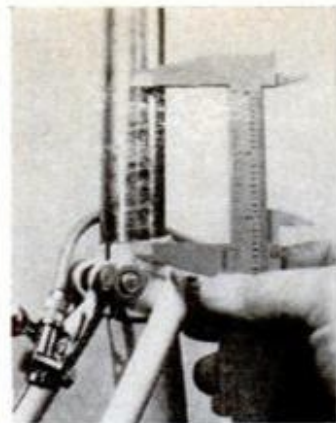
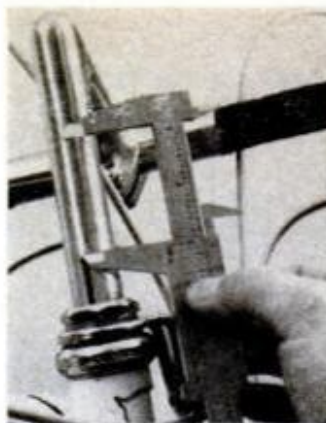
A klutz should only assemble

The Commission has its heart in the right place, though, when it says in Section 1512.4 (a): "Bicycles shall be manufactured such that mechanical skills required of the consumer for assembly shall not exceed those possessed by an adult of normal intelligence and ability." Unfortunately, whoever wrote that one has never assembled a bike from a carton or tried to make it ready for safe riding.

The Commission should only look at bikes for sale on the floor of department stores to see the "normal skill and ability," let alone "intelligence" of the average store stock boy who assembles these bikes with brakes that don't work—or work poorly—wheels so untrue brakes can't be adjusted safely, hubs binding, seats and handlebar stems unsafely high and cables slack. I have even checked bikes coming out of some busy bike shops in the summer and have been appalled at how badly and even dangerously they have been assembled. All the Commission can legislate won't stop poor bike assembly—and if the bike mechanic is so poor, how well can a new bike buyer of "normal intelligence and ability" put the thing together so it will be safe to ride?

No rear brakes allowed?

One of the more puzzling requirements of the new rules and regulations has to do with protrusions. Section 1512.4 (g) states: "There shall be no protrusions located within the area bounded by a line 3½ inches behind the stem and a vertical line through the center of the seat area . . ." This eliminates the rear brake, seat-clamp bolts and the seatpost clamp bolt. I never use my rear



New rules call for seatposts and handlebar stems to be at least twice the distance of their diameters into their respective tubes. They are also to be marked so the rider knows when they are safely inserted.

brake much, but I *would* like to have something to sit on.

No brakes for kiddies?

Section 1512.5 (e) says that sidewalk bicycles shall not have a freewheel feature. Since you can't have a coaster brake without a freewheel feature, and even the Commission recognizes that small children can't grasp caliper hand-brake levers, this regulation makes bikes more dangerous for the under-seven set.

No-cable bicycles

Section 1512.4 (j) says that cables "shall not rub . . . over fixed parts . . ." For generations bike cables, even on the most costly bicycles, have passed through tunnels, with less abrasion than where they pass through spaghetti tubing, certainly no more. I don't know what the Commission expects, perhaps ball-bearing cable races. Certainly if allowed to go into final law, this will make bicycles either do without cables and thus without derailleurs and caliper brakes, or add a lot to their cost.

A pedal for all feet

Section 1512.7 (b) wants pedals with toe clips "permanently attached." I suppose the Commission properly recognizes that toe clips keep feet from slipping off pedals and so help prevent accidents, but *permanently* attached clips? Because toe clips come in small, medium and large sizes, there would have now to be small, medium and large pedals, instead of one pedal and three sizes of toe clips. Up goes the cost of next year's bikes, again.

Mammoth seatpost bolts

Section 1512.18 (h) and (l) and (ii) call

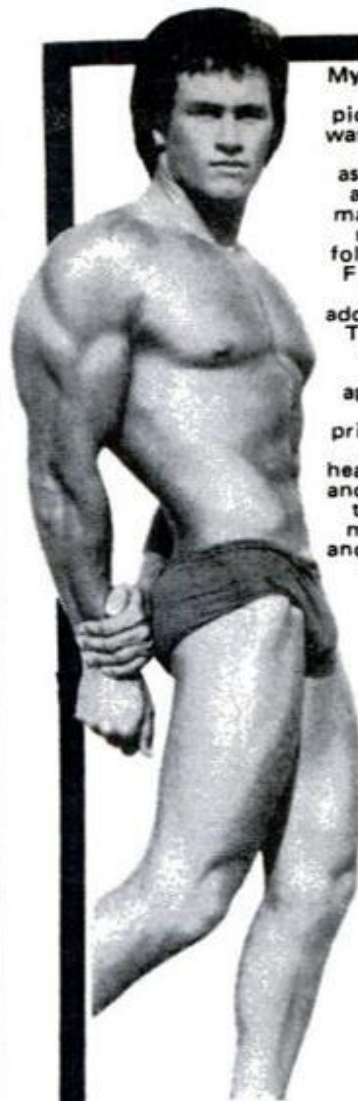


"Safety brake levers" should be outlawed, says Gene. Unless brakes, wheels and cables are precisely adjusted, lever hits handlebar before brakes take hold.

for seatpost and stem bolts to be able to be tightened to a torque of 50 foot-pounds. This is getting to the torque you use to tighten down auto-engine headbolts. I dug out my old torque wrench and tried to torque three seatpost bolts to 50 foot-pounds. I stripped the first two and the third one busted with a loud "twang." Stem bolts, being longer and thinner, just twisted and broke off down in the head tube. I have never heard of anyone else having problems with seat or stem bolt working loose after proper tightening. Seatposts and stems breaking, yes, if not down into their respective tubes at least 2½ inches as shown in the photos on page 48. Here the Commission is right in calling for these members to be twice the distance of their diameter into their respective tubes, and to be so marked or etched so the rider knows when they are safely inserted.

I'm about out of space, so I'll conclude by saying that it's a pity these new bike safety regulations were not designed by bike riders, because if they were, none of these (and there are more than I have described) regulations would exist to raise the cost of good bicycles substantially, or even forbid their existence, and make them less safe.

The Commission should be concerned with high-rise handlebars, where kids ride "Easy Rider" style in an awkward, hard-to-steer position with elbows at chin height. The Commission should have outlawed so-called "safety brake levers" instead of passing them over by classifying them as brake levers. As the photo shows, these levers may stop you normally, but unless brakes are precisely adjusted to within 1/8 inch from rim flats, wheels are true and cables have not stretched, the "safety" lever hits the handlebar while the hand lever can still be depressed for an effective panic stop. ★★



My name is Robert Nailon. A glance at my 'before' picture below shows that I was once a real skinny guy.

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ALL OUTDOORS

TEN THAT ARE TOPS

Best gear of the year? There's a great deal of good equipment, much of it especially well made because it is designed for rugged outdoor use. Some items and services have impressed me particularly. Several are new; others have developed a reputation for long-range reliability. Here are 10 categories or products I have personally tested, examined or studied that deserve recognition as outstanding for outdoor use:

Keeping out the cold

No types of clothing or wrapping will keep you warm—your own body does that—but a number will insulate you from cold winds and help you keep the heat you've got. Down is still considered the lightest, most efficient insulator, but anyone who's had a down parka or sleeping bag thoroughly soaked knows the problems of drying them out. Although two new synthetics—DuPont's Fiberfill II and Celanese's Fortrel PolarGuard—can get wet like anything else and are fractionally less efficient than down, they dry out with remarkable speed, can take washing-machine treatment, are easier to work with during manufacturing and are less expensive. Neither are brand-new, but both, this year, have appeared in more quality outdoor items. Down is still best when the weather's dry and the price not too high, but these excellent synthetics deserve consideration as well.

Better water

Regrettably these days, almost every source of "natural" pure water outdoors must be suspect unless you know better for sure. A hiker, particularly, who needs a lot of water to drink plus large amounts to reconstitute and cook his dehydrated food may not have enough along. But rather than add bad-tasting purification tablets, he now has several small filtration units available. They work slowly with a hand pump or gravity feed, but cost only \$10 to \$50, claim to prevent all traveler's upsets connected with contaminated water, and are small enough for backpacks. With names like Pocket Water Purifier, Mini Water Purifier and PCP

Purifier, they are handled by mail-order suppliers such as Dick Cepek, South Gate, Calif., and Herter's in Mitchell, S.D.

RV aid

A really rapid way to lose friends in a campground is to let sink water run out of the camper and onto the ground. Open catch buckets are inconvenient, and even illegal in Oregon. Best answer we've found is a "Covered Bucket" from Satellite Industries, 3132 Fernbrook Lane, Minneapolis, Minn. 55441, and its dealers. This \$14 collapsible five-gallon plastic holding tank comes with adapter attachments, five-foot drain hose and a shutoff valve. It will not overflow, it stores compactly, and it is certainly the cheapest made-to-order portable holding tank around.

High performance afloat

Again this year, the offshore winners are from Don Aronow's Cigarette Racing Team, Inc., boatbuilders in North Miami Beach, Fla. Dr. Bob Magoon's record-setting 40-footer that ran from Miami to New York in less than a day was one; *Dry Martini*, the boat that earned Dr. Carlo Bonomi another world's championship, was also a Cigarette. Now a production version of Bonomi's slim 90-mph hull will be available in a 60-mph consumer model named the Awesome 35. With only an eight-foot beam, it will be just about the hottest trailerable offshore boat around.

Pick of the year in superpower outboard motors would have to go to Mercury's Twister III and the Evinrude and Johnson V6 mills. Available only for racing, they are forerunners of future production engines estimated to reach 200 hp.

Mini boats

Very compact inflatables and foldables are now available for boatmen and fishermen. For a craft that can stow in a closet, there are blow-up models from Bonair Boats, Gladding, Sears, West Products and others sized down to backpack dimensions. Two from California we tested and found particularly useful are the Pack/Raft inflatable

from American Safety Equipment, Encino, and the Porta-Bote foldable by K Enterprises, Menlo Park. The dual-chambered Pack/Raft III, popular with hunters and fishermen, now has a new camouflaged duck cover accessory. The nine-foot Porta-Bote can also be covered as a duck blind, but mounts an outboard motor as well or rigs rudder, leeboards, spars and canvas to become a sailboat. Folding up in about a minute, the 50-pounder becomes a package that is only about four inches thick and 10 feet long.

Where to travel

For the outdoor action category, we would have to pick Manitoba for lake trout, New Brunswick for Atlantic salmon and, amazingly, Lake Michigan as well as Puget Sound for Coho. The Florida Keys, Padre Island, Tex. and San Diego rate PM's high



Pack/Raft III, five-pound inflatable, supports 450 pounds.

marks for all-around fishing recently, Toledo Bend for hawg-mouth bass, the Chesapeake for duck, Staniel Cay in the Exuma chain of the Bahama Out Islands for the tops in skin diving, and Central and South America for exotic angling.

Yellowstone is a winter mecca of snowmobile-trail riding. For RV touring, we'd pick Utah, Arizona, Colorado and Wyoming for starters. Pack hiking is hard to beat in Montana, Idaho or Maine, with a bow to British Columbia once the snow comes for cross-country skiing.

If you're thinking about adventure trips, ask your travel agent about white-water river runs here and in the Alps, far-out tours of the Andes as planned by Braniff Airways, or South Seas and Asia with Lindblad tours.



Porta-Bote, compact new foldable, rows, powers, sails.

Selective shades

This year Corning Glass Works took its photochromic glass, with its remarkable ability to change light transmittance according to light intensity, and came up with Photobrown and Photosun glass for additional outdoor comfort in prescription and sunglasses. Brown glasses, newly popular, will be available along with Photogray by spring; those we tested have been particularly satisfactory. Actually, you don't notice they darken as the light gets brighter or lighten when you go indoors. But after a day of shooting, sailing or fishing, the payoff is in rested eyes. Where glare is excessive, we add clip-on Polaroids; they also help for fishing and thin-water navigating when "reading" depth by color is necessary.



Corning prescription lenses darken as light brightens.

Fish hustler

Like other fishermen, I'm willing to believe a bottle top, chunk of chewing gum, shirrtail or orange peel will lure fish and is worth a try when nothing else seems to work. The most amusing lure I've seen recently is a little job called the Hooker, from Law-Lure Products, Box 1524, Escondido,

(Please turn to page 52)

ALL OUTDOORS

(Continued from page 51)

Calif. The fish-shaped plastic body is transparent, and inside you can put pieces of colored paper, smaller minnows, bugs, worms, sinkers, rattles, salmon eggs, or a picture of the fish's mother-in-law. Even the hooks can be unscrewed and stored inside. Opening the Hooker to change contents takes but a moment if the fish aren't interested. Fishing action isn't guaranteed, but it should keep the angler busy.

Trophy tents

If you tried to name a dozen companies giving creative thought to tent design the last several years, they might include Gerry, Camp Trails, Alpine, JanSport, Sierra, Holubar, Eureka, Trailblazer, Stag, Browning, Sears, Coleman, Camel, Thermos and Stephenson—several more than 12. Tents are no longer the heavy, awkward cumbersome shelters that GIs loathed. Many are flame-retardant. Backpacking has helped to lighten them, European influence has brightened them, new synthetic fabrics made them stronger and better. Many brands can now be recommended, and we have been impressed with the double-wall concept of Cannondale's new Hideaway T-91. Shaped to resist strong winds and planned with a large vestibule for storage outside the sleeping area, the tent has an insulating dead-air layer to retard condensation and heat loss. For a two-man tent of only 7½ pounds, this one has a lot going for it.

Special mentions

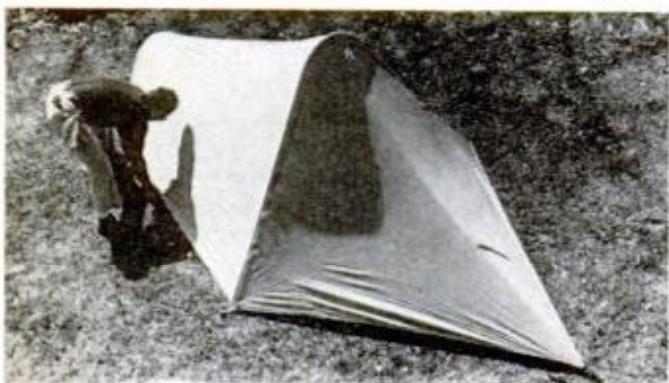
A number of outdoor items not brand new or remarkably different have attracted our attention nevertheless, and deserve commendation. The Signal Products Operation of Olin Corp. has set up an admirable trade-in program on old flare guns of various

brands so they can be credited toward the newly introduced Winchester Marine Signal Launcher. When it comes to emergency equipment at sea, reliable and heavy-duty gear can mean the saving of a life and boat.

Scorned by many campers as one thing they are trying to escape, a TV set doesn't normally belong on an outing; that is, until the rains come and you have small restless children along. Then, we have found, our small Panasonic set with built-in rechargeable batteries can rescue a dismal day. Loud playing or lighting up a campsite with it late at night is, of course, offensive. But it can equal a ray of sunshine on a soggy day when the youngsters are unwilling to nap and have played their last word game.

A word should be put in for the old-fashioned hammock. Small net models available will fit in half a pocket. For the lucky RV traveler with more room, there are the big comforting cotton-rope models from the Southern isles, stocked by such outfits as L.L. Bean of Freeport, Me. Jungle-type hammocks with their own tents and netting are offered by some suppliers. In any form, they make a good reminder that relaxation is a valued part of the sport.

Each year fortunately brings a number of pleasant outdoor books and some are excellent. *The Wilderness Handbook* by Paul Petzoldt would certainly rate as a major addition any year. As a practical mountaineer, outdoorsman and teacher, Petzoldt is a ranking authority; his descriptions of what can really go wrong on an expedition and how to avoid problems make fascinating reading about a hidden part of the sport. Chapters on how to act rationally under stress and avoid panic add adventure to a volume that could become an outdoorsman's textbook. ★ ★ ★



Cannondale Hideaway tent has air-space insulation.



Hooker transparent lure is loaded with appetizers.

Where do the Pros get their training?

Almost half of successful TV servicemen have home study training and among them, it's NRI 2 to 1! A national survey*, performed by an Independent research organization, also showed that the pros named NRI most often as a recommended school and as the first choice by far among those who had taken home study courses from *any* school.

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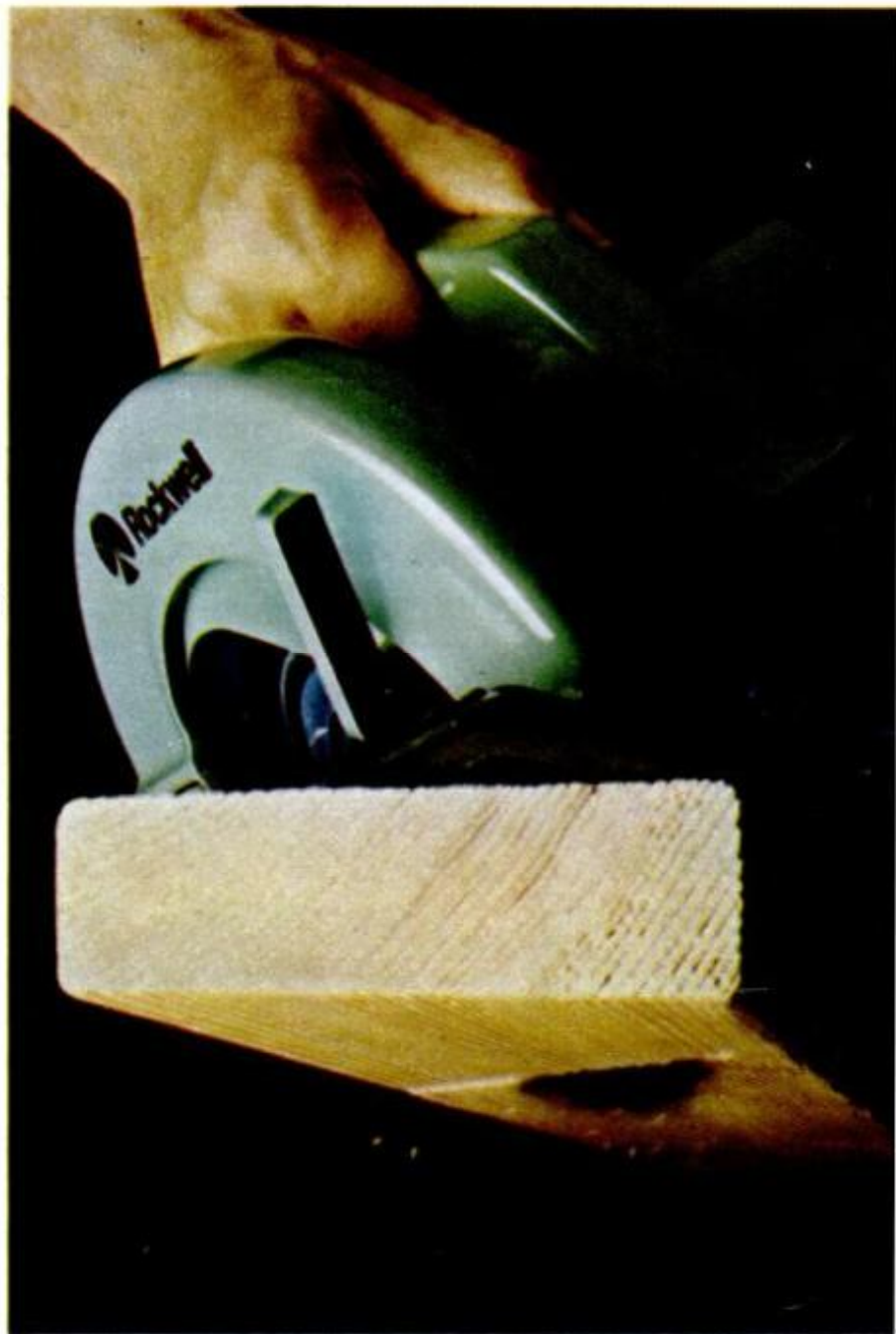
And it's just one of a line of Rockwell circular saws priced from \$19.99 to \$39.99.

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Boats that break the records

That old urge for more speed is making new boats go faster than ever.

by Bill McKeown
BOATING EDITOR



Official outboard record is 136.381 mph set by Jim Merten (above) in 1973. Dr. Bob Magoon, in his Mercruiser-powered Cigarette (right), averaged 55.4 mph for 23 hours, 1257 miles, Miami to New York.

A speedboat skipping along the uncertain surface of the water can turn into an airplane or submarine at any instant. It takes special skills—and courage—to set records afloat, yet recently several have been broken.

Fastest recorded run on water is Donald Campbell's 382 mph in his turbojet *Bluebird*. Because the craft disintegrated and

killed him before the timing was completed, the speed is not official. Lee Taylor drove his *Hustler* the same year, 1967, to set the jet record of 285.213 mph, and Larry Hill traveled 202.42 mph in 1971 in his hydro, *Mr. Ed*.

In 1966, Gerry Walin of Seattle rode a rocket-shaped outboard, designed by previous record-holder Hugo Entrop and pow-

Almost a record

Unofficially, Gerry Walin, of Edmonds, Wash., was clocking over 150 mph Sept. 12, the fastest an outboard had ever traveled, when his rocket-shaped hydro went airborne off Lake Havasu, Ariz., in a flip that left Walin critically injured. His 1966 record of 131 mph had been broken last year by a Mercury topping out at 136.4 mph.



Outboard muscle from a 99.6-cu.-in. production Evinrude powerhead and special high-performance lower unit ran rig.

Bug-shaped from above, the plywood hull held Walin on his back in tiny cockpit while he steered with side levers.

Almost airborne, the craft was the same boat that Walin used to set his 1966 record with an 89.6-cu.-in. Evinrude.





Trimaran prototype of fast offshore sailers, French *Pen Duick* set Atlantic, Pacific records.



Courageous defended America's Cup against Australia as fastest 12-meter sail yacht.



Fastest offshore, 1973 and 1974 world champ Dr. Carlo Bonomi averaged record 83.2 mph in marathon with his *Cigarette*, *Dry Martini* (top).

Unlimited-class Gold Cup winner, *Pride of Pay 'n Pak*, (directly above), used Rolls-Royce power to set top speed of 124 mph for a single heat.

ered by an Evinrude outboard, to a world's record of 131 mph. Last year Jerry Merten from Oshkosh, Wis., upped it to 136.381 in a Twister-Craft cabover with Mercury power. This fall Walin tried again in the same boat and was traveling an estimated 155 when he flipped and was critically hurt.

Offshore there have been a number of new records. Miami physician, Dr. Bob Magoon, clipped 8 hours 46 minutes from the 1964 record for Miami to New York with a 55.4 mph average aboard his 40-foot MerCruiser-powered *Cigarette* hull in July. This year's world champ and Hennessy Cup titleholder, Italian Dr. Carlo Bonomi, set an 83.2 mph world record average from Spain to Majorca in his 36-foot *Cigarette* with Kiekhaefer Aeromarine engines. Paul Cook's *Kudu II*, a new Ron Jones 35-foot cat of glass and Hexcel aluminum construction holds the U.S. record of 79.2.

Gold Cup unlimited winner, *Pride of Pay 'n Pak*, set a heat record of 124 mph this summer, and Mercury T-3 outboards have been edging Evinrude and Johnson V6s for closed-course records in the 90s, straightaways up to 120.

And considerably slower, with a top speed of about 12 knots, the 12-meter yacht *Courageous* showed that U.S. sailors are still the speediest around. ★★★

Calculators get smaller, smarter and cheaper

Here's how to pick the right one.

by Ivan Berger
ELECTRONICS EDITOR

Plug for a.c. power supply means longer battery life

Enough digits?
Six are minimum,
eight are handier

Floating decimal makes calculation more flexible. Two-place decimal is okay for dollars and cents

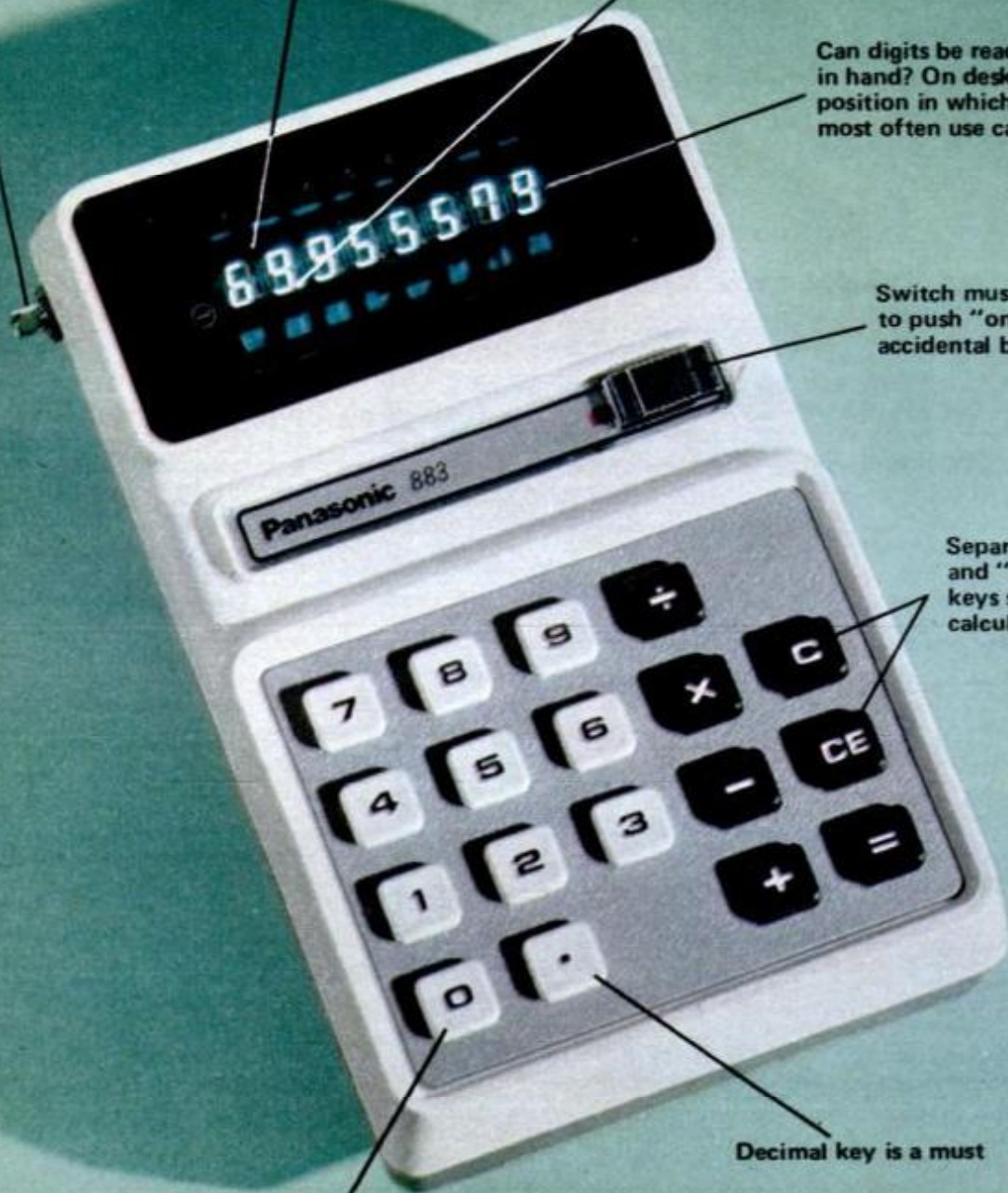
Can digits be read easily in hand? On desk? Decide position in which you'll most often use calculator

Switch must be hard to push "on," preventing accidental battery drain

Separate "clear" and "clear entry" keys simplify long calculations

Decimal key is a must

Key "feel" must be positive, so you can tell without looking whether entry is completed



Everything else may be going up in price, but calculators aren't—they're coming down, dramatically. Hand-held calculators, news when they first appeared for about \$400 each, have now come down to \$16.95, with rumors flying of \$10 calculators to come.

That's probably rock-bottom, though. The emphasis already has switched from how inexpensively a calculator can be made to how well and conveniently it can be made to work and still sell at a moderate price, and in the smallest package that will still leave room to push its keys. Though wrist-watch-size calculators (which have been designed and could be built today) are probably too small to be really practical, today's smallest can be very small indeed, yet still pack a lot of calculating power.

The Sinclair Scientific on our cover is a prime example. For just \$69.95, it does trigonometric and logarithmic calculations as well as the usual four calculator functions (addition, subtraction, multiplication and division) all in a package just $4\frac{1}{2}$ by 2 by $\frac{1}{16}$ inches (shown one-third larger on our cover). That's just about everything you could get in a \$30 slide rule, with a lot more accuracy (to five significant figures) and a lot handier size. If you don't need a slide rule, you can get a four-function, eight-digit Sinclair the same size, for just \$40—sembled or in kit form (see photo on page 72).

But just how much calculating power, and how many (and which) features do you need—and do you need a calculator in the first place?

At today's prices, if you do enough arithmetic each month to grumble about (or enough to make occasional mistakes) you can probably both use and afford a calculator—to help you check prices and unit costs when shopping, keep your checkbook straight, or check your bills for accuracy. For the rock-bottom minimum of calculation, something like the \$16.95 Novus will probably do fine. Its decimal point is present at two places, for dollar-and-cents figuring, and its six-digit display lets you add, subtract, multiply or divide up to \$9999.99—probably more than you usually keep in your checking account.

But if you use it at all regularly, you may find yourself hankering for some of the

additional basic conveniences found on calculators like the Panasonic 883 at left. Having a *decimal key*, for instance, means you don't have to enter the zeros for round numbers of dollars, and lets you multiply decimals (when figuring percentages, for instance) without having to keep track in your head of where the decimal point should wind up in the final result.

Floating decimals, now found on most hand-held calculators, show exactly as many digits after the decimal point as there are significant figures to display—no trailing, final zeros. Floating decimals are versatile, adapting themselves automatically to each calculation for maximum accuracy; but since having no fixed decimal-point position can make fixed-decimal calculations like dollars and cents harder to read, some calculators offer preset decimal settings as well. Common settings include two-place (for dollar-and-cent addition and subtraction), three-place (dollar-and-cent multi-



Cheapest calculator—at least as we go to press—is this \$16.95 Novus 650 Mathbox, which lacks some desirable features, such as a decimal-point key.

plication and division, with the extra digit helping you round off correctly) and five places (where you need high, but not overbearing, accuracy). A few calculators will *round off* figures, raising the last digit by one if the next digit would have been five or over, but most just cut off any figures that won't fit their displays.

In the latter case, most calculators *underflow*, displaying the highest, most significant digits, and dropping off the less significant digits at the right of the figure (usually with some indication that the answer shown is not complete and of how

All the basics are shown on Panasonic's \$70 Model 883 (left). But similar Panasonic 840, now available, is smaller, costs only \$50.

many digits have been dropped before the decimal point). This indication varies from machine to machine, though: Of the three typical calculators we tested, one blinks, one displays apostrophes (easily overlooked, alas), and one has an overflow key (a rather uncommon feature) that shows you any remaining digits when it's pushed.

A calculator's *display* must be big enough for you to see at a convenient working distance, and must be visible from whatever viewing angle you'll be using: straight up for hand-held use, at about a 45° angle for use on a desk. The Sinclair Cambridge (below) and Scientific, for instance, are very convenient for hand-held use (you can hold and operate them with the same hand), but their narrow viewing angles make them

awkward on a desk. On the other hand, because the Casio's display is set to one side of its keyboard rather than above, it becomes most convenient for desk use and quite inconvenient when hand-held, even though its display angle is wide enough for any use.

Credit balance, a minus sign in front of negative results, is now almost universal (some earlier calculators would show the result of four minus five as a string of nines, rather than -1). But some minus signs are easier to read than others: Of the calculators shown on these pages, for instance, the Panasonic shows it as a red dot below and to the extreme left of the display, the Kings Point shows it as a minus sign at the far left, and only the Sinclair



Sinclair Cambridge comes assembled or in this three-hour kit (not for beginners) for \$40. Size is identical to Sinclair Scientific (shown oversize on cover).

Extra features handy for most home calculations are shown in the Casio \$40 Mini Memory (right), found in many other common calculators as well.



"T" setting on this Casio's on-off switch controls memory. Most calculators with memory use a separate switch

and Casio show it clearly as a minus sign immediately before the figure.

The displays consume most of the power in the average calculator, far more than do the transistors that perform the calculations. Some calculators are therefore coming out with less power-hungry, liquid-crystal displays, whose digits darken or turn silvery instead of lighting up. These are easier to read in bright light, too, not "washing out" as self-illuminated displays do—but in dim light, they're much harder to see, and some users have trouble seeing them from all but a few angles. So if you're interested in liquid crystal display for longer battery life try it under typical indoor illumination before buying it.

Batteries are very important, of course,

in your selection of any portable device. If you'll be using your calculator in one place all the time, or for several hours each place you use it, you might prefer an a.c.-operated, desktop model that must be plugged in to operate, but offers the advantage of a larger display and more comfortably-spaced keys. If you frequently use your calculator in one place, but do need to use it portably from time to time, a hand-held model with rechargeable battery is probably your best bet. If you travel a lot, running the risk of leaving your recharger home, you're safest with a model whose batteries can be replaced when dead, especially if they're easy-to-find types such as 9-volt "transistor" batteries, or AA "penlight" cells (smaller AAA batteries, or

Memory ("M" on most machines, "T" on this one) stores intermediate totals, constants, for later use

Percentage key eliminates decimal confusion when figuring percentages

Overflow key allows 16-digit result on 8-digit calculator, shows 8 digits at a time; it's handy, but uncommon



hearing-aid-type mercury cells are harder to find). Even the disposable-battery types, though, often have sockets for optional power supplies, so you can conserve battery life by running them from your a.c. house current or off your car's battery whenever possible.

The keyboard is important, too. The keys themselves should fit your fingers, feel good, and give you some sort of tactile indication that you've pressed the key in far enough to complete entry. We're partial to keyboards that "click" when pressed, but we've heard that some may click without registering if you press the side rather than the top of the key; check all the keys for that before you buy. Check, too, that no keys stick, and that the calculator won't register a number twice if you accidentally tap the key so fast its contacts bounce. Keys should

also be big enough to hit easily, and far enough apart to minimize the chance you'll hit the wrong one.

A look at the keyboard will also tell you whether it uses *algebraic* or *arithmetic entry*. Algebraic keyboards, with separate keys for +, -, and =, let you key in additions and subtractions exactly as you'd write them down. Arithmetic keyboards, recognizable by their += and -= keys, require a slightly different key sequence: you push += *after* all positive numbers, -= after all negative numbers or numbers to be subtracted (multiplication and division are the same for both key systems). Though the algebraic system is more natural, most people, we find, can pick up the arithmetic system in no time flat. The only problem occurs when you're switching between calculators; so if you're buying more

Scientific calculators are specialized tools, but their prices are coming down into the consumer brackets.

This Kings Point SC-40 is \$150; Sinclair Scientific on cover is less versatile, but is only \$69.95.

Radian/degree conversion switch. If you don't know what radians are, you don't need it

Scientific notation shows figures as "mantissa" multiplied by powers of 10 in exponent

Trigonometric function keys

Pi keys saves entering 3 to 10 digits

Brackets and parentheses let you complete one calculation within another, partially-finished one

Log, natural log and powers of e are useful in many formulae



than one for your family or business, make sure they all use the same entry system.

A "clear" key is a must, and a separate "clear entry" key is a major convenience if you ever do long calculations. The clear key erases the whole calculation and resets the machine to zero—handy, if you find you've set the calculation up wrong, or made an error a few steps back. Clear entry keys just erase the last entry you made, so you can correct that without disturbing all the correct steps you've made before. Some calculators have a single CE/C key, whose first stroke clears the last entry, and whose second clears the entire example; this is probably almost (but not quite) as convenient.

For common *percentage* calculations, such as discount, tips and taxes, many calculators have percentage keys which automatically adjust the decimal point as needed.

Memory and *constant memory* are useful extras found on many middle-priced machines. The constant memory lets you repeatedly multiply or divide by the same number without having to re-enter it each time (and often lets you add or subtract it repeatedly as well). A K switch or button is a common sign of a constant memory, though many calculators without the switch still have a constant memory built in (for instance, the Sinclair, the Panasonic and the Casio did). On such machines, once you've multiplied a number by the desired constant, all you have to do to multiply another number by the constant is to key in that number and the equals sign.

You can also square a number on a constant-memory machine by keying in the number, X and =.

The accumulative memory, shown on the Casio on page 72, is a bit less common. It automatically adds together all totals of a series of intermediate calculations: Every time you hit the "equals" key, that result is added to whatever is in the memory. A typical application would be making invoices: Multiply a dozen apples at 12 cents apiece (\$1.44) and 16 clams at \$1.25 per dozen (\$1.666 . . .) and all you have to do is press the recall button (T on the Casio) to get the total of the invoice; \$3.1066 . . . or \$3.11.

On some machines, the Casio included, if you shut off the accumulator, you can still recall and use its contents though further totals won't be added to the memory. To



Calculator you can program to perform sequences of operations automatically is Hewlett-Packard's \$795 HP-65; 950 premade programs are also available.



Business calculators are as complex as scientific types, but are preprogrammed for typical business calculations. Hewlett-Packard's new HP-70 costs \$275.

subtract a total from the accumulator, there's usually a red = key.

A *single-key memory* has a single M key that performs two functions: Press it while there's a number on the display, and the memory will clear itself, then memorize that number; press it after a function key (+ or X, for instance), and it will recall the memorized number to the display.

Full-control memories have keys labeled M+, M-, MR and sometimes MC. Pressing the first of those keys adds the number on the display to the memory; pressing the second subtracts the displayed number from the memorized total; pressing MR brings the total from the memory to the display;

(Please turn to page 168)

Plane at 20,000— pilot at altitude zero



NASA and the Air Force are flying unmanned aircraft by remote control from ground-based cockpits. Airborne TV helps the swivel-chair pilot to guide the plane.

by Frank A. Tinker

The layout around me was deceptively simple. The display of flight and engine instruments was standard, the controls the same as those of a light plane or basic simulator. But this was neither simulator nor aircraft.

I sat in a remote-control cockpit in NASA's control center at Edwards Air Force Base, Calif., aware that the instruments and controls before me had actually guided distant aircraft in test flights.

These planes are unmanned RPVs—Remotely Piloted Vehicles—and the science of flying them is advancing so rapidly that some military men predict completely pilotless air combat in possible future wars. The technology could have civil applications too.

Actually, the “ghost flying” of airplanes goes back some decades. A remotely piloted Curtiss-Robin was flown in 1928. In recent years, the radio control of elaborate model aircraft has become common.

A military ancestor of today's RPVs is the buzz bomb that Germany flew against Britain during World War II. But this pilot-



less craft was a drone and not remotely controlled. It flew a preset course until a time switch cut off the fuel, causing it to dive.

Much more advanced drones are part of today's American arsenal. A target version of the Teledyne-Ryan Firebee has been used for years by our Air Defense Command. The Firebee is used in simulated attacks from the sea. As it sweeps toward our shores, manned fighters try to intercept it and destroy it.

Another Firebee carries a bomb and is guided by an operator located a safe distance away in a Hercules C-130 "mother

ship." The drone is guided to the target initially by radar and on-board TV, then is "locked onto" the target, continuing the rest of the way automatically.

The use of drones for reconnaissance and radar-jamming is one of the less-discussed developments of Vietnam and the surveillance contest we engage in with communist countries. Red China, for example, has exhibited a number of U.S. drones claimed to have been downed over her territory.

In Vietnam, reconnaissance drones were widely used. They followed a preprogrammed route over the region to be scanned photo-

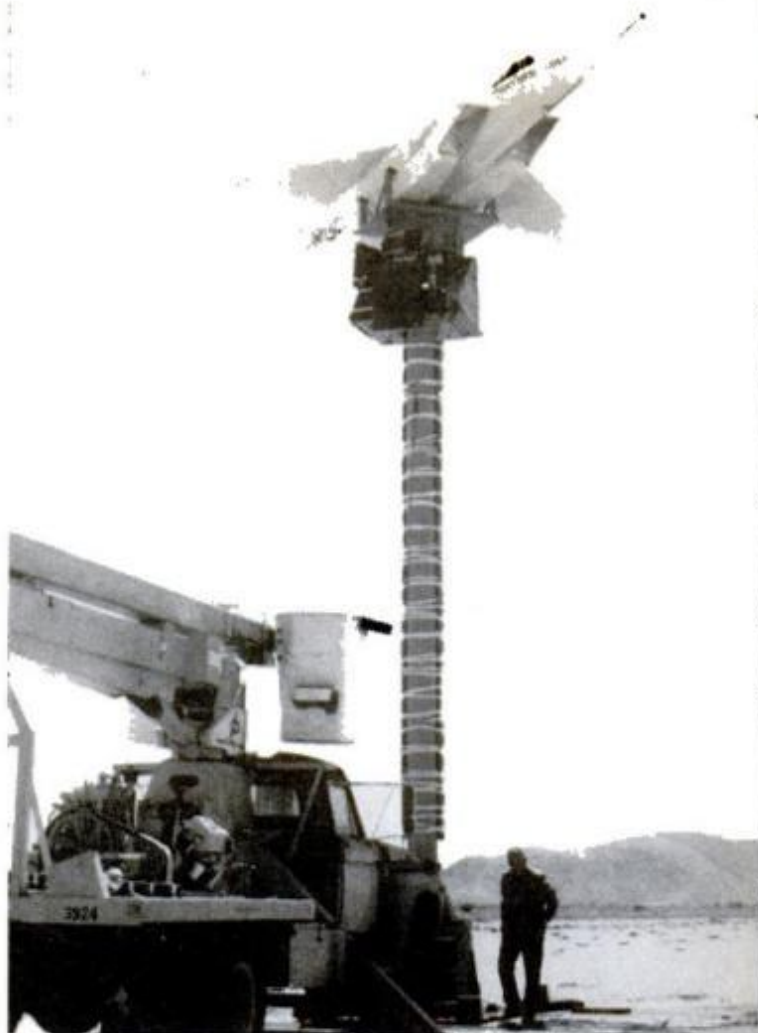
graphically or electronically. They also dropped propaganda leaflets (hence the nickname, Litterbug) and, in all probability, electronic snoopers. Returning to secure territory, they were recovered by helicopter, usually with an air grab, and made ready for another mission.

Unlike the drones, which are equipped with an automatic pilot and follow, at least partially, a preprogrammed flight, the true RPV is completely controlled by a ground-based pilot.

NASA is a leader in RPV development, starting a research program at Edwards AFB in 1969. Two years later, a twin-engine Comanche was equipped for remote control. Although a flesh-and-blood pilot has been aboard during test flights, he functions simply as a backup.

The NASA remote pilot system uses telemetry to relay control commands to the plane and flight information back to the ground-based pilot. He uses the instruments as if he were flying blind, navigating mainly by radar and referring to a TV screen mounted over the instrument panel when he needs outside visual contact. The TV picture is relayed from a camera in the cockpit or the nose of the plane aloft.

NASA research has already been put to practical use in the testing of the new F-15



Prior to flight, the scale-model F-15 undergoes static tests atop platform at Edwards Air Force Base. Model is under 24 feet long, weighs less than a ton.

Now: Dogfights without planes

Though the Air Force's new F-15 fighter is still being tested, pilots have already "flown" the bird in hundreds of dogfights against a variety of opponents.

This trick is made possible through the use of an elaborate simulator—reportedly the only one of its kind in the world—at a McDonnell Douglas facility in St. Louis. McDonnell Douglas makes the F-15.

The F-15 pilot sits in a cockpit that's a replica of the real thing. His assignment: to "maneuver" his aircraft so its guns are brought to bear on two opposing planes.

The cockpit is situated in the center of a 40-foot spherical chamber, the wall of which forms a 360° screen for the projected images of the two opposing aircraft. These planes are being "flown" by pilots in smaller but

similar simulators. They, in turn, see the F-15 projected on the walls of their chambers.

When the F-15 pilot sees his "enemies," their size is directly related to range. They grow as they come closer, shrink as they fly farther away. As the pilots "fly" their aircraft, their stick, rudder pedal and throttle movements are translated into action that moves the images correspondingly. Performance characteristics of the aircraft involved are also taken into account.

To further enhance the realistic quality of the experience, the pilots hear flight noises and the firing of their own missiles and guns. As they fly through tight turns, their bodies feel the pressure through specially designed G-suits. If a pilot pulls too many Gs, the lights grow dim to simulate a gradual blackout.

Keeping track of all the variables in the three-aircraft dogfight is a computer with the capability of executing some 2,500,000 instructions per second. It's the hard-working computer that keeps the action going.



The test vehicle hangs below the big wing of a B-52, which will carry it up to launch altitude.

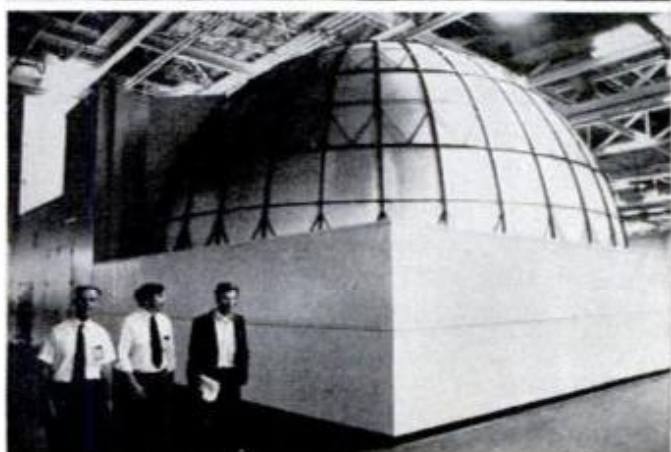


Engineers check out F-15 model: a smaller, cheaper stand-in for a \$57-million fighter plane.

superfighter. The full-scale fighter weighs some 40 tons and costs a reported \$57 million. By contrast, the three-eighths-scale RPVs, identical replicas of the F-15, cost about \$250,000 each and weigh less than a ton. Made of fiberglass strung over an aluminum frame, they have a wingspan of only 16 feet and are slightly over 23 feet long. The control surfaces are activated by a receiver that obtains its commands from the remote ground pilot. A battery-operated hydraulic system furnishes the muscle.

In October, 1973, the first such model, complete with remote-control package, was air-dropped from a B-52 at 45,000 feet and maneuvered down to "pick up" altitude by remote test pilot Einar K. Enevoldson, who has been with the program since it began. Even on this first unpowered flight, the model was put through high angle of attack flight maneuvers. Then, at 15,000 feet, its 79-foot-diameter chutes were deployed and an air grab made by a waiting helicopter.

Actual landings are planned in the future,



The images are obtained from models of the full-sized planes. They are shot with a TV camera—at a variety of attitudes—to yield realistic projections of dives, loops and other maneuvers.

The complex simulator system is currently used as an engineering design aid in fighter research and development. A future possibility, according to McDonnell Douglas officials, is to use the simulator to train pilots in air-to-air combat maneuvering.

Members of the McDonnell Douglas simulation department recall a remark made by Irv Burrows, the company's chief test pilot, after he had piloted the F-15 on its first actual flight: "It flew just like the simulator."

That's the kind of talk the simulation experts like to hear. ★★★

Two F-15 fighters realistically projected on 360° wall screen inside an air combat simulator (above, left), as seen by pilot occupying cockpit centered in the 40-foot spherical chamber. Pilots in smaller simulators "fly" other planes, carry on dogfights. Simulator, in McDonnell Douglas Corp. St. Louis plant, is at left.

Airline traffic is already controlled from the ground

with the RPV powered by some type of rocket engine. A special TV system may also be installed to give the test pilot complete visual coverage. Right now, the RPV's assignment is to demonstrate the spin characteristics of the F-15, a risky maneuver for supersonic aircraft that results in one plane loss for every 60 such spin tests.

In March, 1974, while NASA personnel kept their fingers crossed, Enevoldson pulled the RPV up into a stall, then kicked it into a violent spin.

"It spun around too fast to count," reported one observer.

But when the test pilot applied corrective controls, the small plane came out of the spin in the standard way.

Although these flights are intended only to supplement tests with the full-scale F-15, the data obtained are of real value to the aircraft engineers involved. The tests also serve to point up other advantages of the RPV. The RPV's performance is not hindered by the physical limitations of a human pilot. You can forget about G-stress in turns and sudden pullouts.

The absence of an on-board pilot also eliminates the need for a cockpit, oxygen systems, ejection seat and other safety devices, resulting in a lighter, simpler, cheaper plane. Small wonder that the Air Force is holding competitions for RPV contracts, has a full-time Drone-RPV office, and is

now working on mini-RPVs that may be produced for as little as \$20,000. It's estimated that even larger RPVs, capable of carrying considerable weaponry, need cost but a few hundred thousand dollars, or about one-tenth the going price of a cheap manned fighter.

The Air Force is using Edwards AFB for its own tests of a reconnaissance RPV called the "Compass Cope." One prototype crashed after several successful flights during the summer of '73. No explanation for the accident was given.

Two new prototypes built by Teledyne Ryan Aeronautical—not the maker of the crashed plane—were delivered to Edwards last spring and one of them was flown last summer.

Air Force and Teledyne officials were more than happy about the maiden flight, the results of which were announced as this issue of *Popular Mechanics* was ready to go to press.

The plane stayed aloft for 1 hour and 50 minutes, "demonstrating takeoff, primary flight maneuvers and landing capabilities while under remote flight control of a ground operator," according to officials. "It flew at speeds up to 200 mph and at altitudes up to 25,500 feet . . ."

Designed for high-altitude, long-endurance flight, the Compass Cope has an 81-foot wingspan, a fuselage 37 feet long, and is powered by a single turbofan jet engine with a rated thrust of 4050 pounds.

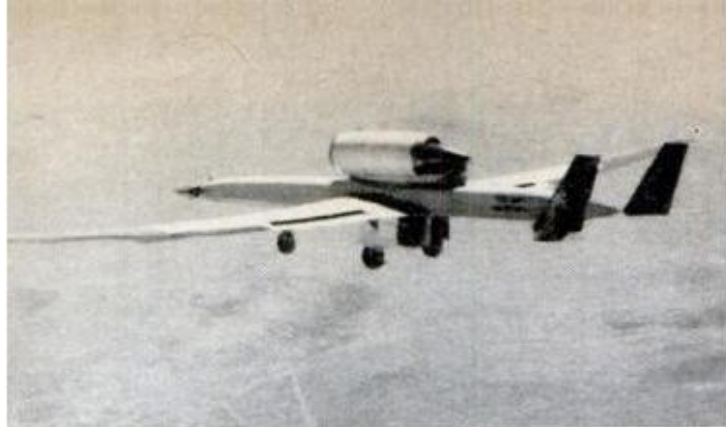
Despite the earlier Compass crash, RPV research has gone forward smoothly. Still, officials are concerned about the possibility that an RPV will somehow break loose from its radio tether and take off for the wild blue yonder. A human pilot who could take over the controls was aboard NASA's Piper Comanche, but military testers use other safeguards. Chase planes follow the RPV, ready to take over control with their own radio units or to send a signal triggering the RPV's chutes.

Though it has obvious military applications, is there also a role for the RPV in civil aviation? Proponents say the RPV would be ideal for hazardous types of flying—the testing of new planes, crop dusting and fighting forest fires.

The work already accomplished with the F-15 scale model demonstrates that flight-

Chopper is on hand to catch experimental model on its descent by chute from altitude of 15,000 feet.





This RPV is the "Compass Cope," a surveillance plane. Maiden flight to 25,500 feet was a success.



Guided entirely by ground control, NASA's Piper Comanche cruises over California desert.

testing would be a logical application. But crop dusting? Here the tolerances may be too small since the job frequently requires pilots to drag the landing gear through the tops of foliage and fly by "instinct" more than by sight or instrument. On-board TV cameras would provide little help.

Similarly, aerial forest-firefighting depends largely on the pilot's ability to "feel" his way through severe turbulence, with the plane often poised on the brink of a stall. Another factor is that there would not be any money saved in replacing a human pilot with a complex radio-control system.

