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Popular Mechanics

25 decorations
you can make
in time for
Christmas

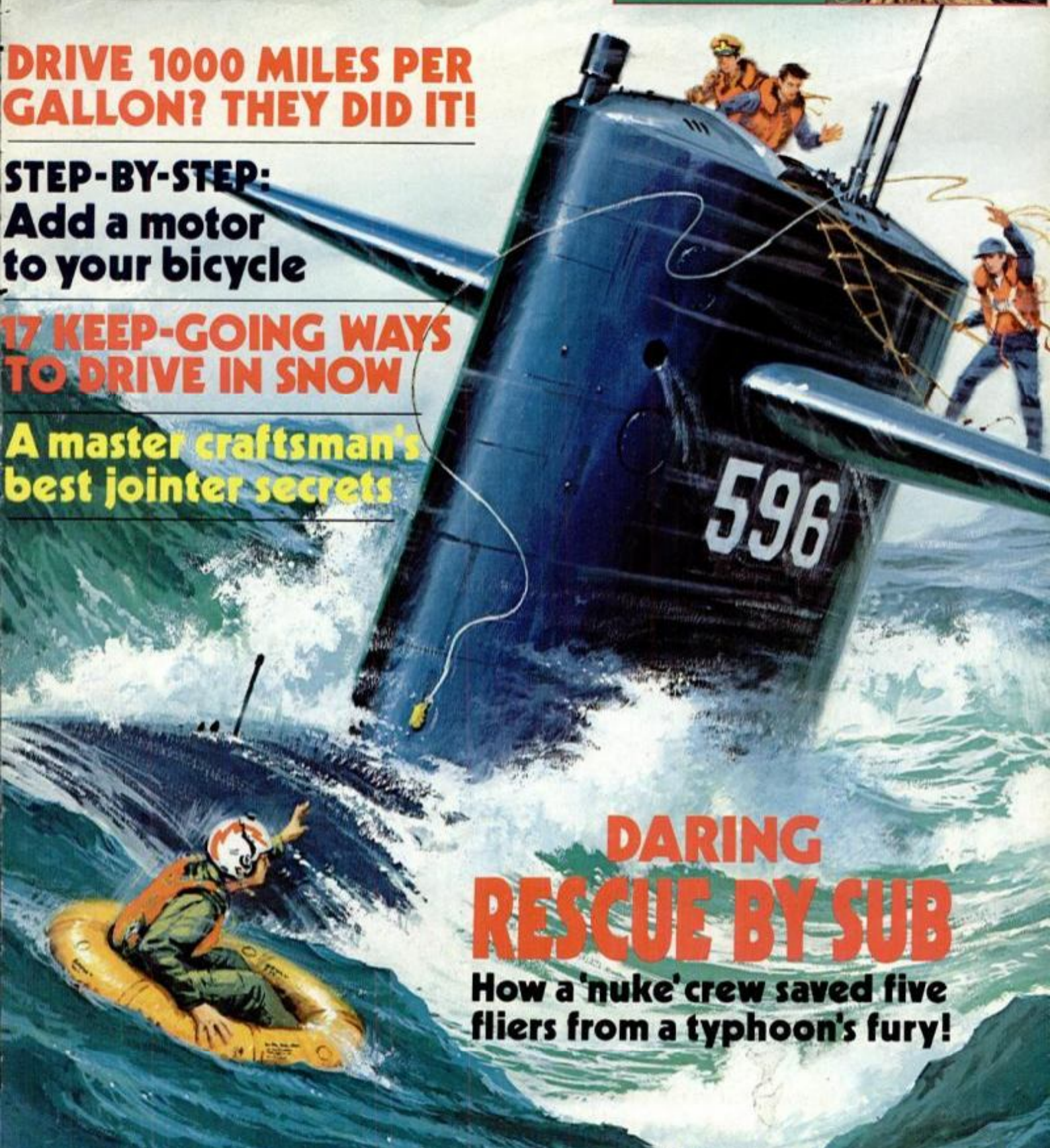


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**STEP-BY-STEP:
Add a motor
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**A master craftsman's
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Give the holiday gift everybody wants—Seagram's 7 Crown. Only Seagram's 7 has the unmatched quality that makes everyone's favorite drinks taste better. No wonder it's America's most given gift.