A much better case can be made for the application of RPV technology to the flying of commercial airliners. Though the average passenger's faith in gadgetry would be sorely tested by the knowledge that there was no human hand in the cockpit to bring him down safely, the fact remains that in recent years the control of all airline traffic

This F-106 is almost a drone. Electronic black boxes can guide it to target and fire its missiles.



has passed from the cockpit to the ground.

The United or Pan Am pilot, for example, flies his jet in accordance with company rules and under the direction of a ground controller. His altitude is assigned and his route narrowly laid out between navigation points. The only time his skill really is needed is on takeoff, landing and during an emergency.

During most of the flight the pilot does not physically control the plane. This is routinely done by an autopilot, which flies a much straighter, more level course than any human could.

The autopilot can be coupled to the ground navigational system so that it steers unerringly along the desired course. Autopilots can even be tied in with the instrument landing system. Thus the plane is brought down the glide slope without a hand touching the controls, the power automatically reduced at flareout and then completely chopped off at touchdown.

If the pilot has become little more than an airborne monitor of a plane's systems, why does he even need to be aloft? It can be argued that it's safer to use a ground-control pilot who's a specialist in landings, someone who does nothing but bring down plane after plane during his duty shift. Would he not be superior at the job because of his constant practice? He would also have the advantage of working in a stable, comfortable environment instead of a cramped cockpit. A backup pilot could ride in the plane, ready to take over if the link between ground and plane should break down.

If all this seems far-fetched, keep in mind that overseas there already are trains that are run in just this fashion.

How far the automation of aircraft may go is anybody's guess right now, but the techniques and hardware are already with us. ★ ★ ★

How electronics will take the jackknifing out of truck driving

by Edward A. Lacy



When a big tractor-trailer rig jackknifes at high speed, there's no controlling it. The results are disastrous for the driver, for his rig and cargo and for nearby motorists, who are usually wiped off the road by the tons of steel and cargo suddenly sliding into their paths.

In 1975, however, air-braked trucks will be built with modifications to make such devastating mishaps no longer possible. By federal law, the big rigs will be required to stop within certain specified distances, on both wet and dry pavement, at speeds

up to 60 mph, within a 12-foot-wide lane.

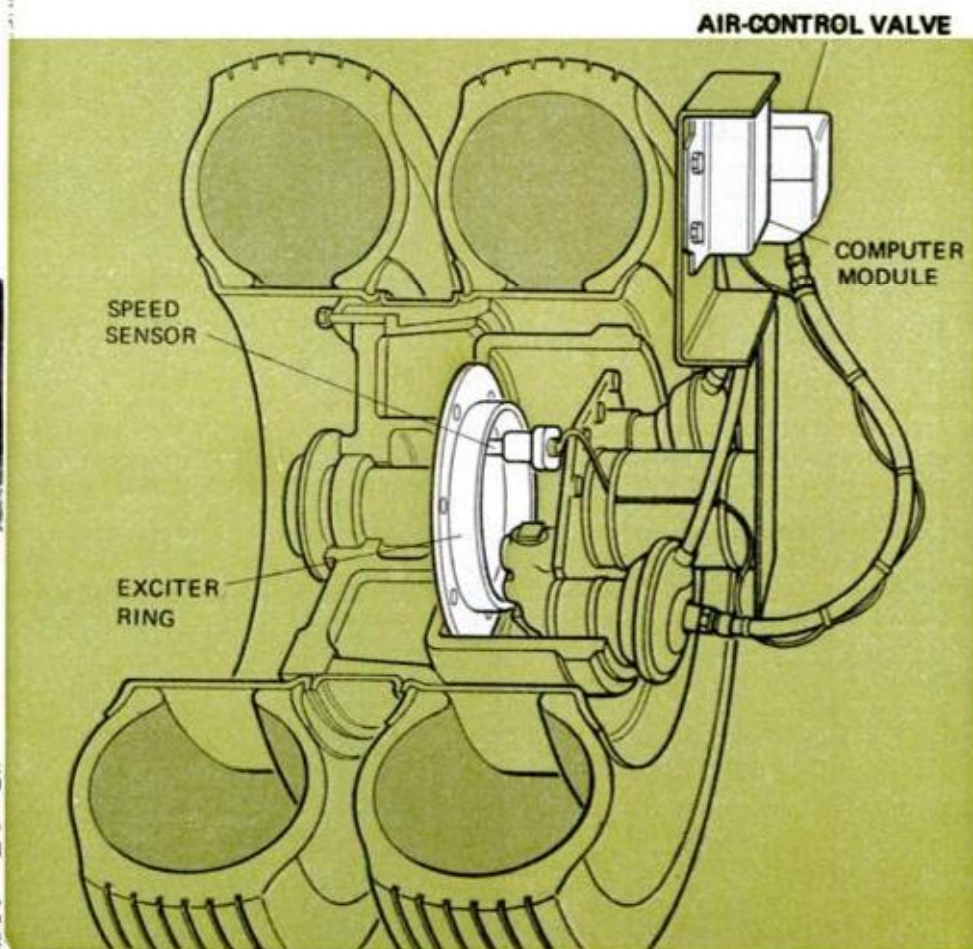
Federal Motor Vehicle Safety Standard 121 does not specifically require antiskid brake systems, but to stop a fully loaded air-braked rig safely within a 12-foot lane, that's what will be needed. It's impossible for a driver to maintain stability under braking without an antiskid system. Test drivers at skid-control facilities have tried. The best of them can do it at 20 mph, sometimes even at 30 mph, but from there on up, they're helpless.

lets up on the brakes. That is, it reduces pressure to the entire axle. And it repeats this cycle several times a second as long as the brake is applied.

An axle-by-axle control system gives better control on the steering axles than a wheel-by-wheel system and is favored by all manufacturers because its fewer parts allow for greater reliability and lower cost.

Antiskid systems are required on the steering axle and the last two driving axles of the tractor and of the trailer. Obviously,

ANTISKID BRAKE COMPONENTS



Test driver in a big rig cannot keep the vehicle within 12-foot-wide lane under emergency braking, even when heavy trailer is not attached. Here, the vehicle smashes down pylons on right side of the lane; on the highway jackknifing of tractor (cab) and trailer would wipe out the surrounding traffic. With the system (left) that is to be built into trucks next year, jackknifing will be a horror of the past. Wheel speed is monitored, and when a lockup is imminent, the computer signals for lower pressure in the air-brake system. It happens so fast it's as if a superman were pumping the brakes many times per second.

In a passenger car you can maintain control at speeds higher than 30 mph without antiskid control, up to a point, by rapidly pumping the brakes to prevent wheel lock-up. But pumping the brakes to avoid wheel lockup simply won't work on air-braked vehicles—there's no good way to feel the response of the brakes. But then there's no need to with the antiskid systems.

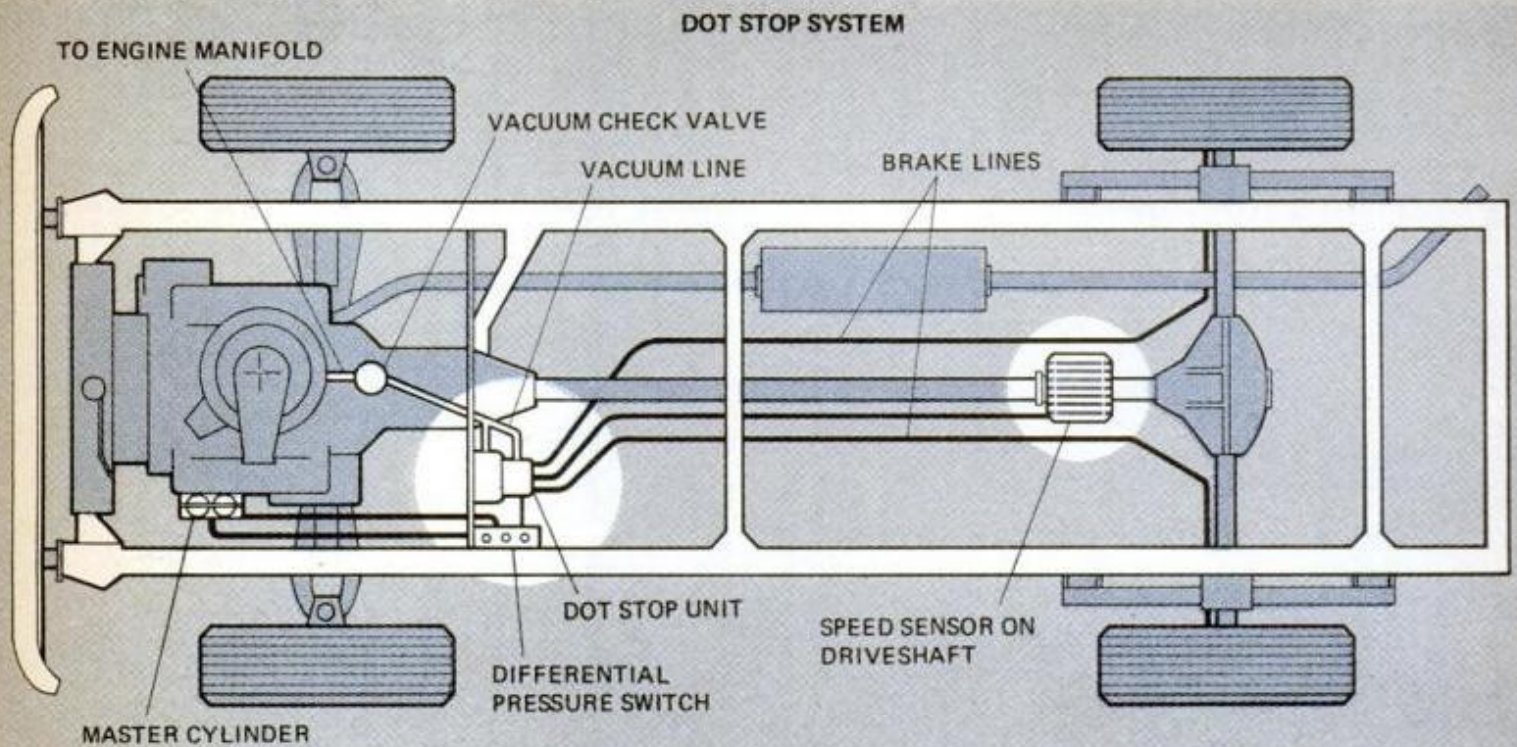
Here's why: Basically, all of the antiskid systems are similar; they measure wheel speed, determine if they are going to lock up, and, if lockup is imminent, the system

for the smaller rigs this is each axle, but for the "gravel trains" with 11 axles, only the last two axles of each trailer and the tractor will require antiskid.

Each axle's antiskid system is a complete, independent unit and requires only electrical power from the brake stoplight circuit and air pressure.

The wheel-speed sensor used by most manufacturers consists of two pieces: a slotted rotor (or exciter) about 11 inches in diameter that is bolted to the wheel hub and drum (or other rotating part) and a

Each axle has its own separate computer



Antiskid system for light and medium-duty pickups is Bendix's Dot Stop which varies pressure in the hydraulic lines to rear wheels to prevent lockup. At Bendix

Automotive Development Center, two pickups (below) brake hard from 50 mph simultaneously. Truck without antiskid system spins wildly out of control.



magnetic pickup attached to the brake. With each rotation of the wheel, the sensor generates 60 to 120 pulses which are sent to the computer module.

This module, a compact "black box" which measures about 6 inches square, receives signals from both wheels on the axle. Each axle has its own separate computer.

"Skid-control systems would have been introduced many years ago had reliable solid-state electronics been available," according to Bill Birge, vice president of engineering for the Kelsey-Hayes auto-truck group. "To do the job with vacuum tubes would have been virtually impossible, in terms of cost, space and reliability."

Birge explains: "Today, reliable integrated circuit devices allow us to put hundreds of active functions, such as transistors, into a package one-half the size of your fingernail."

While not all of the systems use integrated circuits, they all make use of solid-state circuits.

Upon receipt of the signals from the wheel sensor, the computer almost instantaneously analyzes the situation, comparing the information with data in its memory, and decides if a wheel is about to lock up. If it is, the computer sends an electrical signal to the air-valve solenoid to ease up on the air pressure to both wheels to a level just below that which would cause the wheels to lock. If there is no indication of lockup, the system idles along waiting for an emergency.

System response is amazingly fast. From the first indication of lockup until the release of brake pressure is a mere fraction of a second, time enough to prevent those jackknives caused by braking.

The most sophisticated systems automatically adjust for varying truckloads, road surface conditions, and degree of brake application.

As a protection against rain, salt spray and the range of high and low temperatures encountered throughout the United States, exposed electrical connectors are kept to a minimum. For this reason, the valve control and computer are usually built into one sealed, watertight enclosure. Electronic circuits are encapsulated in epoxy for shock and temperature protection.

Exposed electrical connectors have unique weatherproof designs. Bendix's "Corker" connector, for example, is designed to prevent entry of water even under hydrostatic pressure or total immersion.

Temperature extremes, from Florida sun to blizzards in Wyoming, would wreck an antiskid system's electronics if they were not built to take such torture. Therefore, most systems have been designed to operate in temperatures from -40° to $+180^{\circ}$ F.

Fail-safe design is the name of the game. If the antiskid system fails, the vehicle will simply revert to conventional braking. At the same time, a failure light will flash to warn the driver of system failure.

Since existing rigs do not have to be retrofitted for antiskid, it will take several years before all tractors and trailers on the

... the computer almost instantly analyzes the situation, comparing the information with data in its memory, and decides if a wheel is about to lock up. If it is, the computer sends an electrical signal to the air-valve solenoid to ease up on the air pressure to both wheels . . .

road are equipped with antiskid systems. In the meantime, a tractor with antiskid can still be used with a trailer that does not have antiskid. Similarly, an older tractor without antiskid can still run with a trailer that has the feature.

The research and development that has gone into antiskid systems for commercial trucks will soon benefit owners of light and medium-duty pickups. Antiskid systems designed for hydraulic brakes will be built into pickups later next year and at low cost. An example is the two-wheel, Bendix Dot Stop system illustrated on the opposite page. Such systems, using computerized control of hydraulic braking pressure, will take dangerous skids out of your pickup truck driving just as the air-brake systems will eliminate jackknifing of the big rigs. ★ ★ ★

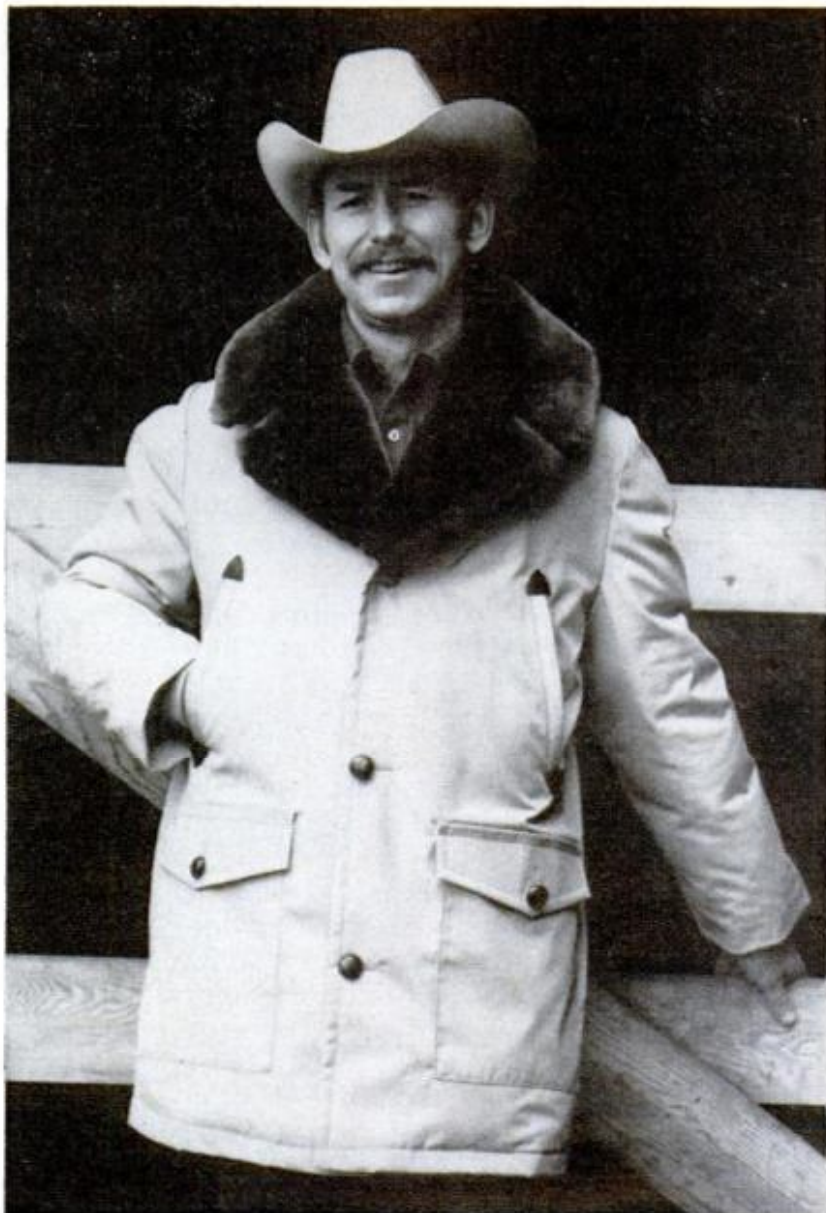
Wear for a warmer winter

Gear is lighter, brighter and it holds in the heat.

by Bill McKeown
OUTDOORS EDITOR

Ever since snowmobiles created a need for special clothes to keep you warm while seated in a strong wind, winter sports wear and work clothing have improved dramatically. Now we can don layers of lighter gear that make snow hiking, hunting, fishing and camping comfortable. Hypothermia—that critical lowering of body temperature—plus effects of wind-chill factor hasn't been eliminated, but we have much more control.

Down is still the most efficient (and most expensive) insulation, but new Dupont Fiberfill II and Celanese Polar Guard are better in wet weather. Excellent mail-order sources are available. ★★★



Down and synthetic almost-equivalents keep out cold without adding weight. Eddie Bauer Stadium Parka (upper right) is goose-down insulated, has hidden hood; \$125 postpaid from Seattle. White Stag's Dacron II Magnum Coat (above) has double layer of Fiberfill II. Woods Bag & Canvas Trail Pac 20 combines down bag, foam pad. K&S boots are blaze orange.



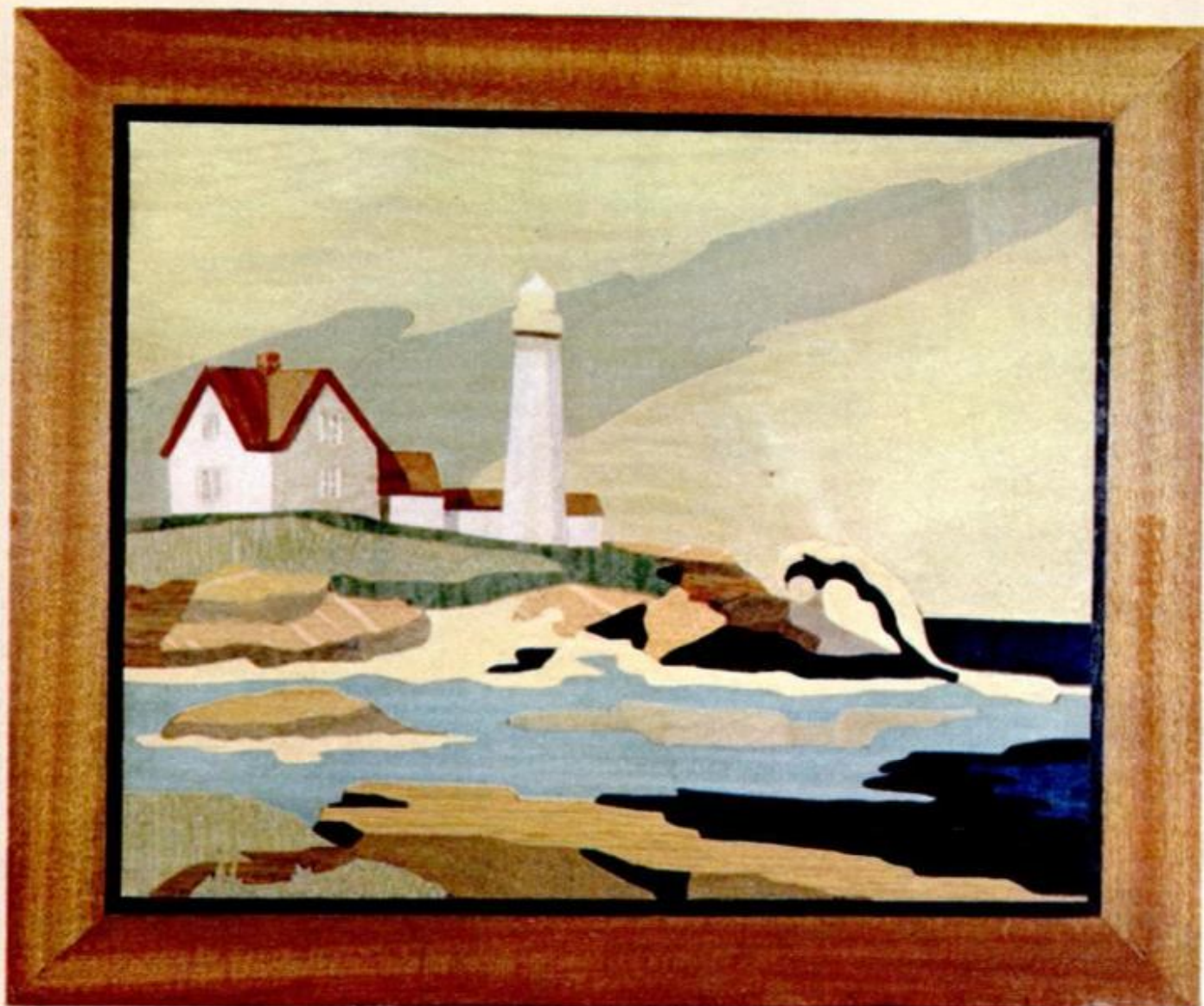
Snowmobiles are inspiration for many snow-belt styles; Scorpion this year introduces a Chuck Connors Jacket (top left) with faded denim look, sherpa lining, trim.

Burt Retractable Ski Binding by Garcia (upper right) is called the first to release during a fall and then automatically return ski and latch in place; \$100.

Two-piece snowmobile suits seem to be a trend. New Polaris Competition Suits (above) and "wet look" TX Racing Slicks are available from Polaris dealers.

Hunting clothing from Sears includes blaze orange Ted Williams heavyweight insulated jacket (\$39), pants (\$30). Sears has new Winter Sports Catalog of clothes, gear.

On or off machines, new snomo clothes add cold weather class. Safari Suit (right) in men's and women's models, comes in red, white or blue from Polaris.



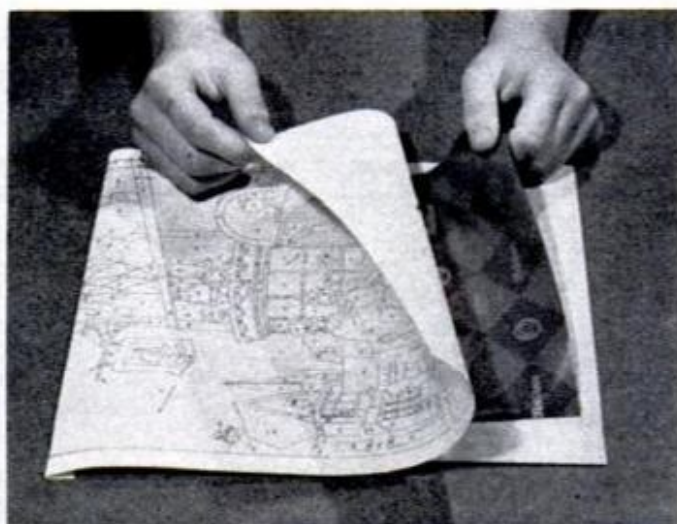
Lighthouse-Maine, 1791

Marquetry: A difficult art made easier

by Raymond Capotosto



1. Marquetrie kit contains all necessary materials to "paint" a picture in wood. Many designs are available.



2. Tape pattern to one edge of the waste veneer and leave it attached there for duration of cutting steps.

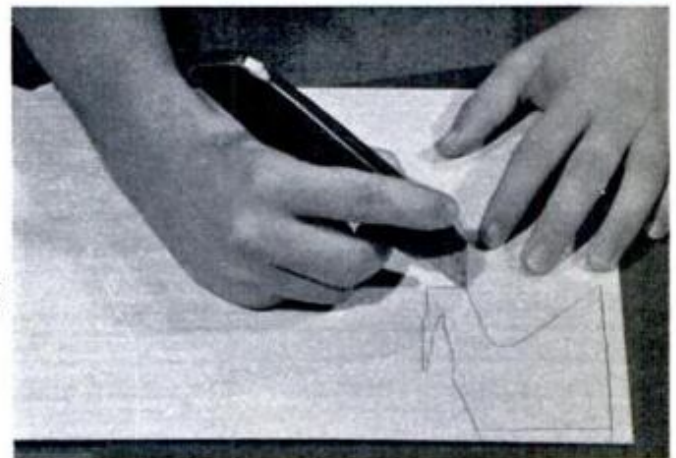
Marquetry, the craft of making pictures with inlaid wood veneers, used to be an art form practiced only by craftsmen with unusual skills. But that's been changed.

Now, regardless of the level of your skills, you can try this fascinating hobby and be assured of success even on your first attempt. A revolutionary new technique of sequential, or progressive, cutting simplifies the work.

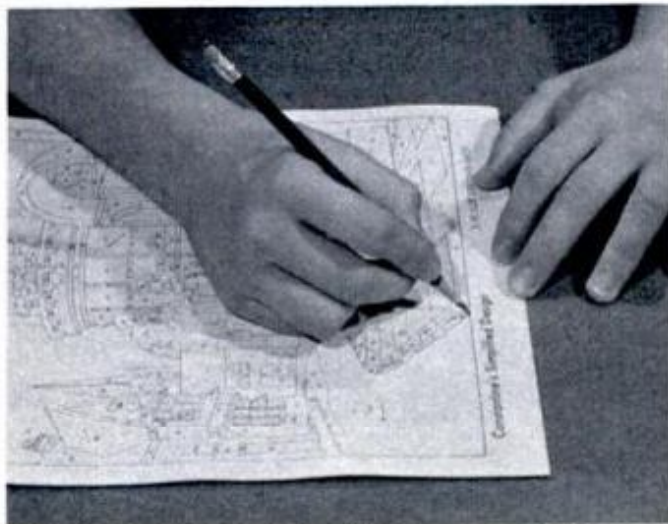
The old method used veneers $\frac{1}{8}$ -in. thick which were necessarily cut with a fret saw so that the required accuracy made it a rather difficult task. The new method utilizes veneers of only $\frac{1}{40}$ -in. thickness which are easily cut with a sharp utility knife in conjunction with the "window technique." The result is finer work with less effort.

Marquetry kits are available in a wide range of interesting scenes and subject matter. Unlike many hobby-craft kits that contain prefabricated parts requiring only assembly, these kits contain the necessary colorful veneers, a full-size working pattern and accessory items—but none of the veneers are precut. The finished product reflects your efforts and creativity. There are, however, precut kits available for those who prefer the easy way.

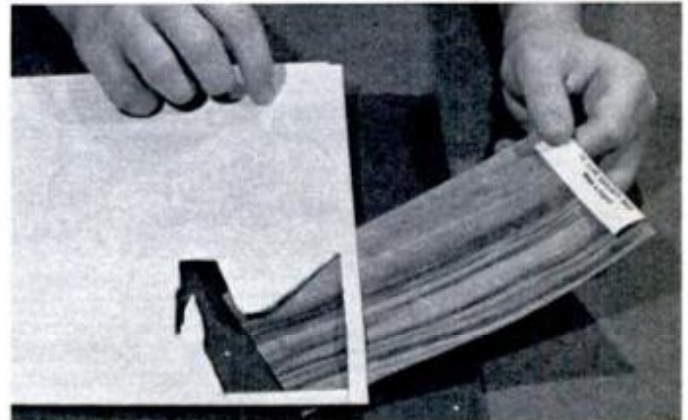
The window method is derived from the simple process of cutting



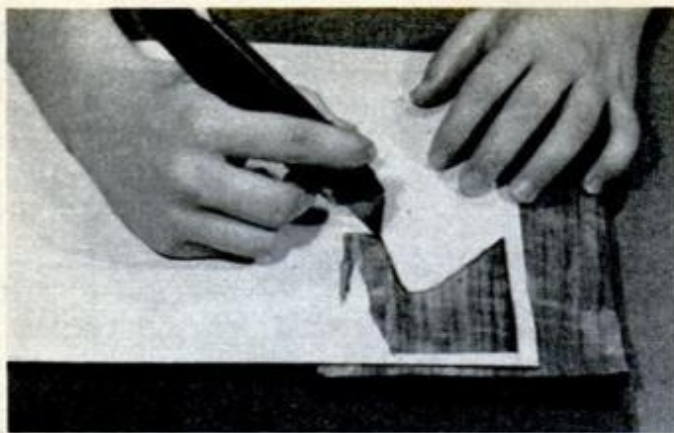
4. Make light scoring cut first; then make second pass using a knife to cut completely through the veneer.



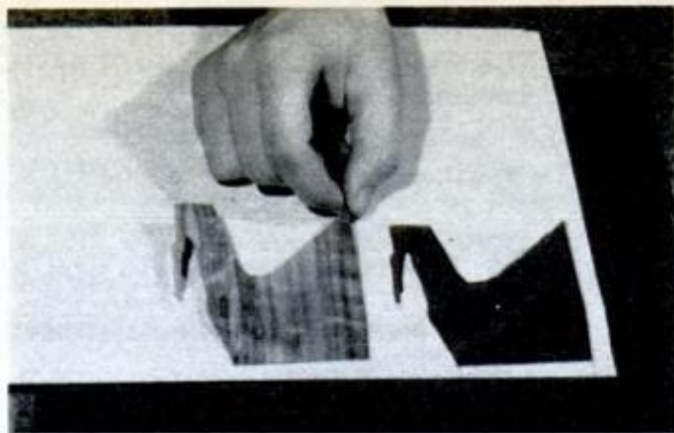
3. Trace and cut each individual segment before you go on to the next segment as the work progresses.



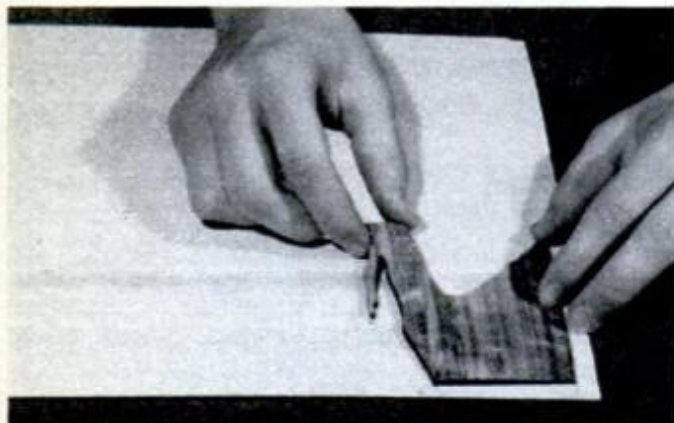
5. Insert veneer under "window." Number and select each wood specie according to the key in the plan.



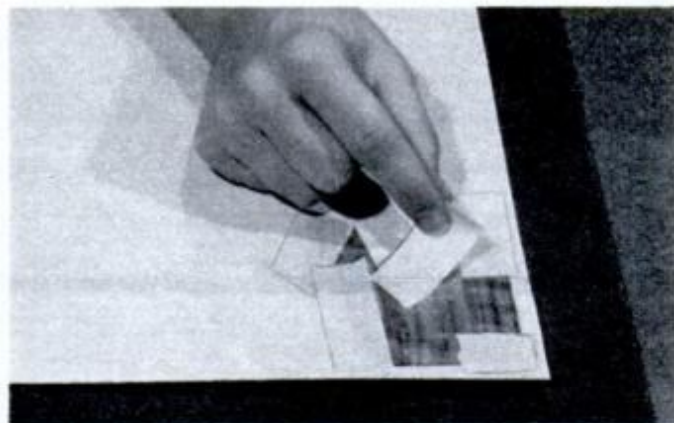
6. Window technique provides knife template. Make a light score and then remove veneer for severing.



7. Here is initial cutout segment. When it's carefully scored and cut, it matches the opening accurately.



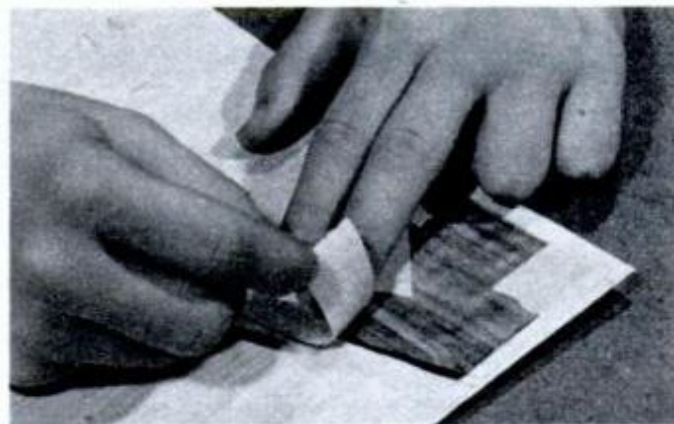
8. Insert inlay piece in opening in waste veneer, where it remains to be joined gradually by the others.



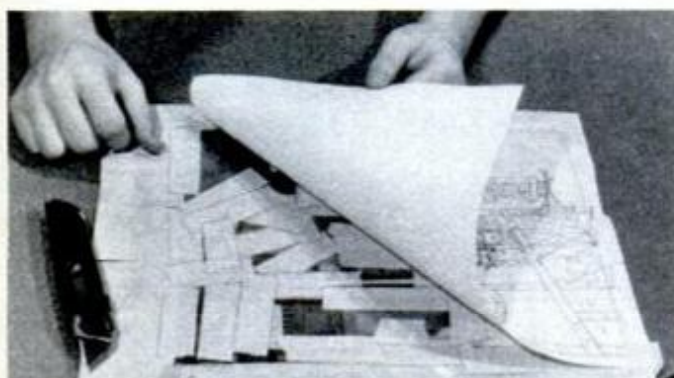
9. Tape inlay in place, then use carbon paper and pattern again to trace an adjoining segment.



10. Insert dark colored veneer under second opening cut in waste; then score and sever it with knife.



11. Tape dark narrow band, the second inlay, in place. This procedure is simply repeated for all segments.



12. Progress view of the half-completed picture showing face side. Tape is on back, or working side.



13. Completed inlay ready for final steps. Remove all tabs of tape prior to gluing picture to panel.

a hole, or window, in a piece of "waste" veneer supplied with the kit. This is actually a piece of good veneer which serves as a template for cutting the inlay required to fill the window. As the picture progresses, the waste veneer is gradually discarded and replaced by the picture segments.

The full-size pattern from which you work is printed in reverse so that you do all cutting from the back. The reason for this is that when a knife blade cuts into veneer it forms a V-shape as it forces the fibers apart (see diagram page 89.) This means that the face side of the veneer will produce a tight-fitting joint because it is cut with just the tip of the blade.

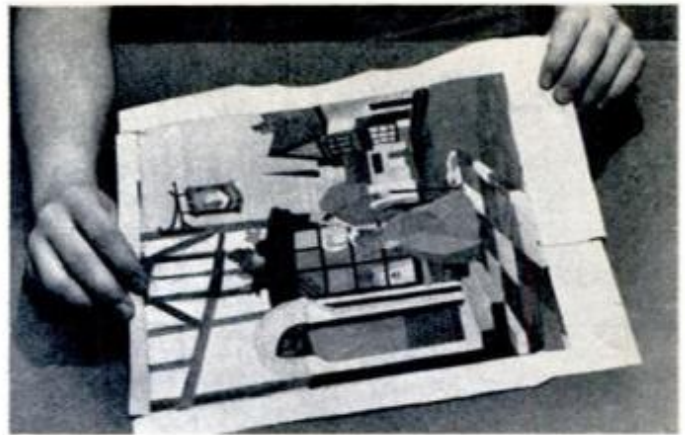
You begin by taping the working pattern along one edge of the waste veneer so that it can be flipped back and forth as required. A sheet of carbon paper is placed between the pattern and the waste. Use a hard, sharp pencil and trace the first segment to be cut. Lift the pattern, remove the carbon and with light pressure on the knife, cut around the line you have traced to make a score cut. Make another pass with the knife to sever the fibers cleanly.

The varied veneers supplied in the kit are numbered, as are the various segments of the picture in the pattern. The veneers have been selected and numbered with care in order to produce the necessary colors and contrasts which make up the total picture. The recommended grain direction for each component is also indicated in the pattern.

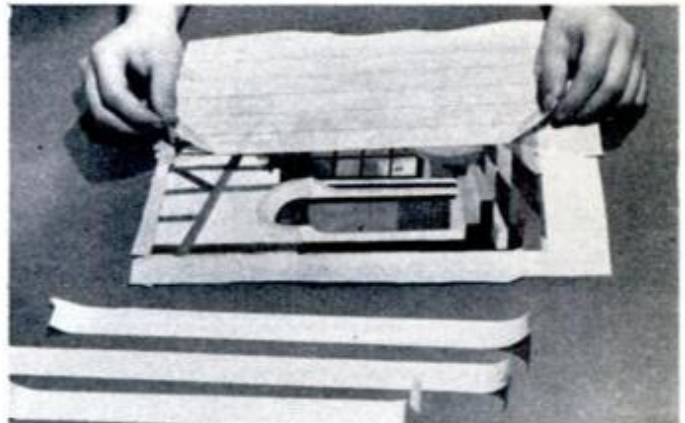
Now, with the opening in the waste as a starting point, select the proper veneer and place it under the opening. Use the edge of the opening as a template to guide the blade around the contours to make a light score cut. Remove the scored veneer and proceed to cut it through. Finally, insert the segment into the window and secure it with tape. Flip the pattern back into place over the waste, insert the carbon again and trace an adjoining segment of the picture. Cut out the window and an inlay veneer, tape it into place and continue to repeat the procedure until all the waste veneer has been filled with the inlaid veneer segments.

When all of the inlay segments have been cut and taped into place, the assembly is turned right-side up. Long strips of tape are now used to cover the entire surface

(Please turn to page 166)



14. Remove tracing pattern now and turn the tape-stuck work right side up for front taping.



15. Cover complete face of picture with long strips of tape in order to hold the inlays in position.



16. Remove the tabs on back after front is covered with tape; then trim borders of the picture.



17. Add border strips of contrasting wood to the four sides and miter the corners for a neat fit.



Tabletop and benchtops are made of clear-pine 2x8s doweled and edge-glued. Pegged stretchers add great rigidity to table and benches.

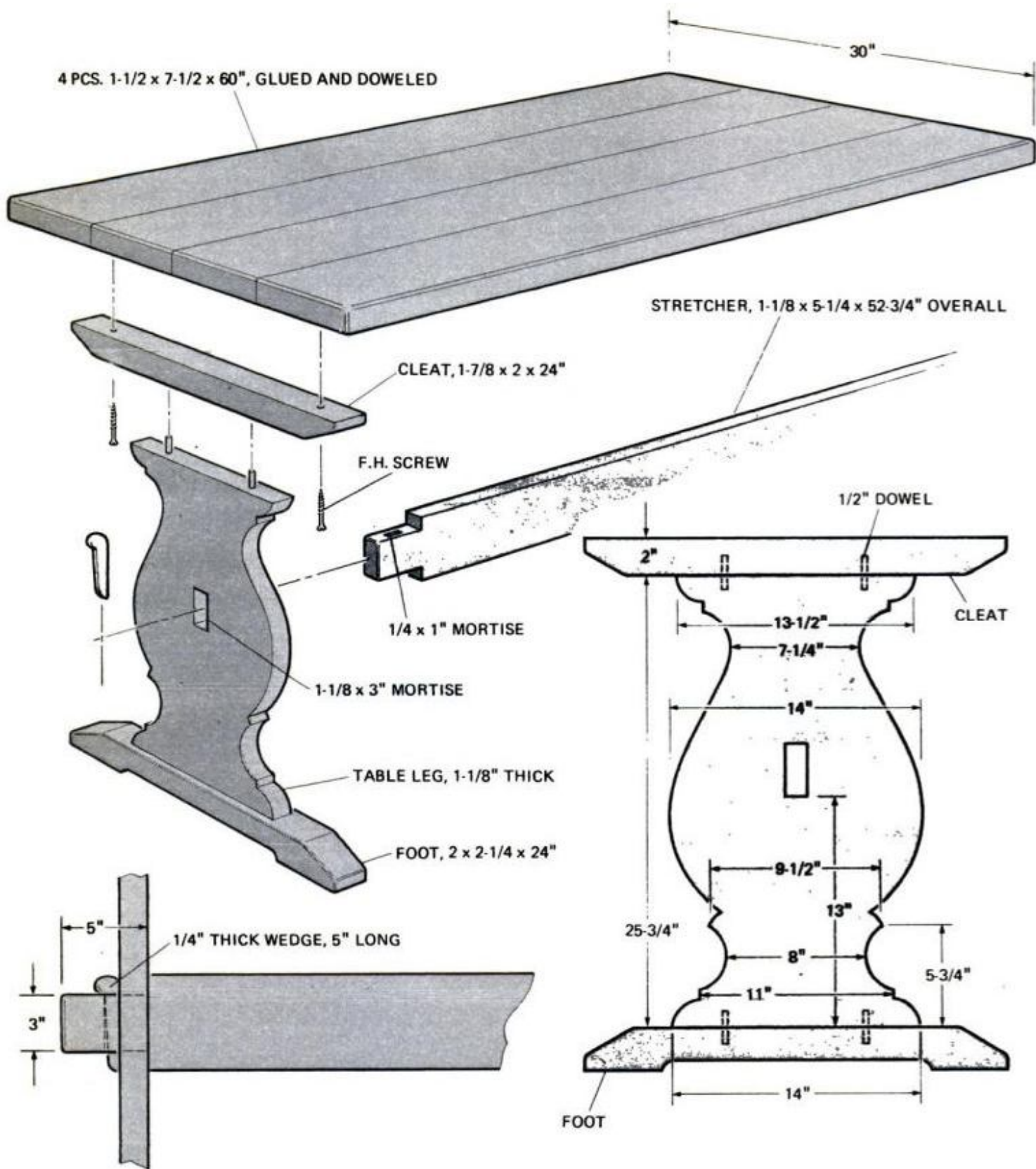
Color Photo: George Ratkai

A photograph of a rustic wooden trestle table. On the table, there is a still life arrangement featuring a copper-colored vase with green foliage, a cluster of purple grapes, a red apple, and several walnuts. The table has a simple design with a thick top and a central trestle support. The background is a plain, light-colored wall.

Beautiful trestle table you can make

Simple and rugged,
it's an easy-to-build piece
that will become a family heirloom.

by Everett Johnson

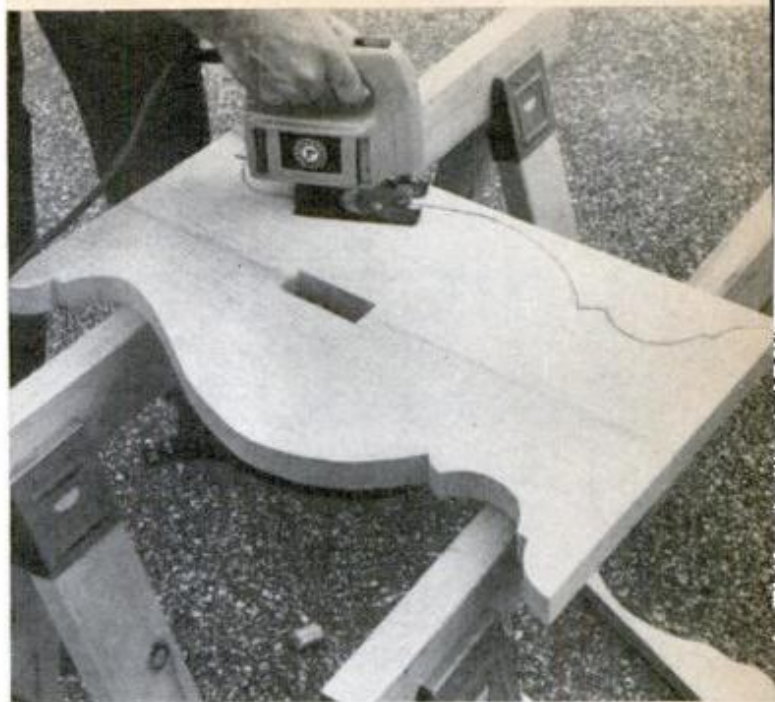


Serving six people comfortably, as well as offering the rugged good looks of Early American pine furniture, this hand-pegged, trestle dining table is a period piece you'll use and admire for years to come. Its beauty lies in its simplicity, both in design and construction. Best of all, it's made of common clear pine, which means you can get the wood to make it at any lumberyard. Except for size, the two trestle benches

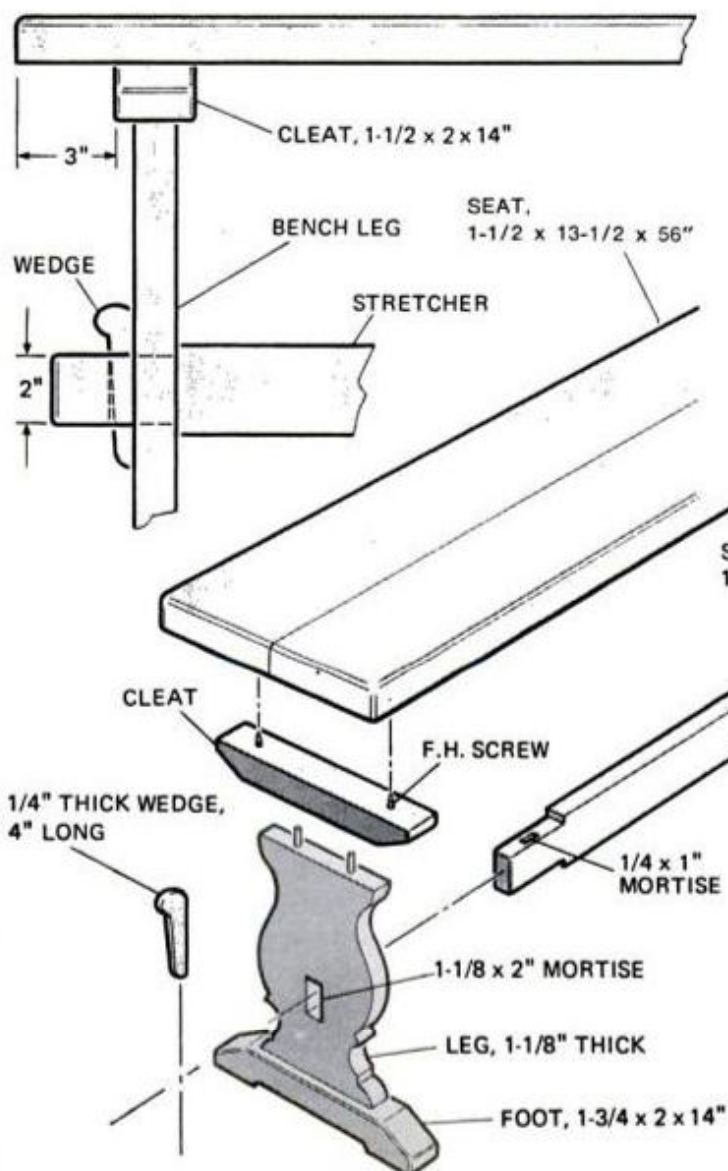
are duplicates of the table, the main difference being the number of pieces required to build up the 30-in.-wide top. The 1½-in.-thick stock, which is used for the table and benchtops, is doweled and glued together edgewise, then clamped. When the glue is dry, top surfaces of the built-up members are planed smooth, sanded with a medium-abrasive belt on a belt sander, or by hand, then the top edges are rounded.

The leg patterns for benches and table are similar, and all six legs are sabre-sawed from 1 1/8-in.-thick pine. Some lumberyards have 1 1/8-in. pine 14 in. wide. Where you can't obtain this width, the stock for the table legs will have to be doweled and glued up like the tabletop. The open mortises in the legs are made 1 1/8 in. wide to accept the shouldered ends of the stretchers. The mortises are easily cut with a sabre saw by first boring a 1/2-in. hole for the saw blade. Cleat and foot members are cut to the sizes given and are attached to the scroll-cut legs with 1/2-in. dowels. Counterbored holes in the cleats permit husky screws to be used to anchor the legs to the table and benchtops.

A 1/4 x 1-in. open mortise is made vertically in the stretcher tenons for 1/4-in. tapered wedges. The mortises are located at a point which will draw the tenon shoulders tightly against the leg when the wedges are tapped in place.

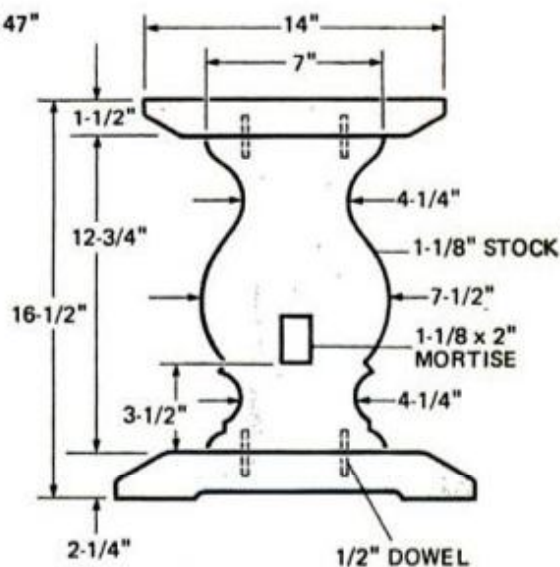


Sabre saw makes quick work of sawing out scrolled table and bench legs. Feed the saw slowly, follow the line closely, then sand the edges with abrasive blocks.



To give raw pine an Early American tone, use honeytone pine, antique pine, Salem maple or medium cherry stain. After applying a coat, allow it to set for a time, but wipe it off while it's still wet so that the shade will be uniform. Then let it dry overnight. Here, you'll find that it's good practice to experiment on scrap pine first. To complete the job, apply a top-coat sealer and wax.