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From a rock band...



After you've rocked up a heavy-sounding AM or FM storm on the RF-1108's 6½" double-range speaker, check out weather, police and fire calls on its VHF-High Public Service Band.*

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to a public service band...



Now listen to real life radio on the RF-1090. Hear the drama of police, fire, truckers and ship-to-shore calls.* Continuous weather* and, of course, AM and FM. All at a price that's nice to hear, too.

to a short wave band.



Listen to across-the-ocean sounds and across-the-street sounds with the RF-2200. Six short wave bands and AM and FM. Plus fast/slow selector for accurate tuning. And features you'd find in higher-priced radios.

Introducing the new Tech Series from Panasonic. There's more to our radios than AM/FM.

A lot more. Like CB, TV, short wave or PSB. In all, 8 different Tech Series radios. And all combine rugged good looks with sound so good, it's hard to believe it comes from a portable. And so many extras like Panasonic batteries and earphone, you'll wonder how we managed to squeeze in the AM and the FM.

*Public service broadcasts vary by area. Check with local authorities.



**Tech
series**

Panasonic.
just slightly ahead of our time.

Popular Mechanics®

On the cover
Crewmen of a downed bomber are saved from a raging sea in a daring feat by the nuclear sub USS Barb. See page 73.
—Painting by Ed Valigursky



DECEMBER 1977

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*The National Test.

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This One



U93S-YLH-T4K2

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On Sale Now Only \$44⁹⁹.

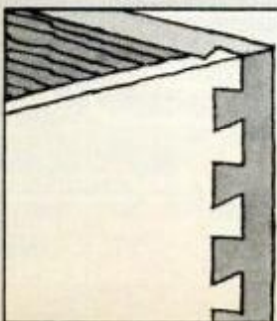


Model (No. 1748)

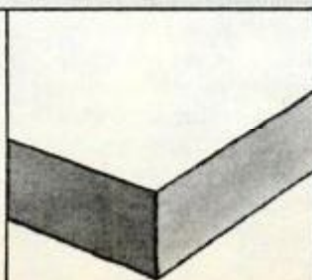
This powerful Sears Craftsman Router, with built-in worklight, has a 100% ball-bearing motor that develops 1-HP and generates 25,000 RPM's for swift, smooth cutting action.

Plus a micro adjust depth gauge that's precision calibrated in 64ths of an inch up to 1½ inches deep. Use it with the bits pictured at right and create precise contours in wood. The possibilities are as various and versatile as your needs. And the illustrations below are merely a small sampling of its total range of functions, when used with the proper accessories.

Dove Tail



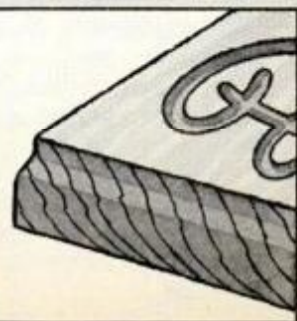
Laminate Trim



Decorative Trim

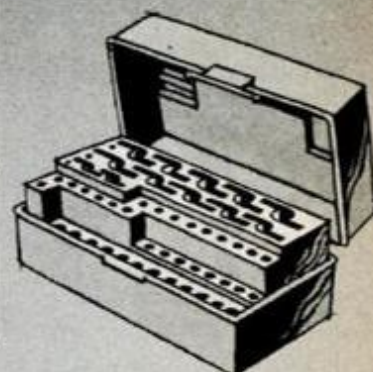
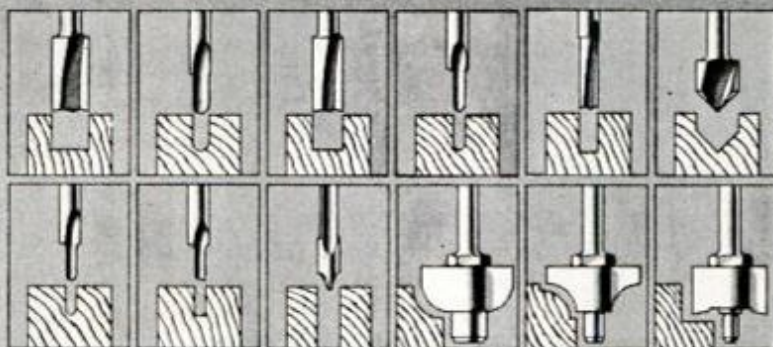