You can get the stains mentioned in a complete finishing kit from Yield House, North Conway, N.H. 03860. ★★★

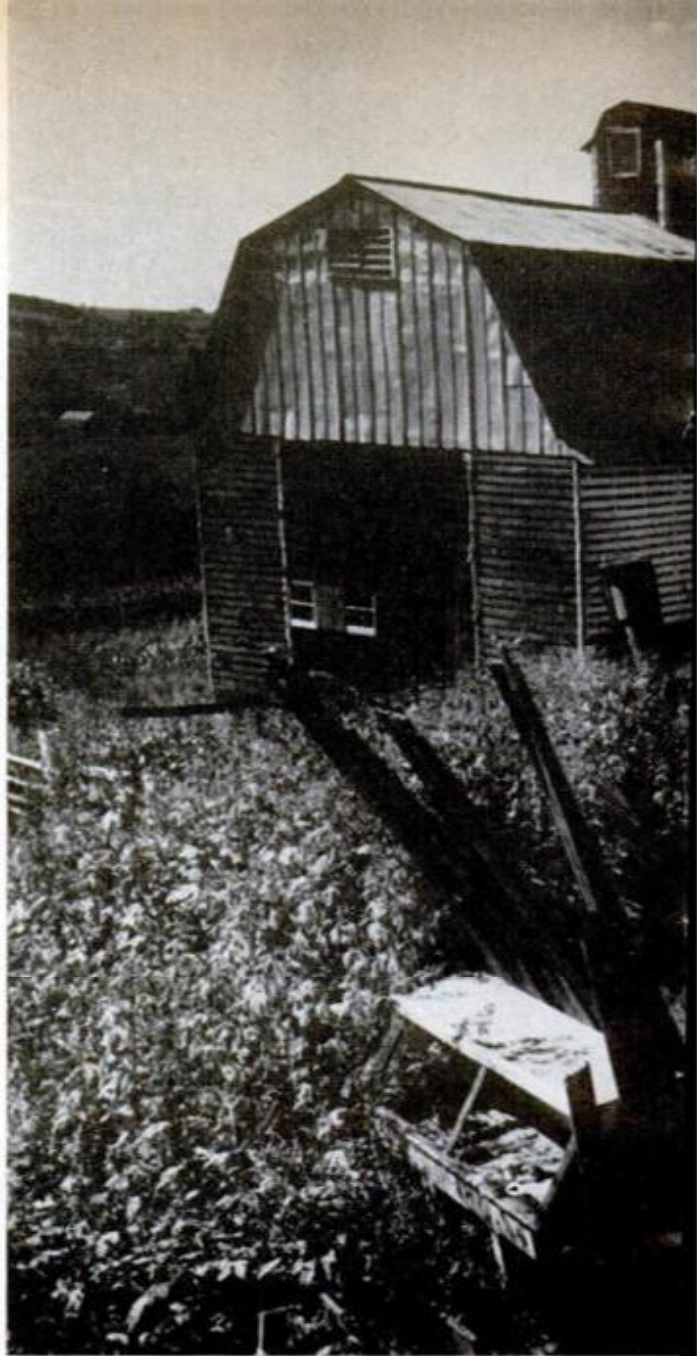


BENCH LEG

A dreamboat takes shape in a barnyard

Retirement spells adventure for Bill Bodisch. He's sold his Iowa farm and will cruise around the world—in a yacht of his own design, built with his own hands.

by John F. Pearson



Bill Bodisch is at the stage of life where he should be content to putter in the garden or idle away his time with his grandchildren. Instead, at 65 he is preparing for the greatest adventure of his life.

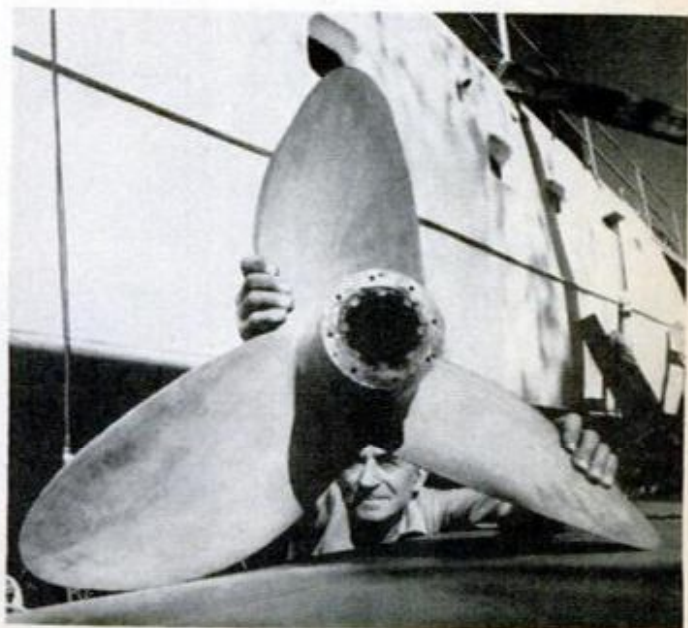
Bill is leaving his Durango, Iowa, farm behind to see the world, to cruise far-off oceans and visit ports he has only read about. There's nothing unusual about that—people who can afford it do that every day. The difference is that Bill will set out in a boat that he designed and built himself.

Bodisch is an American original, a self-reliant man who's largely self-taught. He went as far as the fifth grade but had to leave school to help out on the family farm. He continued to educate himself through correspondence courses, night classes and



A mechanical whiz, Bill Bodisch prefers to make his own gear rather than settle for off-the-shelf items.

Blades for screw were made from steel plate and coated with epoxy. This prop will be used as a spare.



reading. Even among farmers, a mechanically minded breed, Bill is something of a do-it-yourself wizard.

He's a tool-and-die maker, machinist, welder, mechanic, plumber, electrician, carpenter, boat fitter and rigger. He had to be all those things and more to build the 58-foot, 22-ton *Cindy-Marie*, which he named for his granddaughter.

Bodisch laid the keel in March, 1968, and finished putting on the last touches of paint late last summer. At this writing, he and his wife, Mamie, are getting ready for the first leg of the adventure, an overland haul by truck to the Mississippi.

Bill would have finished the boat sooner had he not held down a toolmaking job during the first three years of construction. After retiring in '71, he went at it full-time—seven days a week, with only Sunday night off.

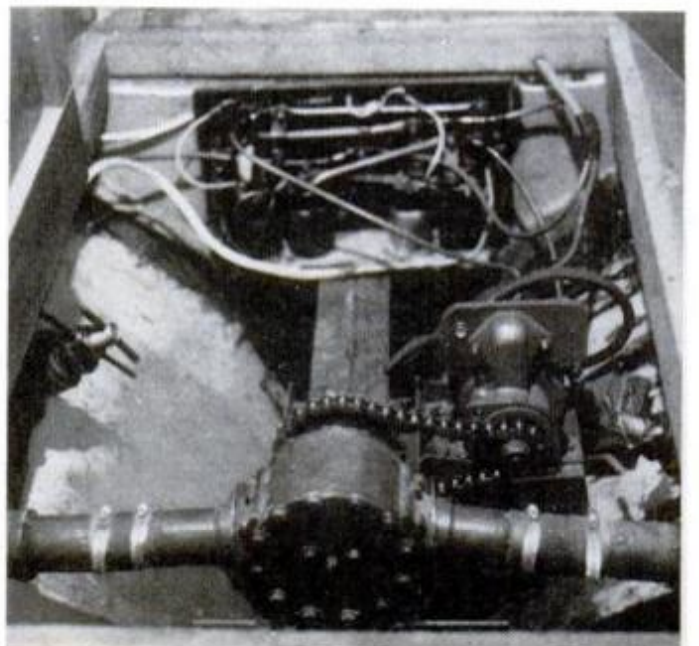
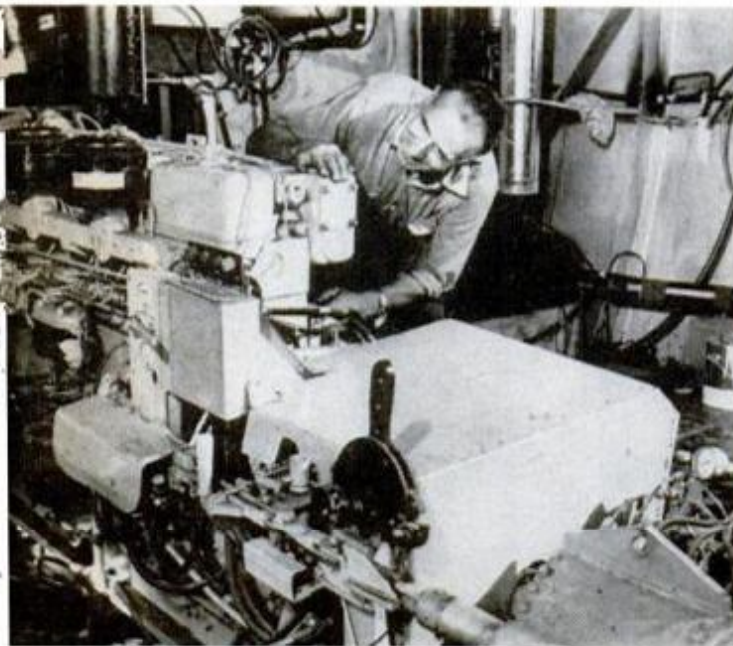
Bill is especially proud of the various systems and components that he designed and installed. The bow-thruster unit, for example, an important aid in docking, is a Bodisch design. A reversible pump is the key component of a system that permits the flushing of dirty crankcase oil and the pumping in of fresh oil. The dirty oil is ultimately filtered through another Bodisch device, making it usable once again.

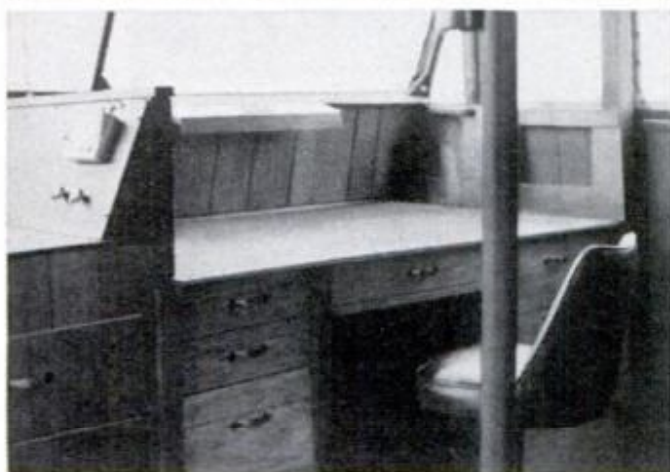
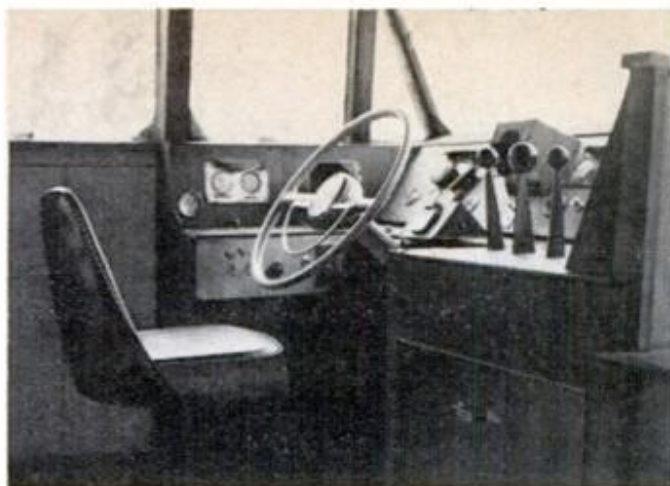
The short, wiry Iowan built the tools he used to bend the 300-pound steel plates that form the hull. He estimates that 12½ tons of steel went into the hull. Even the anchor was custom-made from steel plates and bars.

Bill Bodisch has taught himself navigation, from Navy manuals and a copy of



The *Cindy-Marie* has a 17-foot beam at deck level and is powered with an 85-hp diesel that will drive the yacht at an estimated 10 knots. A 1000-gallon tank will permit the vessel a range of about 3200 miles. The 16-foot-long engine room also contains a shop area and space for photo darkroom. Bow-thruster unit (below), driven by 15-hp electric motor, is another Bill Bodisch "original."





Instruments and controls are neatly arranged in wheelhouse (top), next to the navigation desk (above). The desk will also hold radio gear when the Bodisches get under way. First leg of voyage will take them down the Mississippi to the Gulf of Mexico.

Bowditch. Navigation aids include a radio-direction finder, a sextant and a shortwave rig permitting the ship to pick up time signals from Greenwich, England.

As this is written, four crew-members are "signed up" for the voyage. One of them—a male college student and scuba diver—will earn credits in marine biology during his time at sea. A young woman who works for a computer manufacturer is coming along for the first few legs of the voyage. When she returns to work, a friend is slated to take her place. Gals who know their way around a galley are welcome additions, says Bill, because Mamie doesn't plan to spend her retirement behind a seagoing stove.

After he gets the boat into the Mississippi, Bill plans to sail down to the Gulf and on to Florida. From there it's to the Panama Canal, to Peru, the Galapagos islands, and points west. The cruise may last as long as five years.

The Bodisches have sold their farm so that "we have no strings tugging at us." Bill has yearned for this kind of adventure ever since he was a kid paddling homemade boats through the backwaters of the Wisconsin River.

"If I had to do it over again," he says, "I'd have everything ready so I could throw my dinner pail in the river on my last day of work—and pull up anchor." ★★★



IT'S NEW

NOW



Snow skis for your motorcycle

Put a pair of side skis on your motorcycle and you can safely ride on snow and ice all winter long. The spring-mounted Cycle-Skis fit most makes, attach and remove in minutes, are street-legal in all states. Available in choice of colors for \$198. The Cedar's, Box 4977, Stateline, Nev. 89449. State bike make and size when ordering.



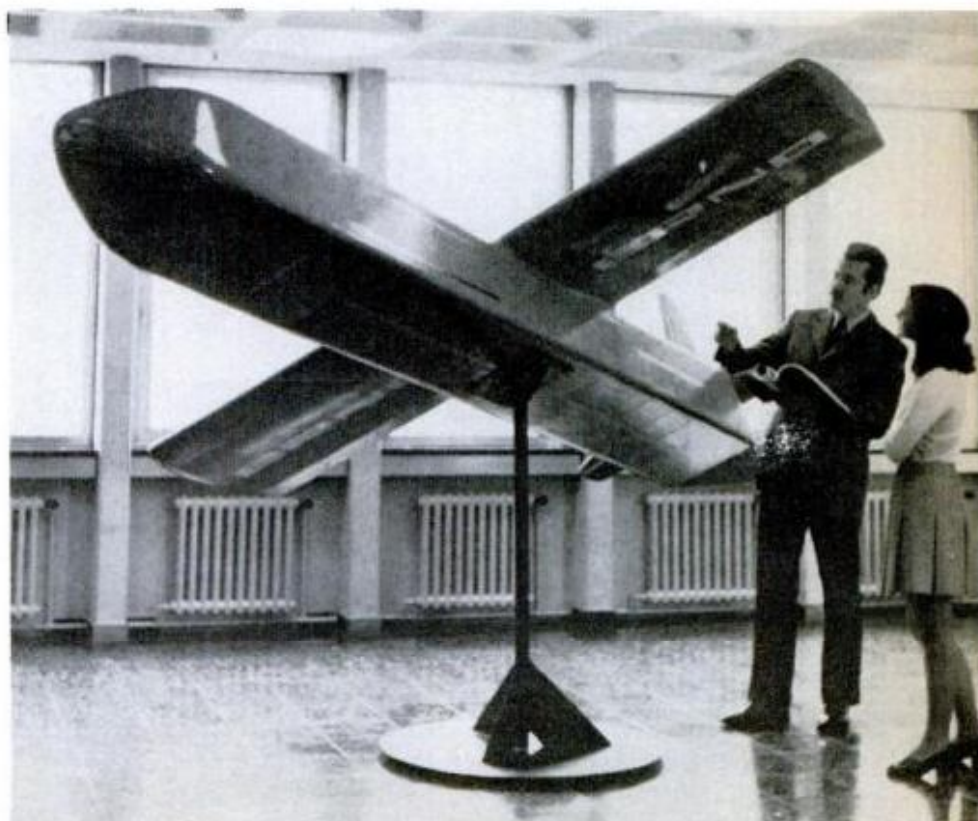


New stock-car racing sport: Now you must pull a house trailer along with you, yet!

Just to make things a little more difficult, these British stock-car racers must pull house trailers behind them as they careen around Britain's largest and toughest race course at Brands Hatch, Kent. Speeds up to 90 mph are possible on straightaways, but extreme care must be taken on curves to avoid jackknifing. Drivers race in various classes according to type of car and size of trailer. Trailers range from small 12-footers up to large 20-footers pulled by powerful cars. So far, top honors go to 24-year-old Andrew Higton pulling a 12-foot trailer with a VX-490 Vauxhall. Open only to British drivers this year, the race will be international next year.

Flying fire extinguisher fights airport fires

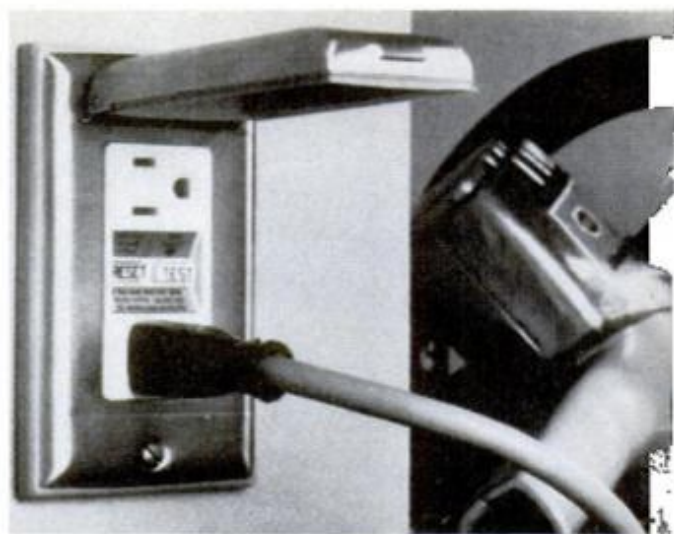
If the missile at right looks a bit like the V1 bombs used against England in World War II, it may be because it, too, is a German development—but this time for peaceful use. Filled with fire-fighting chemicals, the 16-foot rocket is actually a flying fire extinguisher for quick use in airport emergencies. When a plane crashes and burns on takeoff or landing, the missile is launched toward it, and an electronic homing system guides it to the "target." A few feet above the burning plane, it automatically releases the chemicals and deploys a parachute for recovery and reuse. Up to 12 can be launched at a time.



NOW

Instant fire engine

This self-contained pumper unit turns any 6x6 cargo truck or similar vehicle into a fire engine for economical off-road use in rugged terrain. The Lockheed firefighting module can be loaded on a truck in five minutes, is one-fifth the cost of a conventional pumper. It has a 1000-gallon tank, twin 200-foot hoses, floodlights. Lockheed FireStar, Box 33, Ontario, Calif. 91761.



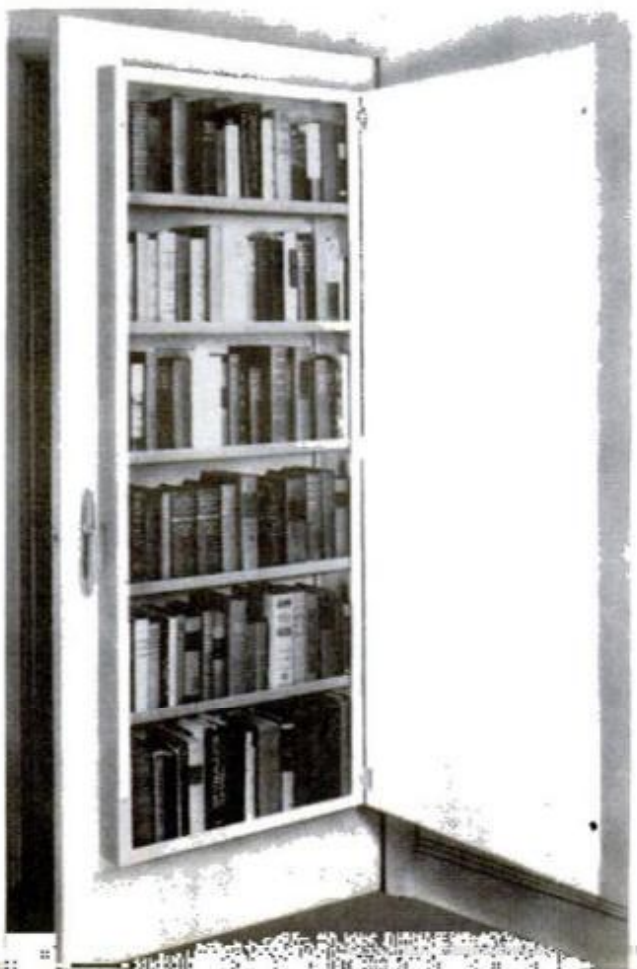
Built-in electrical shock protector

Ground Fault Circuit Interrupter from 3M senses a difference in current entering an appliance, such as a power tool, and breaks circuit if current differs by a hazardous level, protecting user against shock. Fits standard electrical receptacle box for 15 or 20-amp. grounded branch circuits. Suggested retail price, \$41.95 at electrical supply stores.



'Doored' door for extra storage

An interior doorway can add to storage space with this door and a built-in, 7½-inch-deep cabinet (right). Supporting door is made of 1¾-inch solid pine with reinforcing aluminum frame. Steel standards support five adjustable shelves. Cabinet door is held by recessed magnets. Standard sizes available; average-size cabinet, 20x68 inches. Comes ready to finish. Price \$129 without hardware. Space Analysts, Inc., 2247 East 16 St., Brooklyn, N.Y. 11229.





Miniature power-tool crafts kit

Equipped with this miniature power-tool kit, a craftsman has all the tools necessary to do a wide variety of precision operations. Included are 1/10-hp power head, 3-ft. flexible shaft, handpiece with key-type chuck and foot-operated speed control. No. 2272 Crafts Kit also comes with 35 accessories, including cutters, burrs and abrasive wheels. \$99.50. Freedom Electric Co., Bethel, Conn. 06801.



Solid-state portable shortwave receiver

Made in South Africa, the Barlow Wadley XCR-30 (above) is a battery-powered shortwave receiver featuring direct frequency readout. Unit provides precision tuning from 500 kHz to 30 MHz, with a special loop circuit said to eliminate drift. Earphones and external antenna may be attached. Price, about \$260. Gilfer Associates, Inc., 52 Park Ave., Box 239, Park Ridge, N.J. 07656.



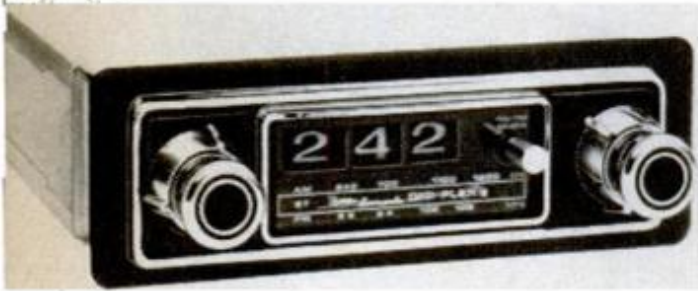
Drivers' glasses improve fog and night vision, cut headlight glare

These yellow-tinted driving glasses are said to improve your vision in rain, fog and dim light by increasing definition, contrast and brightness. A silvery coating across the upper portions works as a sort of two-way mirror—you can see



out clearly, but harsh, blinding headlight glare is reflected away from your eyes when you tilt your head down (top photo at right). In regular and clip-on styles for \$16.45 postpaid. Galvani Imports, 82-90 Broadway, Elmhurst, N.Y. 11373.

NOW

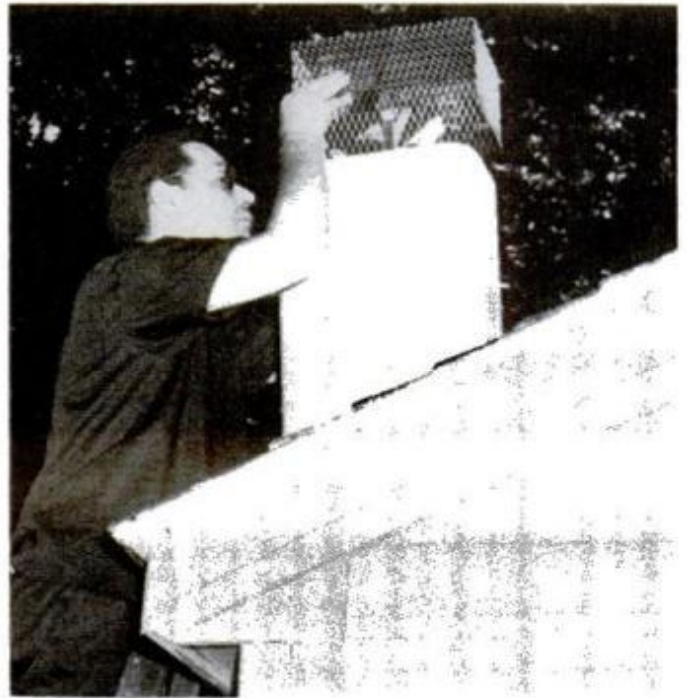


Two car radios with new features

New AM/FM-MPX car radio (above, top) also has a weather band and Citizens Band emergency channel nine. The in-dash unit, Model ESP-9000, uses an automatic cut-in circuit to interrupt other reception modes when a signal is transmitted on the emergency channel. Price not yet established. Model DP-5000 (above), also an in-dash unit, said to be first digital-clock car radio, is \$184.95. Boman Industries, 9300 Hall Rd., Downey Calif. 90241.

Screen stops chimney sparks

Stainless-steel screen (below) with 1/2-in. mesh catches dangerous chimney sparks. Called Spark-Arrest, screen is also said to keep squirrels and foreign material such as leaves out of chimney. Screens for flues with inside dimensions of 8x12 and 12x12 inches (plus made-to-fit screens) are available. Price, \$39.95 from Newark Wire Cloth Co., 351 Verona Ave., Newark, N.J. 07104.

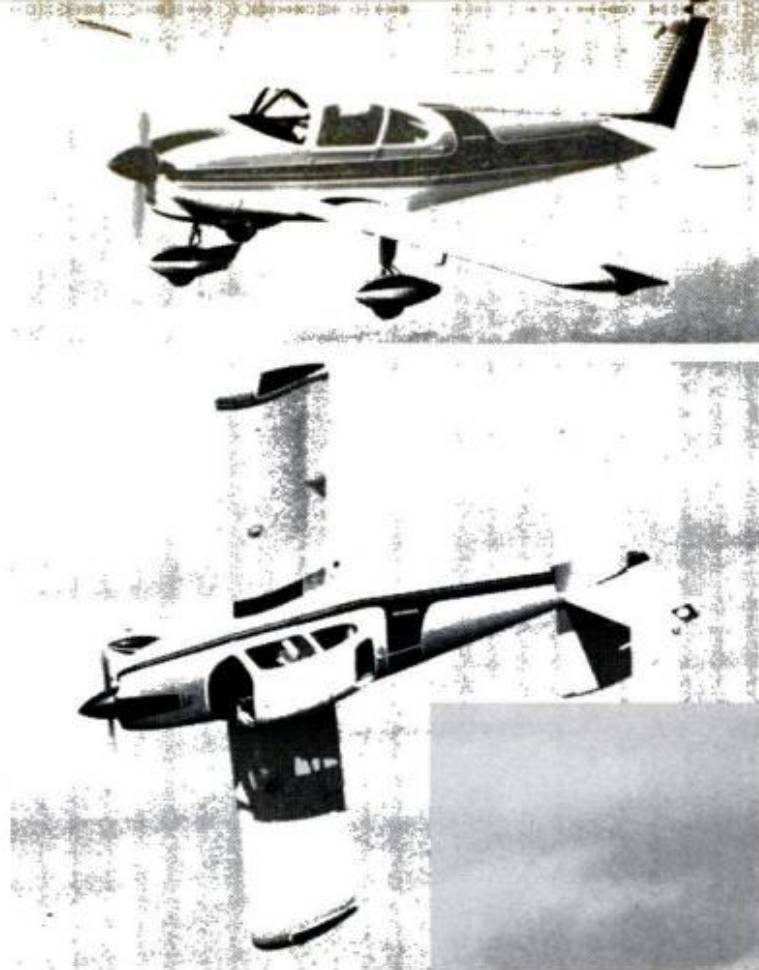


Convenient speed control for power tools and appliances is just a step away

Dremel's handy new foot control governs speed of power tools and appliances. When foot pressure is released, a spring moves treadle to lowest speed position. With spring taken out,

treadle can be set at any speed. Model 217 has outlet for 3-prong plug at back, handles up to 5 amps. when controlling motors; up to 600 watts for lights, glue guns, soldering guns. \$21.95.





Flying Subaru does antics in the air

It's a Subaru all right, but not the four-wheel kind you expect to see on the highway. The racy little tri-gear job doing a wingover above is the latest aerobatic version of the Aero Subaru, a four-place sport plane made by the same Japanese Fuji firm that produces the Subaru car. The flying model, with a 160 or 180-hp Lycoming engine, cruises at 127 mph, stalls at 60 mph and climbs at a brisk 760 feet per minute.



Fold-up table doubles as flat work surface or slanted drawing board

Stacor Craft & Hobby Table folds up for storage and opens to provide either a completely flat working surface or an angled drawing board (left). Table is supported by a metal base in red, white or black enamel finishes. Tabletop is constructed of cross-laminated faces bonded to a cellular core that manufacturer says will not warp. With 24x36-inch or 30x42-inch top; each size comes in economy model (\$54; \$58) or deluxe model (\$59; \$64). Stacor Corp., 285 Emmet St., Newark, N.J. 07114.

It's time for five new clocks

Handsome Seth Thomas clocks below, from the new Butcher Block Collection, have solid wood cases and run on self-contained battery-powered transistor movements. Suggested retail prices of the five clocks are, clockwise from the octagonal model: \$50, \$35, \$37.50, \$37.50 and \$70. For additional information, write Seth Thomas Div. of General Time Corp., Thomaston, Conn. 06787.



NOW

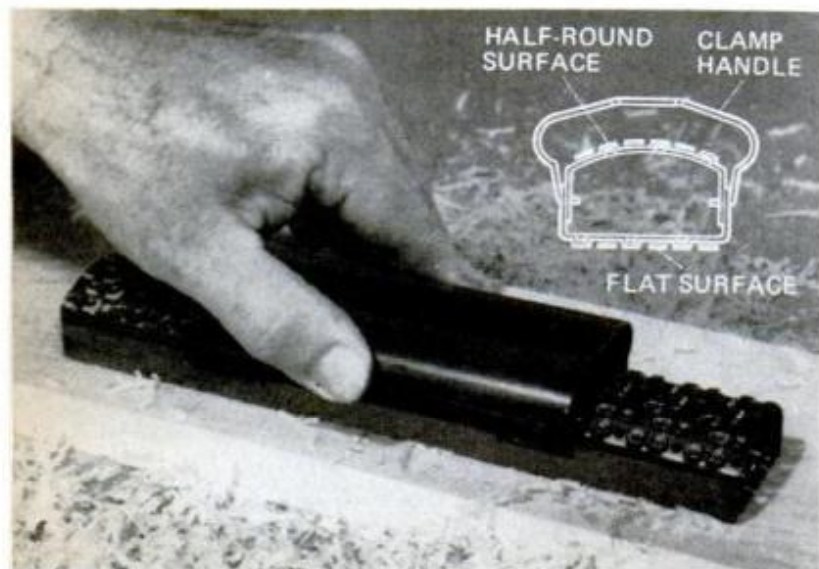
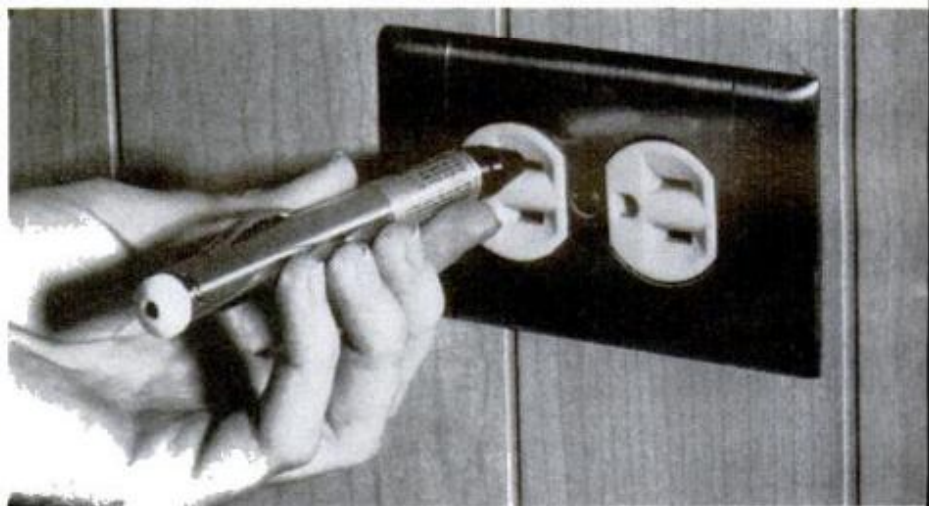


Inexpensive two-projector accessory allows versatility in slide-image control

Connected to two Kodak Carousel projectors with accessory outlets, Pro/Show Director provides professional effects, such as variable-speed dissolves, fade-in and fade-out sequencing, lap dissolves and flashing of secondary images onto an existing screen image or dark screen. Control permits up to 280 35-mm color slides without changing magazines. In a 3 x 5 x 6¼-inch case, the solid-state electronic system operates on a.c. house current. \$101.70 postpaid from Spiratone, Inc., 135-06 Northern Blvd., Flushing, N.Y. 11354.

Pocket tester detects bad grounds

Battery-powered pocket instrument with shirt clip detects improper grounding if light at end of device glows red when blade is touched to metal casing of equipment with three-wire plugs. For three-wire outlets, bad ground exists if *both* slots cause detector to glow when blade is inserted (right). Works on a.c. current from 6 to 220 volts. Price, without batteries, \$7.95. Simpson Electronics, 2295 N.W. 14 St., Miami, Fla. 33125.



Single hand tool works as both file and plane on variety of materials

New hand tool (left) combines multiple cutting edges of a file with shaving action and self-cleaning features of a plane. File-Plane has combination half-round and flat cutting surfaces, with reversible handle (insert). Cuts forward, backward or sideways on wood, auto body fiberglass, plastic laminate, dry-wall and plaster; also makes close cuts on inside square corners. \$4.95. Elgram Industries, Inc., 1840 North Hacienda Blvd., Suite 14, La Puente, Calif. 91744.



How small can a small car get?

One possible solution to city parking horrors and traffic congestion was presented earlier this year in Montreal. Experimental two-passenger urban car (below) is powered by a two-cycle, 12-hp engine, runs on gasoline, can travel 30 to 40 mph, weighs 950 pounds. Designed by General Motors of Canada, Ltd., this short-trip vehicle with a 52-in. wheelbase is being demonstrated by the firm's president, David C. Collier.



Lowest-priced Polaroid ever made

Press button and, zip, your photo is fully developed in one-half minute, needing no coating or mounting. All this from a \$13.95 camera, called Zip, the lowest priced instant-picture camera Polaroid has ever made. Camera uses a new Polaroid black-and-white eight-exposure film (Type 87) producing $3\frac{1}{4} \times 3\frac{3}{8}$ -inch pictures. Includes built-in receptacle for flash-bulbs. Film packs are about \$3.10.



Candle workshop for hours of fun designing and shaping your own candles

You can turn ordinary candles into original designs with this battery-operated candle crafter called Candle Workshop (left, below). Whirling lathe for easy-to-create carved candles has eight-position stop for vertical sculpturing effects and adjusts to candles up to 6 inches long. Traditional or contemporary designs can be highlighted with colorful wax inlays. Safe for use by children, the tabletop shaping lathe is run by four D-cell batteries. Kit includes five colored candle blanks, four double-end shapers, trim and center tool, plus detailed instructions and design ideas (left, top). Priced under \$18, less batteries. Gilbert Industries, Inc., Hagerstown, Md. 21740.



NOW



Cordless air freshener

Waring's Cordless Aire-Freshenizer emits an odor-eliminating scent at the press of a button (above) for about 15 minutes and then shuts off automatically. Battery-powered unit takes refill cartridges available in four scents. Price, about \$16 at appliance, hardware and department stores.



Travel iron is heated by bottled gas

Now you can "rough it" far away from any electricity wrinkle-free. English-made Tilley Iron uses bottled propane or butane gas as heat source. Appliance has gas regulator to reduce high tank pressure; hose and bracket attach to bottled gas container. For price and more information, write Maxitrol Co., 23555 Telegraph Rd., Southfield, Mich. 48075.



Built-in vacuum cleaner

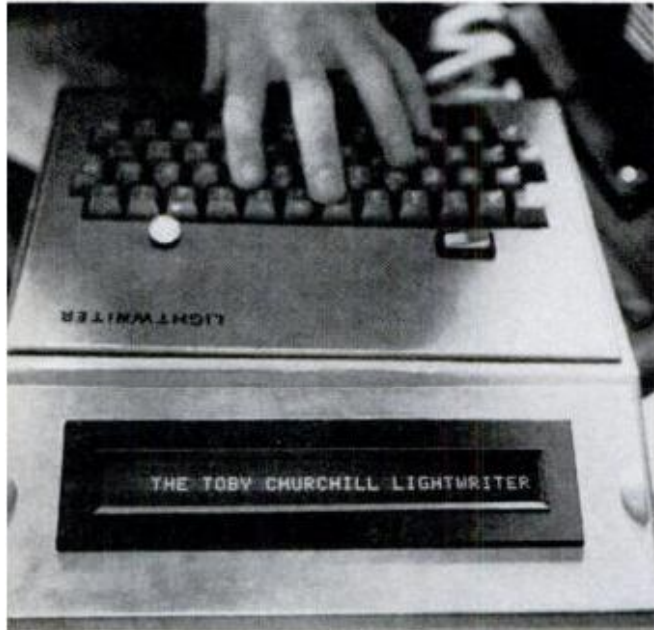
This built-in vacuum cleaning system is designed especially for do-it-yourself installation. Unit mounts in wall, is self-contained, requires no outside exhaust. \$149 with detachable hose, accessories. Wal-Vac, 2851 Buchanan S.W., Grand Rapids, Mich. 49508.



'Talking' typewriter helps the handicapped to speak

Persons unable to speak or hear can "talk" by means of this electronic aid called the Lightwriter. It consists of a typewriter keyboard connected to a lighted readout display. As keys are pressed, words show up on the moving display

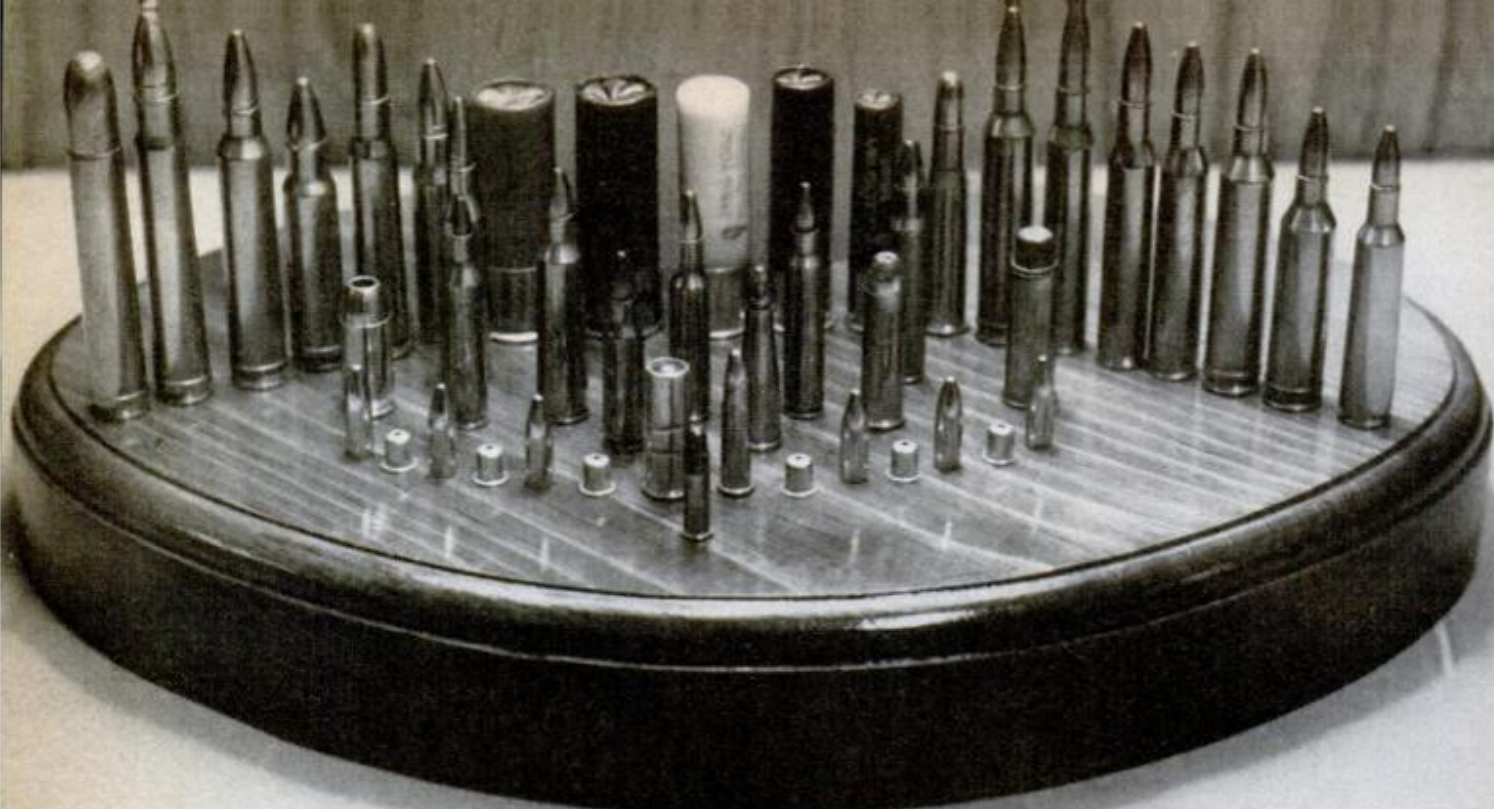
in front (left, below). Two persons facing each other can thus communicate by watching each other's display (right). The device, priced at about \$500, was developed by British engineer Toby Churchill, 20 Panton St., Cambridge, England.



Mammoth camper for pickups rides on its own 'third axle'

Said to be the roomiest and most extensively equipped pickup camper ever made, this Born Free Super Coach rides on a novel "third axle" that supports the rear end and allows it to extend beyond the back of the truck. The 20-foot-long cab-over body sleeps six and features full kitchen, shower, toilet, 41-gallon water supply, 3000-watt generator and 10,000-B.T.U. air conditioner. Because the rear end is always on the ground, the camper is easily detached by jacking up the front and driving the truck out from under it. Off the truck, it continues to provide living quarters, freeing the pickup for other uses. Prices from Dodgen Industries, Highway 169 North, Humboldt, Iowa 50548.





Projectiles for every purpose are available for the shotgun, rifle or handgun shooter for targets or afield.

How to choose the best cartridge

Pick the proper modern ammo and your rifle or pistol becomes more accurate and versatile.

by Tom Faulkner

Back in prehistoric times, one of our ancestors picked up a stone and threw it. At that instant the science of ballistics was born—the propulsion of an object by an initial force.

Since then, man's ingenuity has supplanted stones with spears, arrows, cannon and musket balls, and finally today's high-speed and amazingly accurate bullets.

The variety of self-contained cartridges and shells produced in the last century is astounding. Frank Barne's book, *Cartridges of the World*, lists 477 different types of rifle and pistol cartridges alone, current and obsolete. And the latest ammunition catalog of a leading American manufacturer has 198 separate loadings of shotshells,



Rimless pistol and revolver case



Metal case wad-cutter bullet



Lead wad-cutter bullet

Common terms

Cartridge: Complete unit consisting of brass shell casing that holds primer which, when struck by gun's firing pin, explodes and ignites powder, drives out bullet.

Shotgun shell: Similar to cartridge but has brass or steel base and body of paper or plastic. Ahead of primer and powder is projectile of many small pellets or single large "rifled slug" completely encased in shell.

Center-fire: A cartridge or shell with a separate component primer inserted into the center of its base.

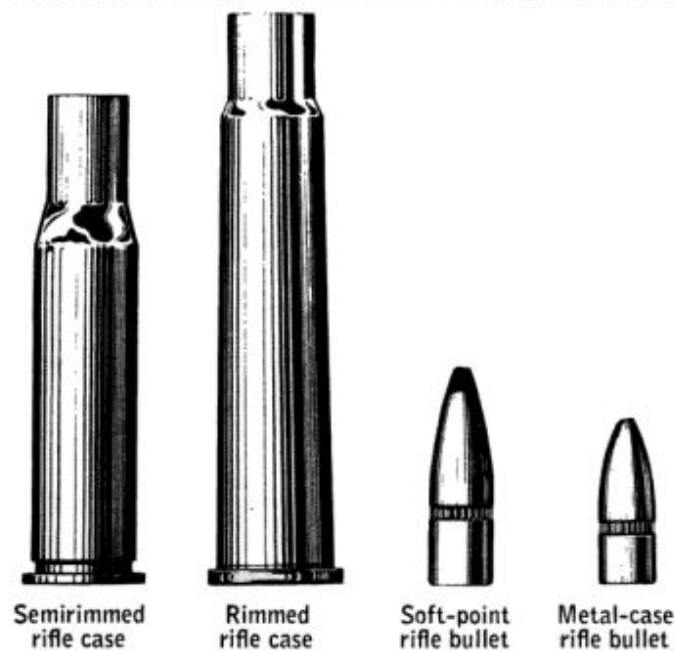
Rimfire: A small cartridge with primer mixture inside the outer rim of its base.

Caliber: Approximate diameter of a bullet in fractions of an inch or millimeters. Also used to designate a specific cartridge: e.g., the .30-30 and .30-06 are different cartridges of the same caliber. One millimeter equals about .04 inch so a 6-mm cartridge is about .24 cal.

rifle and handgun cartridges, including 46 different center-fire rifle calibers. To understand modern ballistics related to small arms, and how to pick the perfect shell for your requirements, you'll need to know some of the basic terms given below.

Rimfire cartridges. Low in cost, mild in report, with virtually no recoil, the .22-cal. rimfire is the best buy for simple plinking, training of beginners, practice and serious target shooting or small-game hunting. While there are over a dozen types, you need but five for all kinds of shooting. These are the .22 Short standard velocity for indoor ranges or short-range plinking; the .22 Long Rifle standard velocity for all rifle and pistol plinking and target practice; the .22 Long Rifle standard velocity in rifle or pistol match grade for serious target shooting; and the .22 Long Rifle high-velocity hollow point for small-game hunting.

Center-fire rifle cartridges. Current center-fire rifle ammunition can be divided into three general groups for hunting purposes:



Semirimmed rifle case

Rimmed rifle case

Soft-point rifle bullet

Metal-case rifle bullet

small game such as woodchucks, foxes and bobcats; medium-sized game including deer, antelope, mountain goats and sheep; and big game, covering such North American species as caribou, elk, moose and bear.

While varmints can be hunted with any caliber, the small target and frequent long ranges involved make high velocity and flat trajectory more important than bullet size or energy. Best choices are found among the many modern .22 center-fire cartridges, particularly those with muzzle velocity of 3200 feet per second or better. These include such fine performers as the .222 and .223 Remington (200 to 250 yards), .225 Winchester and .22-250 Remington (200 to 300 yards).

Medium game requires larger calibers (between 24 and 30), and heavier bullets (100 to 180 grains). For long-range hunting of antelope, mountain goats and sheep, high velocity and flat trajectory are critical. Good choices here are the .243 Winchester and 6-mm Remington (both 24 cal.), .25-06 Remington, 6.5-mm Remington Magnum and .264 Winchester Magnum (both 26 cal.) and .270 Winchester. Many deer hunters prefer larger calibers and heavier bullets. The old .30-30 is still dependable for short-range Eastern hunting. Better all-around choices for all ranges include the .280 Remington and .30-06 and .308 Winchester.

North American big game dictates still heavier bullets (175 grains and up) and plenty of wallop in the form of high energy. Two powerful versatile calibers are the 7-mm Remington Magnum and the 300 Winchester Magnum. For the very large dangerous Alaskan brown bear, the 375 H&H Magnum should be considered. Shoulder-bruising blockbusters like the 458 Winchester Magnum are appropriate only for African game in the elephant and cape buffalo class.

Center-fire handgun cartridges. Virtually any handgun caliber can be used for plinking and small-game hunting. But for medium-sized game, only heavy calibers such as the .357 Magnum, .41 Magnum, .44 Magnum or the new wildcat cartridge, the .44 Auto Magnum, should be used—and then only at ranges within 100 yards.

Long standard for law enforcement use, the .38 Special is being replaced by some agencies with the heavier .357 Magnum. Another recent trend involves use of hollow-point bullets. Some public objections have surfaced as a result, based on lack of understanding of what is involved. Law offi-

Gauge: For shotgun shells. Originally the number of lead balls with same diameter as barrel that would make a pound. Smaller barrels are larger gauge. However 410 is actually .41 cal. and 67½ gauge.

Muzzle velocity: Speed in feet per second of bullets or pellets as they leave end of barrel.

Muzzle energy: Product of velocity and weight of bullet as it leaves muzzle, expressed in foot-pounds.

Trajectory: Flight curve of bullet since gravity causes it to begin dropping the instant it leaves the barrel. To strike a target at any distance, a bullet must head for a point higher than the target to compensate for "drop." The greater the velocity, the flatter the bullet's trajectory curve will be.

Wildcat: Modified cartridge designed by a private experimenter. Not produced commercially.

cers are trained not to draw and fire a gun unless the situation calls for such drastic action to protect their lives and those of others. The .38 Special has often proved inadequate against armed and dangerous criminals—resulting in the wounding or killing of policemen and others. Common sense dictates that our police protectors be armed adequately to carry out their duties. Hollow-point bullets, by reducing both penetration and ricochet, lessen danger to innocent bystanders and increase safety for the general public.

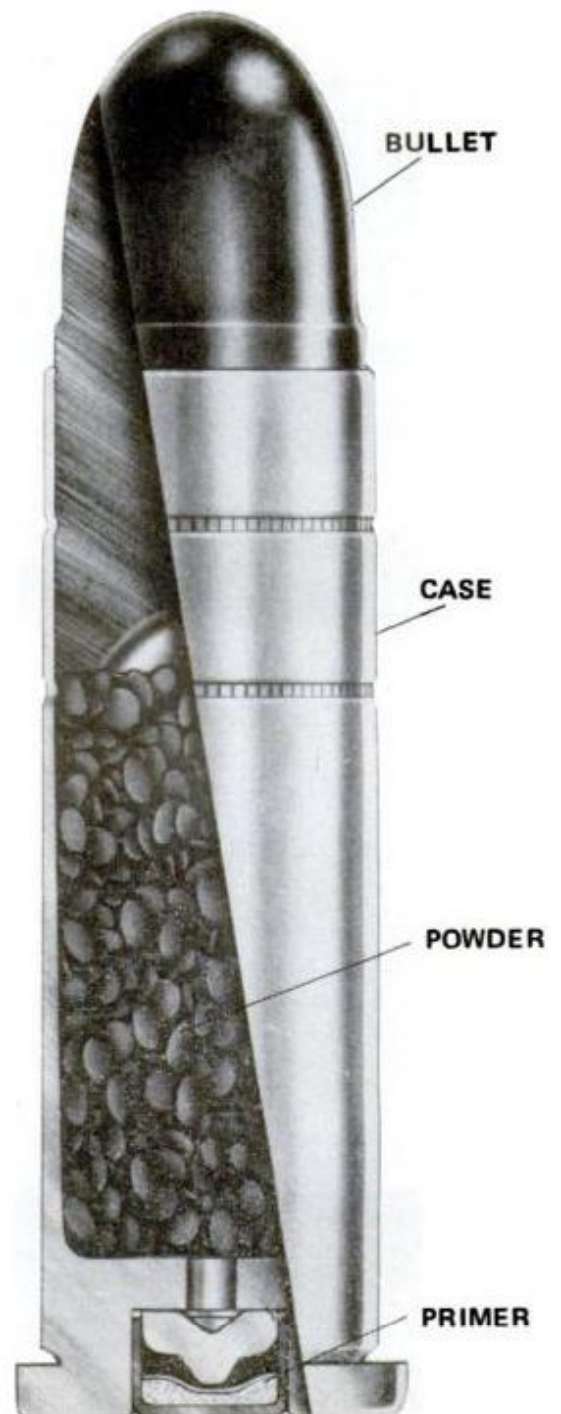
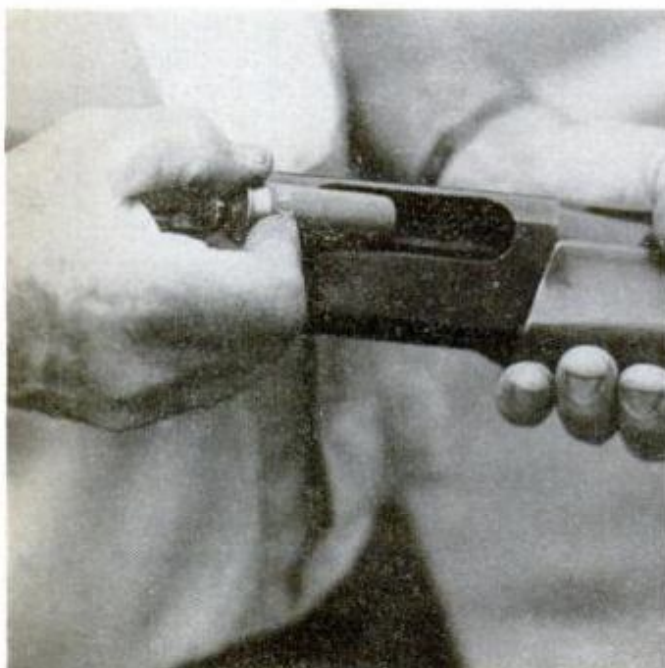
A number of special-purpose cartridges with wax or plastic bullets for inexpensive

indoor target practice, and shotshell loads for snake and rodent control, are available. Handloaders, particularly, can use these to advantage.