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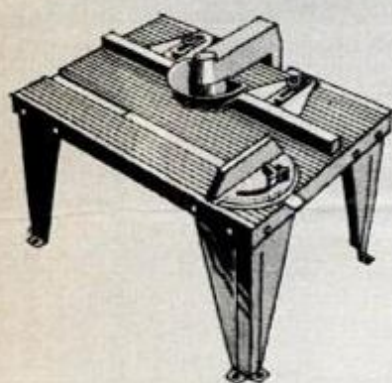


Router and start creating...

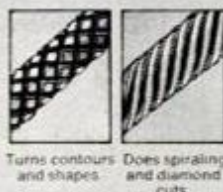
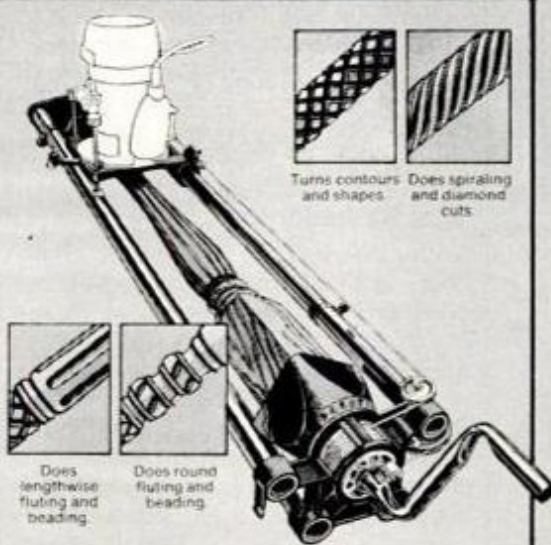
bit by bit.



NOW ONLY \$34.99 **SAVE \$10.00** on Sears 17 piece Craftsman Router Bit set. These high-speed, Kromedge® bits stay sharper longer – up to five times longer than ordinary steel bits. And they're precision ground for a tough cutting edge.



NOW ONLY \$29.99
SAVE \$10.00 on Sears deluxe Craftsman Router/Sabre Saw Table. This table is made with a heavy duty, die cast aluminum top and comes with a precision miter gauge and aluminum fence.



Turns contours and shapes. Does spiraling and diamond cuts.



Does lengthwise fluting and beading. Does round fluting and beading.

NOW ONLY \$49.99
SAVE \$10.00 on Sears Craftsman Router-Crafter. Only Sears offers this unique tool which turns a router into a precision lathe-like tool for a variety of detailed wood-working jobs. Router not included.



NOW ONLY \$6.99
SAVE \$4.00 on Sears Craftsman Router Carrying Case. This Permanent polyethylene carrying case resists rust, dents, cracks and the lid is fitted with bit-holding slots.



Sears

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Tools that have earned the right to wear the name.

LETTERS TO THE EDITOR

How not to blow diodes

I had a problem with the meter described in *Don't Electrocute Your Car Battery* (page 68, Oct. '77). Nowhere in the article did you say anything about polarity of the zener diodes. I blew a 6-volt diode because it was in backward.

E.W. PADFIELD
JACKSON, N.J.

You're right. Diodes are to be wired so their polarity bands face the resistor, not the meter. This may seem backward, but you're using the property of zener diodes to conduct reverse current only when a certain voltage level is reached.