Shotgun shells. Common gauges today are the 12, 16, 20, 28, and 410, plus a small number of 10-gauge guns for long-range waterfowling. Shell boxes often have a confusion of large numbers plus small words that tell you what you're buying. The numbers show gauge; shell length— $2\frac{3}{4}$ inches for standard shells, 3 inches for magnums; powder equivalent related to old black-powder loads; weight of shot in ounces; and size of the shot. For example, a stan-



Shotgun shells with bodies made of plastic today in place of cardboard keep powder dry in the field and insure dependable patterns. Magnum three-inch long-range shells can be used in guns chambered for them.



CENTER-FIRE PISTOL CARTRIDGE

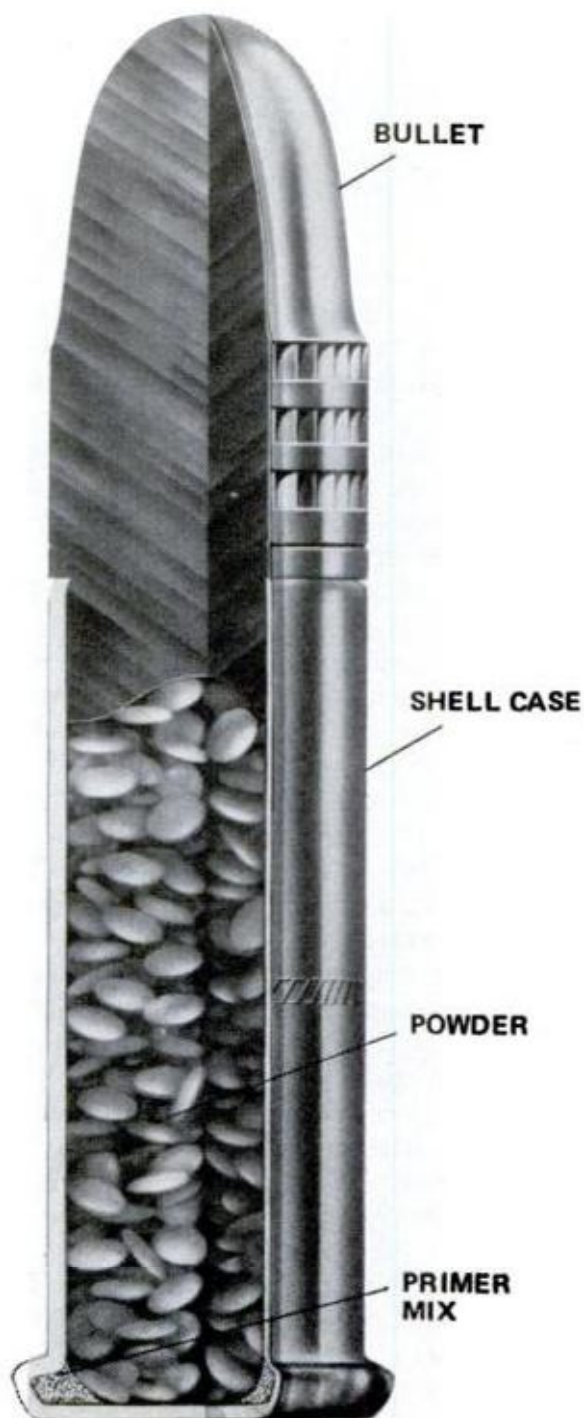
ard hunting load of "3¾—1¼, 6s" simply means 3¾ ounces of powder equivalent with 1¼ ounces of No. 6-size shot.

The rule in choosing shotgun shells for hunting is "bigger bird, bigger load and heavier shot." Some very expert gunners may be able to use small gauges, but the 410 is too light for hunting and should be reserved for the ultimate challenge in skeet shooting. Check this year to find if steel shot is now required in your area.

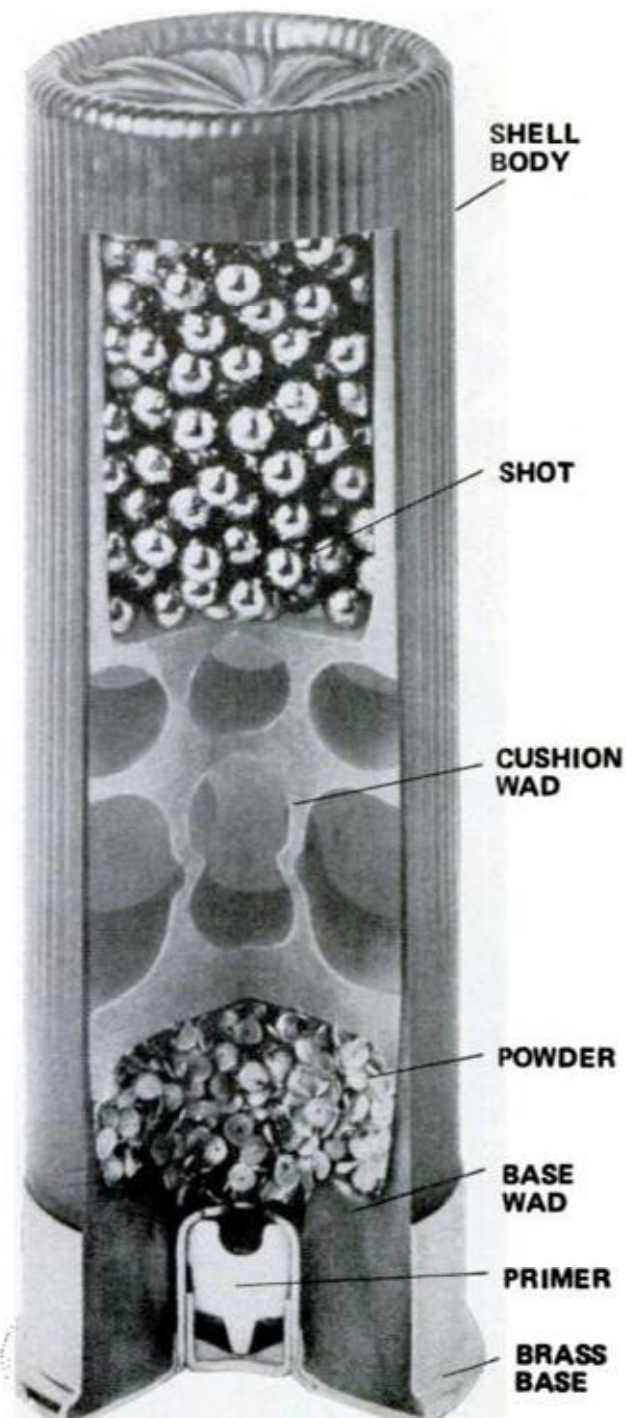
As a final note, consider today's rising costs. Reloading of ammunition, learned by working with an experienced handloader, can cut your costs by more than half. ★ ★ ★

Author's 10 favorite rifle calibers

- .22 Rimfire:** Economical and fun in rifle and pistol plinking, target shooting, very small game.
- .222 Remington:** Ideal for varminting and bench-rest shooting.
- 6-mm Remington and .243 Winchester:** Best combination varmint and deer calibers.
- .25-06 Remington:** Choice for all Western United States game up to deer.
- 7-mm Remington Magnum and 300 Winchester Magnum:** For all North American big game except Alaskan brown bear.
- .30-06 Springfield:** Most versatile caliber for all game in the United States. Best choice for the one-rifle hunter.
- .308 Winchester:** Excellent all-around deer caliber.
- .375 H&H Magnum:** Solid security for the largest and most dangerous North American game.



RIMFIRE SHELL



SHOTGUN SHELL

Modernize that old minibike

A new motorcycle engine can turn that worn-out, garden-variety machine into the hottest bike in the neighborhood!

By Doug Richmond

Photos by the author

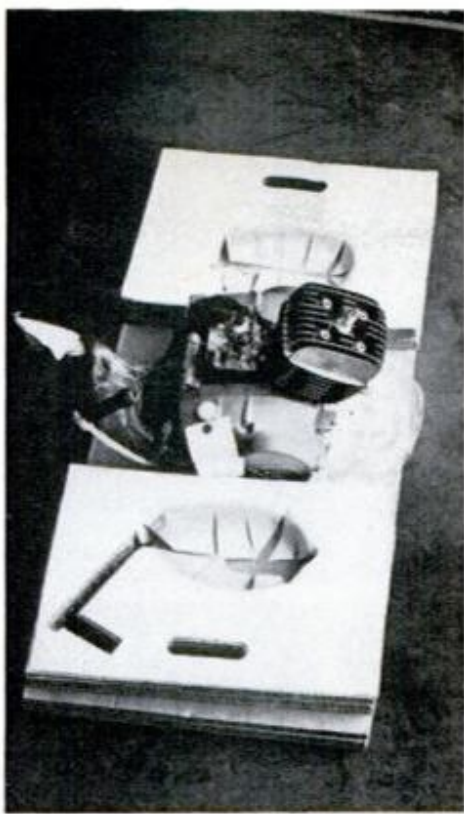
There are countless minibikes sitting in basements and garages because of worn-out engines or power trains. These bikes are equipped with industrial-type power plants and torque-converter transmissions. They've caused so many problems that they're regarded as more trouble than they're worth.

Most of these old minibikes have perfectly usable chassis, and would require only new engines with motorcycle-type transmissions to turn them into exciting "new" machines. The problem with doing this has been in the mounting: Motorcycle engines are specifically designed to be installed in a given chassis, and putting one in a different frame can be well-nigh impossible. Recently, however, Pacific Basin Trading Co. (the Hodaka people) introduced the Fuji "Phoenix," a new engine that was designed with a universal-mounting system.

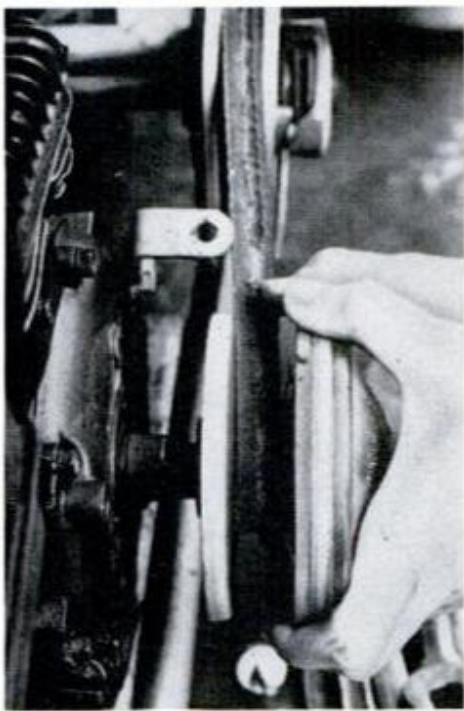
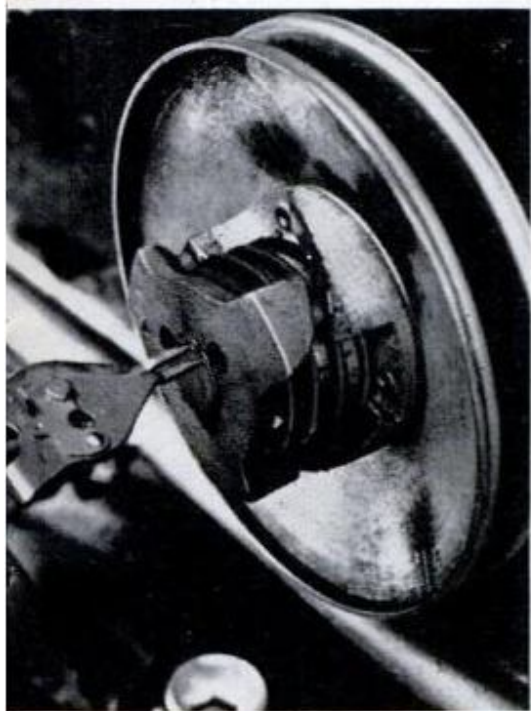
I bought a Phoenix F480, an 80-cc engine with a four-speed transmission, added a Taylor Products Model 800 muffler and installed them in a Bonanza chassis. Total installation time was about eight man-and-boy hours. Although there is an almost infinite variety of minibike designs, this chassis is pretty much typical of the platform-frame bikes.

With two-cycle engines such as the Phoenix, maximum power is obtained by means of an expansion chamber—one of the finest noise generators devised by the mind of man! In this installation we were primarily interested in a tractable, *quiet* machine,

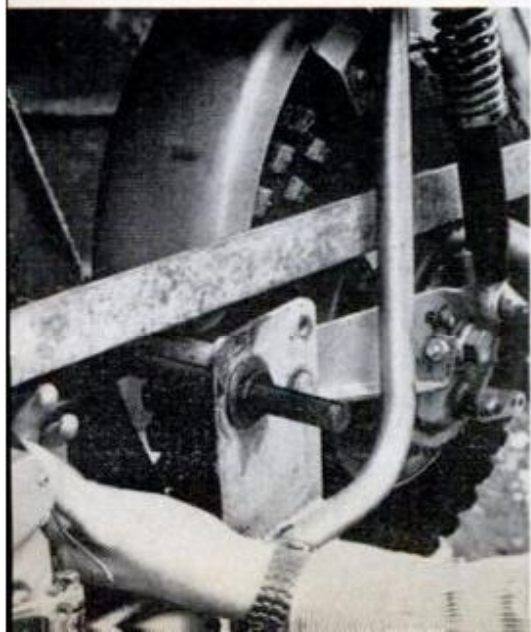




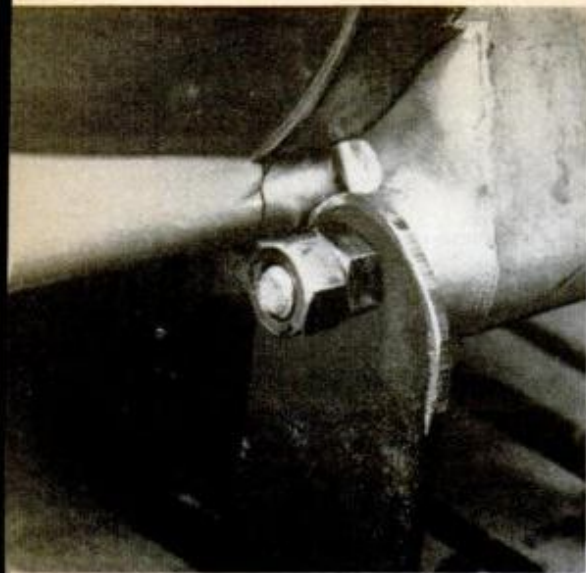
New engine that adapts easily to platform-frame minibikes is the Phoenix F480 from Hodaka. The 80-cc two-stroke is complete with four-speed transmission and compactly packaged. All you do is add a muffler and exhaust system and route it appropriately for your machine. The F480 engine, about \$200 plus freight and handling, can be obtained at your local Hodaka dealer or distributor. For the one nearest you, write to Hodaka Motorcycles, Box PM-327, Athena, Ore. 97813.



Remove old engine from the minibike frame. At far left, the torque converter is being readied for removal. After all hardware is loosened and taken off, pull the unit off (left). Clean up the frame and possibly paint it before mounting the new engine.

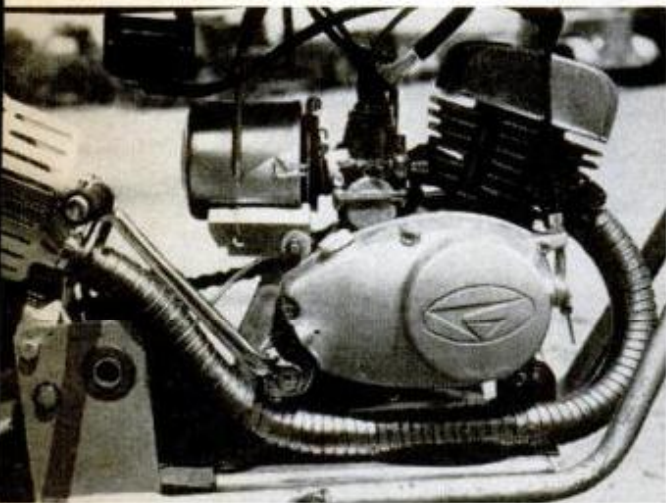


Engine mounts are shaped on a grinder (left) as necessary before you install the new engine. Align the new mill before tightening it in place: With rear wheel centered in the frame, align the sprockets. Check chain clearance with a straightedge or yardstick as shown at far left. Allow at least $\frac{3}{4}$ -inch clearance between the drive chain and swing-arm cross member.



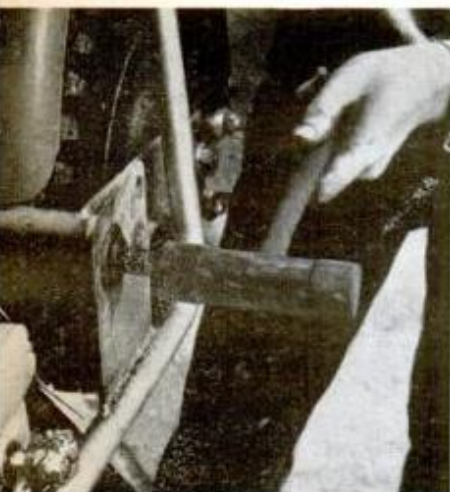
Engine mounts (shown at far left) should have all edges rounded. Note double-nutted mounting bolt. Engine mounting bolts should be double-nutted or secured with Loc-tite.

In-line fuel filter (near left) should be used with all minibikes since bikes are usually refueled from cans, often under undesirable conditions.



Exhaust pipe was fashioned from flexible steel tubing (far left). Always run the exhaust tubing along top of the frame, never underneath it where it would be damaged easily.

Repair links often fail because they're installed dry. At left, master link is lubricated with a Teflon-moly compound before chain is installed.



Old jackshaft can be left on the minibike, but if there's a possibility it may be used again, knock it out with a soft hammer, as shown at far left.

Conversion complete, minibike is ready to ride. Note that the 0.4-gallon fuel tank is secured to the frame with silver duct tape, a practice common in motorcycle racing.

rather than having a super-fast, noisy one.

If you do the job, the toughest part will be with the exhaust pipe. The average automotive muffler shop is unable to cope with the 1¼-inch inside diameter pipe. We solved that by using flexible-steel exhaust tubing, obtainable at industrial-equipment outlets and better auto parts houses. Its only disadvantage is that it is not oil-tight and rather messy, although it seals itself fairly well after use.

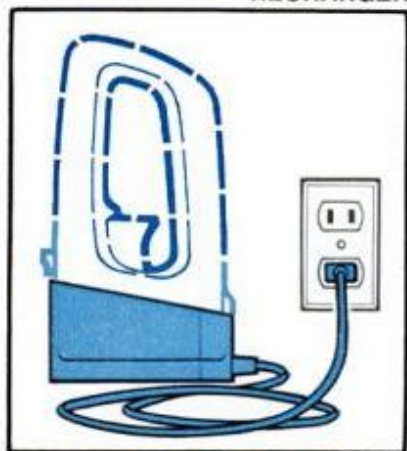
Most minibikes had jackshafts in a cross-

over configuration, that is, power input on one side—usually the left—and output to the rear sprocket was on the other. When installing a Phoenix, every effort should be made to eliminate the jackshaft as a power-waster and maintenance headache. Usually the rear wheel can be turned around and the sprocket installed on the left side.

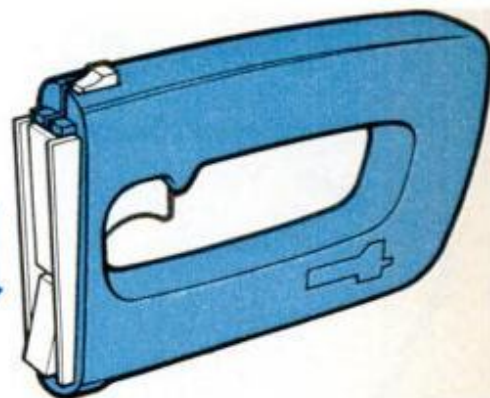
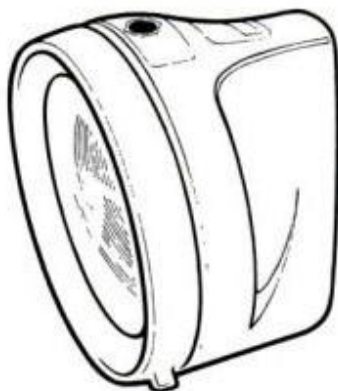
You can put the brake mechanism on the left, or just eliminate the rear brake. I prefer the latter and accomplish rear-wheel braking by downshifting the engine. ★ ★ ★

One power handle drives variety of cordless tools

RECHARGER

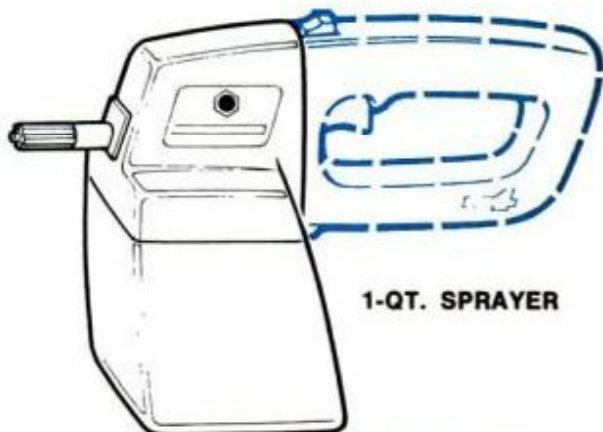


SEALED-BEAM LANTERN



ENERGY PAK

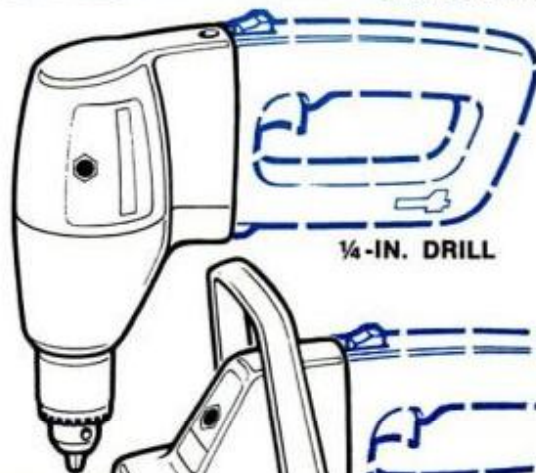
Black and Decker Manufacturing Co. has introduced what it calls the Mod (modular) 4 system designed to lower the cost of cordless power tools significantly by the use of one power source. Once you buy a single cordless tool, whether it be a drill, grass shear, shrub trimmer, garden sprayer or sealed-beam lantern, from then on you need only buy tool heads. The initial tool comes with a removable energy pack that can be interchanged from one tool head to another. If your first Mod 4 tool is a drill, for example, and you now want a shrub trimmer, you buy just the trimmer without its power pack handle. The initial purchase includes a 16-hour battery charger to recharge the handle. Mod 4 tools are to be available at hardware stores in early spring. —Wayne C. Leckey, *Home and Shop Editor*



1-QT. SPRAYER



GRASS SHEAR



1/4-IN. DRILL



SHRUB TRIMMER

Art: Peter Trojan

An end to trailing cords, raggy edges and an aching back



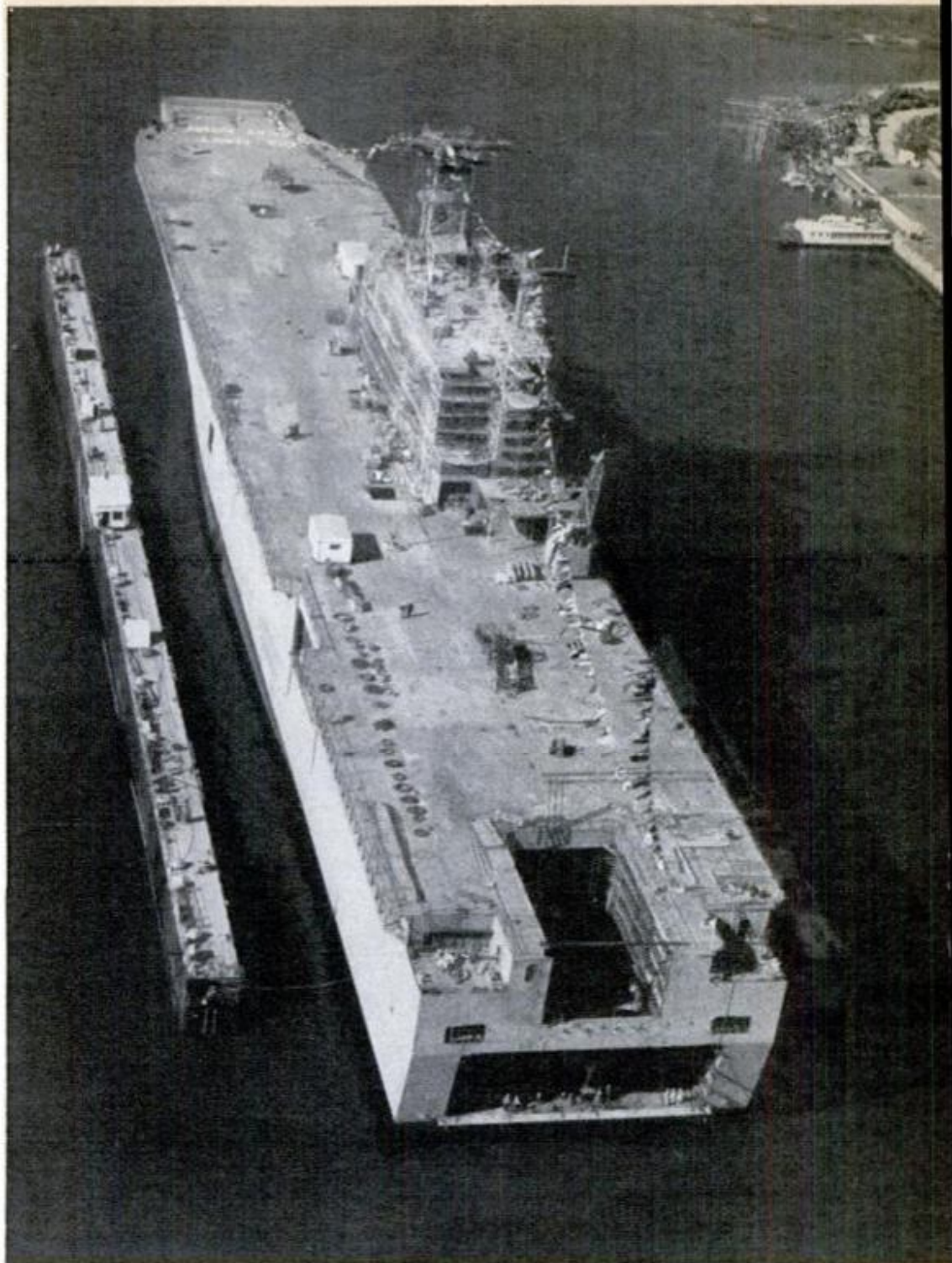
To save your aching back, there's a unique concrete mixer for do-it-yourselfers that lets you mix over 100 pounds of concrete in as little as two minutes simply by wheeling it around like a cart. Called Roll-a-mix, it has a one-piece, 20-in.-dia. drum molded of high-density polyethylene and fitted with a tire to make it serve as one of the wheels. A British product, it's \$59.50 postpaid from the U.S. distributor, Tri-ment Co., 1018 Bloomfield Ave., West Caldwell, N.J. 07006.

For manicuring the edges of walks and around trees, fences and shrubs, Rockwell now offers a two-in-one lawn tool that you can convert from an edger (top right) to a rotary trimmer (bottom right) merely by rotating its head 90°. Tool comes with 6¼-in. blade and 2.4-ampere motor turning 13,000 rpm. It weighs only 7½ lbs., is double-insulated, has a long handle for painless no-stoop trimming. Price: \$29.99.



Use-it-anywhere cordless drill by Rockwell International (above) with special keyless chuck and built-in battery charger makes its debut in time for Christmas. A sliding thumb-button locks the spindle for tightening or loosening the ¼-in. chuck by hand. When it's fully charged, the nickel-cadmium battery pack in the drill's handle provides enough power to drill 50 ¼-in. holes in a fir 2x4. The drill, weighing less than 2 pounds, comes with break-resistant housing and "ray-gun" design. It sells for \$26.99, including the recharging cord.





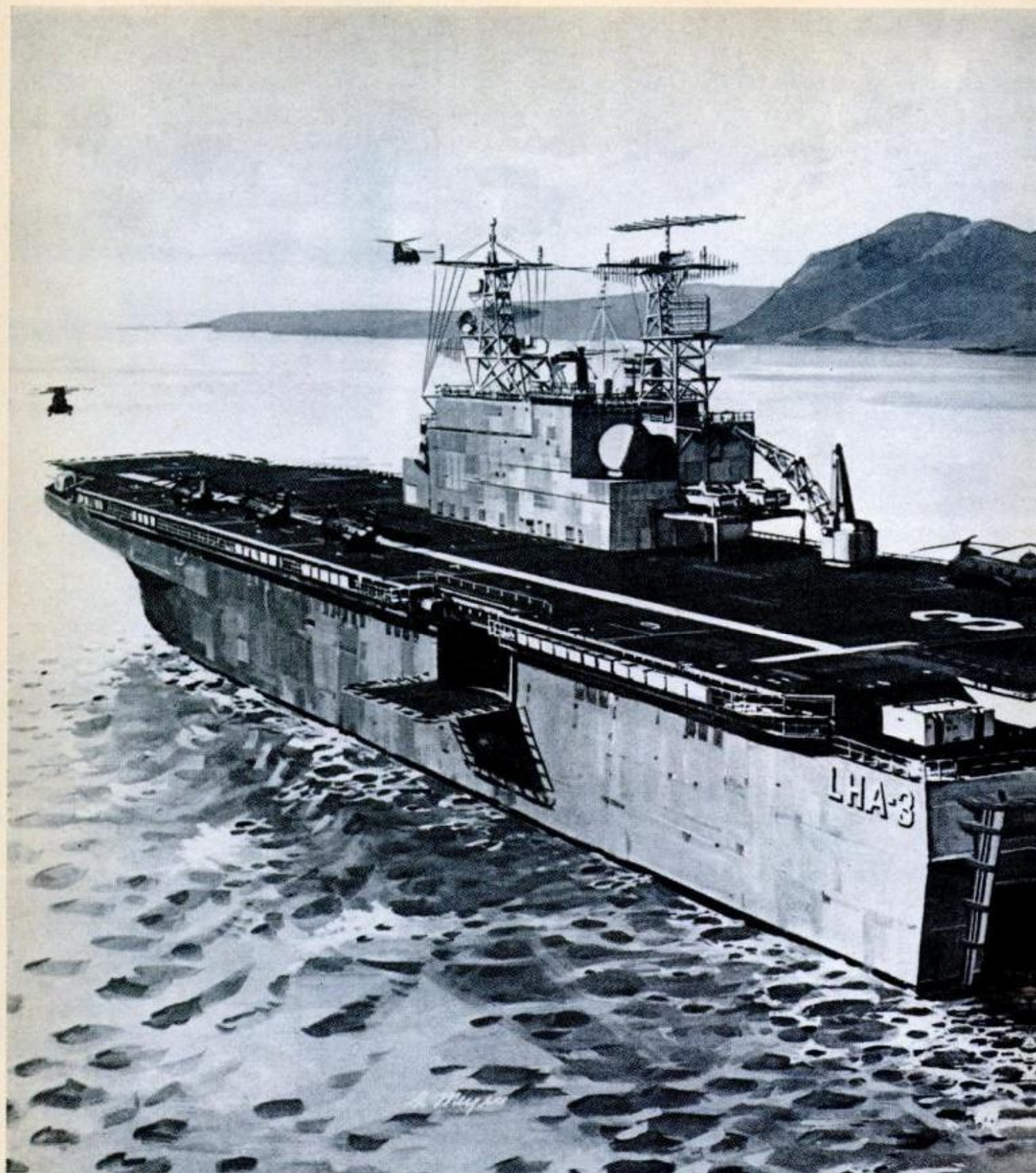
Only slightly smaller than a modern aircraft carrier, Navy's new LHA assault craft, shown nearing completion at right, has 820-foot-long flight deck for helicopters and jets and can simultaneously launch troop and tank-carrying barges from water-level stern well. It displaces 39,300 tons, is 20 stories high, has 800 crewmen.

The Navy's big new beachhead buster

This mammoth do-anything assault craft can smash an enemy with guns, planes, tanks and troops—all in one massive, mighty blow.

by Mort Schultz

Imagine everything going off at once—like a Fourth of July fireworks display—and you'll have a small idea of what it will be like when the Navy's mighty new



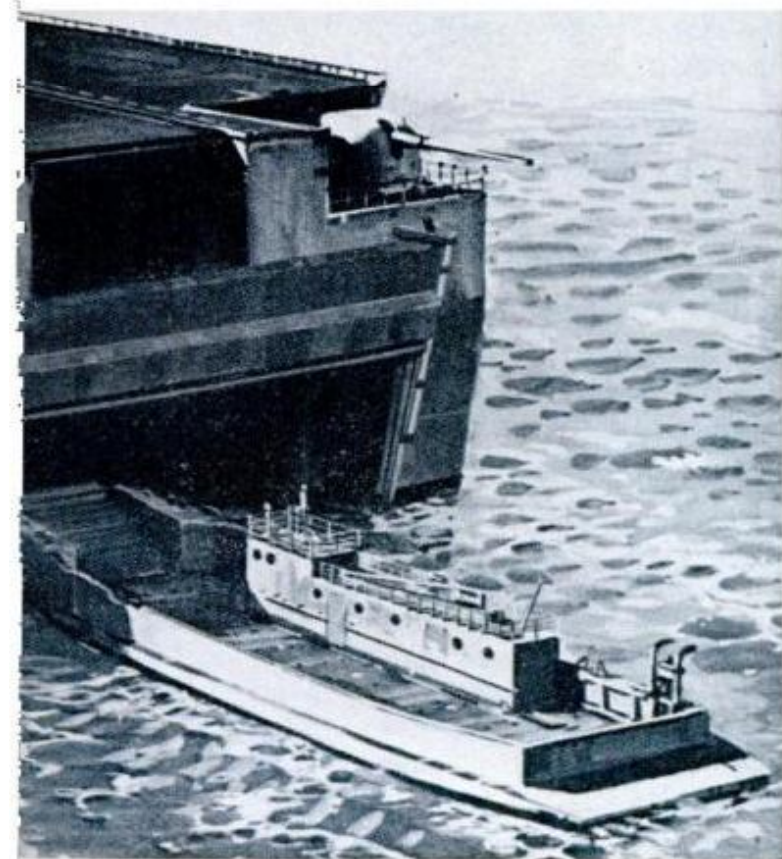
beachhead assault ship goes into action. Virtually a one-ship task force, she's like nothing any navy ever had before. Huge troop-carrying helicopters leave her flight deck for an enemy-held beach. Jet fighters streak shoreward to cover their landing. At the same time, giant doors in the ship's stern swing open to disgorge fast-moving amphibious landing craft filled with troops, tanks, trucks, artillery pieces, even bull-

dozers—everything needed to take and hold a beachhead. While all this is going on, antiaircraft batteries, deck guns and missile launchers blast away at any would-be attackers to protect the invading force.

That's the LHA—a new concept in warships for a new kind of warfare. As our permanently based overseas forces are being reduced in number, the need for a fast, mobile strike force that can hit anywhere



How LHA will go into action is depicted in artist's concept at left, showing simultaneous launching of helicopters from flight deck and landing craft from floodable docking well at stern. Above is bow view.



from long range becomes increasingly more urgent. The LHA—for "Landing Helicopter Assault"—was developed just for this purpose. A combination floating airfield, mobile military base, troopship and high-speed amphibious assault vessel all rolled into one, she can be deployed at a moment's notice to any part of the world where U.S. forces are needed. According to Marine Commandant General Robert E. Cushman

Jr., she will be the backbone of our amphibious forces for the rest of this century.

There are 60 other amphibious assault ships in our present fleet, but none like the LHA. Some launch helicopters. Some deploy landing craft. And some transport equipment and supplies. None, however, does all these things at once. The LHA can—she puts it all together for the first time—and that's why she'll become one of the most versatile, all-purpose ships in the Navy.

The first LHA is scheduled to begin sea trials this month, and four more will be built over the next two years. The initial craft, LHA-1, will be named the USS *Tarawa* after the bloody 76-hour World War II battle in which more than 3300 U.S. Marines were killed and wounded. The other four sister ships will be LHA-2, the USS *Saipan*; LHA-3, the USS *Belleau Wood*; LHA-4, the USS *Nassau*; and LHA-5, the USS *DaNang*.

The LHA will be among the largest ships in the fleet, second only to our newest, most modern aircraft carriers. She is, in fact, bigger than the *Essex*-class carriers of



Largest man-made object ever to be moved on land, the first nearly finished LHA is rolled sideways from her construction site (top photo) onto launching platform (bottom photo)—a distance of some 50 feet. The huge vessel, weighing 19,500 tons, is transported on a complex system of wheels and rails. At launching time, the drydock-like platform will be flooded and the ship floated off for completion of outfitting and start of sea trials. The USS *Tarawa* shown here is one of five such mammoth LHAs scheduled to be built for the Navy during the next two years.

World War II. Fully loaded, she displaces 39,300 tons, is 20 stories high and carries a crew of 800. Her 820-foot flight deck—nearly three football fields long—is capable of launching nine giant troop-carrying helicopters at a time. As soon as these are in the air, a second wave of nine more can be sent off, followed by still another. These mammoth copters will be of the CH-46D Sea Knight type or the CH-53D Sea Stallion. The Sea Knight carries 17 troops, the Sea Stallion 36. Both can also transport vehicles and artillery.

In addition to troop copters, the LHA can launch jet aircraft for close-in air support as well as gunship attack copters of the UH-1 Huey type, equipped with machine guns and rockets. She can also handle the AV-8 Harrier, the British-built vertical-takeoff attack jet now being adopted by the U.S. Marines.

Below decks, even stranger and more startling things happen. A gigantic well in the stern 78 feet wide by 268 feet long is flooded to bring the water level inside up to that of the surrounding sea outside. Then the stern opens up like a gaping mouth and out pour streams of battle-ready landing craft swarming toward shore.

An elaborate system of ramps and elevators interconnecting various deck levels inside the ship enables tanks, armored vehicles, artillery pieces and other equipment to be moved quickly from parking berths to the launching well and rolled right onto the waiting landing craft. As each landing craft reaches the beach and unloads, it returns to the ship for fast reloading of more troops, vehicles and supplies. The troop-carrying helicopters can also return and reload, making repeated assaults in rapid succession. This way, the LHA can keep a steady procession of landing craft and troop copters roaring toward the beach with fresh men and materials.

Inside the LHA there are more than 1½ acres of parking space for tanks, vehicles and artillery. Other supplies, such as food rations, ammunition and drinking water, are prepacked onto one-ton pallets for rapid movement to the launching well on nine elevators, two conveyors and an overhead monorail. The largest landing craft the LHA can accommodate is the 135-foot LCU, which can carry three 60-ton tanks to a beach. Each LHA has three LCUs plus assorted smaller landing craft.

All together, an LHA can simultaneously

launch enough troop-carrying copters and landing craft to put an entire 1800-man armored battalion on an enemy beach at one time. To protect herself, her own armament consists of three 5-inch deck guns, six 20-mm machine guns and two 8-cell rocket launchers that fire the Sea Sparrow anti-aircraft missile.

The island superstructure that towers above the flight deck of the LHA houses a combat control center that's the last word in computerization and communication facilities. Here is where the gun and missile fire of escorting ships is controlled and coordinated to bring an enemy under withering attack from all directions. Here, too, is a centralized air traffic control system to direct all aircraft in the combat zone.

The LHA's ability to launch a coordinated, concentrated and extremely swift and lethal sea and air attack all from one ship gives a commander extraordinary flexibility that can keep an enemy constantly surprised and confused. He can order an air assault, landing troops and equipment by helicopter many miles inside enemy territory. Or he can order a frontal assault on a beach by landing craft. Or he can order both at the same time, hitting an enemy front and rear.

When landing craft return to the ship from a raid, they enter the flooded launching and docking well, the stern doors close, and the well is pumped dry. As the water recedes, the craft come to rest neatly and securely on the floor of the well.

Unlike those who manned World War II-vintage assault craft, men stationed aboard the vastly bigger LHA will live in relative luxury. Living quarters are spacious and comfortable, and there are many recreational facilities, including a game room, hobby shop and library. The ship has an airconditioning capacity of 1200 tons, suf-

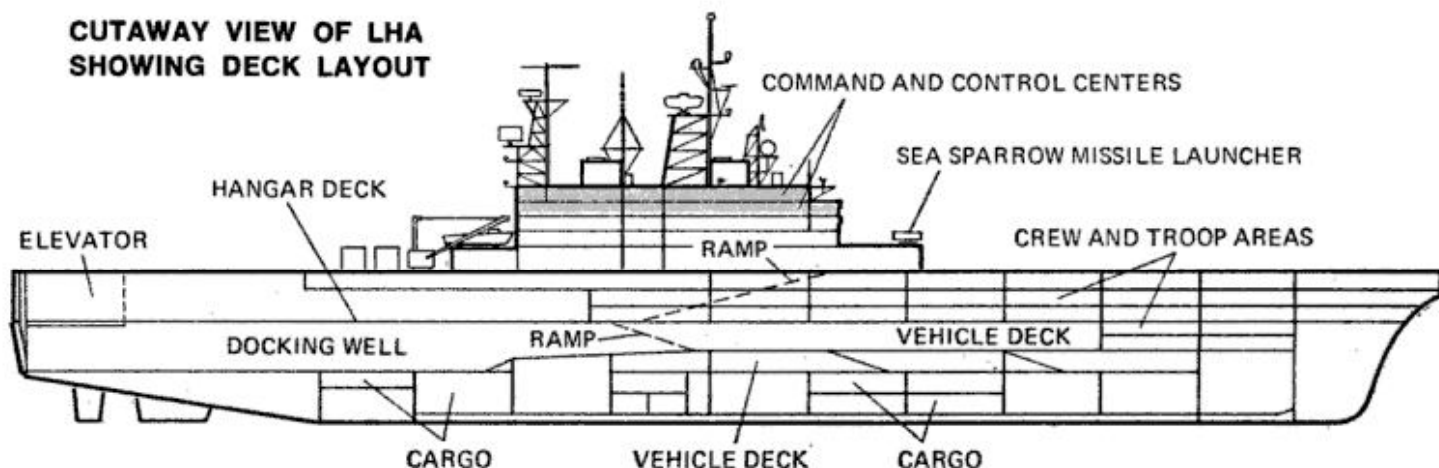
ficient to serve 500 homes. She can distill 140,000 gallons of seawater daily for drinking—enough to meet the needs of 6000 people—and her electric system generates enough current to light 11,500 homes.

The LHA's main engines—two giant steam turbines each turning two 16½-foot-diameter propellers—develop a total of 140,000 hp, equivalent to the combined power of 700 average-size cars and enough to drive the ship at a sustained speed of more than 20 knots. The boilers generating steam for the engines are among the largest made in the United States and have enough capacity to supply electric power for a city with a population of 160,000. There's also a 900-hp bow thruster to steady the bow of the ship in rough seas and permit tight-radius turning maneuvers in combat.

Each LHA carries a price tag of approximately \$231 million, not including her aircraft, making her the most expensive amphibious assault ship ever built. But if this seems high, it must be remembered that a good part of the heavy cost will be offset by eventual savings gained through the reduction of permanently based overseas personnel the LHAs will make possible.

Also, the LHA is not only a ship of war; she is a ship of mercy, too. In times of natural disasters, such as floods, earthquakes, famines and violent storms, the LHA can be sent anywhere in the world to help rescue victims and provide food and medical aid. Her 300-bed sickbay can accommodate more patients than many city hospitals. Included in it are four operating rooms, two X-ray rooms, a blood bank, three dental operating rooms, a physiotherapy room and a well-stocked pharmacy capable of providing care for thousands. So in peace or war, the remarkable LHA promises to be one of the most useful and effective vessels our Navy has ever had. ★★★

**CUTAWAY VIEW OF LHA
SHOWING DECK LAYOUT**



Trim the fat from your vacation slide shows

by Ivan Berger
PHOTOGRAPHY EDITOR

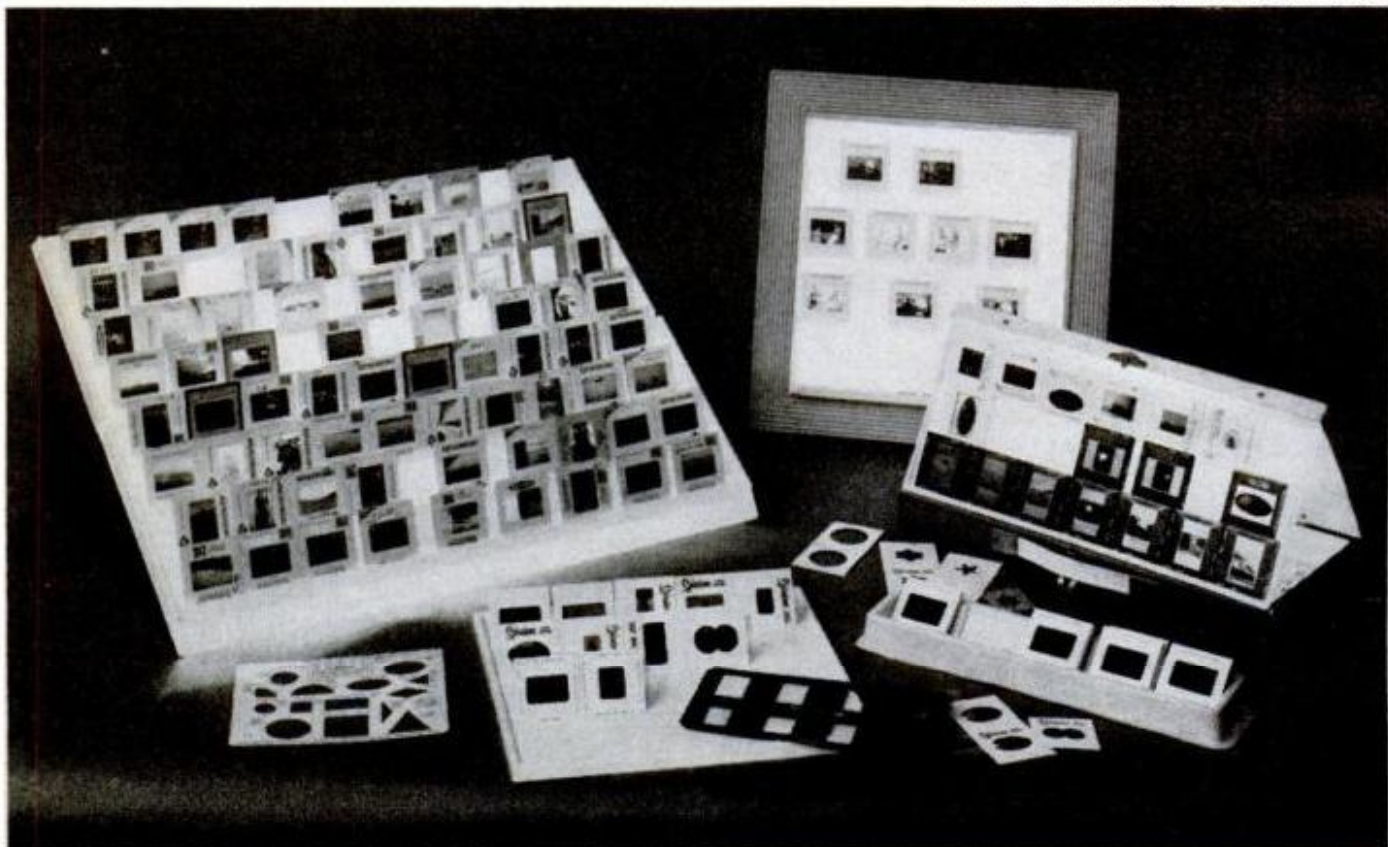
Light boxes to help you weed out the bad slides from the good, and special mounts that help you crop excess or undesired areas from your slides make your shows more interesting. Shown here, left to right, are Harwood 80-slide editor (\$13), Richard Idealite daylight-colored lightbox (\$29 with optional 35-mm slide rack shown), Smith-Victor 21-slide folding editor with slide bin (\$7). Indemar flat viewer in foreground (\$2) holds cropped slides in Spiratone mounts; Smith-Victor holds slides in Erie and Heindl mounts (top row), GePe glass mounts (bottom row), GePe mounts with Heindl Maskins (center row). White plastic cropping guide (left foreground) is from Heindl; dark one (center) from Erie Slide Club.

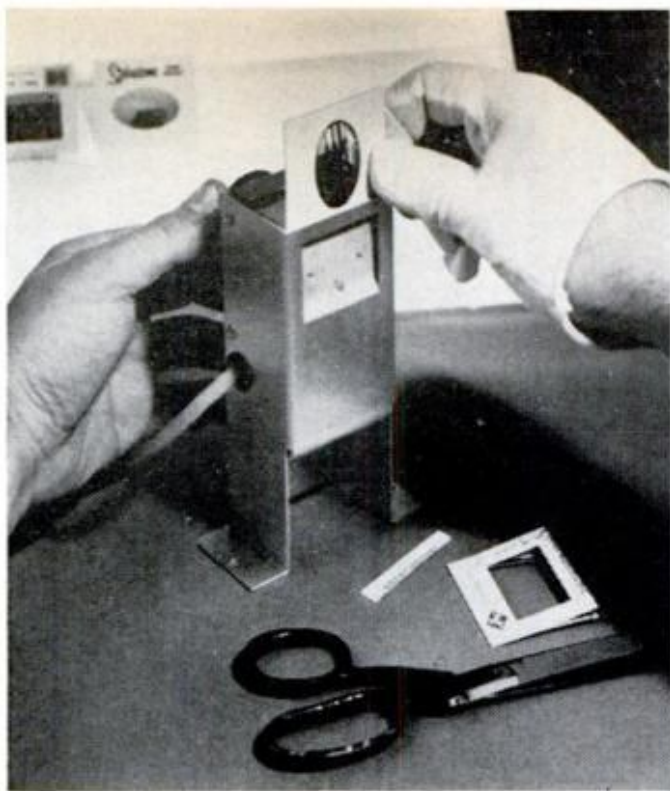
When was the last time you *really* enjoyed somebody else's slide show? Now ask yourself when was the last time others really enjoyed one of yours. If the answer makes you squirm uncomfortably, cheer up—a little intelligent thought, planning and ruthless pruning of the slides you show can give you slide shows that can compete on favorable terms with TV shows (the reruns, anyway).

The first step is to go through your slide shows with a stranger's eyes. The slides that are crammed full of memories for you but would look dull to others have to go. So do the slides you just goofed up "a little"—these may be under or overexposed, out of focus, tilted, or with distracting backgrounds or extraneous areas in the frame; but save those slides—there are ways you can salvage them.

Showing a slide is not the same as running a slide show—a complete show consists not just of sparkling images, but of images in some coherent sequence. For your vaca-

Photos: Kal Weyner; slides by the author





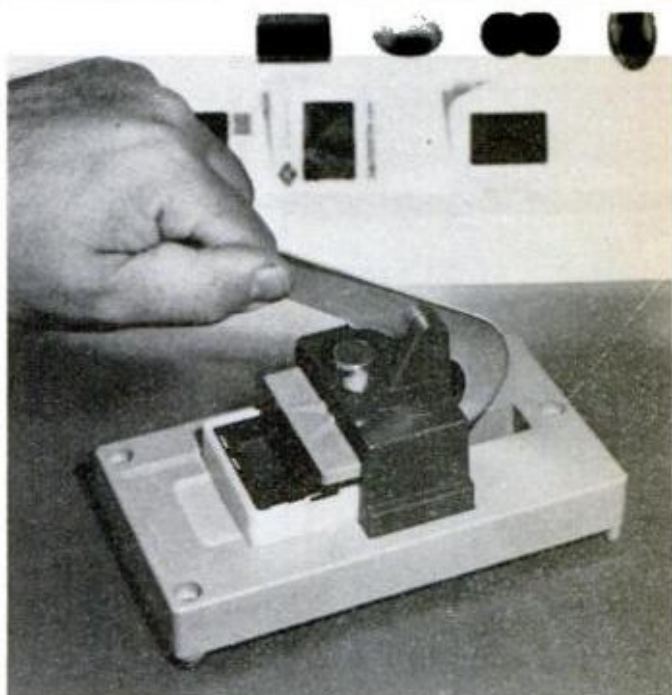
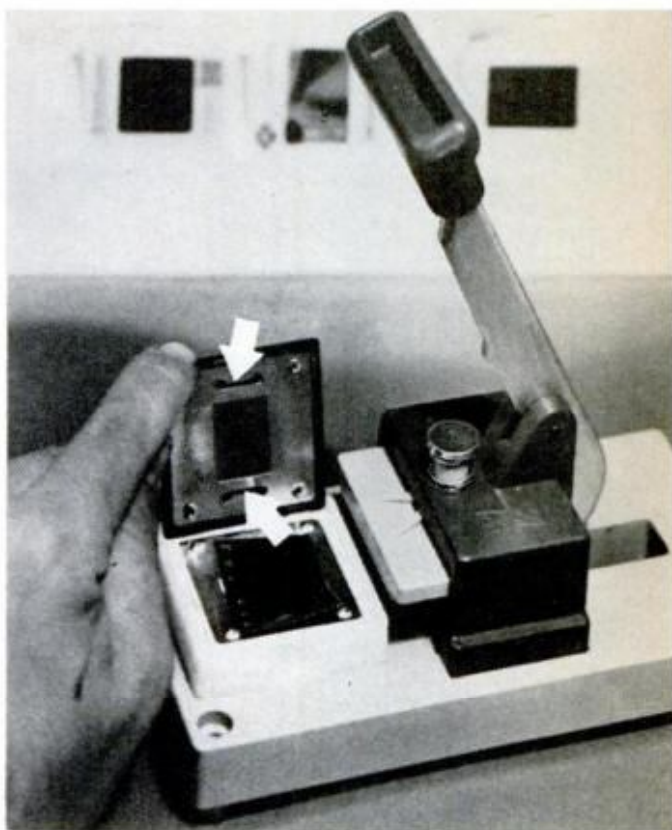
Seary press for heat-sealing slide mounts applies heat and pressure simultaneously to all edges; \$19.10 from Porter's Camera. Kodak editing glove prevents fingerprints on slide.

tion slides, a chronological sequence ("first we went here, then there . . .") works fine, but see if the images themselves suggest some other sequence to you. (You might, for instance, compare the mountains you saw in Colorado one year with those you saw in Austria another year.)

Slide sorters, like the sampling on page 124, are a big help in arranging sequences and in sorting out the best from the good slides remaining. Table viewers with built-in slide changers, or your projector's stack loader, can help preview the sequence to make sure it works. You can do it without the sorter too, and even without the stack loader, though the work of loading all your slides in trays, weeding them out, and moving slides ahead to fill the gaps may prove discouraging.

And don't just weed out bad slides—weed out good ones, too, if you have something else that's similar or better. The good ones you're not using may make good gifts (for friends you met on the same trip, for instance), or they might be usable in a different sequence of slides to make some other slide show.

Good slide shows may be harder to make up than good home movies. Like a movie, the slide show must have continuity; but since each of its images stays longer on the screen, each slide must be intrinsically more interesting than an equivalent movie shot. Occasionally, a dull shot may be needed as a bridge between two sequences, but it should



Press for GePe pop-together slides works with pressure-sealing cardboard mounts, too. Grooves in GePe binders (arrows) ordinarily hold film chips in place, but note that chips can be trimmed and mounted offcenter, as shown. Battery-illuminated base helps you judge slide chip placement accuracy, lights only when handle is raised, to conserve battery life. GePe slides can be snapped together by hand, too; the press is strictly a convenience.

Framing errors can be cured with little expense



Grab-shots like this one (at Bear Mountain picnic) often contain extraneous, distracting detail. Erie No. 8 mount, 22x23-mm, eliminated it and extra millimeter of blanket I'd included in foreground.

Ovals seem best for subjects with an antique air, such as in this scene at Mystic Seaport, Victorian houses or portraits with a period "feel." The purpose here was mainly to crop out the empty corners.



Slide: Gene Pitts



I couldn't shoot myself, so a friend unfamiliar with my wide-angle lens took this vacation snap of me—plus a lot of railing and a fellow passenger. Even cropped, it's still just a snapshot, but a better one than before.

Circles are rather static with most subjects, but this one was fine as a gimmick "porthole" for shot of a Maine schooner. Rub finger around inside edge of mount before inserting the slide; this minimizes fuzzy fibers.



FOLD-N-PRESS
200 St. Paul, Rochester, N.Y. 14604
©1971: TM Appl. Pending. All Rts. Res.

A MIX'N'MATCH® SPECIAL

Tall and thin rectangle complements its tall, thin subject. Sideways it could hold a panoramic landscape or a seascape after masking out dull, excess sky or flat uninteresting foreground—almost Cinemascope.

PROCESSED BY
Agfa



AGFACHROME

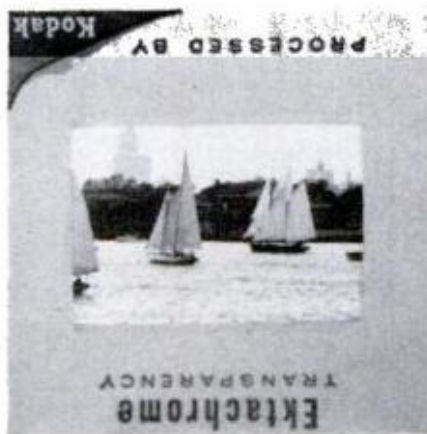


Spiratone
CROP
MOUNT



Too much sky and foreground calls for near-square 17x21-mm GePe mount (crossed, halves form 17x17-mm square). Slide, dull by itself, gains meaning when flashed quickly on the screen to end more interesting sequence shot at rear of boat.

A gimmick, but at least a fitting one—"binoculars" frame schooners sailing off Brooklyn during New York's annual mayor's cup race. Other gimmicks to be used sparingly include hearts, keyholes, palettes, stars.



flash on the screen just long enough for its meaning to be caught.

The show's continuity depends on what you say, as well as on the slides and their order, so think of what you have to say well in advance, taking notes if necessary (none of that "This is . . . either the Taj Mahal . . . or a great old movie house in Newark" nonsense, please!).

If you have a dull slide that has an interesting story behind it, line up enough interesting and related slides to hold your viewers' visual interest while you tell your tale, so you don't have to leave the bad one

hanging on your screen for minutes at a time.

What about the slides that are interesting, but technically a little off? Slide duplication is one answer to a lot of problems: unbalanced color, mild exposure errors, framing errors—but that's an article in itself. The last one, though—framing errors—can be cured with little expense, equipment or experience, using commercially-available slide-cropping mounts (see samples on these pages).

Some of these crop mounts frame your

(Please turn to page 164)

DECEMBER 1974 127

How to take your car in tow

Trail a mini behind your motor home. Use it for side trips from your campsite and as an extra tow rig for small boats, trailers.

by Ray Gill

Once you've selected your campsite, parked your motor home, and settled down for the night or the weekend, the idea of driving 10 miles back into town for milk and eggs is not appealing. A bike or motorcycle, after dark along strange roads, may not seem like the ideal answer, but how about your small family car or an easily handled dune buggy?

Today it's easy to tow your little car behind a pickup camper, van or motor home. There are many types of tow bars on the market, including fold-up jobs for Jeeps, spreadable bars which clamp to bumpers and two-piece rigs for VWs and Karmann Ghias which attach or separate with pins just below the front bumper. An example is a VW tubular tow bar from Valley Tow-Rite, of Lodi, Calif. It is easily pinned in place to the front of a Volkswagen's torsion bar. When not in use, it can be unbolted and stored in a car trunk.

The complete rig costs about \$53 and comes with two four-foot safety chains crossed under the front neck of the tow bar tongue for double safety. The crossed chains will catch and cradle the bar's neck if it somehow pops off. This is unlikely, however, since the coupler has an under-jaw ball-gripping design which can be tightened for automatic ball tension. In addition, a spring-loaded lock prevents accidental release when trailering.

The unit is especially made for VWs and dune buggies. It is not intended for Super Beetles, 411 S/W or sedans or fastbacks, but is fine for Bugs. And there is no need to tie the steering wheel down. Towed in this fashion the front wheels will track along without any problem.

Behind a big camping rig, a small car that weighs less than the truck-like towing ve-



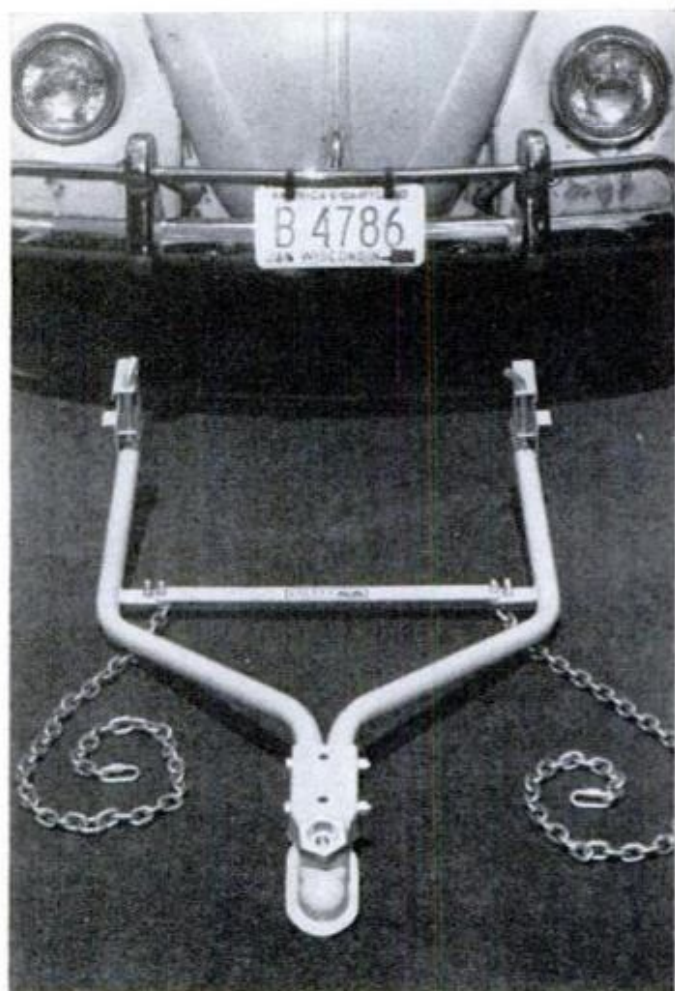
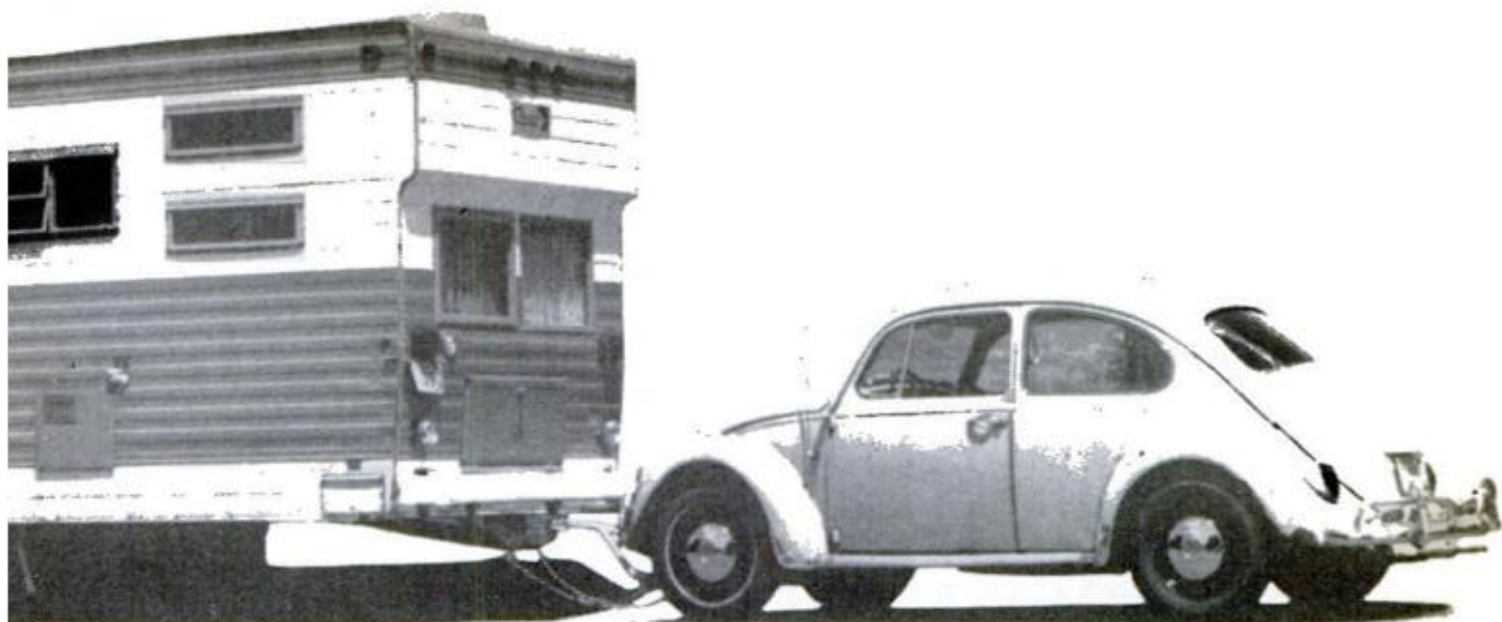
hicle will roll easily and not need a trailer-brake hookup. It's advisable to start and stop slowly and with care.

Do not use the lights of the towed car; this will run down its battery on long trips. For a temporary hookup, rig a set of wires from the towing vehicle to the rear stop lights of the towed car. For a better and more permanent installation, buy a set of trailer lights, plug them into a properly wired rear-outlet socket on the motor home, and clamp the lights to the rear bumper of the tow car.

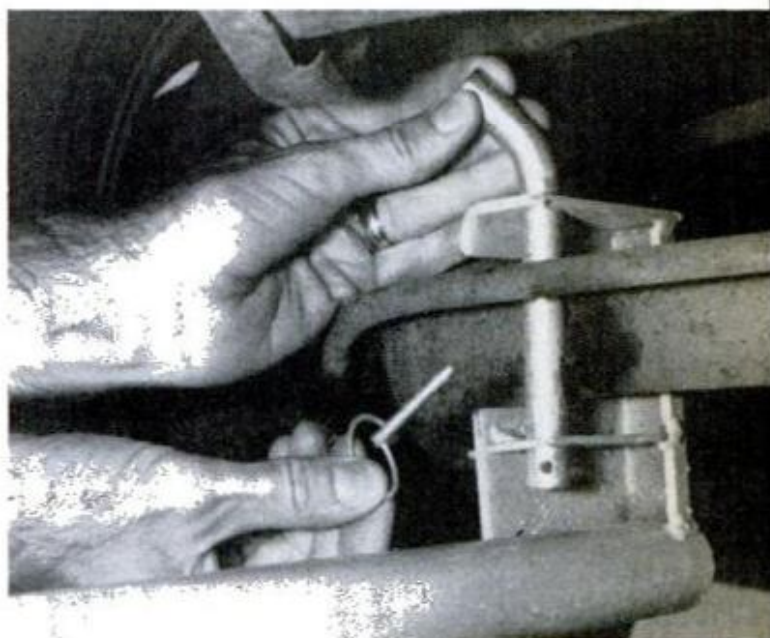
If sway of the towed car is noticed and a problem, a sway-control equalizing hitch can be used. The four-wheel ground contact of a towed car, however, makes it much more stable than a two-wheel trailer. While there is horizontal stress from the weight of the towed car, the up-and-down vertical stress on the tow bar, as with a conventional trailer, is missing. There is also a possible benefit when trailering a small streamlined car behind a boxy motor home. The towed car can tend to break up air turbulence and drag encountered by some motor homes above 45 mph.

Note the mileage on the odometer of your car-in-tow before and after trips as well. Mileage will be rolling up but the car will actually not be "running." Without your record sheet, your little towed car will show a lot more false-mileage driving distance than it has been driven with its own engine—a point to make when selling the vehicle.

The basic Volkswagen Bug with stick shift can be towed as is. Just make sure the



Tow bar to tow car has been simplified with this rig for VW Bugs and dune buggies. New from Valley Tow-Rite, the unit above unbolts so side bars and spreader brace can be stored in car trunk. Attached to front of VW's torsion bar (upper right) it locks in place with drop pins through holes in bar. Hitching up to a two-inch ball, unit has under-jaw design and spring-loaded lock for positive coupling. Included are two four-foot safety chains which are crossed under hitch to catch and hold it up in case of accidental breakaway.



tires are good and properly inflated, the shift is in neutral and the transmission oil is adequate. This also applies to other small manual-shift cars, but it's wise to check your dealer. Some recommend filling the transmission to a higher level. Fully automatic-shift cars are a different problem, and most makers recommend against towing them any extended distance. It is not impossible, however, and your local dealer can show you how to disengage the transmission to allow it. If you'd rather not try, roll your small car up on its own trailer and tow it that way.

Don't forget that your small car behind may also carry a light cartop boat and even its mini-trailer. Usually it is much easier to load a boat on a low passenger car rather than a tall motor home. For easiest towing, consider aiming the cartopped boat aft with

the bow at the back in order to streamline the rig.

In addition to motor homes, a small car can also be towed behind another compact of the same size, and can mount a tow hitch of its own. For VWs, a special rear hitch is available. Extension arms bypass the motor underneath and are firmly bolted to holes drilled in the frame. The neck is anchored to the Volkswagen bumper with a U-bolt, and allows a sliding action reported not to impair any impact movement of even the newest bumpers. Holes for safety chains are provided in a bolted-on fitting. To round out this custom-designed VW package, Tow-Rite has a special connector suited to the VW's electrical system.

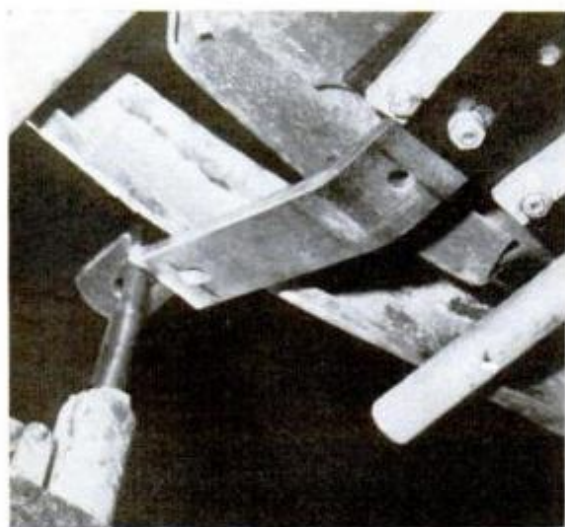
Most American cars need only a four-way connector, and customized arrangements are available for a number of sports im-



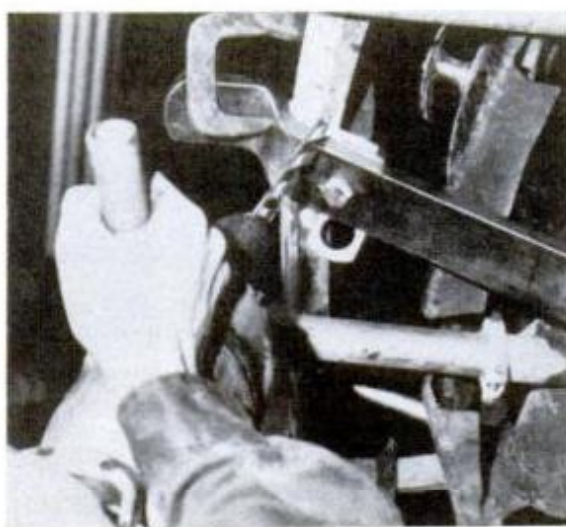
Towed car becomes tow car with additional rear hitches available for compacts and imports. Shown above is the Valley VW model.



Extension straps bypass the motor area and are positioned after their clamp-bar plate has been slipped over the frame.



Hitch ball bar, which runs back from the clamp plate above the frame members, is next jacked in place below the bumper.



Holes are now drilled on each side of the hitch ball bar through the bumper in order to take the U-bolt which secures the bar.

ports where five-way connectors provide for ground, taillights, stop lights and turn signals. The receptacle part of the connector comes with spring-hinged cover to keep out moisture and dirt and locks to the trailer plug when open to prevent disconnect while underway. A mounting bracket secures to bumper or hitch so that cutting a hole in the car body is not necessary.

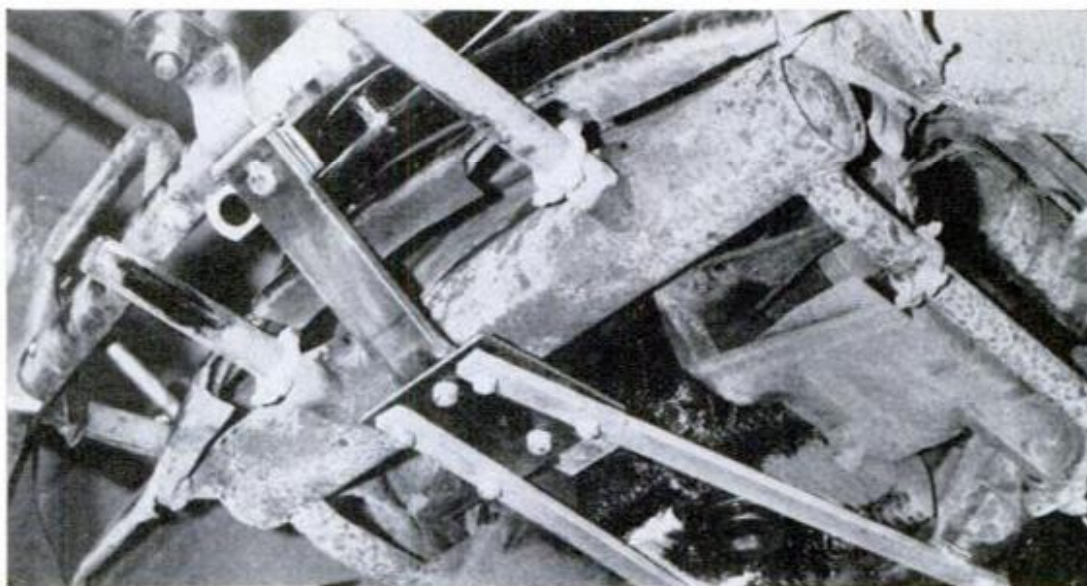
With small cars that are lower and narrower, it is wise to select low-profile boats and campers to tow. A rough rule for the total trailer weight a compact can handle is that it should not exceed half the gross weight of the tow car. That would work out to a trailer of about 1000 pounds for vehicles such as the VW, MG and Opel.

Accessory dealers and mail-order suppliers such as J.C. Whitney in Chicago can provide tow-bar rigs for small-car models

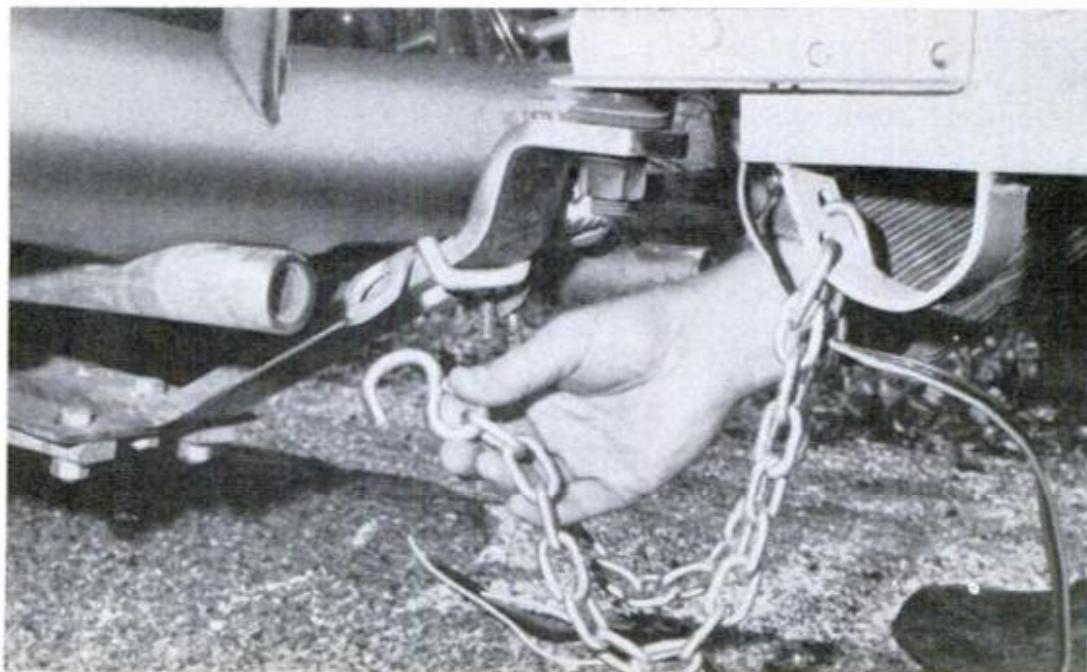
up to large sedans requiring four-point hookups and brake and guide-cable attachments for \$50 to \$100, and up. Trailer and camper light kits and harnesses are also supplied.

Even a small car behind a motor home will increase gas consumption slightly, but the benefits are many. Using the little one for local shopping and sightseeing is a great convenience while your large camper holds down its campsite parking spot. Along the way, the car in tow can carry a quantity of luggage and camping gear.

But then at camp, the small car parked beside the larger rig offers a separate weatherproof playroom for the kids, a guest room if the seats fold down, and a support for a tent fly stretched between the vehicles for cooking area and extra lounging space in good weather or bad. ★ ★ ★



Completed assembly shows bars and straps bolted securely in position, with frame and bumper holding the hitch in place, clear of motor and muffler. Hitch can handle recommended trailer weight about half the total gross weight of the towing vehicle. Bolting on ball is final step.



With trailer hooked on proper-size hitch ball, safety chain is attached and wires connected for tail, stop and turn-signal lights. For compacts and imports many custom plug-and-socket hookup fixtures can be used to match electric system to that of trailer. Now, mini is ready to tow.

How to pass emissions tests without a hassle

More states are checking exhaust emissions. Do it yourself beforehand, and you'll pass—you'll have a perfect tune-up, too.

by Charles R. Self Jr.

No self-respecting Saturday Mechanic would drive in for a state safety inspection before knowing he was going to pass it. Check lights, horns, wipers, tires, brakes and so on *before* the examination. That's the only way to avoid the hassle of last-minute repair and *two* inspections.

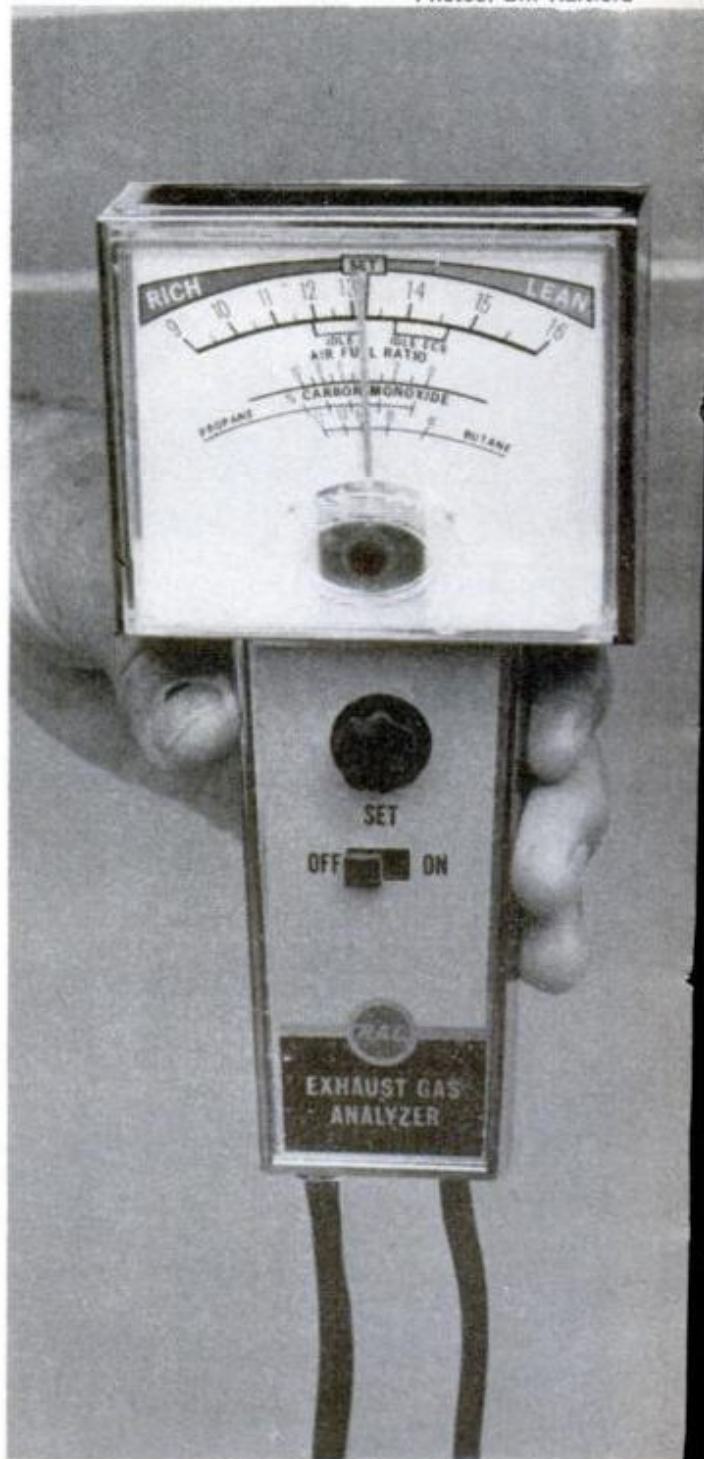
Soon, if not already, you'll be doing the same preinspection check on your car's exhaust emissions—so you'll pass state emissions inspections. All you need is a compact, home-garage type of exhaust gas analyzer (EGA).

By using the EGA to measure air/fuel ratio and adjust your carburetor for combustion efficiency, you'll also be doing your own carburetor tune-up. Often that's something you don't get even at professional service centers, where a tune-up can be a once over of your ignition system only.

Start your tune-up by checking and gapping points and plugs, setting timing, inspecting the distributor cap and wiping down ignition wiring. Then you can turn your attention to the carburetor. With an exhaust gas analyzer you can set a carburetor correctly even if you've never done it before. An EGA designed for home use comprises an exhaust pipe probe, sensor and a meter that gives readouts of air/fuel ratio and percentage of carbon monoxide (CO), a deadly, invisible, odorless gas.

This type EGA is a good compromise for the home mechanic who can live with reasonably accurate results at an affordable price (from \$60 up). The extremely accu-

Photos: Bill Hartford



Exhaust gas analyzers for do-it-yourselfers are becoming more widely available. Some, like this Rite Autotronics unit, are hand-held. Power can be internal batteries or 12 volts from your car battery.

rate infrared analyzers used by service stations and government analyzing stations cost over \$2000.

To begin, let your engine reach its normal operating temperature. Then check to make sure the choke has dropped out of the system (look down the carb throat and see if the butterfly is straight up and down and no longer blocking the air passage). Now connect a tachometer. Bring the engine to correct idle speed (as high as 1000 rpm on newer cars). Idle speed on most cars since 1970 can be found on a specifications panel located inside the engine compartment. On older cars, you may find it necessary to check the factory manual, or call your local dealer's service department.

Hook the red lead from the analyzer to the positive battery post, and the black lead to the negative post. On some analyzer models this connection won't be needed since they contain their own batteries.

Flip the tester to "on" and let it sit for about 30 seconds. Don't insert the probe into the exhaust pipe just yet because clean air is necessary for initial adjustment of exhaust gas analyzers. Adjust the SET control knob so that the pointer falls within the set marks. Resetting shouldn't be necessary but if you want to check it again during a tune-up, blow lightly into the sensor and wait a couple of minutes with the probe clear of the tailpipe. You must have clean air flowing through the sensor to get an accurate "set" at the meter.

Place the sensor at the rear of the car. You can leave it on the ground for quick checks but move it above the tailpipe for longer tests because a fair amount of water will condense and run from the probe into the sensor. Usually, you'll be under the hood for a while, so a good procedure is to keep the sensor raised and thereby keep the condensation out of it.

Connect all the neoprene hoses and attach the probe into the tailpipe. There's a clip on the probe to hold it within a few inches of the end of the pipe. Check the meter for your reading at idle. If the settings are within specs, leave well enough alone. If not, carburetor adjustment will be necessary.

Idle mixture is usually set in one of two ways: the lean-drop method and the quarter-turn-rich method. The differences in the two procedures are simple: the lean-drop method requires you to keep turning the mixture screw to the lean side until the

idle rpm drops a specified amount from the best idle setting. The quarter-turn-rich method gets you to turn the idle-mix adjustment one quarter turn richer after reaching your best idle setting. Check your service manual for the correct procedure.

For pre-emission cars, you should see a meter reading of 13.0 to 13.2 air/fuel ratio, unless you've got a very low-compression engine which might show as rich as 11.5 (topping out up around 13.0). On emission-controlled cars, with air pumps, the ratio should be a much leaner 14.0 to 14.2. Keep a check on the idle speed as you make adjustments, and readjust speed as necessary.

On emission-controlled cars without air pumps, the range will also be 14.0 to 14.2;



Analyzer probe clips to tailpipe and hose feeds exhaust-gas sample to sensor unit. Sensor produces electrical signal of strength dependent on air-fuel ratio being burned in your cylinders. Signal is conducted to meter circuitry for a direct readout of the air/fuel ratio and of the percentage of carbon monoxide present in your engine exhaust.



Analyzer components are connected with leads long enough to let you check emissions from driver's seat. This is convenient if you have a dash-mounted tach. Be careful removing probe: It gets red hot!

Hand-held instrument is convenient to use. For road tests, secure sensor to bumper and meter somewhere on dash where it can be read easily. Instead of taking 12 volts off car battery as here in static test, use lighter socket on instrument panel.

if it's off, back out the mixture screw slowly and gently until the meter reads a rich 12.5. From that point, allowing your meter to stabilize and making sure the idle speed is correct, start turning the idle-mixture screw back in, about $\frac{1}{16}$ turn at a time. Always let the meter have 30 seconds or so to react.

Keep turning until you reach the 14.2 showing and then recheck the idle speed. If it has changed, reset it and then recheck the air/fuel mix readout. Repeat until both figures are correct.

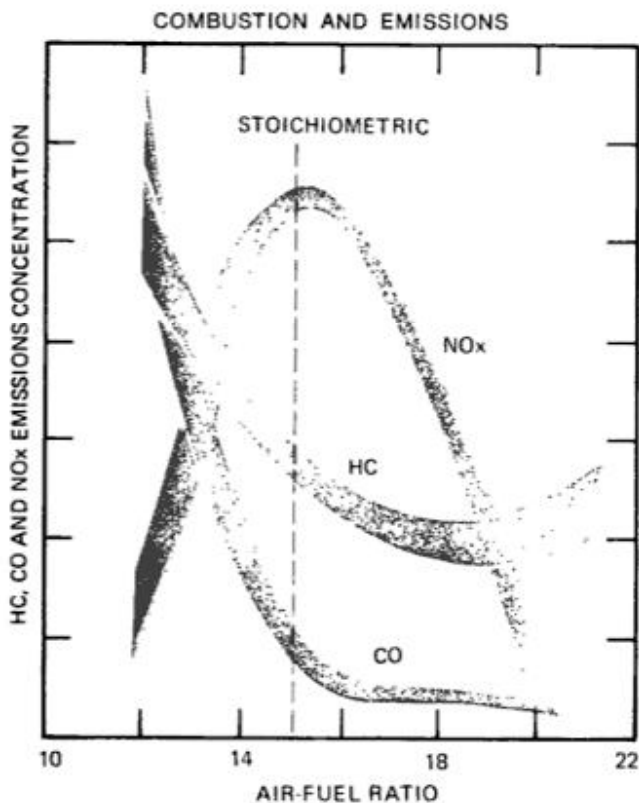
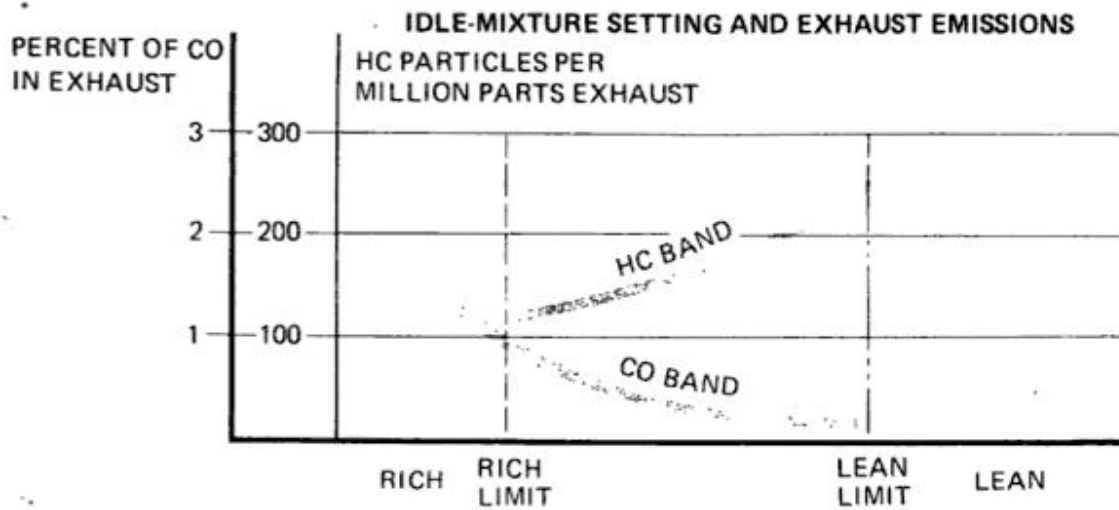
If your car is equipped with idle-limiter caps on the mixture screws, the range of adjustment should be enough to allow you to bring both idle speed and the idle mix into the proper range.

To check out your accelerator pump, set the engine speed up to 800 to 1000 rpm. Snap the throttle open several times, disregarding the meter reading during the throttle opening. After a few seconds, the meter should settle down and show a deflection of one point or more. If it does, the



accelerator pump is okay. Return to proper idle setting.

Road testing can be done by mounting the sensor unit on the rear bumper. Some units are supplied with spring mounts. With the engine at normal operating temperature, locate a straight and level road, take the car up to 40 mph and hold it there for a couple of minutes. At steady, moderate speeds the air/fuel ratio should check out between 13.5 and 14.5. Again, check manufacturer's specs for any possible variations for your car and engine.



Idle adjustments are complicated by nature of exhaust emissions. Leaning idle mixture increases amount of unburned hydrocarbons.

Exhaust gas relationships: Note that oxides of nitrogen curve is opposite those for HC and CO. Stoichiometric mixture is the burning of all fuel possible.

Several other points should be considered before analyzing your exhaust: Make sure the positive crankcase ventilation (PCV) valve is operating (usually pulling the valve loose and giving it a shake will produce a rattle if it is operating properly); clean or replace any dirty fuel filters; make sure you have enough gas in your tank for proper fuel flow; make sure the fuel vent system is open; make sure the heat riser on the exhaust manifold is free and working. On cars with air pumps, you'll need to disconnect and plug the manifold hose to the pump. On cars with dual exhausts, select the pipe containing the heat riser valve for the probe.

Meter care is important. Protect the meter and sensor from excessive vibration and impact. If it operates on internal batteries, and you have no plans to reuse it immediately, pull out the batteries and store them separately. Hang up the sensor unit and probe so that any condensation will drain.

Another point of care: The EGA can be used with two-cycle engines, but the oil in the fuel will affect the readings, and will eventually clog the sensor. The same holds true for an old car that burns lots of oil.

Finally, don't use any solvents to clean the meter face. A mild solution of detergent is best. ★★★

For carburetor tune-up, a factory service manual is almost a must. If you don't have one you can order it with the stub enclosed in your owner's manual. If you don't have the stub, request your dealer to put in your order.

If the meter reading on your EGA is consistently higher, or leaner, than normal and you can't get it to conform to specs, there are some checks you should make. Check the intake manifold carefully for leaks. If you locate a suspicious spot, put a few drops of kerosene on the spot while watching the meter. If the meter goes to the rich side when kerosene is applied, you've found the source of a leak. Any such leaks must be corrected before accurate tuning can be completed.

Use the right saw blade

When one type of saw blade is used to cut all kinds of material, it's almost like using one size nail to build a house. Only when a plywood blade is used to cut plywood, or a hardboard blade is used to cut hardboard, for example, can you turn out the best work and get the most from your bench saw or portable power saw.

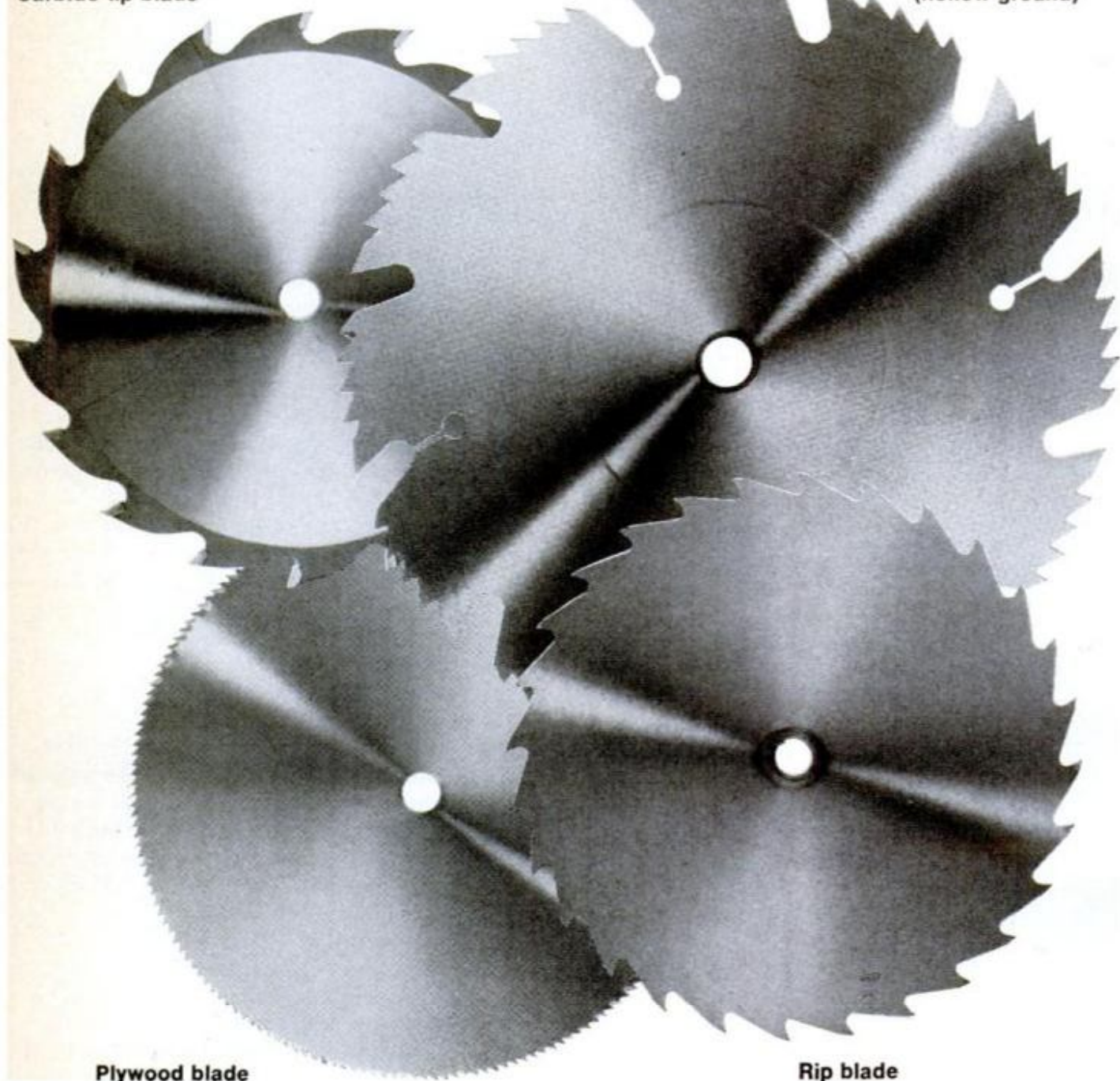
That's why a selection of blades having a wide range of tooth patterns is available,

each designed to cut a specific material in the best, fastest and smoothest way.

For general-purpose cutting, both with and across grain, a flat combination blade is your best bet, but, again, it won't match the extra-smooth cut you get with a hollow-ground planer blade. Thus it's important to keep several types of saw blades on hand so you can switch from one to the other, whatever your cutting requirements. ★★ ★

Carbide-tip blade

Combination blade
(hollow ground)

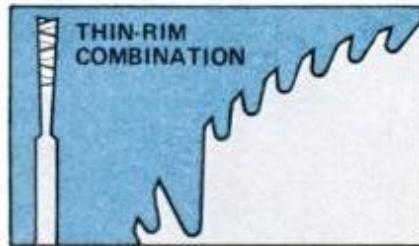


Plywood blade

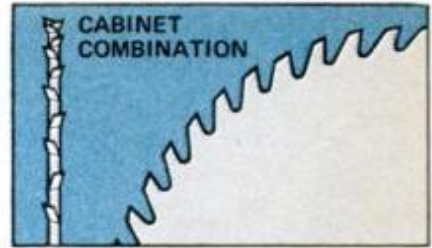
Rip blade



For ripping all hardwoods and softwoods. Has heavy hub, is taper-ground for extra clearance.



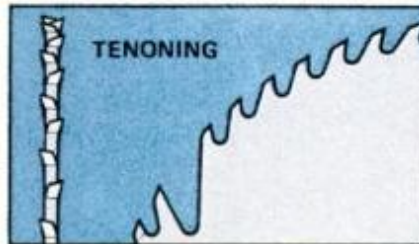
Finest combination blade for fine trim and finish work. Use it to rip, crosscut, miter.



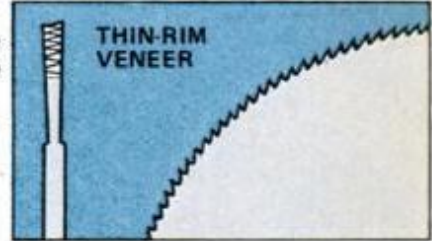
Cabinetmaker's combination blade cuts in any direction through either hardwoods or softwoods.



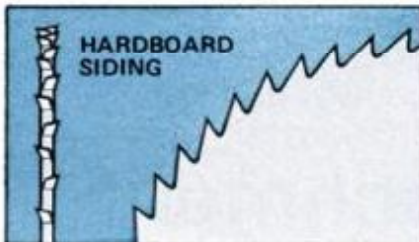
Cabinetmaker's blade. Produces free, smooth and accurate cuts in any direction in hardwoods.



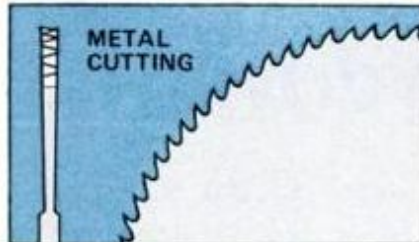
All-purpose blade, wide-kerfed for cutting tenons, splines in all hardwoods and softwoods.



For satin-smooth finish cuts in either plywood or thin veneers without splintering.



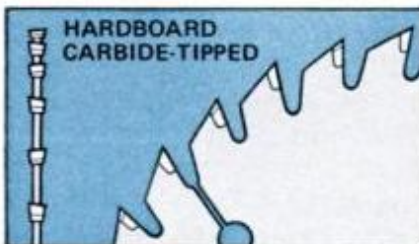
Best blade for cutting tempered hardboard (Masonite) underlayment, siding, perforated board.



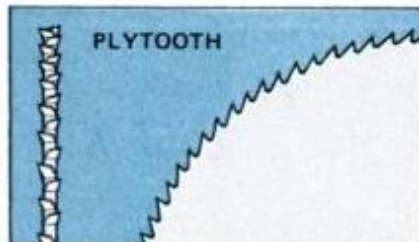
Intended for aluminum, brass, bronze, copper, zinc and lead. A truly professional blade.



For rough-cutting (rip and cross-cut) through all woods that have an occasional nail.



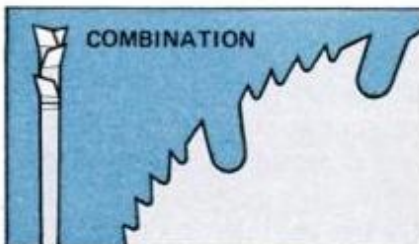
Excellent for wood, but can be used when cutting hardboard siding. Its 32 teeth cut fast, straight.



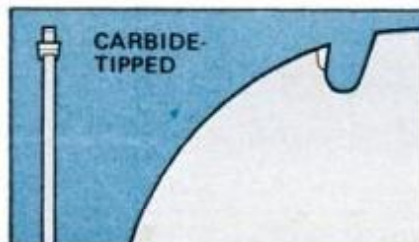
Fine-tooth, smooth-cutting blade for plywood, composition board, soft board and the like.



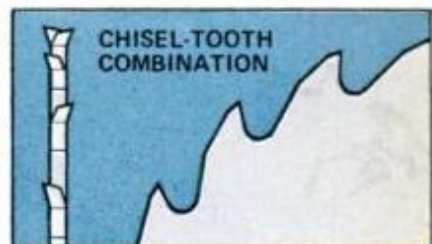
For light-gauge sheet steel, roofing, guttering and downspouts, up to 1/16-in. thickness.



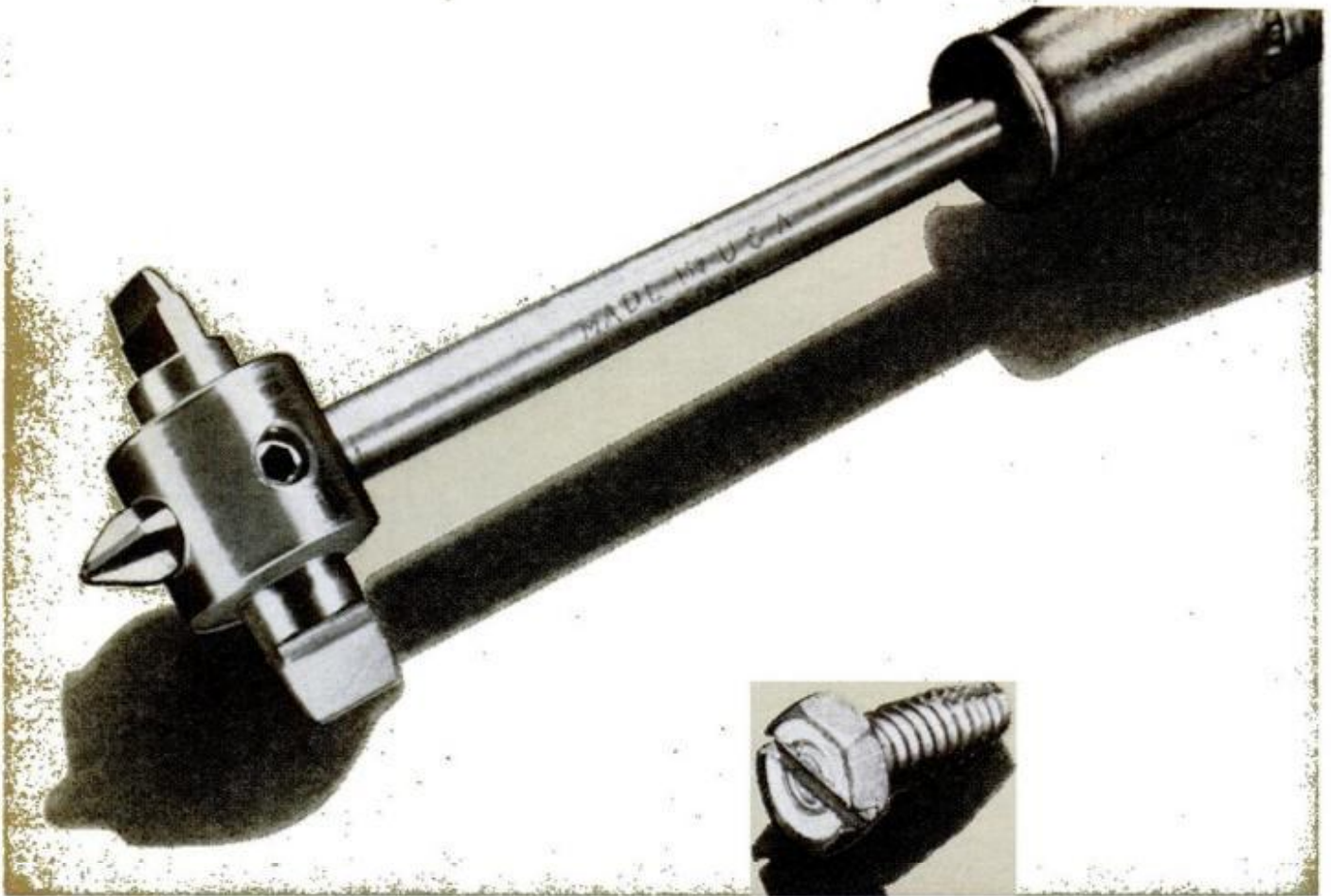
Good for ripping, crosscutting, mitering on all hardwoods and softwoods. Comes taper-ground.



Carbide-tipped combination blade for long cutting life; ideal for abrasive materials.

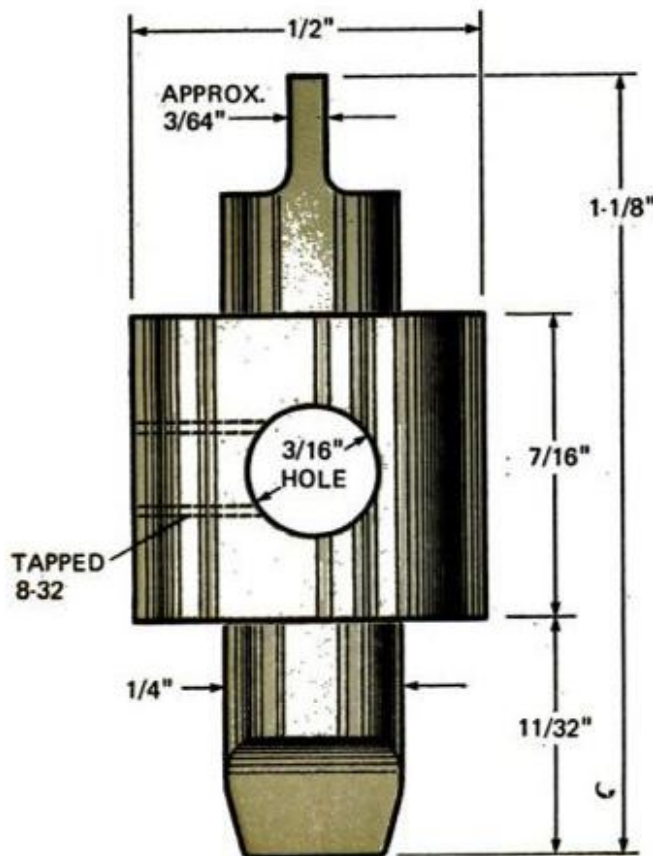


All-purpose, fast-cutting blade for all woods. An excellent contractor's framing blade.



Offset attachment is shown mounted on Phillips-type screwdriver that has a 3/16-in. shank.

Offset screwdriver attachment



An interesting and not difficult lathe project is the making of an offset screwdriver attachment—a tool handy for turning screws in restricted space. It is called an “attachment” because it can be mounted on a Phillips-type screwdriver or similar tool to take advantage of an existing handle and shank. It can, of course, be provided with its own handle.

The offset attachment shown was made from 1/2-in. drill rod, to fit the 3/16-in. shank of the Phillips driver. First, a 3/16-in. diametrical hole was drilled in the blank, about 1-in. from the end to be supported by the tailstock. Then, at right angles to it, a hole was drilled and tapped for an 8-32 hollow-head setscrew.

The blank was mounted in the lathe by gripping one end in a chuck and steadying the other with the tailstock center. A section (containing the holes) about 7/16-in. long was left at the original 1/2-in. diameter, and portions for at least 1/2-in. each way were turned to a 1/4-in. diameter.

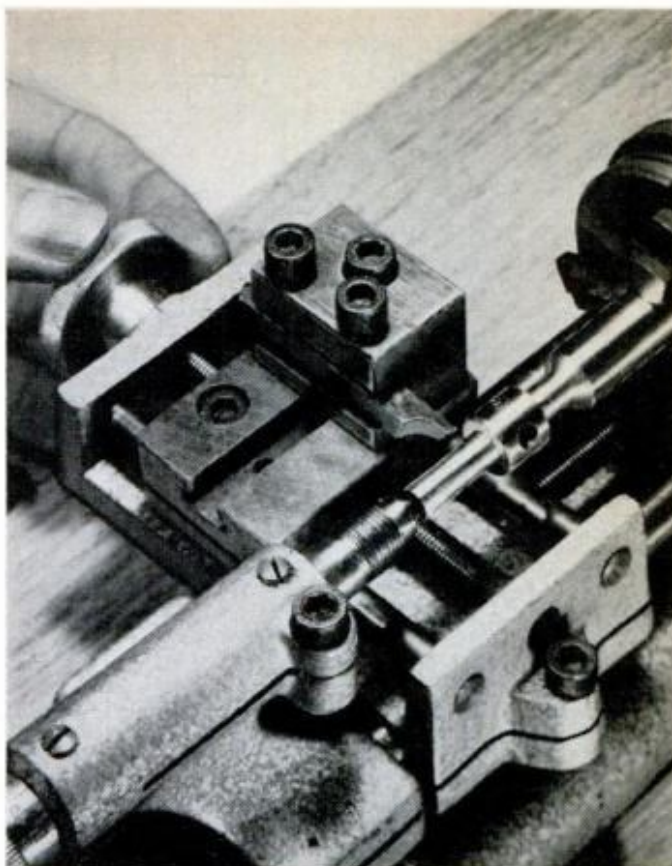
The blank was cut to an overall length of 1 1/8-in. leaving the blade stubs each

about 1/16-in. long. These stubs were flattened at their outer ends to form blades that are at right angles to one another—one being parallel to the diametrical hole. The "flattening" was done mostly by milling, but could have been accomplished entirely by filing or grinding. In fact, the attachment could be fashioned entirely from 1/2-in. rod by sawing and filing.

After final touching up to remove burrs, the attachment was hardened and then tempered to a dark-purple color. Hardening is done by heating the metal a bright color, then quenching it immediately in water. It's tempered by polishing a spot with emery cloth and carefully reheating. When the spot turns purple after quenching a second time, the metal is tempered. Ordinary drill rod, of high-carbon steel, can be hardened this way. Low-carbon steel must be case-hardened with Kasenit compound.

If the offset unit is not used on an existing screwdriver or other tool, a handle for it can consist simply of a 3/16-in. rod a few inches long. Of course, offset attachments could be made in larger or smaller sizes than that illustrated.

—Walter E. Burton



In machining the blank, use the cutoff tool for the final shaping, after roughing out the turning with a taper-nose bit that has a side rake.

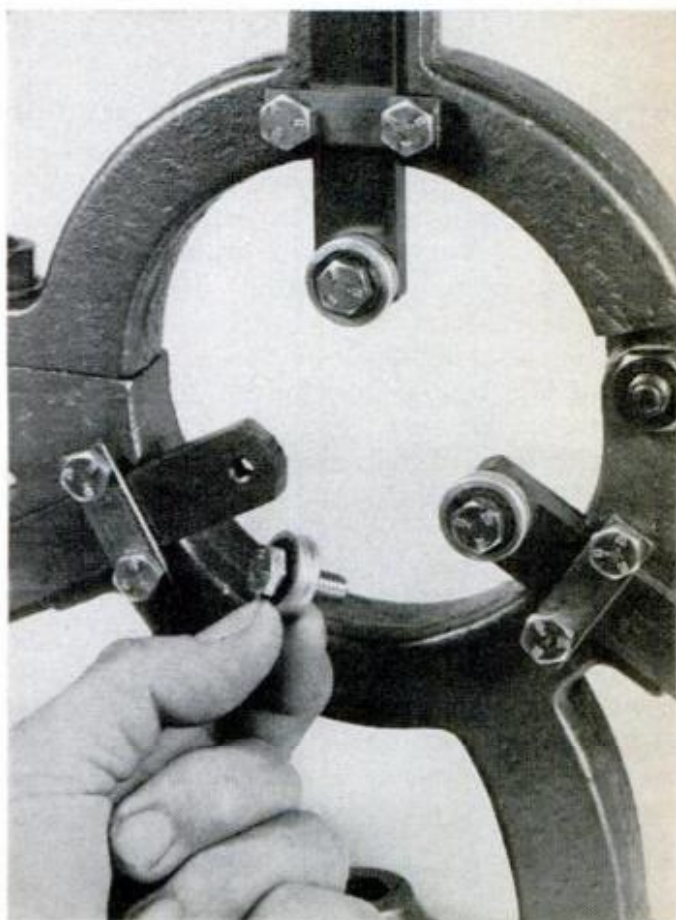
Roller bearings make steadyrest nonmarring

If you have had to use a lathe steadyrest for outboard support when facing the end of an aluminum turning, you know how difficult it is to keep the three jaws of the steadyrest from marring the soft metal. To give support, the jaws must bear against the work, of course, but I found a simple way to make them nonmarring: I fitted the end of each jaw with a roller bearing.

First I removed the jaws, then drilled and tapped a hole in each for a short 1/4-20 hex-head machine screw. I drilled at a point where the bearings would project 1/4 in. beyond the rounded end of the jaws. When fitted with bearings, the jaws continue to provide full support to the work, but rather than rub against the metal they turn and leave no mark. Bearings should be of the sealed type to keep machine chips and other foreign matter from getting into the bearing races. The hex-head screws make it easy to remove the bearings when you wish.

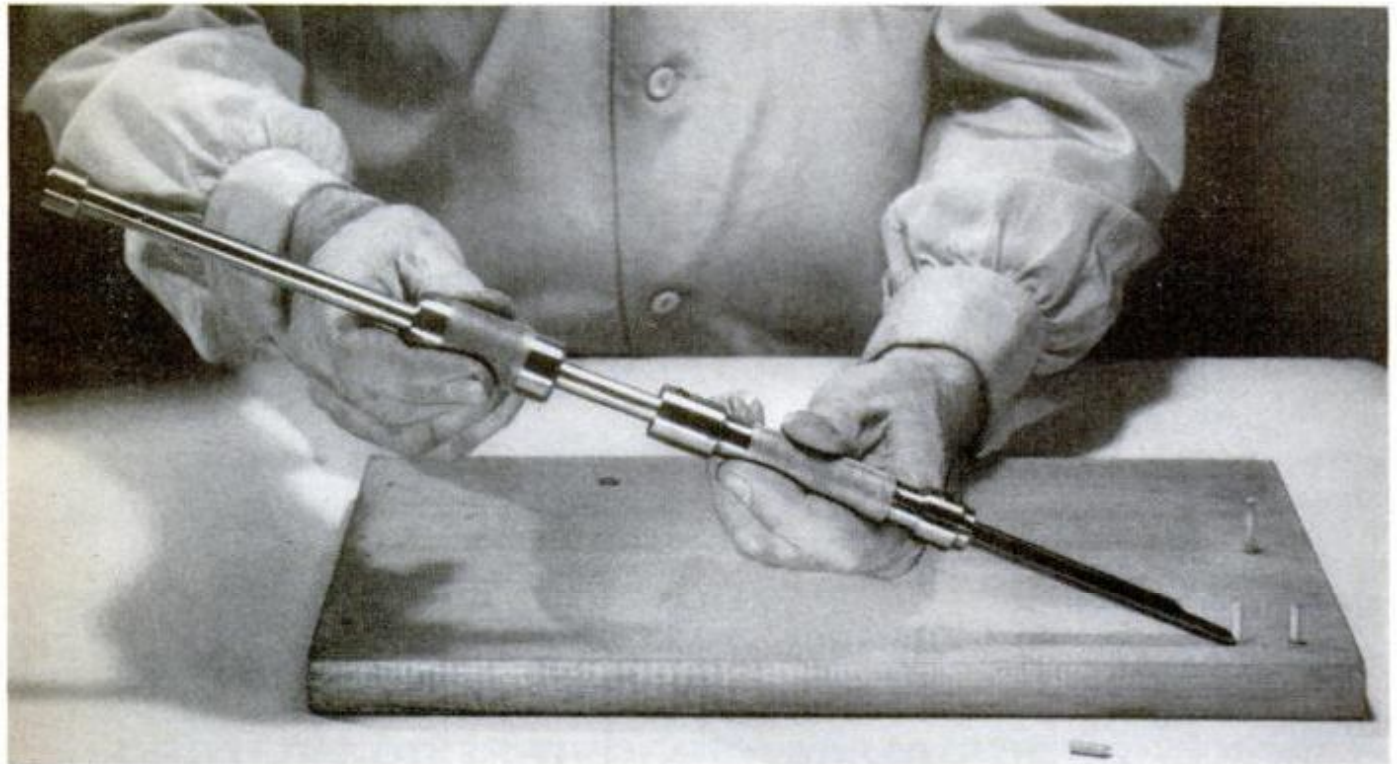
—Philip Duclos

A short 1/4-20 machine screw is used to hold each free-turning bearing to the steadyrest's adjustable jaws by tightening the screw in a tapped hole.



Self-hammering toolholder

by Walter E. Burton



Intended for relatively light work, the self-hammering tool is shown here being used in a chiseling operation.

Punches with built-in hammers (sliding metal cylinders on a rod) are familiar to many mechanics. By using virtually the same arrangement, I went one better and made a tool that not only would handle a punch but a variety of other bits, all interchangeable.

These bits include various chisels; carving tools; center and piercing punches; embossing, dapping, chasing, or background-decorating punches; engraving points and other "percussion" attachments; and also fittings used for pulling operations, such as a cotter-pin-extracting hook.

A feature of this self-hammering tool is that the hammer is always present and ready to go. Also, the bit can be held in precise position while the hammer operates. And, in some instances, hammer blows can be kept uniform—as by letting the hammer fall from a fixed height in punching sequences.

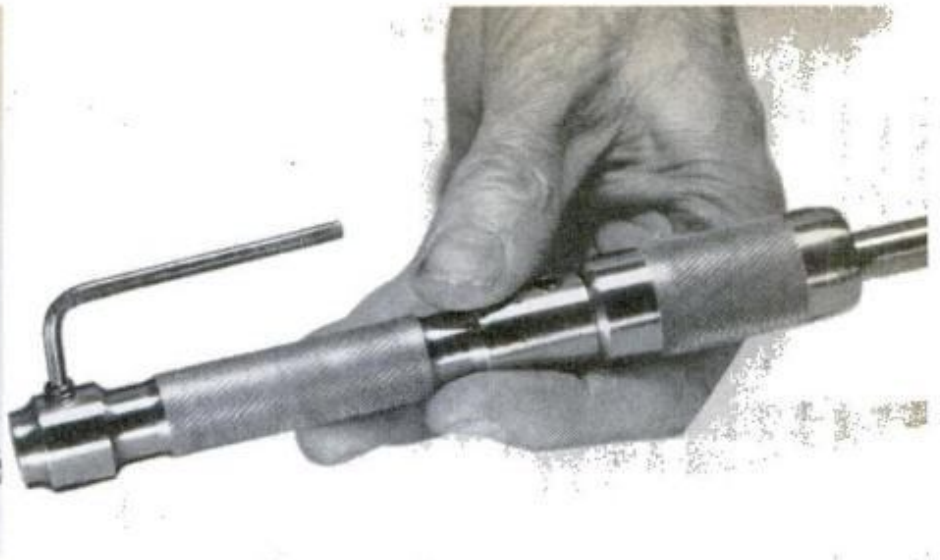
The "power" of such a self-hammering tool involves the characteristics of the slid-

ing hammer. The unit illustrated was intended for relatively light work. With a typical punch in its chuck, it weighs slightly over one pound. It has a four-ounce hammer 2 in. long; other hammer sizes could be made, and used interchangeably.

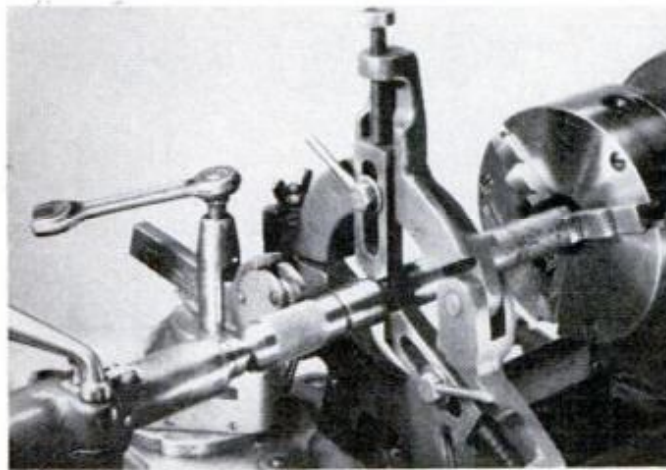
The tool has four principal parts, other than the bit being used: A "chuck" that serves also as the handle or grip; a hammer; a rod on which the hammer slides, and a cap to prevent the hammer from sliding off the rod and to enable the tool to be used for pulling or extracting operations. All parts are steel.

I machined the chuck from $\frac{3}{4}$ -in. rod to the shape and dimensions indicated in the drawing. The central portion was knurled for a better grip.

A $\frac{1}{4}$ -20 setscrew (two could be used) locks the bit in the $\frac{7}{16}$ -in. hole in the outer end of the chuck. The opposite end of the chuck is drilled to receive the $\frac{3}{8}$ -in. hammer-guiding rod. Another $\frac{1}{4}$ -20 setscrew locks this rod in its socket. The rod was



When pointed punch is inserted in chuck, the setscrew is tightened against a flat filed on the shank of the punch.



Hammer is knurled while held by steadyrest. Same support is used when drilling axial hole for guide rod.

drilled so the screw end penetrates it about $\frac{1}{16}$ in. to discourage endwise shifting.

The guide rod shown is 9 in. long. This is sufficient to let the hammer travel about 6 in. In delicate work, it may travel only a fraction of an inch.

The hammer is simply a steel cylinder having a $1\frac{3}{32}$ -in. longitudinal hole, which is sufficiently larger than the $\frac{3}{8}$ -in. guide rod to enable it (the hammer) to slide freely.

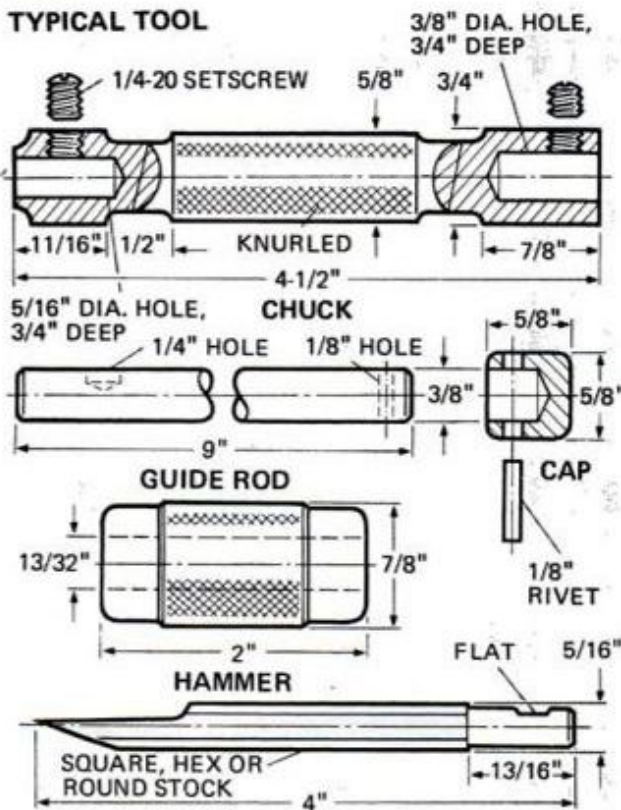
The guide-rod cap is secured with a $\frac{1}{8}$ -in.-diameter rivet made from unhardened drill rod (which is less likely to shear than a soft-iron rivet when you're "reverse hammering").

Chisels and other bits were made as needed, usually from drill rod or by adapting existing tools—such as a nailset, whose shank was machined to fit the chuck. A flat setscrew seat was filed on each bit. Besides discouraging burrs from interfering with bit removal, such a flat tends to prevent the bit from dropping out of the chuck if the setscrew is loosened by vibration.

After being shaped on a lathe or by filing, the bits were hardened and tempered as for similar conventional tools. But because the tool was not intended for severe service, parts of the hammer assembly were not hardened. Bit-cutting edges and points customarily are shielded, when not in use, with slip-on-caps.

It is common sense to handle such a self-hammering tool with as much care as any other rather long implement that has a sharp end. ★ ★ ★

TYPICAL TOOL





Cloth-tape inlays

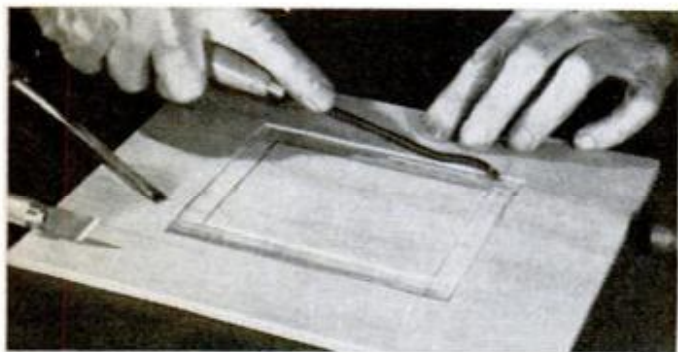
by Walter E. Burton

At first glance, the colorful design on the lid of this trinket box looks like expensive enameled inlay work. Actually it's nothing more than patterned fabric tape cemented in shallow channels and coated with a clear plastic finish, but the simulation is nearly perfect.

Any fancy cloth tape, $\frac{1}{4}$ to 1-in. wide, can be used this way; a metallic braid will produce a handsome inlay of delicately wrought gold bands.

The picture sequence shows how you first create $\frac{1}{32}$ -in.-deep channels for the tape with a router and chisel. Then you miter the tape like the corners of a picture frame with a 45° template and a wood chisel, after which you apply white glue sparingly to the channels and press the tape in place flush with the surface.

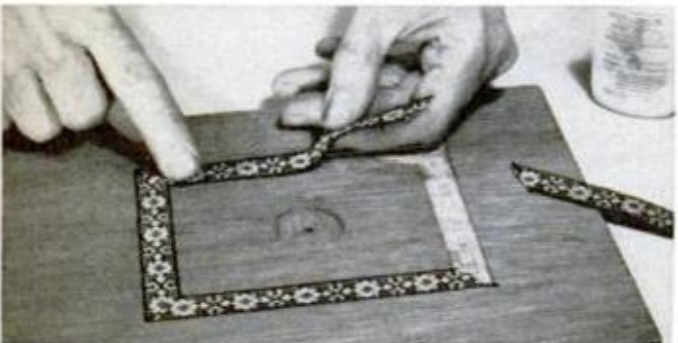
Finally, you finish both box lid and cloth tape with two coats of a transparent urethane to enhance the wood grain and bring out the beauty of the tape pattern.



Shallow channels are first routed to equal thickness of the tape, then corners are squared with chisel.



Ends of tape are mitered by holding sharp wood chisel against 45° template and cutting over hardboard.



White glue is spread evenly in channels, then tape is pressed in place. Wipe excess glue with damp cloth.

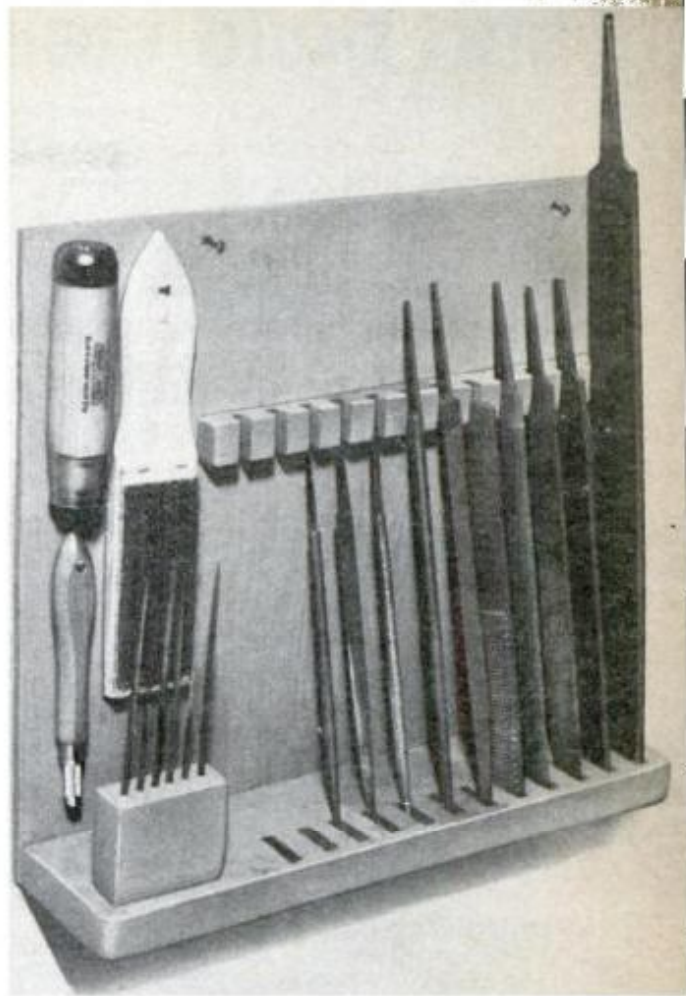


When glue is dry, tape is given two coats of clear urethane finish, finally the rest of the wood surface.

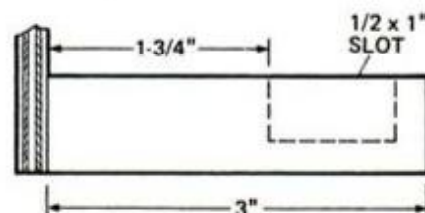
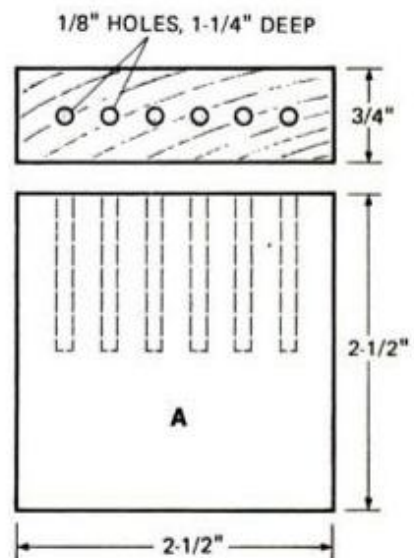
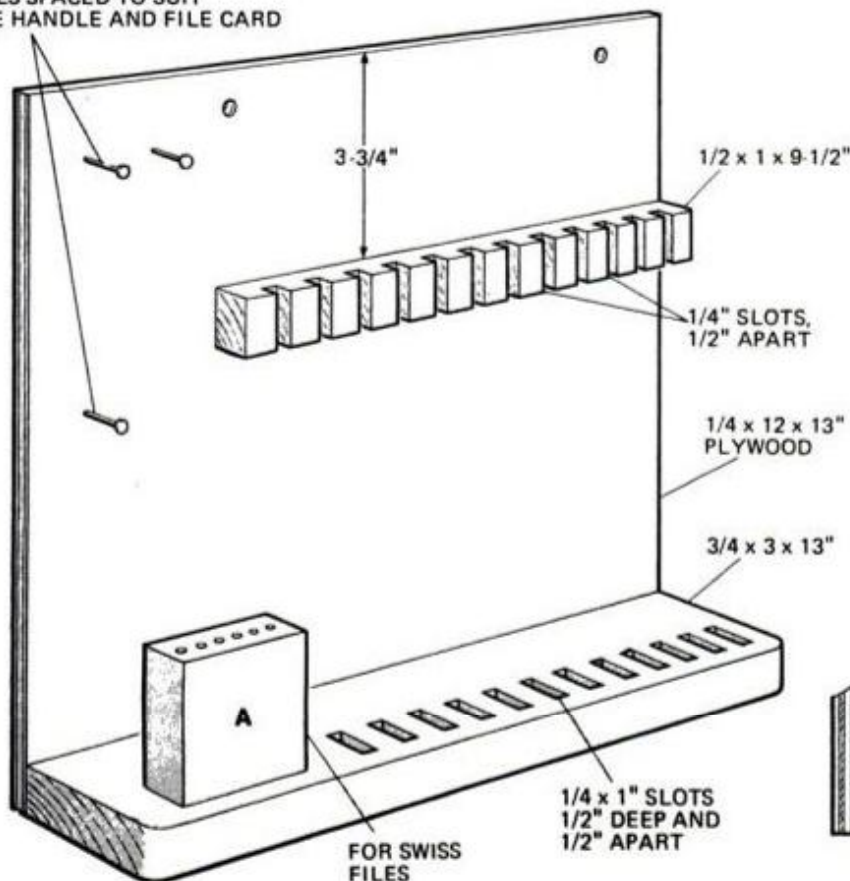
Wall rack keeps files handy

Like so many tools, your files become a lot handier when they are kept in a wall rack such as this one. Not only can you select the one you want at a glance, but it's the proper way to keep files in A-1 condition. Tossing them on top of one another in a drawer is a sure way of ending up with dull files. In addition to storing your files in one convenient place, a rack like this will let you keep a card file handy for cleaning each after use.

I found the few pieces of wood required in my scrap box, and I made the 1/2-in.-deep slots in the shelf for the ends of the files with my portable electric drill. Of course, a 1/4-in. straight-shank router bit chucked in a drill press will make the slotting job go faster. I wound up spraying the completed rack with a couple coats of paint.—Lynn R. Mortensen



NAILS SPACED TO SUIT
FILE HANDLE AND FILE CARD



How to lay out and build stairs

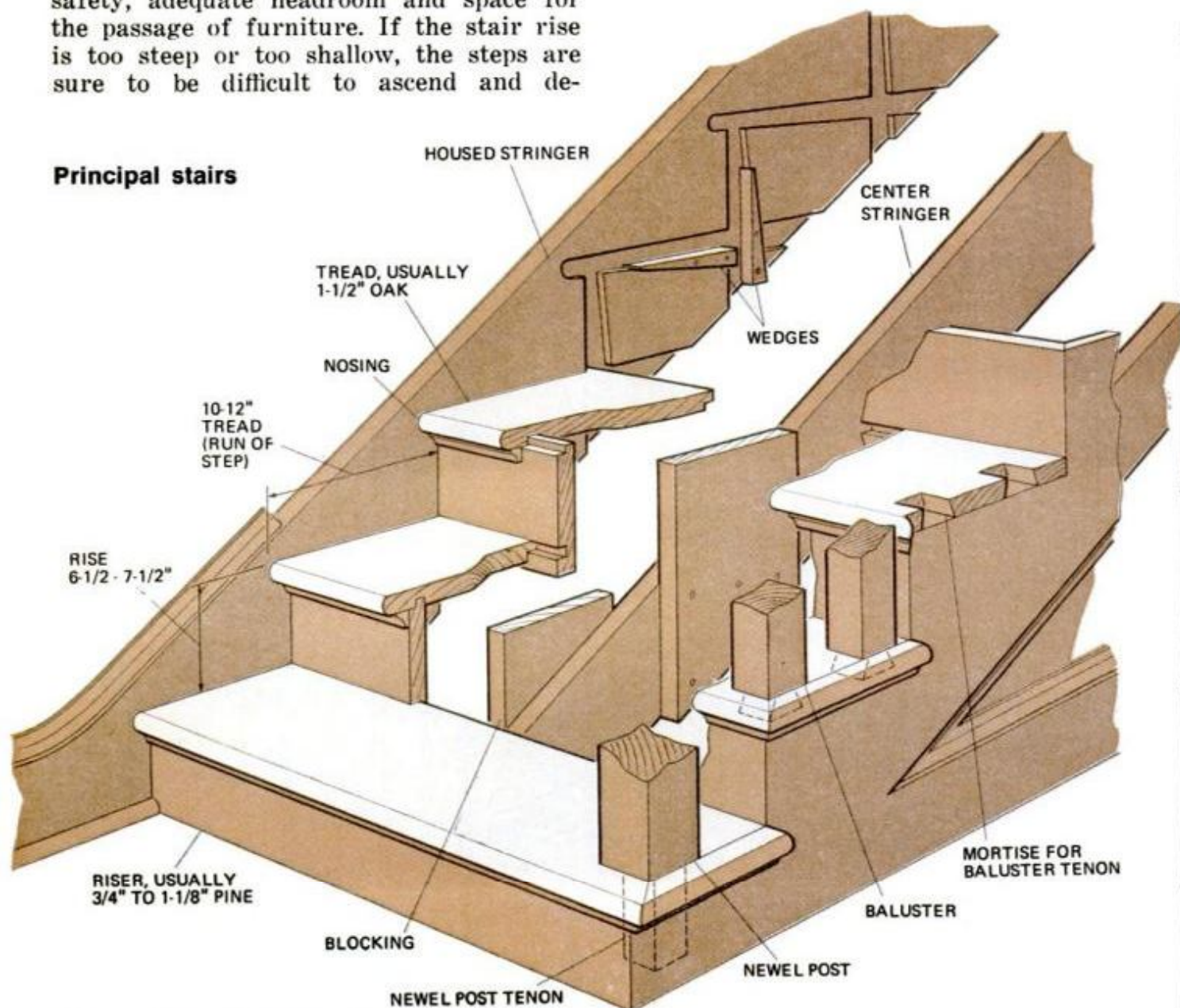
Chances are, the stairs a homeowner is most likely to replace are either in the basement or on the back porch. Interior stairs are generally of the more intricate housed-stringer type (below). This type should be left to professional stairbuilders.

You can build stairs either in your shop or at their location. Generally speaking, the more intricate the stair design, the better it is to do the building in the shop. But if you do, make certain you will be able to move the finished staircase into its position.

Three things to keep in mind when laying out and installing a stairway are safety, adequate headroom and space for the passage of furniture. If the stair rise is too steep or too shallow, the steps are sure to be difficult to ascend and de-

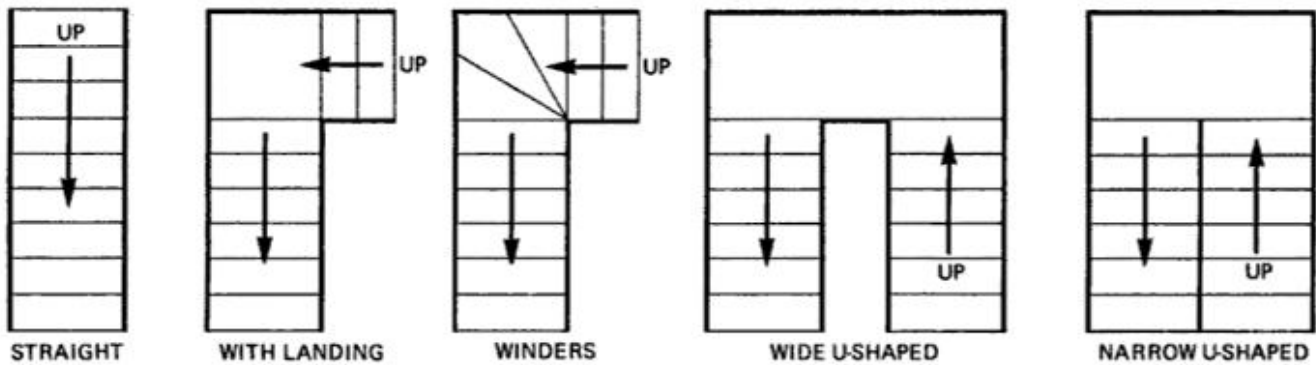
scend, and could cause missteps and falls. Poor layout may result in inadequate headroom which could lead to bumped heads (for tall persons) and inability to maneuver furniture up or down the stairs.

In most homes, there are two types of stairs. Principal stairs are designed to provide easy, comfortable access to another level; they are architecturally coordinated to the room in which they are located. The second type, service (or basement) stairs, are generally steeper and constructed of less expensive materials. We show you how you can build your own.



Types of stairs

Data: John Gaynor



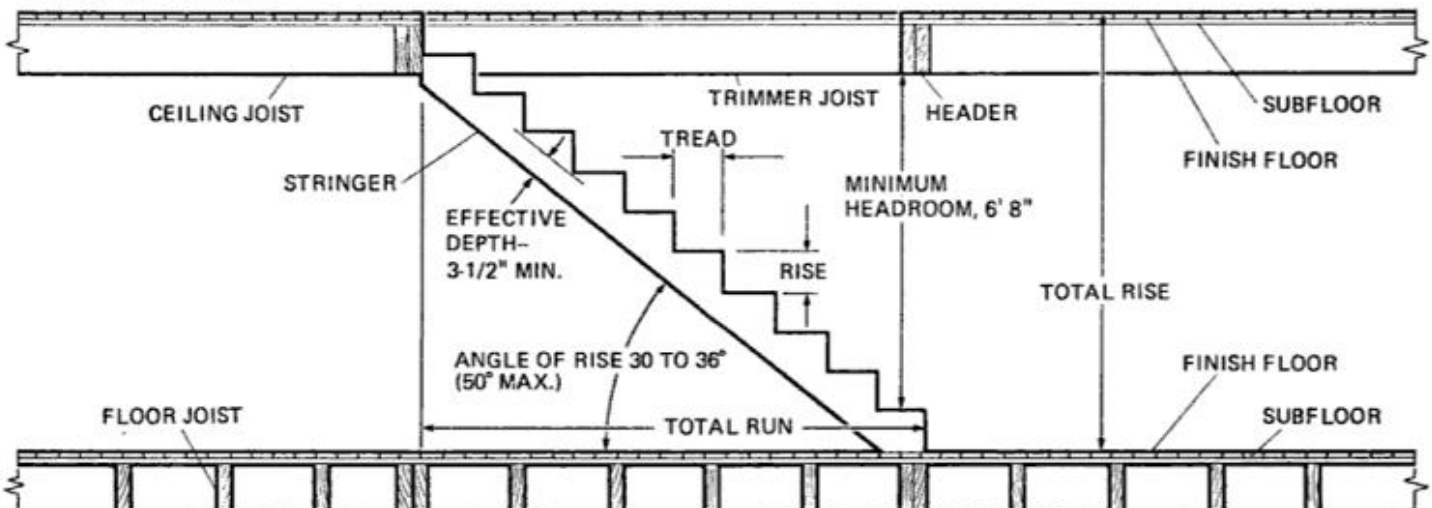
Stairways may have a straight, continuous run with or without an intermediate platform (landing), or they can consist of two or more runs at angles to each other. If your stairs must have an angle, it is at this point that the landing should be installed.

Another stair design incorporates winders—the turn is negotiated by radiating treads. For safety, if winders must be used, they should be installed at, or near the foot—not at the top—of the stairs.

Remember these points when laying out stairs:

1. Allow for minimum headroom of 80 in.
2. Generally, treads should be between 10 and 12 in. wide and risers should be 7½-in. high. The formula used by most professionals is: Twice the riser height plus the tread width should equal 25. When you lay out your stairs, use risers that will put you close to that number.
3. Angle of the stairs should be between 30° and 36°.
4. All stair treads and risers must be equal.

Stairway design



There is a definite relationship between width of treads and height of riser. All stairs should be laid out to conform with these well-established rules.

Any variance from these standards will result in awkward stairs which create a safety hazard and are tiring to use. If the treads are too short, the risers will be too high, so that your toe is likely to kick the riser on each step. But when the treads are too

long, the risers will be too low, enough so that you will be making a conscientious effort to shorten your stride; this, too, is tiring.

Experience has proven that a riser of 7 to 7½ in. is about perfect. By using the formula mentioned, you will find that the tread for a 7½-in. riser is 10 in. For comfort, as the riser gets shorter, the tread should be correspondingly wider. For example, a 6½-in. riser should have a 12-in. tread.

Mathematics in stairbuilding

When replacing an existing stairway, you already know its location and width, but you will need to determine the correct height of the risers and width of the treads. (If a landing is to be included, consider it—for design purposes—as simply another step. Its length and width will be decided by the available space at the landing location.)

To figure the number of risers needed, you first select a suitable riser height. Then divide the total rise—distance in inches from top of the lower floor to top of the upper floor—by the riser height chosen.

If you get a full number as your answer, let it represent the amount of risers needed. Usually, however, the result will include a fraction. When this happens, divide the story (total) height by the whole number that's nearest (above or below) the fractional answer. The result of this second division will give the riser height. You can then proportion the tread by using the formula outlined on the preceding page.

In another formula to adjust riser height, you multiply the tread width by the riser height. Ideally, the answer should be as close to 75 as possible. Thus, a riser height of $7\frac{1}{2}$ in. multi-

plied by a tread width of 10 in. gives the perfect combination—75.

Here's an example of such calculations, assuming a story height of 9 ft. 6 in., or 114 in. and a riser height of $7\frac{1}{2}$ in. When you divide the 114-in. story height by $7\frac{1}{2}$ in., you get 15- $\frac{1}{5}$ risers. Obviously, you cannot have a fifth of a riser, so the nearest whole number to use in the next calculation is 15. In other words, you can assume that 15 risers will be required, so you now divide the total story height of 114 in. by 15 in. to get 7.6 in., or approximately $7\frac{9}{16}$ in. as the height for each riser.

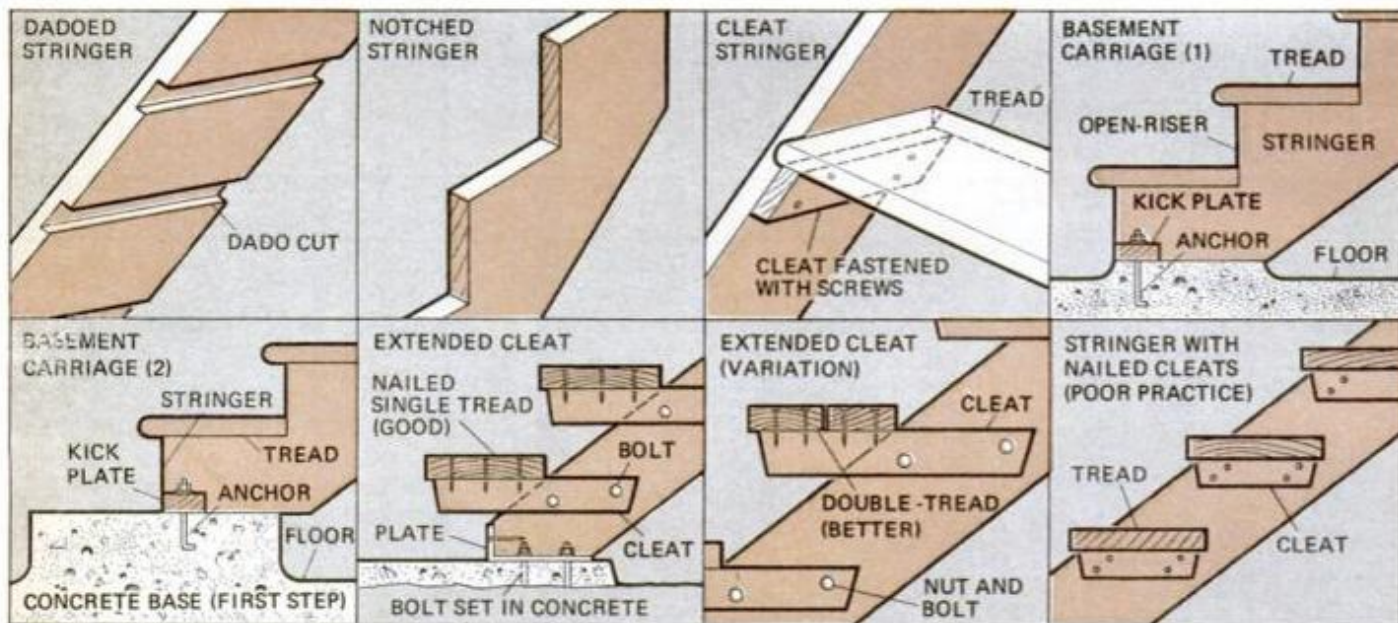
Next, to find the width of the treads, multiply the riser height by 2 and subtract this from 25. For example, $2 \times 7\frac{9}{16}$ in. equals $15\frac{9}{8}$ in. Deduct this figure from 25, which leaves $9\frac{7}{8}$ in. as the correct tread width.

Thus, the figures you should use for this example stairway are:

1. Risers: 15, each $7\frac{9}{16}$ in. high.
2. Treads: 14, each $9\frac{7}{8}$ in. wide.

Note that there is always one more riser than the number of treads. The last riser is that which extends from the top step to the level of the higher floor.

Types of stringers (carriages)

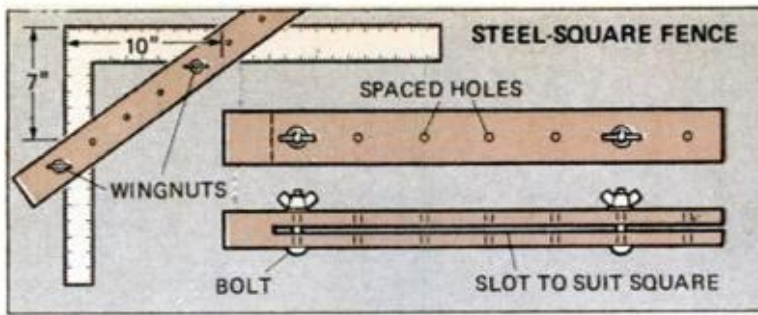


Planning stringers

Treads and risers should be fixed solidly to stringers that are set level and plumb. Several methods for fastening treads and risers to stringers are shown above. Stringers shown here can be built by a careful do-it-yourselfer. The intricate housed stringer (page 144) with tapered dadoes and wedges is better left in the hands of a pro.

In contemporary architecture, open stairways are frequently called for; that is, no risers are used.

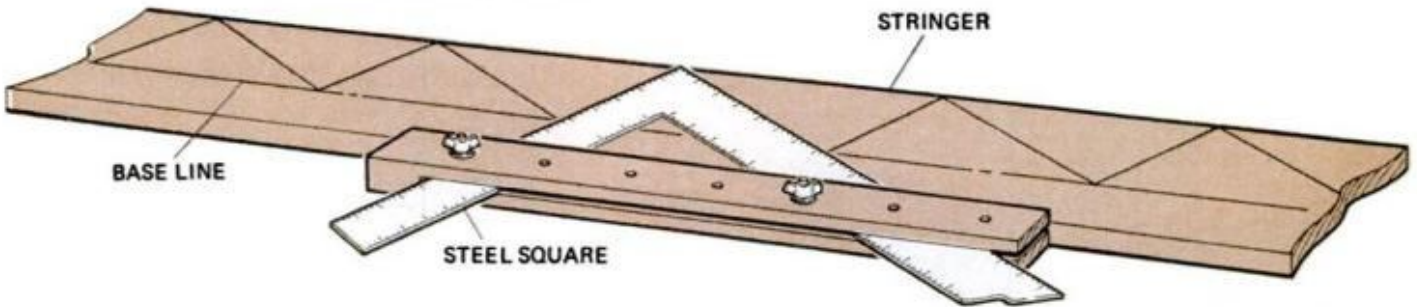
This type of stairway is becoming increasingly popular as modern architecture comes into greater use. However, when you contemplate replacing a stairway in an older home, the stair design should remain conventional—unless the entire home decor is being changed—in order to conform to the house style. It's safe to say that in a majority of cases a stairway should be replaced by a design that is similar to that of the original stairway.



For accuracy, use a fence

It is just about impossible to lay out a stringer accurately without an aid such as the fence shown at left. Use hardwood and simply bore a series of in-line holes down the center of the fence to accommodate a pair of wingnuts. Then, saw a slot through from the top to the bottom so that the fence can be used on the square as shown.

LAYING OUT A STRINGER



Laying out stringers

Since lumber shrinkage is one of the stairbuilder's worst enemies, you will be wise to use only well-seasoned lumber when you build your stairs. If you plan to construct a principal stairway, you can purchase treads and risers of standard widths from a local lumberyard. Most yards also stock (or can quickly get) standard oak treads that are dressed to an actual thickness of 1-1/16 in. These days it is not uncommon to find risers constructed of 1-in. pine (actual dimension, 3/4 in.). But since there is less chance of cupping and warpage with the heftier stock, you'll find it better to use 1 1/8-in. material (5/4-in. stock).

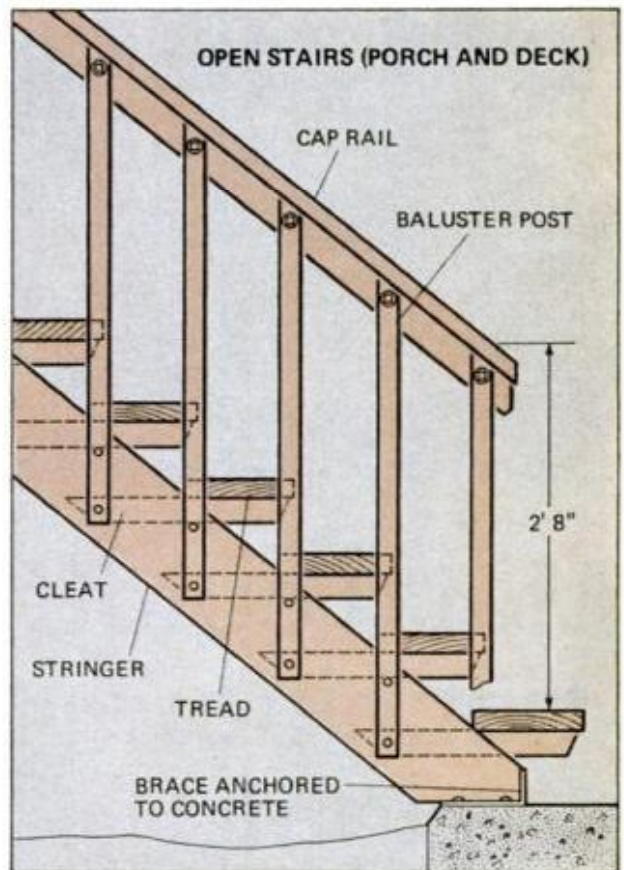
Starting steps (with curved ends), newel posts, handrails and balusters also are stock items carried by most building-supply outlets.

Secondary stairs are generally built using 2x6, 2x8 or 2x10 lumber for the stringers and treads. If risers are to be installed on such a stairway, they can be of 3/4-in. stock.

After calculating the number of risers and treads required, and their respective height and width, begin by laying them out on the stringers as shown in the above sketch using a steel framing square. Your layout must be accurate. To prevent a compounding of errors—as you tick off the steps—a simple fence constructed as shown above can prove an invaluable aid.

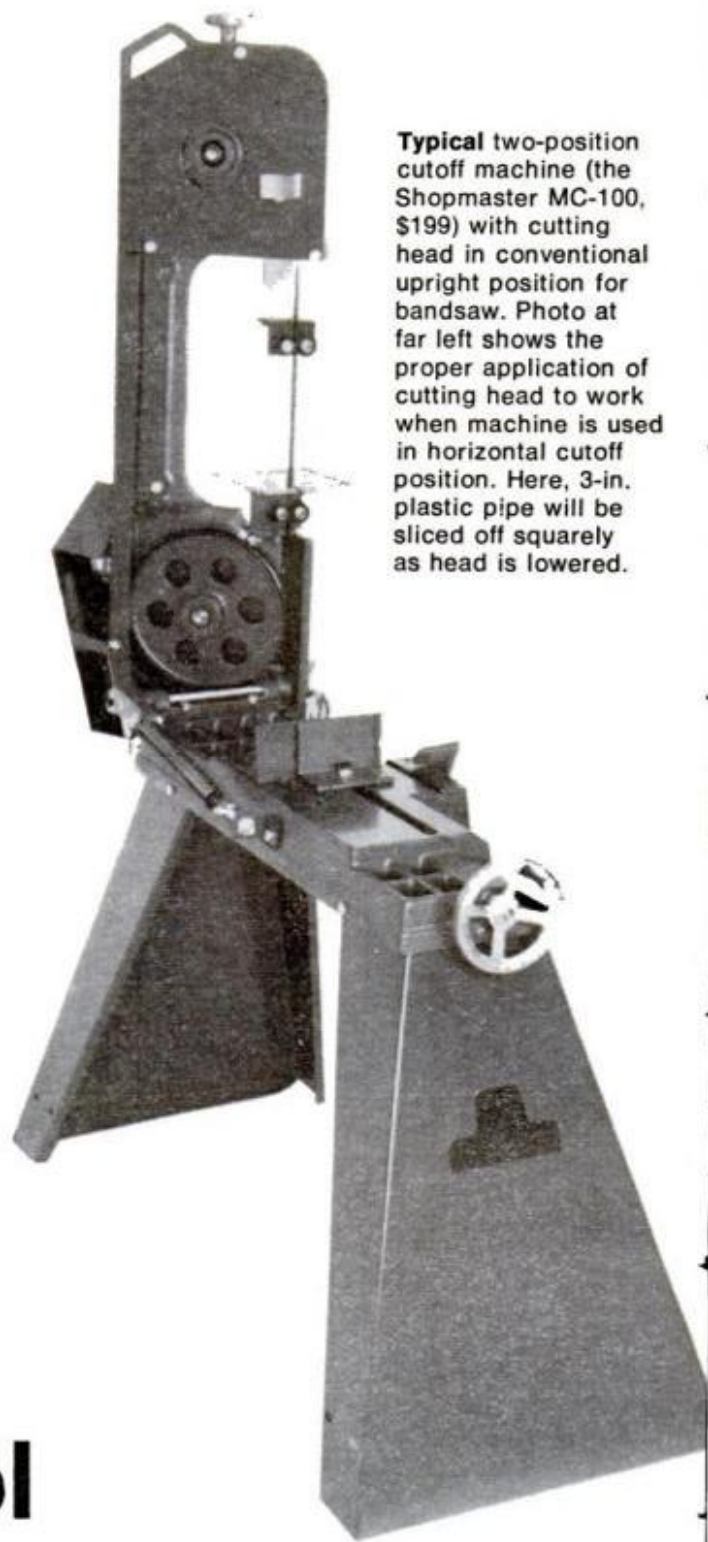
After riser and tread positions have been indicated on the stringers, you can proceed with construction of the stairs. Stringers can be cleated, dadoed or notched, depending on your preference. If they are of the latter type, for structural reasons you must adhere to the 3 1/2-in. minimum distance between base line and edge of stringer as shown in the drawing on page 145.

If stringers are to be dadoed, construct a template or jig from 1/4-in. plywood which can be clamped or tacked to the stringers to guide your router. When you're satisfied that the jig is accurate, make match marks on it so that it can be aligned accurately on the stringer each time it is relocated. To plow the grooves use a router with a straight cutter. The jig design should allow at least one riser and one tread groove to be made with each clamped setup.



About handrails

For safety—particularly for the elderly—all stairways should have a handrail. On a closed stairway, it is simply attached to the wall using handrail brackets. On open stairs, the handrail is located atop balusters which end against a newel post at the foot of the stairs. Usually balusters are dovetailed into the treads, but they can be installed by toenailing three or four finishing nails into the tread. If you use the latter method, predrill pilot holes to prevent splitting the hardwood treads. Regardless of stair style, handrails should always be 32 in. above the tread at the riser line. ★ ★ ★



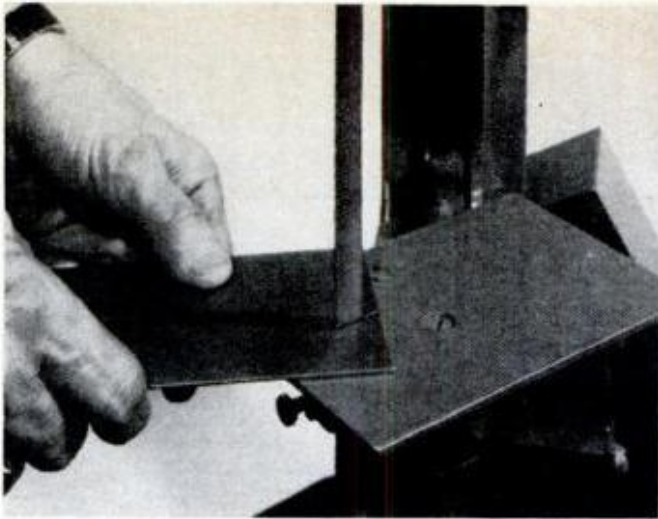
Typical two-position cutoff machine (the Shopmaster MC-100, \$199) with cutting head in conventional upright position for bandsaw. Photo at far left shows the proper application of cutting head to work when machine is used in horizontal cutoff position. Here, 3-in. plastic pipe will be sliced off squarely as head is lowered.

Metal cutoff machine: A mighty handy shop tool

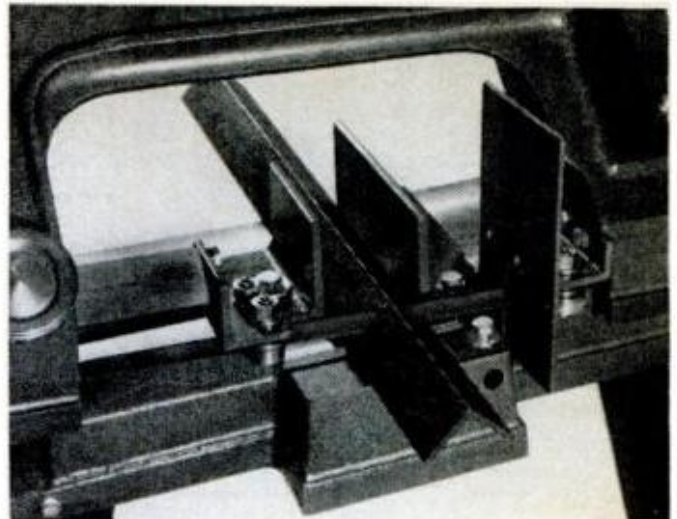
When you need to cut steel pipe, angle iron or bar stock, nothing does it faster and more accurately than a metal cutoff machine. Such machines, long associated with machine shops and industry, were seldom found in a home workshop. Only after pint-size versions of the bigger machines were made available at reasonable prices—some for under \$200—did their popularity spread to the home shop.

Differing from the conventional wood-cutting bandsaw, these unique machines perform not only in a normal upright position, but in a horizontal cutoff position as well. In the latter position, the workpiece can be of any length since the frame comes down at an angle to clear the material you're cutting, and the roller guides twist the blade so it is square to the work.

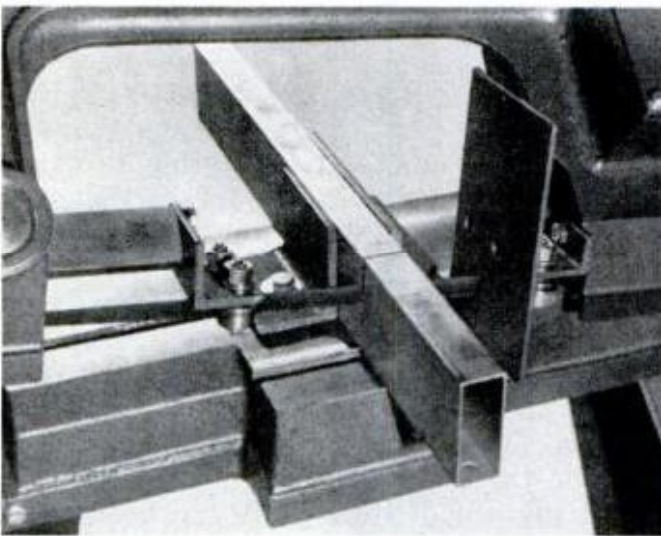
These smaller "little giants" are rugged.



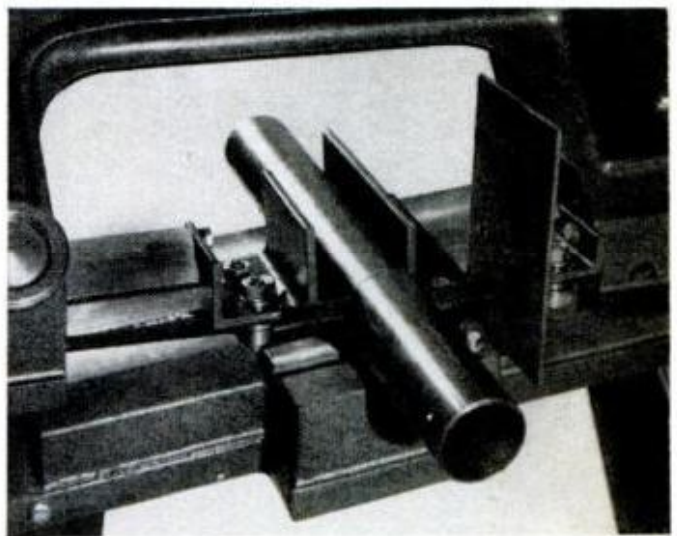
Contour cutting is done with machine in its normal upright position. Here, work is fed into blade.



When cutting angle iron, clamp stock like this so blade is always in consistent cutting position.



When sawing rectangular bar stock, position work so you saw edgewise rather than across surface.



When slicing through round stock, position blade guides as close to work as possible for accuracy.

They have automatic shutoff switches and adjustable spring tension for feed control. They are precise in their cutting and cut up to a 45° angle, doing the same work as their bigger industrial brothers, but with less capacity. They not only can cut metal efficiently, but are excellent for plastics, rubber and, in some cases, wood. When cutting rubber, you should use a scap blade. The average-capacity machine on the market will cut a 4½-in. piece of round material and 6-in. flat material.

Bandsawing is a high-production, efficient and precise method of cutting metals. The chip removal is fast and accurate, wear is distributed over many teeth and there is a uniform chip load per tooth, plus removal of a minimum amount of material. Besides straight cutting and angle cutting, contour cutting can be done with less horsepower.

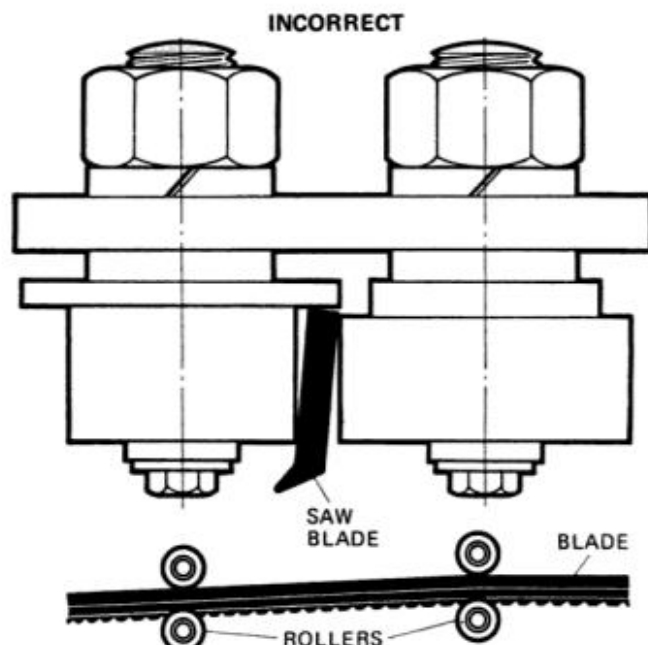
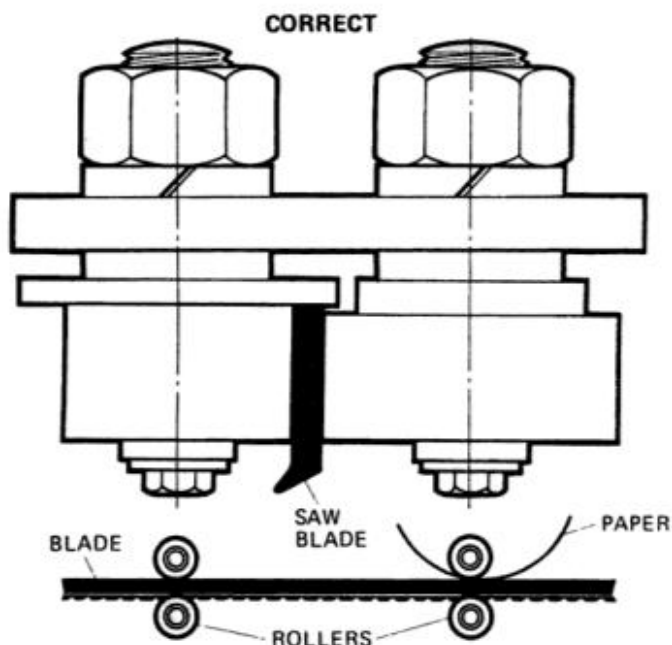
Because of their versatility, many saws are not used to their full capabilities or are

not fully understood, often resulting in excess blade breakage and wear, and inaccurate cuts.

In general shop use there are several different shapes of materials to be cut, such as angle iron, round and square stock and castings of odd shapes. It's important that the stock be properly mounted in the vise, and that you do not simply drop the main cutting head when starting the cut. This not only can cause blade breakage, but also result in inaccurate cuts.

The most popular blades are the 14 and 18-tooth ones. This is the number of teeth per inch. These two are the usual types of blades furnished and recommended for general cutting. If, however, you are to mass-cut a material in a production run, it is well to check with your blade supplier as to the best tooth structure to use.

For use with 14 or 18-tooth general-purpose blades the following chart, based



on a 1725-rpm motor drive, gives the proper speed and pulley size to use when you cut various metals (most machines come with three-step cone pulleys):

Material	Feet per minute	Motor pulley	Machine pulley
Tool steel, stainless steel or alloy steels	65	Small	Large
Mild steel, hard brass, bronze	120	Center	Center
Soft brass, aluminum, other light metals	220	Large	Small
Nonmetals: carbon, fiber, plastic, rubber, etc.	220	Large	Small

Be sure the blade is not in contact with the work when the motor is started. After allowing the saw to come to full speed, begin the cut by letting head down slowly onto the work. *Do not drop or force.* Let the weight of the saw head provide the cutting force. The saw automatically shuts off at the end of the cut. *Caution: never operate the saw without blade guards in place.*

The rate of feed is preset at the factory for general work: To increase the feed, turn the feed-screw adjustment clockwise; to decrease, turn it counterclockwise. Do not adjust more than one turn at a time. Proper feed is important; excessive pressure can break the blade or stall the saw; insufficient pressure dulls the blade rapidly.

Mounting the material properly in the vise is important. You will note that it is best to mount the material in such a manner as to maintain an even cut. For example, a rectangular piece is placed on edge so that the blade at the point of con-

tact will have a consistent cutting area. When it's placed in a flat position, there is a tendency for the cutting action to drag, since the greater the flat surface that you are cutting, the greater the drag on the machine. In some material, this can cause inaccuracy.

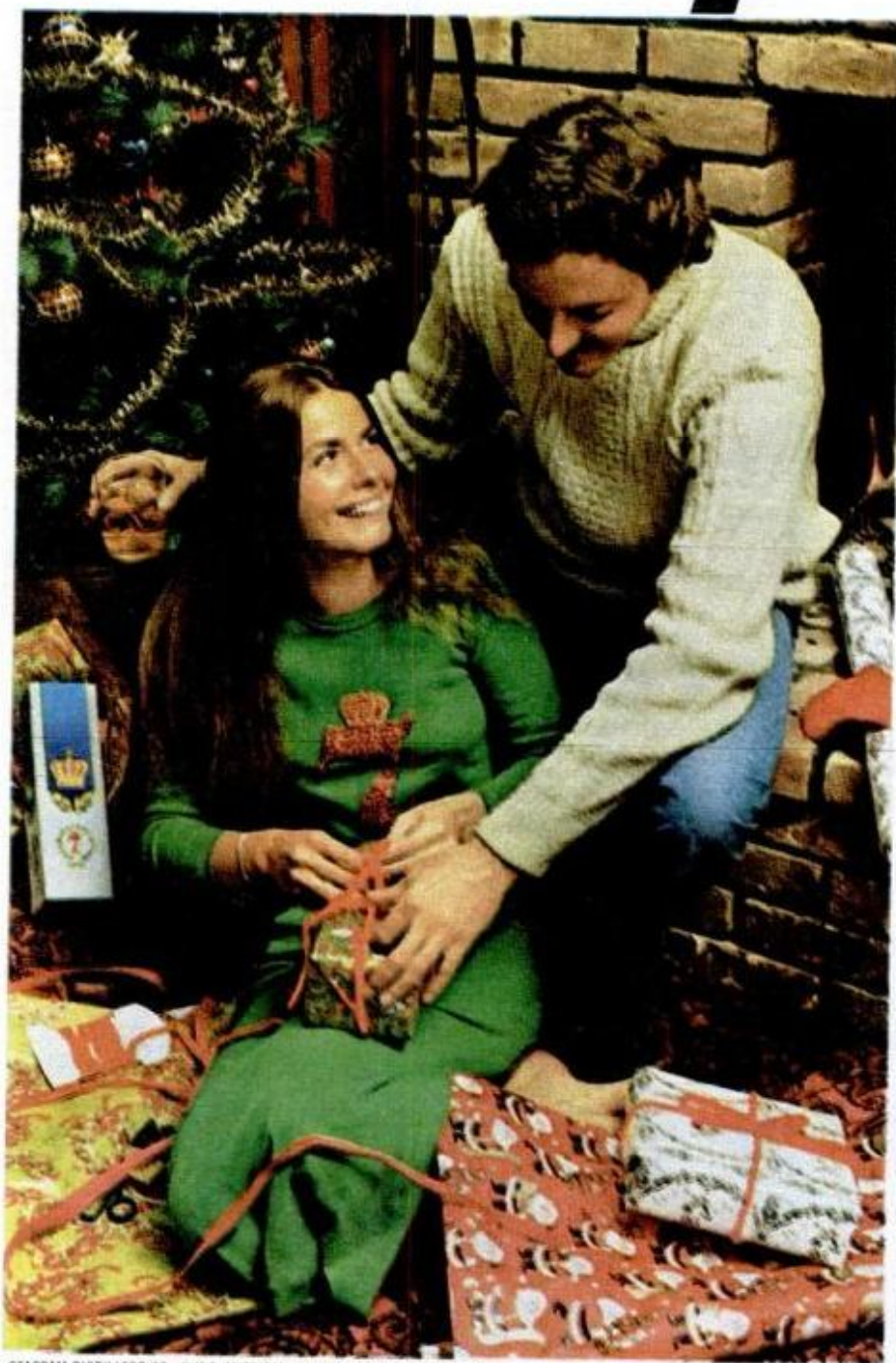
It's important to know what's wrong when your metal-cutting bandsaw is cutting out of line or stripping teeth, the blade is breaking too often or there is excessive wear on the blade.

Cutting out of line: This can be caused by too heavy a feed. To correct this, you simply reduce the speed. It is also possible that the guides are not set as close to the work as possible. Also, the guides could be out of alignment and need adjustment. Usually, they guide the blade too loosely. They should be reset, but not so tightly that they will bind. Sometimes the set may be out of one side of the blade, because of improper mounting.

Breaking of blades: In most cases this is caused by the guide being out of alignment, thus causing the blade to twist, or there could be a lack of tension on the blade. Guide adjustment would apply here, bringing them as close to the work as possible to eliminate blade twist. You should always keep the blade tight or taut.

Stripping teeth: Usually the teeth are too coarse for the work being cut or there could be unusually hard spots in the material. In this case, it is best to change the blade or to rotate the stock if possible. Excessive wear on a blade is usually caused by the blade being run too fast in the type of material being cut. ★★★

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CAR CLINIC

BY MORT SCHULTZ

The real thing

I got a bit overzealous with silicone spray about a year ago. In addition to treating the rubber on doors and trunk lid, I gave the windshield wipers a spritz. This has left a glaze on the glass that hasn't disappeared. I've tried removing it with gasoline, kerosene, boiling water and every glass cleaner I could find. What should I try now?—Frank Henry, New York

The glaze has not disappeared because it is being continually applied by the silicone-treated windshield wipers. Cleaning the glass is not the answer. You have to clean the wipers. Believe it or not, you can do this by washing them with Coca-Cola—an excellent solvent. If the glaze persists, replace the blades.

Aerodynamic accumulator

Fog and small specks form all over the rear bumper of my 1972 Dodge Challenger, which has a 340-cu.-in. engine with four-barrel carburetor and dual exhaust pipes. I apply a heavy coat of wax after washing the car every week, but this doesn't help. Is there a solution?—Tom Radden, Lexington, Ky.

Change the decorative chrome tailpipe outlets to the curved standard-type tailpipes. You have to deflect the exhaust downward or the low-pressure area behind the car will continue to draw in the exhaust and cause your accumulation problem.

Nosy nuisance

What is the reason for an odor of gasoline from my 1972 Plymouth station wagon? This has been the case since I bought the car new. There are no leaks and I take great pains never to overfill the tank.—John Gazi, Galveston, Tex.

Perhaps the seal between the fuel filler housing and the car's body is incomplete. This would permit fumes to escape into

the interior of the vehicle. Open the fuel filler door, and look between the filler door housing and the sheet metal of the wheel housing for a black rubber seal. If it seems loose, buy a tube of black silicone rubber sealing compound used for household repairs and reinforce this seal.

A new wrinkle

Is there anything I can do to get wrinkles out of a vinyl roof?—Larry Robinson, Hartford, Conn.

Apply a clean damp cloth over the area. Using an ordinary household iron, press out the wrinkles. Some cautions: Set the iron's temperature control for medium heat (this is the setting for cotton) or lower; keep the iron moving all the time; and don't allow the cloth to get dry since excessive heat will damage vinyl.

Mutual admiration

I'm sure you can appreciate how tough it is sometimes to find the cause of a problem. I had a real rough engine idle with my 1971 Pinto (two-liter engine). After spending much time and money, I noticed that the bracket holding the idle-stop solenoid to the carburetor was cracked. I replaced the bracket (that cost a few cents) and set curb idle to specification. Guess what. No more rough idle!—Marvin Meyers, Long Beach, Calif.

I also appreciate good tips. Thanks.

Rain, rain, go away

The windshield wipers of my '72 Chevrolet are so noisy I hate to use them. They're adjusted properly and are mechanically perfect. Dealers have no cure. I've heard this problem is common in these models. Any ideas?—Jim Fischer, Salem, Ore.

(Please turn to page 150D)



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Kings, 15 mg. "tar," 1.1 mg. nicotine; Longs, 17 mg. "tar," 1.2 mg. nicotine, av. per cigarette, FTC Report Mar. '74

CAR CLINIC

(Continued from page 150B)

Several Chevy owners I've spoken to have gotten satisfaction by replacing the brand of blades originally put on the car with a different brand. However, several things may cause blades to chatter. If the rubber is cracked or stiff, blades should be replaced. Foreign matter on the blades, such as dirt, wax, or road salt, can usually be removed by cleaning the blades with a household powder cleanser. Another cause of chatter is a change in angle of attack, which can come about if wipers aren't operated for a long time and rubber sets because of constant pressure in one position. Remove the blades from the arms, turn the blades end to end and reinstall them.

Civic overflow

Why is there a constant loss of coolant from my 1974 Honda Civic? There are no leaks. No sooner do I add coolant, then the level falls off and I have to add more. I don't overfill.—Frank W. Moorer, Natick, Mass.

Aeration may be causing your problem, but it is easily cured. Aeration in the cooling system forces the coolant out of the overflow. The Civic cooling system has an air-bleed valve. It's on the engine, right beneath the carburetor air cleaner. As you add coolant, loosen this valve to let air trapped in the system bleed off.

Freaky leak

I am having a problem with my 1971 Volkswagen Squareback. The oil pan leaks, and so far changing gaskets hasn't helped. Can you tell me what to do?—E. E. Yates, Dayton, Ohio

Most often the cause of such a problem is a bad oil-strainer gasket, a ruptured crankcase oil seal or weakened pushrod tube seals—in that order.

SERVICE TIPS

■ **Chrysler Corp.** advises you to be on the lookout for a transmission problem if your 1974 passenger car (or Dodge light truck) is equipped with a 400 or 440-cu.-in. engine and A-727 automatic

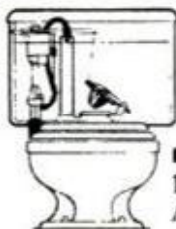
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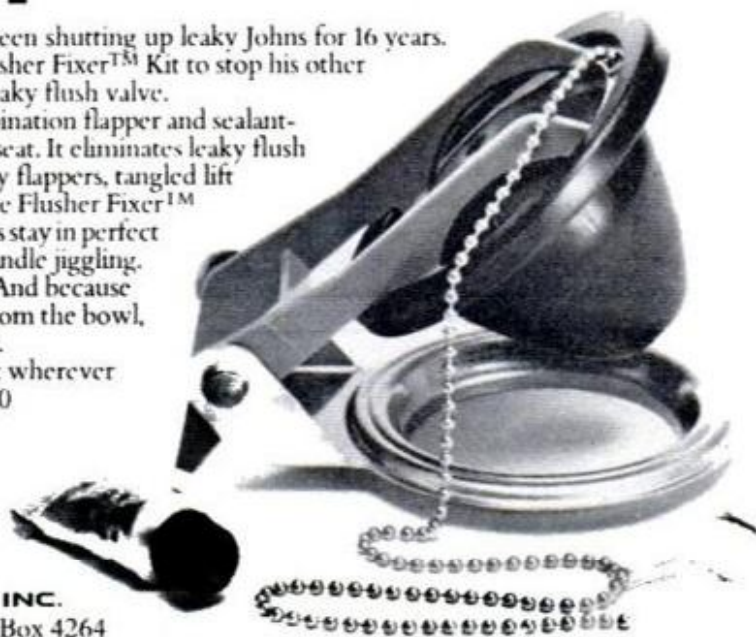
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transmission. The trouble centers around the front oil-pump housing gasket, which may blow because of an out-of-flat, front-pump-housing mounting face on the transmission case. If it does, there will be reduced line pressure and a loss of drive at idle speeds with a "bump" occurring as engine speed is increased and as the rear clutch engages. The condition could eventually cause rear clutch failure. To correct this condition, replace the transmission case. This is covered by warranty.

■ **Finding parts for older cars** can be a problem. If you haven't been able to find what you need at auto parts supply dealers or auto wrecking yards, try the following outfits, which have what you need. When writing for information, enclose a stamped, self-addressed return envelope to insure a prompt reply:

- Alvin E. Anderson, 173 Hotchkiss St., Jamestown, N.Y. 14701.
- Bud Chittenden, Box 276, Goldenrod, Fla. 32733.
- Burchill Antique Auto Parts, 4150 24th St., Port Huron, Mich. 48060.
- Burton Waldron, Box C, Nottawa, Mich. 49075.
- B.S. Antique Auto Parts, 9113 East Garvey Ave., Rosemead, Calif. 91770.
- B.S. Wisniewski, Inc., 215 West Maple St., Milwaukee, Wis. 53204.
- D. Neale, Box 67, Gabriels, N.Y. 12929.
- Hank's Vintage Auto Parts, 14th and Elm, Quincy, Ill. 62301.
- Jim's Auto Parts, Box 933, South Miami, Fla. 33143.

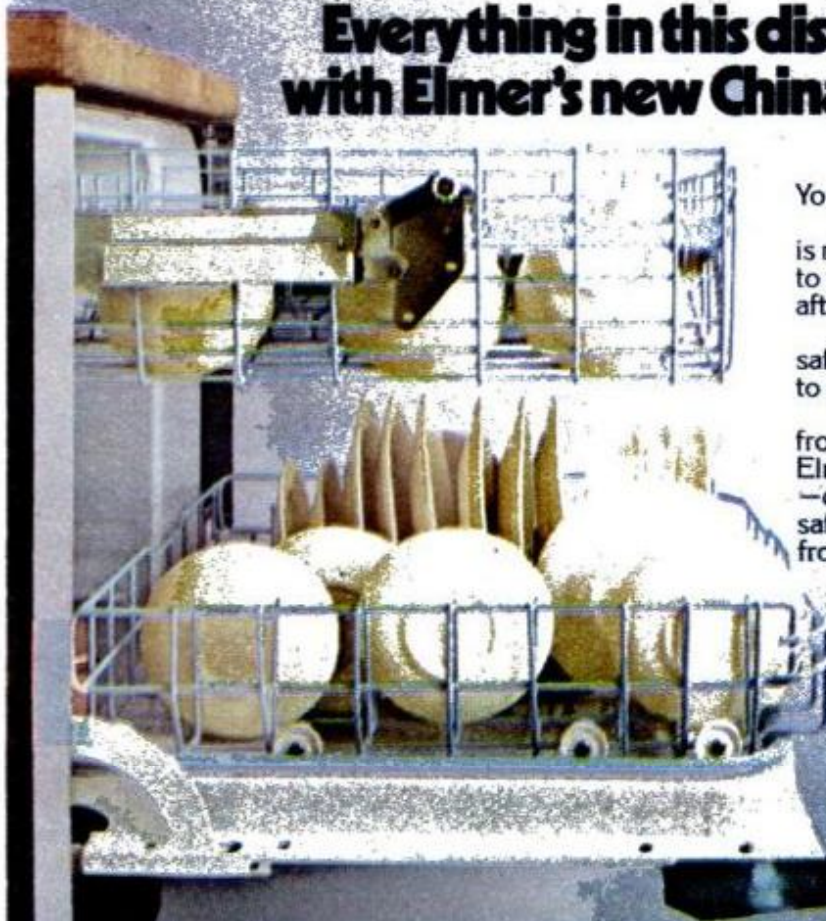
- Joe McCormick Auto Parts, 23 Cedar St., Saranac Lake, N.Y. 12983.
- J.C. Whitney Co., 1900 South State St., Chicago, Ill. 60616.
- Link Belt Co., 220 South Belmont Ave., Indianapolis, Ind. 46222 (for gears only).
- N. B. Pease & Co., 43 Foundry St., Palmer, Mass. 01069.
- Roy Butler, Midwest Classic Antique Cars, 3034 Larimer, Denver, Colo. 50205.
- Vintage Auto Parts, Inc., 24300 Woodinville Snohomish Hwy., Woodinville, Wash. 98072.

The following organizations are not direct sources for parts, but may provide information about other outfits that we haven't listed:

- Antique Auto Clubs of America, National Headquarters, Hershey Museum, Hershey, Pa. 17033.
- Car and Parts, Box 299, Sesser, Ill. 62884.
- Hemmings Motor News, Box 380, Bennington, Vt. 05201.
- Horseless Carriage Club of America, National Headquarters, 9031 East Florence Ave., Arrington Square, Downey, Calif. 90240.
- Motormark Weekly, Box 308, Frankton, Ind. 46044.
- Veteran Motor Car Club of America, 15 Newton St., Brookline, Mass. 02146. ★ ★ ★

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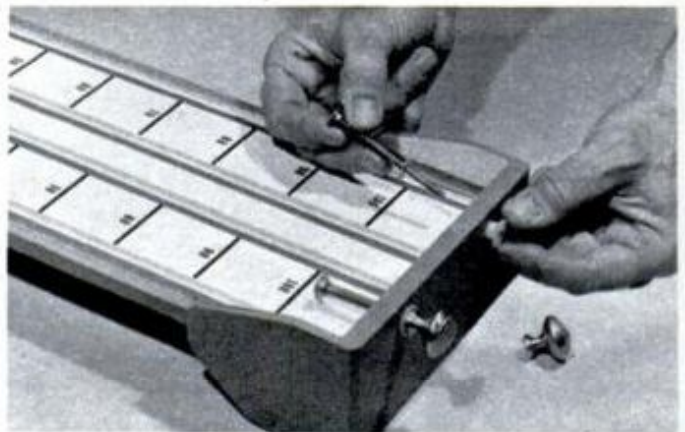


Color photo: Rosario Capotosto

Spring-powered toy racetrack

Here's an exciting toy that will provide youngsters with all the thrills of a real speedway. I call it the Derby Hill 500. Four plastic cars are sent roaring down the track by two or four "drivers," each pulling one or two spring plungers. The car that goes the farthest or crosses the checkered finish line first wins.

The four roadbed sections required can be placed either side by side or end to end



Stovebolt slipped through coil spring and capped with drawer knob makes a plunger to propel the cars. Holes for plungers are centered in each track lane.



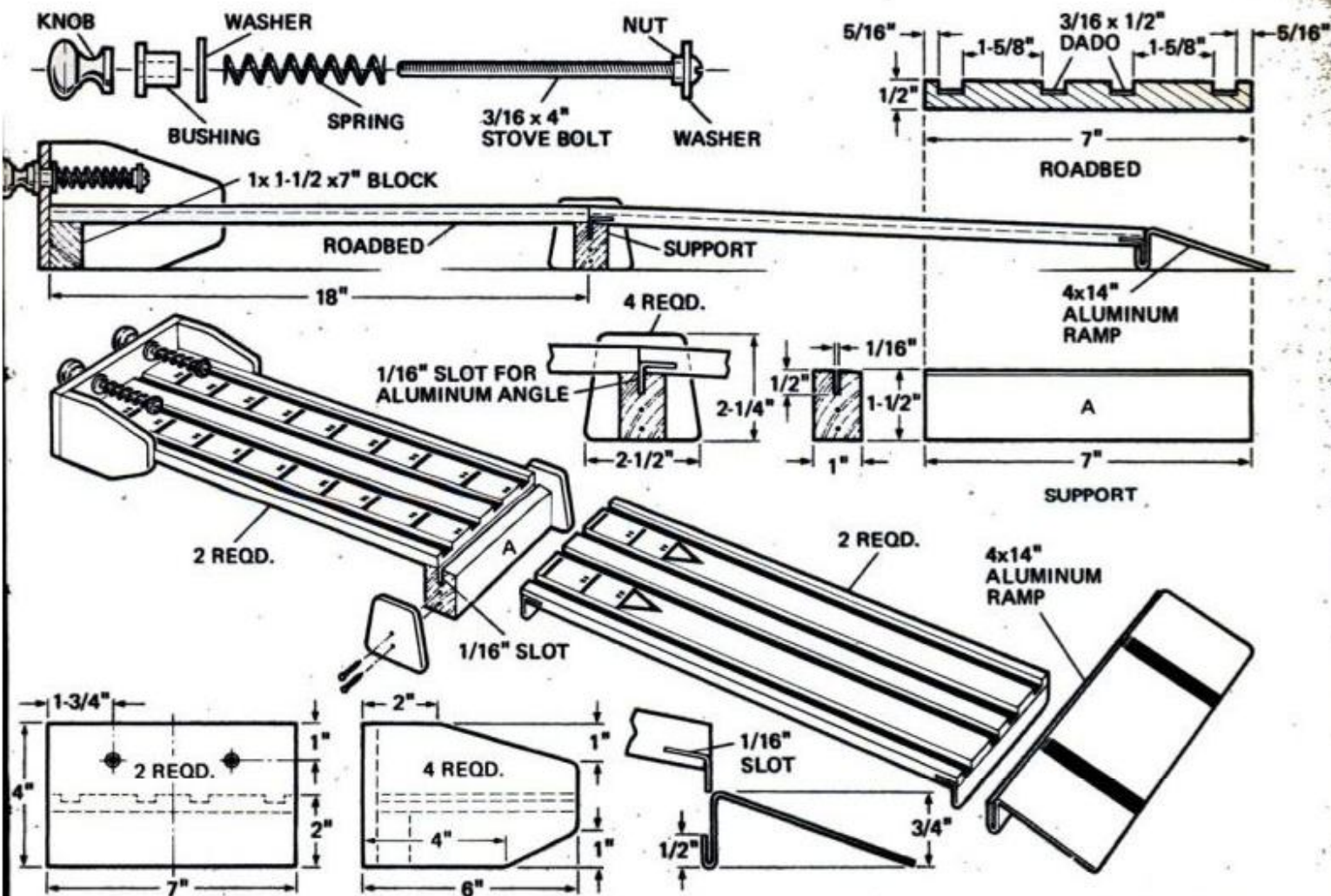
Black charting tape, $\frac{1}{8}$ in. wide, is used to rule lines on track surface (top). Green tape marks wheel channels; press-on numerals make neat numbering job.

to vary the fun. Placed in pairs side by side, the sections provide a four-track raceway 36 in. long. Hooked end to end, the sections provide a 6-ft.-long raceway. In the latter case, only two cars are driven and drivers are stationed at opposite ends, each taking turns racing his car down and up the inclined track. The driver who scores a total of 500 points first wins.

Each roadbed section measures 7 in. wide by 18 in. long and has four $\frac{1}{2}$ -in.-wide grooves spaced to suit the wheels of the particular plastic race cars used. The cars I used were purchased at Woolworth's and are about 6 in. long.

The drawings show how the roadbed sections are supported and how they hook together. Metal angles formed from sheet aluminum engage saw kerfs in the support blocks. The outboard end of the track hooks similarly into an open fold in the metal ramp.

Stick-on scoring numerals are used for marking the track, and $\frac{1}{8}$ -in. black matte charting tape (Prestype) is used to rule off scoring divisions.—Nello J. Orsini



Art: Peter Trojan



Turned-handle cutting board

Here's a gift you can turn out in a few hours—though it will last a lifetime. Start by preparing a 1½-in.-thick piece of cherry, rock maple or walnut and a full-sized cardboard template. Center the template accurately on the hardwood slab and mark the outline. Drill 1-in. holes at the base of the handle, then cut the blank to shape with a sabre saw or a bandsaw.

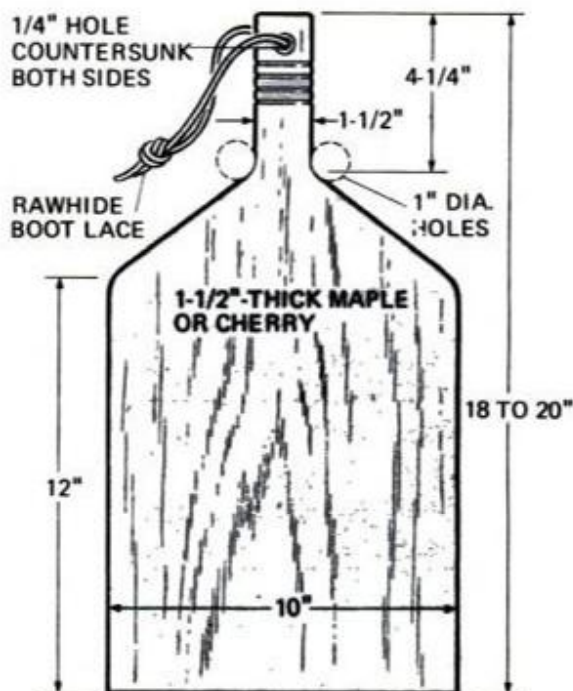
Find the precise center of the blank and mount it in the lathe, being sure both centers are set deeply into the end grain of the wood. Keep the lathe speed slow—about 900 rpm. Start cutting with a gouge at midpoint, working away from the board toward the handle end. Make successive cuts in this direction, starting each bite closer to the base of the handle.

To blend the handle with the flat blank, hold the gouge on its side with its handle nearly parallel with the sloped sides. As you slice in, roll the gouge flat and toward the handle end. Finish turning the handle with gouge and skew, then sand it smooth with strips of 120-grit paper.

Now remove the work from the lathe and sand the rough-sawn edges on a disc sander. Drill and countersink the hole for the leather loop and give the flat surfaces a thorough sanding with 100 and 120-grit paper. Finish with two or three coats of linseed oil and a coat of paraffin dissolved in mineral spirits. Thread a 24-in. length of rawhide boot lace through the handle and knot it.—*Dave Warren.*



Use ¾-in. gouge, sharply honed, to begin turning handle section round. Keep hands clear of whirring blank.





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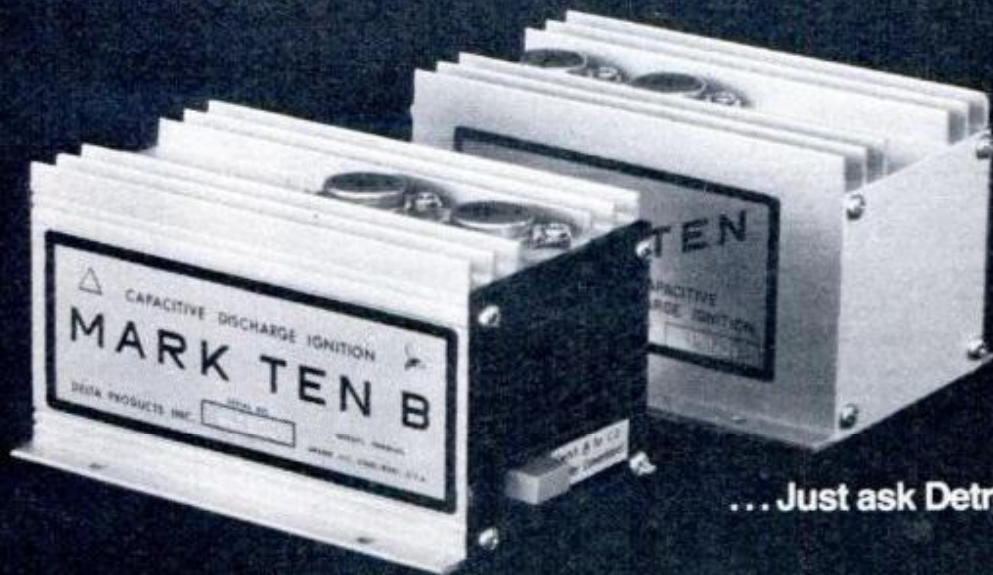
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At mealtime, what could be handier than the salt and pepper, butter, sugar and cream on a lazy Susan centered on the table? A gentle turn brings what you want within reach without your asking. The lazy Susan also makes an attractive centerpiece for a flower arrangement.



Lazy-Susan table server

You don't need a lathe to make this handsome lazy Susan table server. You can buy the 12 little gallery spindles already turned at many lumberyards. If your local do-it-yourself center doesn't stock them, you can buy a set of 12 spindles from Way-Mar Co., Box 164, Hartsdale, N.Y. 10530, for \$3.50 postpaid.

The circular base is cut from a glued-up square of cherry $\frac{3}{4}$ x 18 x 18 in. You make it by cutting four triangular segments from a 10-in. board with the miter gauge set at 45° and flipping the board for each pass. The butting edges of the four segments are shaped with a glue-joint cutter, or drilled for dowels. The glued-up square will have lateral-running grain of interesting symmetry and good workability when you're ready to shape it.

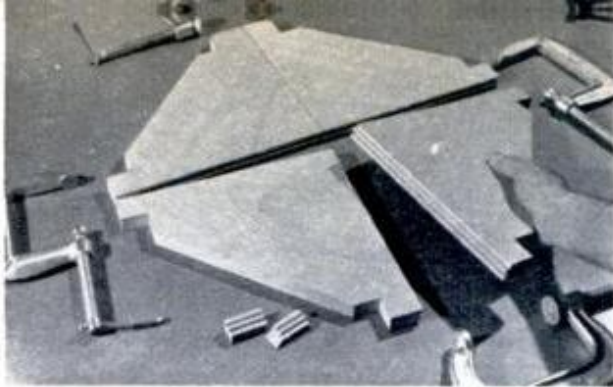
The stock for the upper ring is glued-up

the same way, but to economize on lumber, the segments need not be full triangles; they may be truncated. Cut them from a 6-in. board to the same measurements you used for the base. When the four are joined, you will have an 18-in. square with a square opening in the center. When sabre-sawing the ring, you'll have to insert a piece of scrap stock across the center of the opening to provide a surface for the saw's pivot point. This can be toenailed in place. Be sure to saw the outer circle of the ring first. Use a router or shaper to mold the edges.

Alignment of the spindle holes will be easy if you tape the ring to the base and drill the holes from the bottom side of the base and partly into the underside of the ring. Make an identifying mark on both pieces so they can later be matched as they were when drilled.

A worthwhile tip: Sand the parts and

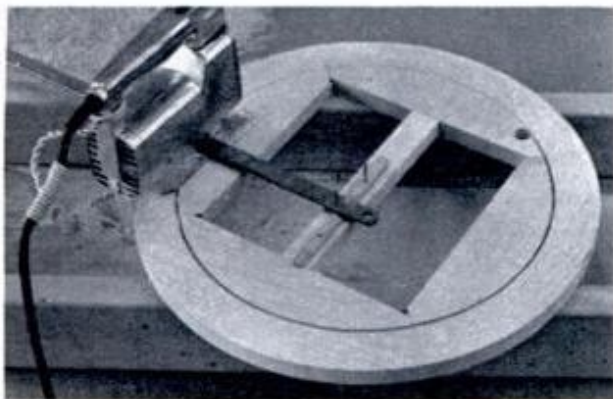
(Please turn to page 164)



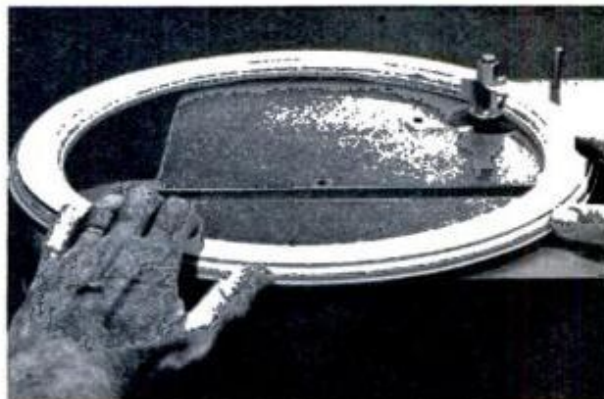
Four triangular segments for circular base are ready for jointing butted edges prior to gluing.



C-clamps are used at corners; bar clamp applies pressure to center area of glued-up work.



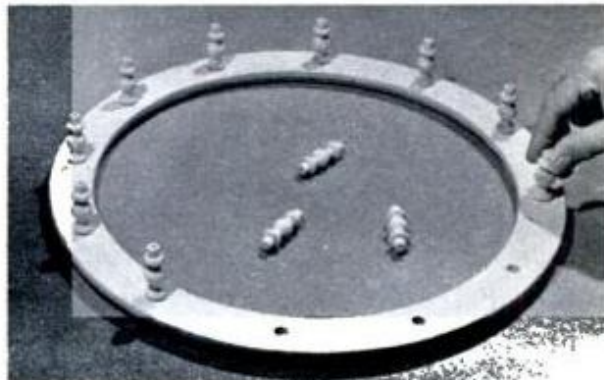
Outer cut of ring is made first to preserve support for saw's pivot when making inside cut.



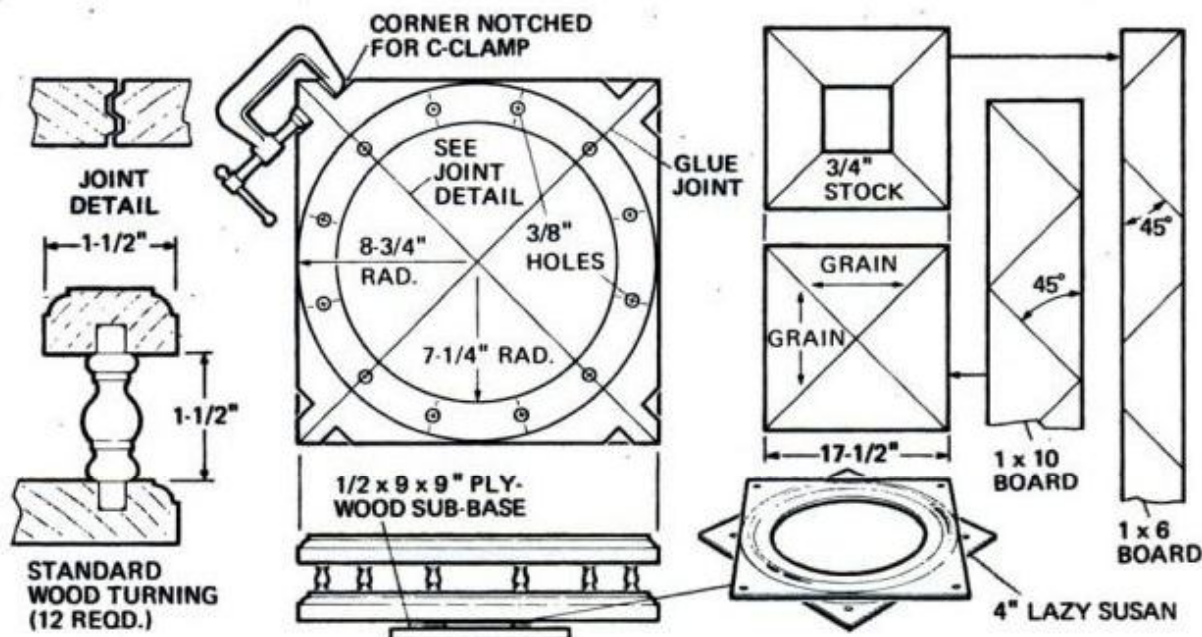
Collar controls depth of cut when you shape edges with shaper; you can also use router.

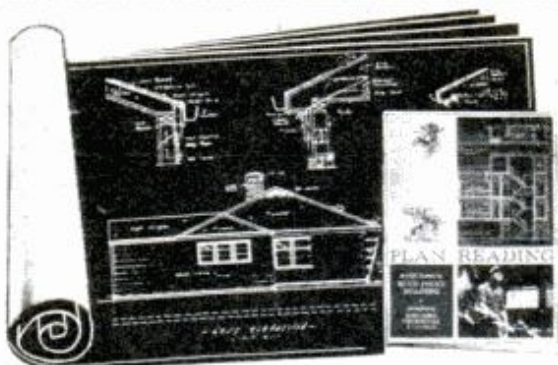


Pilot holes for spindles are drilled in base and ring at same time to assure perfect alignment.



Ready-made spindles fit $\frac{3}{8}$ -in. holes. They are not glued until finishing has been completed.





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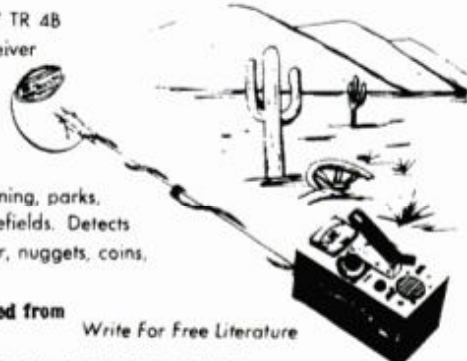
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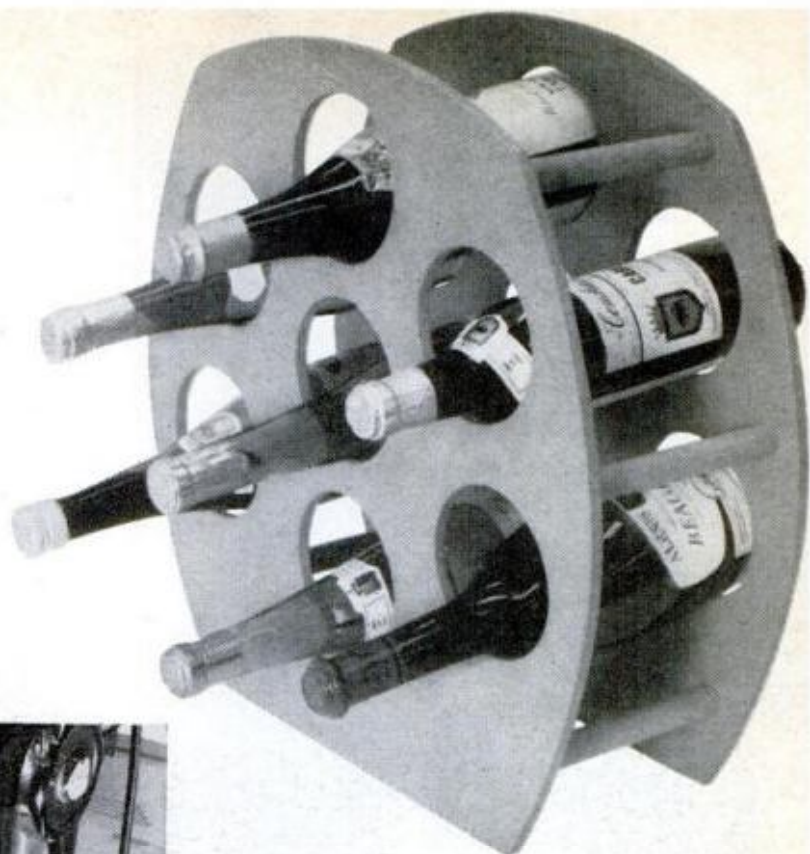
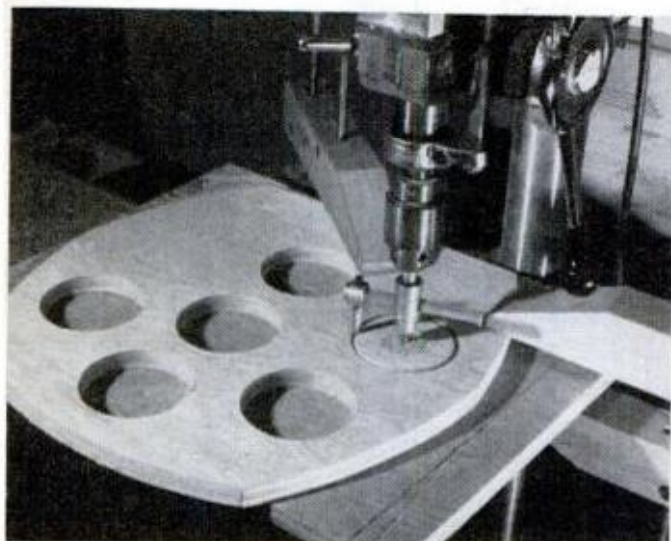
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A circle cutter is the most efficient tool to use for cutting large holes. If you don't have a drill press, you can cut the holes with a jigsaw or sabre saw. An adjustable circle cutter should not be used in a portable drill.

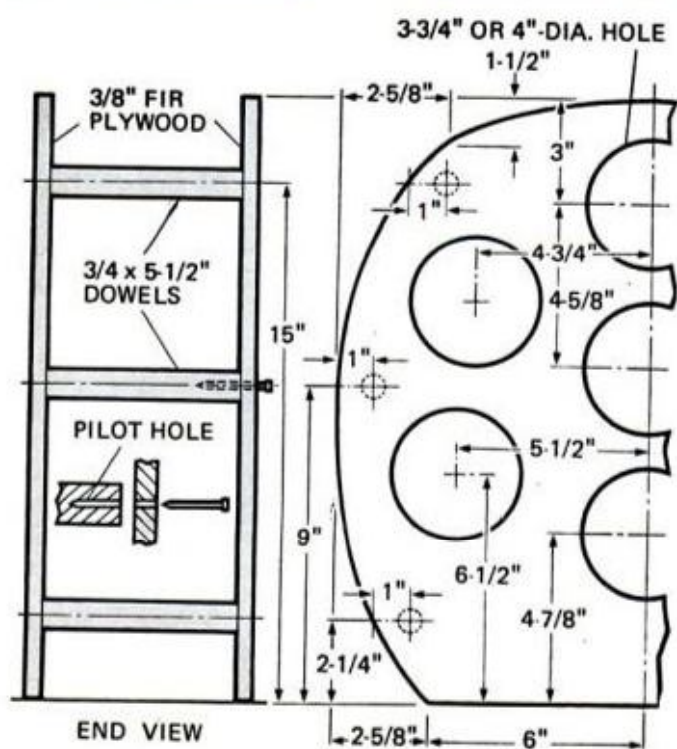


Wine rack keeps conversation flowing

You can build this eye-catching wine rack in an evening and, if you use a quick-drying latex paint, stock it with your favorite collection before you go to bed.

Tack-nail two pieces of $\frac{3}{8}$ -in. plywood together so you can cut and edge-sand them as a pair. The seven oversize bottle holes are easy to cut with an adjustable circle cutter if you have a drill press. For safety and a clean-cut hole, use a back-up scrap on the drill-press table. Clamp the workpiece with at least two clamps, making sure they clear the cutter. Keep your hands away from the tool, and run the press at moderately high speed, but feed slowly. If you have no drill press, you can cut the holes with a sabre saw, then drum-sand.

To assemble with dowel spacers, mark their locations on the front panel (while the two pieces are still joined) and drill small pilot holes for the nails through both pieces, plus dowel ends, with a $\frac{1}{16}$ -in. bit. Drive finishing nails in the holes so they project $\frac{1}{2}$ in. Apply glue, locate the nail over the pilot hole in each dowel and drive it home. After dowels are attached to one panel, add the other. Set nailheads, fill holes and paint.—*Rosario Capotosto*



For either a righty or lefty, this "ride-'em cowboy" sketch bench is made to order for a young artist. A built-in compartment keeps everything handy. Removable pegs in holes in the top edges of the rails permit large sketch pads to be supported by the easel by angling them against the pegs.



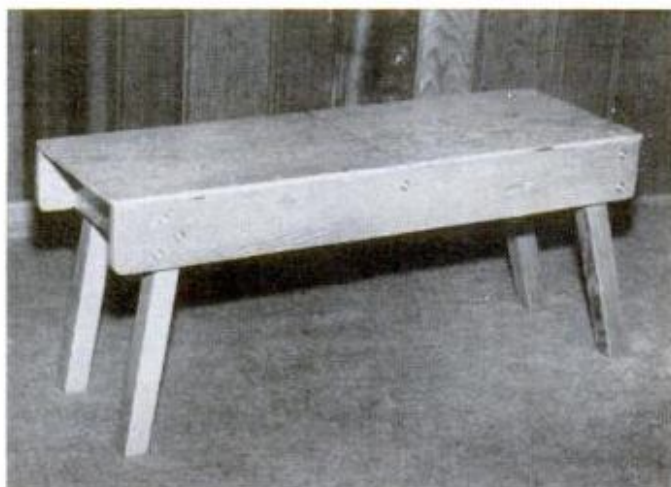
Sketching bench has retracting easel

Sometimes referred to as an artist's sketch donkey, this two-in-one bench serves a dual purpose: an easel for holding canvases for the aspiring young artist, and a practical, sturdy bench.

The main material is $\frac{3}{4}$ -in. fir plywood which is used for the sides, ends and the cross member at the back of the storage compartment. The seat and easel are $\frac{1}{2}$ -in. plywood, and the legs are ripped and dressed from $1\frac{1}{2}$ -in. hardwood.

Dadoes and screws are used for rigidity, and cup washers are used under all exposed screwheads both for looks and to prevent snagging clothing.

As seen in the plan details, two hardwood

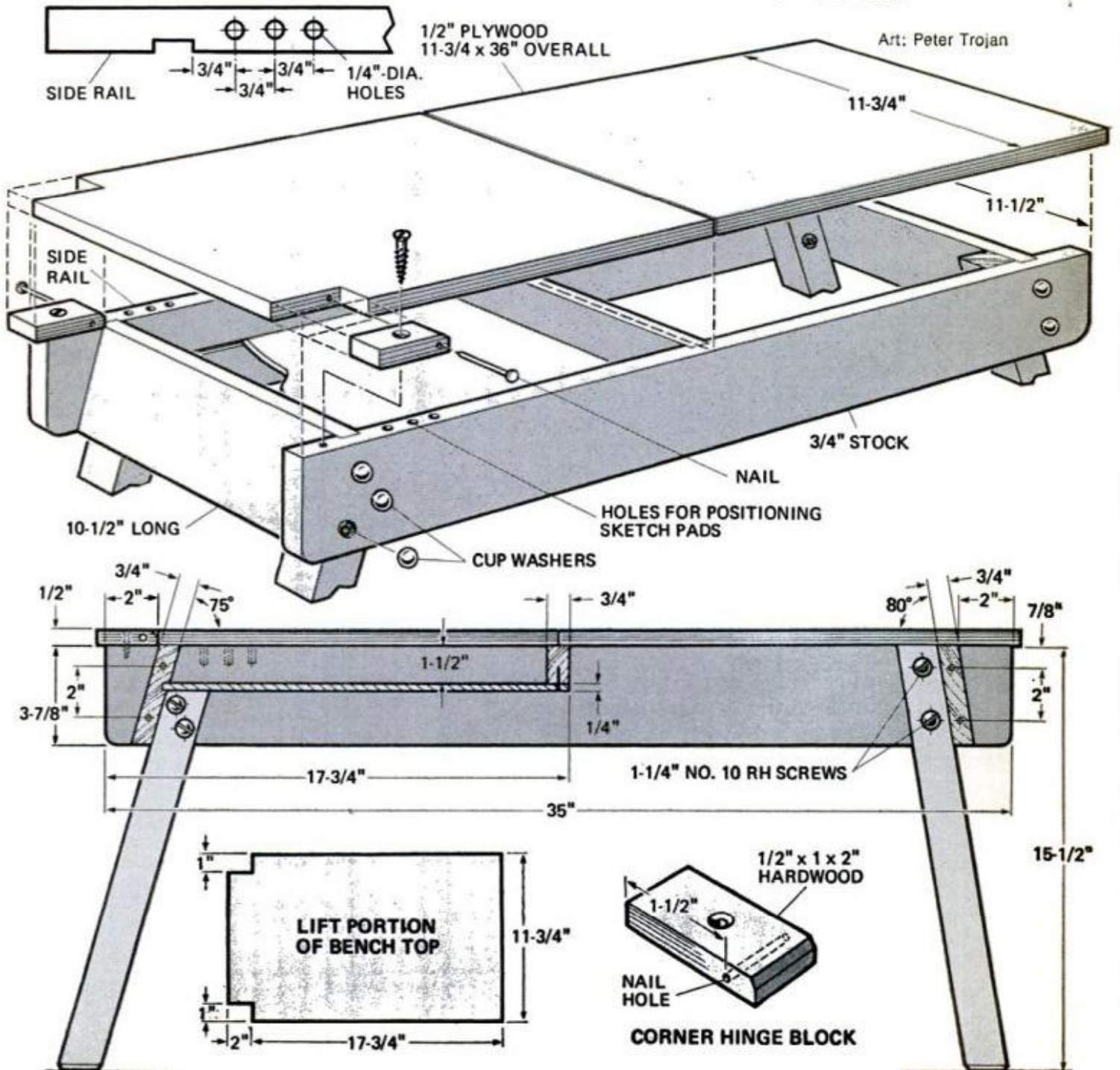
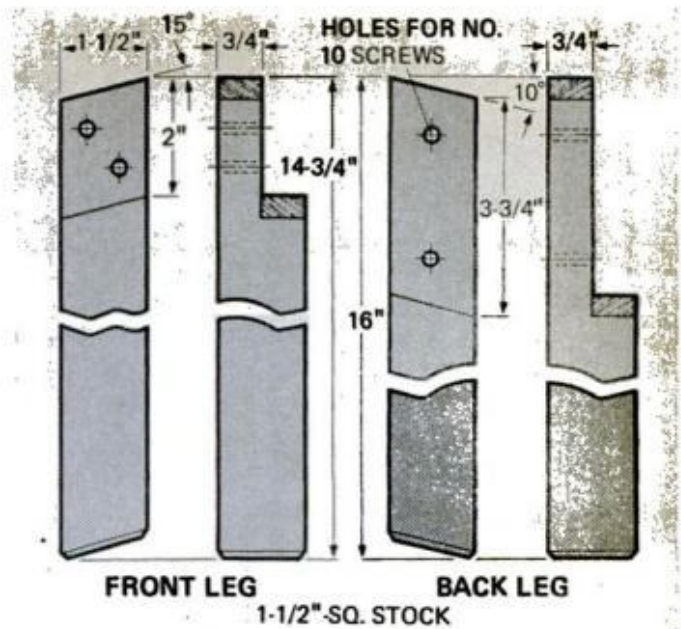


With easel lowered and pencils and crayons put away, sketching bench becomes a plain handy seat useful in many ways: To sit on in front of an open fire, to serve as a luggage rack, or just to pinch-hit for extra seating when the gang's all there.

blocks are glued and screwed to the front outside corners to act as pivots for the lid. Two 2-in. common nails or No. 6 x 2-in. screws pass through holes bored in these blocks and enter the edges of the lid. When lifted for use as an easel, the short end bears against the front cross rail.

The four legs of 1½-in. dressed hardwood are notched to fit flush with the outside faces of the side rails and are screwed to the rails with 1¼-in. rh screws.

A ¼-in. plywood panel is used for a bottom for the storage compartment and is housed in grooves cut in the end and side rails.—C. L. Widdicombe



LAZY-SUSAN TABLE SERVER

(Continued from page 157)

apply the finish before assembling your server for a top-notch job. A coat of sanding sealer followed with stain and a final coat or two of clear satin finish such as Wood-glo will do fine.

To complete the project, you'll need a 4-in. lazy Susan bearing. Attach this to a piece of wood scrap $\frac{1}{2}$ x 9 x 9 in. Drill a 1-in.-dia. screw access hole in this subbase, attach the bearing and then screw the unit to the circular base. You can obtain the Wood-glo finish, as well as the 4-in. lazy Susan bearing, from Albert Constantine & Son, Inc., 2050 Eastchester Ave., Bronx, N.Y. 10461.

—Rosario Capotosto

VACATION SLIDE SHOWS

(Continued from page 127)

slides in rectangles nearly indistinguishable from their original, full-frame mounts, hiding just enough to crop away objects which have just begun to infringe on the picture area, or to trim down a too-large expanse of sky or foreground. Others crop the slide radically—into squares, or long, slim, "wide-screen" rectangles, or into circles and ovals.

Still others frame the images in gimmicks: hearts, stars, keyholes, binoculars, artists' palettes, arches, triangles, diamonds, TV screens, or oriental windows. These gimmick mounts should be used *very* sparingly—if you have one in each of your slide shows, that's probably too much. But where they do make a valid point, they are worth using. And sometimes they can make an invalid point fun, too: an Oriental-window frame can visually transplant a palm tree from Miami to the Middle East.

Crop mounts come in many forms, too. Commonest are heat-seal and pressure-sealing types. The hot-mounts can be sealed with gadgets like the one shown on page 125, or with a household iron (if you're careful). Pressure-sealing types require no extra apparatus (though the GePe sealer on page 125 does make things easier), but have the reputation of opening again after a few years. Plastic mounts that snap together, like the GePe models shown, are sturdy and secure, but come in a limited number of frame sizes (of which I found GePe's 14x17 and 17x21 frames handiest). But GePe's rectangles can do double duty as squares, if you mount the front and back halves at right

angles to each other. Heindl also makes thin masks that can attach to the outside of a standard 2x2 slide mount, and smaller ones that stick directly to the film chip before mounting, as well as thin masks meant for use in glass slide mounts.

You can crop slides yourself, of course, using either thin, opaque tape (make sure it has clean, unfuzzy edges), or Kodak Opaque liquid. But you'll have to remove the slide to work on it, so it's probably easier to use crop mounts.

Getting the slide out of the mount is easy: Just trim about $\frac{3}{16}$ to $\frac{1}{4}$ inch off the original cardboard mount; Kodak mounts bulge a little at this point, which helps you find the right spot. But if you're in doubt, trim cautiously, sliver by sliver, till you find the edge.

While you're rebinding your slides, you might want to try binding in thin acetate filters, either to correct minor color imbalances or to accentuate the mood of a scene (adding a little blue to an evening shot, perhaps, or heating up the orange of a sunset). Sources for these filters, as well as many of the mounts and gadgets mentioned here, are listed below.

This takes time and effort, of course (and a very little money), but the results should be worth it. Trim the fat from your vacation slide shows and you, too, will probably enjoy your vacation memories more—it's a cinch your audience will.

MAIL-ORDER SOURCES

Erie Color Slide Club, Box 672, Main Post Office, Erie, Pa. 16512; pressure-sensitive and heat-seal crop mounts, squares and rectangles only; cropping guide.

GeMounts and GeMasks, Box 630, Times Square Station, New York, N.Y. 10036; wide range of masks and mounts in a rectangular and gimmick shapes, color-correcting filters.

Heindl Masks "N" Mounts, 200 St. Paul St., Rochester, N.Y. 14604; heat and pressure-seal mounts, masks for glass-mounted or cardboard-mounted slides, wide range of rectangular and gimmick shapes including special models for multi-projector use.

Porter's Camera Store, Box 628, Cedar Falls, Iowa, 50613; Richards Idealite, Indemar. Smith-Victor and other slide sorters, Seary hot-mount press, slide trimmers, slide-mounting filters, slide-changing viewers, projector stack loaders; big, jumbled catalog.

Spiratone, 135-06 Northern Blvd., Flushing, N.Y. 11354; rectangular and gimmick-shaped, heat-sealing slide-mount assortments, heat-sealer, film cutter.

For addresses of other manufacturers, who do not sell by direct mail, write to Popular Mechanics Bureau of Information, 224 West 57 St., New York, N.Y. 10019.

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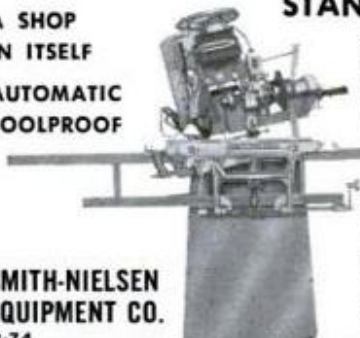
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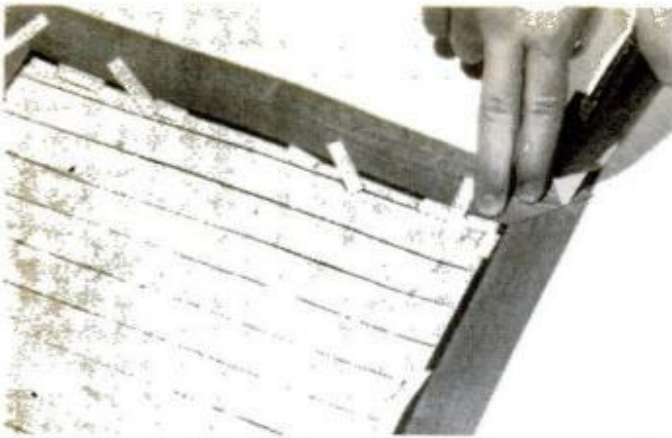


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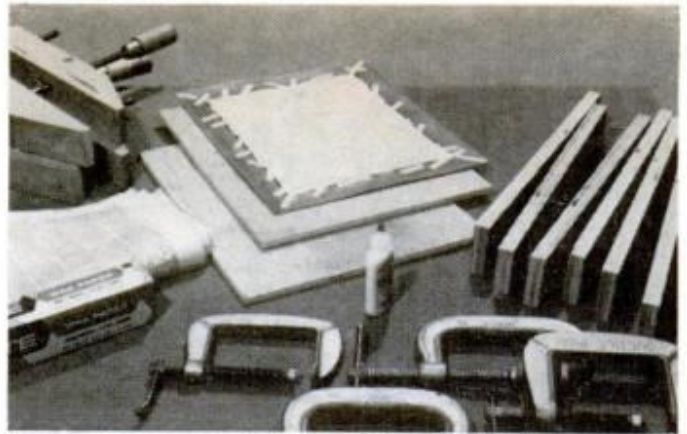
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18. Initial scoring of miters can be done as shown, but make final cut from outer edge to avoid splitting.



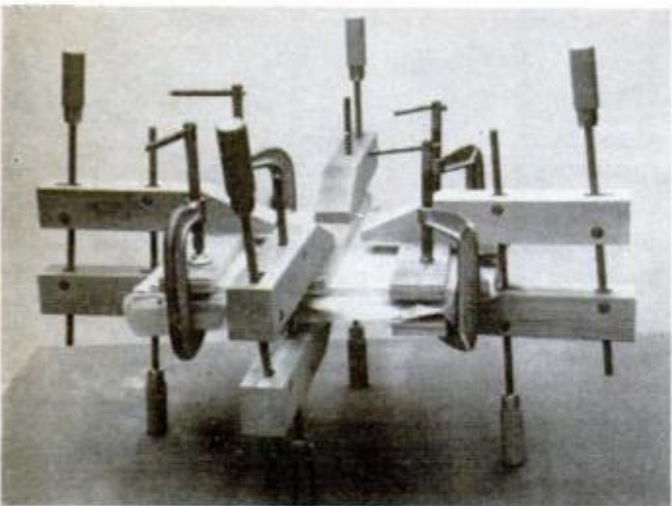
19. Items needed for laminating completed picture to back panel. Use as many clamps as can be applied.



20. Brush white glue on both surfaces. Here the back veneer is already in place on the back panel.



21. Cover face of picture with wax paper to prevent excess glue from sticking paper pad to inlay.



22. Newspaper padding over glued-up sandwich takes up irregularities in surface, insures close contact.



23. Power finishing sander and fine abrasive paper can be used to clean surface if you work carefully.

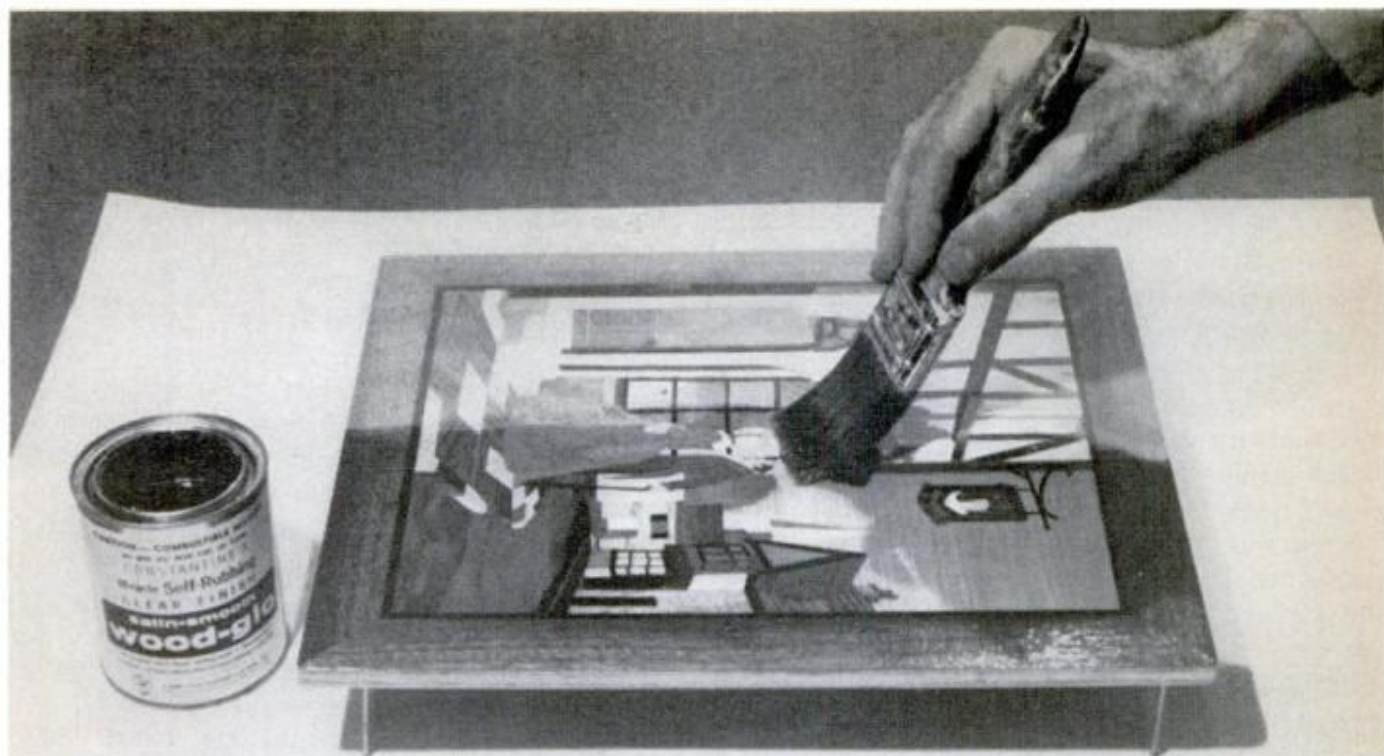
MARQUETRY

(Continued from page 91)

of the picture. Border strips of veneer are cut to fit with mitered corners and these, too, are taped into place.

All the original bits of tape are now carefully removed from the backside preparatory to gluing the veneer to a background panel which can be either hardboard

or plywood. In order to prevent warping of the panel, a backing veneer is supplied. This is glued to the back of the panel to counteract any warping tendencies. Apply white glue to all surfaces to be joined, insert a sheet of kitchen waxed paper against the veneers, back and front, then place a layer of newspaper between the wax paper and two pieces of $\frac{3}{4}$ -in. plywood. Use as many clamps as you can to apply pres-



24. Bring out beauty of different colored wood veneers by applying two coats of a clear finish.

sure. The use of cleats across the glued-up sandwich will insure more even clamping pressure.

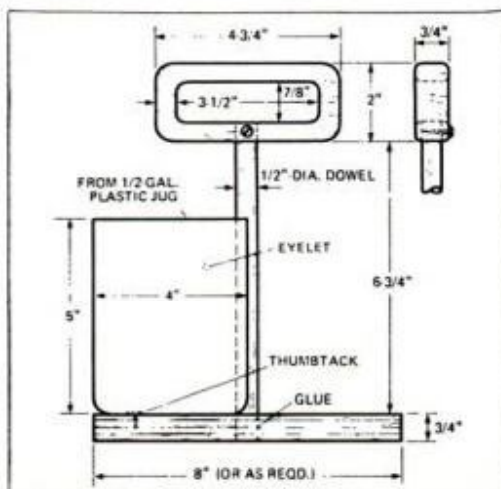
When dry, the surface tapes can be removed by dampening them with water. A thorough sanding, followed with several coats of a clear wood finish will complete your picture.

Marquetry kits are available from Albert Constantine and Son, Inc., 2050 Eastchester Road, Bronx, N.Y. 10461. I highly recommend their Wood-glo for finishing; it brings out the richness of the wood, dries streak-free and its low luster minimizes reflections for proper viewing of your masterpiece. ★ ★ ★

Inexpensive caddy for your tools

This tool-and-supply carrier costs practically nothing to make. Compartments—the lower portions of plastic fruit-drink jugs—are fastened together with eyelets (or

Pop rivets). The assembly slips down over the 1/2-in.-dia. x 8-in. dowel (container contours provide a central tube) before the handle is attached.—*Walter E. Burton.*



Bottoms of four 1/2-gal. jugs were used for carrier shown. Dowel and handle are maple; the handle is fastened to dowel with screw. Thumbstacks secure container assembly to 3/4-in. plywood base.

CALCULATORS

(Continued from page 75)

and MC clears the memory. Full-control memories can store constants, intermediate results, accumulative totals, or any other number. Some desktop calculators may have more than one such memory.

Item-count memories are rarer, and are mostly used for things like invoicing. In the example given for accumulative memory, an item-count would have added up the dozen apples and the 16 clams to come up with 28 items.

Printing calculators are rare in home use, since they're slower-working than display types, bigger (with the exception of the pocket-sized Canon), and cost more (about \$150 up). But for accountants or others who need a printed record of their figuring, printers are invaluable.

Not all calculators, of course, are built for the home. More and more, in fact, are built for scientific or business uses. Scientific types, often called "electronic slide rules," offer several features home calculators don't have—or need. Virtually all scientific models have *square root* keys, but that key alone doesn't really make them "slide rules," though some ads might make you think so. For scientific use, a calculator usually needs keys for such trigonometric functions as sine and tangent, and for calculations using both common (base-10) and natural (base-E) logarithms. Since pi occurs frequently in many formulas, a key that enters it with one stroke can save your having to punch in and remember up to 10 digits (3.1415926654) each time that you need it.

Scientific notation greatly expands a calculator's range. By dividing a number into significant digits and powers of 10, you can shorten a figure like one billion from 1,000,000,000 down to 1×10^9 , giving a calculator with two exponent places (for showing powers of 10) a capacity to display numbers that would otherwise require 100 digits or more to display if written out in full. Some calculators give you the option of entering numbers in conventional or scientific notation; others (usually without a decimal point key) may allow only scientific, which makes them much less useful for common household figuring.

Radians are used instead of degrees to specify angles in many scientific formulas,

so scientific calculators often have switches to set their trigonometric functions to work with either unit (as on the Kings Point shown on page 74), or to convert from degrees to radians or vice versa.

Scientific calculators with algebraic entry often have *parenthesis* and *bracket keys*, to allow one calculation to be performed within another, such as $[(3 \times 2) + (3 \div 4)] \div [(7 \times 5) - (5 \times 4)] = 0.45$. Others use *Polish notation*, or *reverse Polish notation* (signified by the presence of a key labelled ENTER, but no = key), which read equations from left to right without the need for parentheses or brackets. Algebraic entry is easier to learn (you're already using it when you use pencil and paper), but involves more key strokes.

Some scientific calculators have many more functions than we've described. Many, in fact, have more functions than they have keys; a *shift key* (the Sinclair on the the cover has two of them) changes their keys' functions.

Scientists aren't the only ones with complex calculation to perform. Special calculators are now available for businessmen, statisticians and others, with more likely to come. Simpler specialized calculators are available (including a \$75 MITS kit) with metric-to-English measurement conversions as well as the usual four arithmetic functions. At the other end of the scale, *programmable* calculators can take recorded instructions outlining long and complex series of operations, including specialized instructions for anything from pi-network impedance matching to reconciling a check-book—to name just two programs in the basic pack supplied with Hewlett-Packard's HP-65.

Even these complex functions can be performed, though less quickly and conveniently, using only a standard, four-function calculator, appropriate formulas, and perhaps a book of logarithmic or trigonometric tables. That is, after all, how scientists did things for years—but faster and more accurately, with the calculator doing the actual computations.

For specifics on how to use simple calculators for complex figuring, you can get a thin but meaty pamphlet for \$2 from Mallman Electronics, 836 South 113th St., West Allis, Wis. 53214 and a much more detailed book, *Fingertip Math*, from Texas Instruments. ★★★

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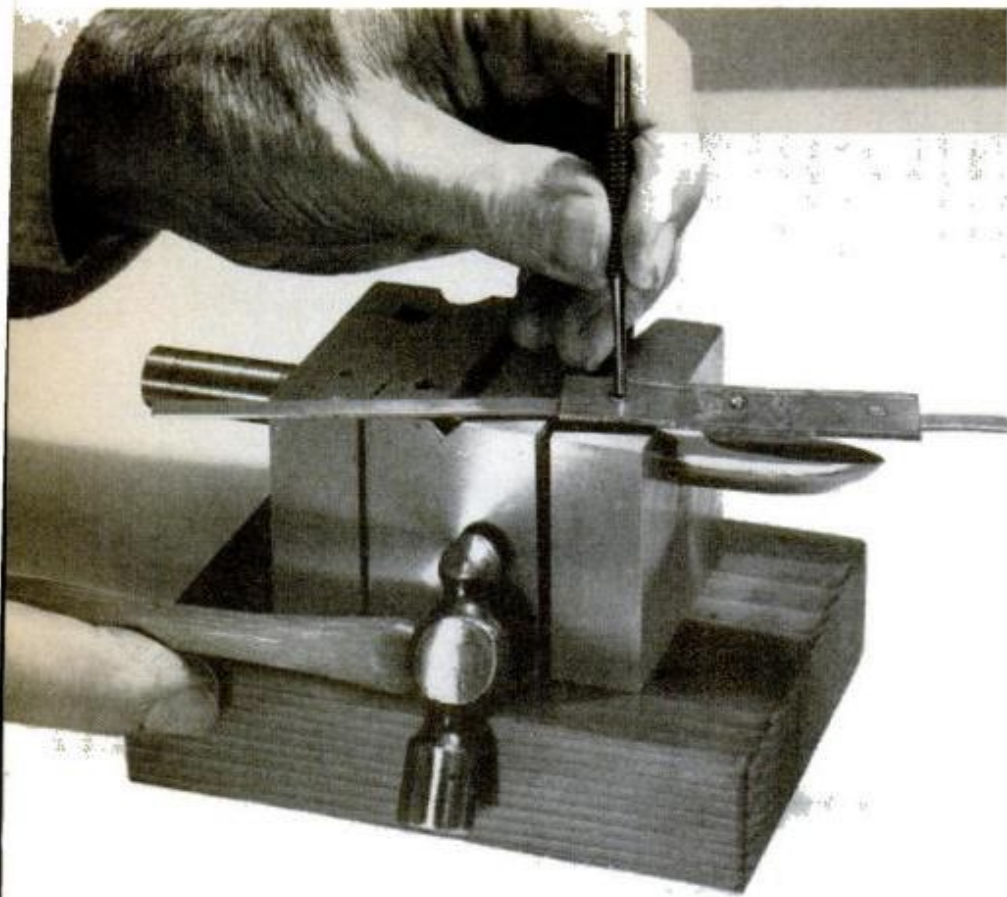
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Bench-block anvil

by Walter E. Burton

Common job for a bench block: A support for punching out pins and rivets.

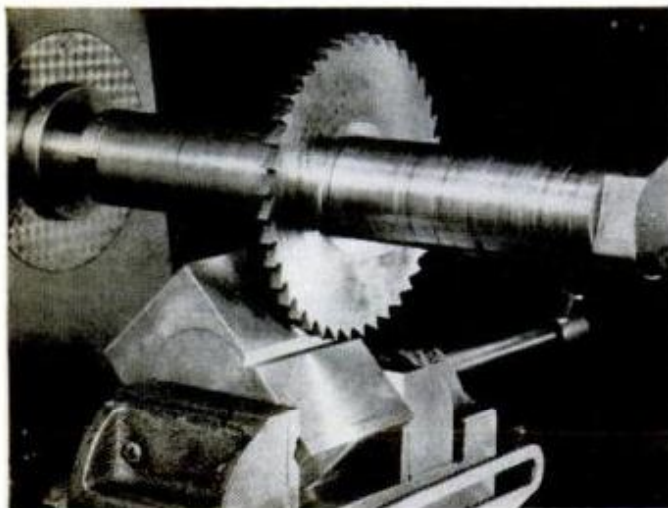
A bench block with some of the features of a small anvil can be a most useful home-shop tool, especially in small-scale work such as model and jewelry making.

A typical bench block consists of a chunk of metal, usually steel and often hardened for maximum wear, in which have been formed a number of holes, slots, V-grooves and whatever other openings or contours the user may need. The holes are useful when pins or rivets are to be driven from a piece of work. Slots can be used for bending metal

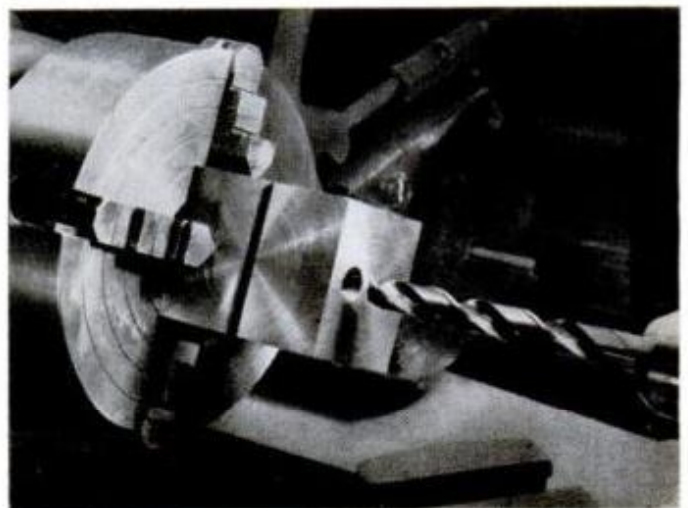
strips, and the holes for bending wire and rods. A V-groove will hold a round bar for punch-marking, stamping, or drilling.

By installing a rod shaped somewhat like the ends of an anvil (bick and horn ends), the tool can be used for working rings, tubes and other shapes where a slender inside support is needed.

To start, find a piece of steel of suitable size. For jewelry work, a very small block will do. The block shown measures 2 x 2¼ x 3 in. The anvil portion is a ½-in. steel



After the block is squared up, tilt it 45° and cut a V-groove across the middle with a milling cutter.



A ½-in. hole is drilled at right angles to the V-groove and far enough from it to avoid intersection.

HINTS

FROM READERS



Pin prevents entry

A removable pin in the throw bolt of an exterior door lock will give added security. Inserted for the night, the pin prevents opening the door from the outside with a key or business card. The lock bolt can't be retracted when the pin is in place. The pin, bent into an L-shape from stiff wire, fits a hole that has been drilled part way into the flat face of the bolt and is inserted in the space that's normally found between the door and jamb.

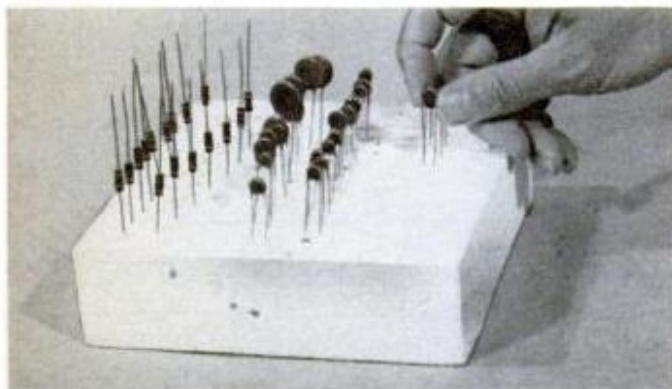
—*Frederick C. Lurz, Stony Brook, N.Y.*



Cookie-jar yard lights

For inexpensive and attractive driveway lights, we made hollow 4x4-in. posts from leftover scraps of redwood siding and added light fixtures made from 88-cent glass cookie jars. The posts were set in concrete, capped with octagonal pieces cut from redwood and fitted with porcelain sockets. Four brass L-hooks hold the inverted cookie jars for easy bulb changing. For a final decorative touch, the lid of each jar was epoxied to its bottom.

—*Asa C. Thoreson, Berrien Springs, Mich.*



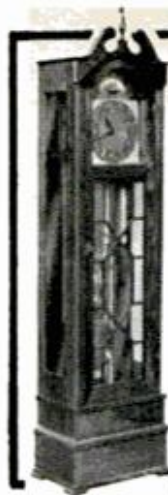
Organizing electronic parts

Electronic projects go together faster if parts are organized in advance. A Styrofoam block is ideal for this. Holes for wire leads may be made with an awl or length of stiff wire.—*Ken Patterson, Regina, Sask.*



No-cost terminal covers

Foam-plastic cup bottoms as battery-terminal covers prevent shorts when you work on engine; filled with grease they retard corrosion. Cable notch is undersize in cups for press fit.—*Robert R. McKay, Dayton, Ohio*

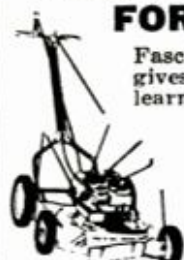


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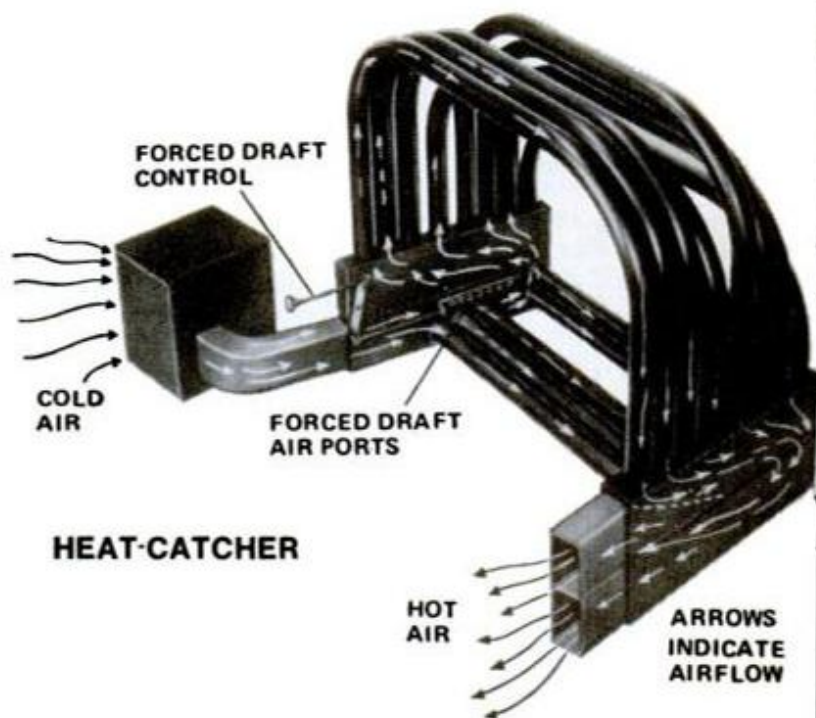
Fireplace heat savers warm the room, not the chimney



There's nothing like sitting in front of an open fire on a cold winter's evening enjoying the crackling sound of a burning log. But do you know that a fireplace sends almost 10 times more heat up the chimney than it throws into your home? That's an enormous waste of heat that could help warm your home and cut your fuel bill if you could retain it.

According to a study made by the University of Illinois, the average fireplace has an heating efficiency of only about 10 percent, a pitifully small amount considering the price of firewood. However, you can make a fireplace much more efficient by adding a heat saver. This is a device that turns a fireplace into a small forced-air furnace. It consists of a series of steel tubes that cradle the fire. Cool air is drawn in one end of the tubes at floor level, heated as it passes through the hot tubes and is blown out the other as hot air. Thus, precious heat that once merely rose straight up the chimney is now diverted and circulated

(Please turn to page 176)



This heat saver, called Heat-catcher, has a total of 3000 square inches of heating tubes which encircle the fire—bottom, sides, top and back. A regular grate is used to support the fire. A plug-in electric (or battery standby) blower is completely encased for safety and soundproofing. A forced draft control helps to start the fire and improves the chimney draft. Prices start at \$179. Made by Lassy Tools, Inc., 96 Bohemia St., Plainville, Conn. 06062.

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FIREPLACE HEAT SAVERS

(Continued from page 174)

into the room like the heat from a furnace register.

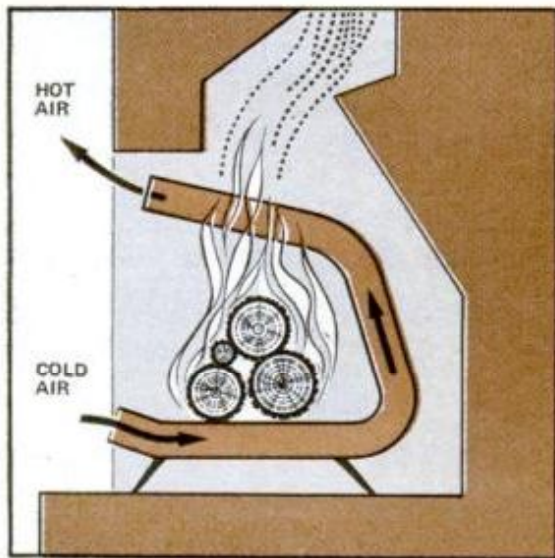
The heat savers shown here are but four of several you can buy. Different makes vary in design. Some work with quiet blowers; others trap and expel heat by natural convection. Some are used in combination with a regular fireplace grate, others serve as both heat recirculator and grate. None require alteration of the existing fireplace; they're all portable units which simply sit in the firepit. There's no danger of sparks being blown into the room, and smoke and gases still can pass between the convection tubes and up the chimney.

—Wayne C. Leckey, *Home and Shop Editor.*

CONVECT-O-HEATER

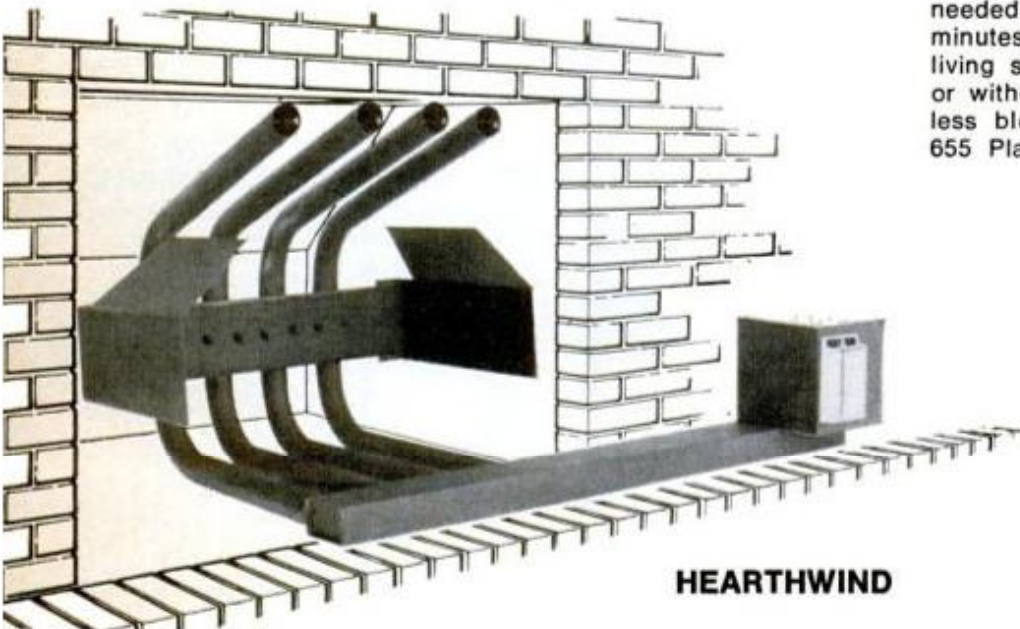


THERMOGRATE



Claimed to double heat output of fireplace, the Thermograte (above) is recirculator and a fire grate in one. It transfers the heat by natural convection. A series of C-shaped tubes draws cool air in at the bottom and sends heated air out the top into the room. Prices begin at \$74.50. Thermograte Enterprises, 51 Iona Lane, St. Paul, Minn. 55117.

Fire is built directly on steel tubes of the Convect-O-Heater (above, left); no grate is needed. It starts to heat the room within 15 minutes, can heat 1200 square feet of living space and comes in four sizes with or without a blower. Prices start at \$69.95, less blower. General Products Corp., Inc., 655 Plains Rd., Milford, Conn. 06460.



HEARTHWIND

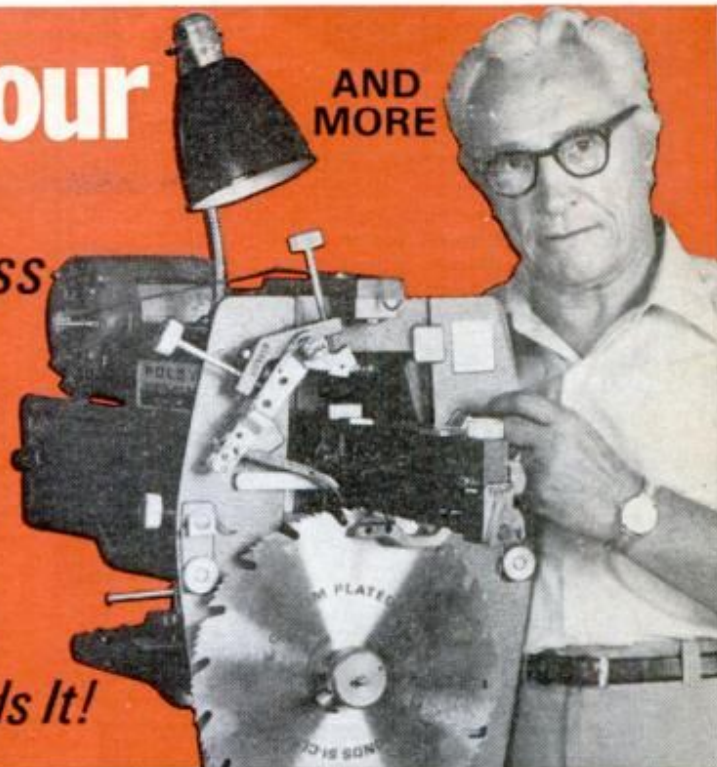
Hearthwind comes in kit form. The assembled fan and fan manifold plug into lower ends of the heating tubes, can be used to control a fireplace thermostatically. Small holes in the fan manifold include a draft when the thermostat calls for heat. Tubes rest on floor of firepit; a separate grate is used to cradle fire. Baffle plates at side and rear direct hot air up, over and around tubes. Standard size sells for \$159. Weather Wall Industries, 2805 Sycamore Lane North, Plymouth, Minn. 55441.

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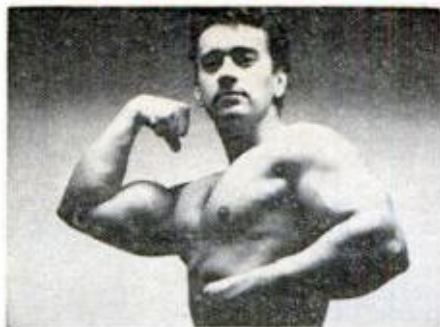
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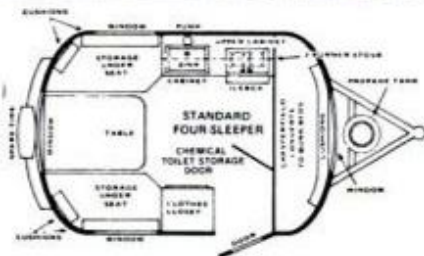
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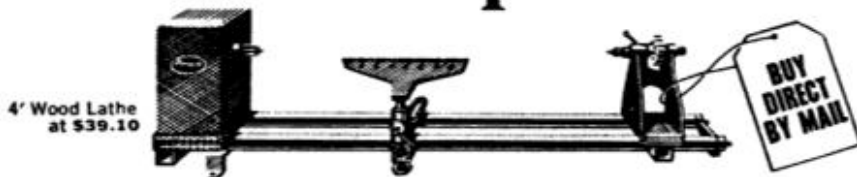
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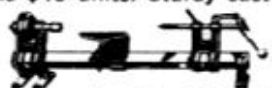
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