PM Boonie Bug embellished

Our Boonie Bug "Ultra Van" is the result of six months of work by my 17-year-old son and myself. We made some changes from original plans in PM (page 94, March '74):
Sun roof above front seats.



PM's Boonie Bug—with some changes.

Sloped front for better airflow.
Rear extended to enclose engine.
Rear seat converts to a 78-by-68-inch bed.

Side hatch access to rear seat.
Paneled ceiling and walls with carpeting on floors.
1966 Mustang seats.
Naugahyde headliner, padded dash and seats.
AM/FM radio, 8-track tape player and CB.

Cost of project was about \$3500, including the 1970 VW bus. We have made many trips with our Ultra Van and find it a real traffic stopper wherever we go.

WILLIAM DAMMANN JR.
PEQUOT LAKES, MINN.

Sounds like you've made a big hit. For other readers, plans for the original Boonie Bug are still available for \$14.95. Send check or money order to Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10019.

On saving your energy

That *Home Energy Guide* (page 115, Sept. '77) is well done. Now, if we could get all your readers to utilize many of the 101 tips it contains, we would be way ahead of the conservation game.

THOMAS S. SEDLAR
FEDERAL ENERGY ADMINISTRATION
WASHINGTON, D.C.

Congratulations on the excellent material offered in the September issue of PM. The energy conservation section is marvelous.

JOHN S. RUCH
PPG INDUSTRIES
NEW YORK, N.Y.

That RV helicopter

Your flying RV (page 102, Sept. '77) was of some interest, but my odds are that 90 percent of *Popular Mechanics'* readers fall within a salary range where not one of us can afford this. The space utilized in showing a flying RV could have been of much more interest if it covered something that everyone could afford. Let's get practical!

ROBERT ABARE
FAIRFIELD, CONN.

How do you expect your readers to believe there is any need to conserve energy when your cover feature glowingly reports on a flying camper helicopter which uses 75 gallons an hour of 100-octane aviation fuel? The chopper, its manufacturer, and your article are ridiculous.

JOHN FECHTER
JEFFERSON, MD.

But it was an intriguing idea, wasn't it? And that's part of our job—reporting on the latest innovations, even though not all readers

may agree on their value. We appreciate your opinions.

On starting projects early

Here's the car I built from PM plans for the "Sidewalk Classic" (page 146, Nov. '63), modified 10 inches longer for hood and radiator. It was built for my granddaughter Traci.

The car was built in my small mobile home. Half of the kitchen is my workshop. The table is my workbench, with hand vise attached. It took me a year and a half. I was in no hurry because she



Sidewalk Classic—better late than never.

was three years old when I started.
TOM CARTER
CINCINNATI, OHIO

Plans are available from PM for \$6.95. Send check or money order to Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10019.

Brighten up life preservers

A friend showed me your article on life preservers (page 52, July '77). I fly in the Philippines, and part of my mission is sea recovery of target drones which, at times, involves sea search. During one search, my crew and I found a Navy issue life jacket (bright orange), while flying at 1000 feet and approximately 100 mph.

Anyone buying a dark-colored, or even white, life preserver is foolish. Finding a person in one of the new "stylish" preservers is nearly impossible. I would advise against anyone buying other than a bright orange or yellow preserver.

LT. DENNIS P. BROOKS
SAN FRANCISCO, CALIF.

Good point from a guy who's been there. **PM**

Great moments in the basement.



Making a shearing cut with a skew chisel may not be everybody's idea of kicks.

But for the man with a shop in the basement, and a lathe in the shop, it's one heck of a feeling.

Probably second only to seeing his own work take shape. An intricate chess piece. A cabriole leg. Or anything else that wood and skill and imagination can turn into something beautiful.

For the man like that, we make the Rockwell 14/11" Gap Bed Wood Lathe. One heck of a tool for \$329.99* for some very good reasons.

A ribbed, one-piece bed with inch-and-a-half, precision-ground ways.

A 14-inch swing over the gap, 11 inches over the bed, and 36 inches between centers.

A ball-bearing headstock, and an adjustable tailstock with a graduated ram.

A built-in indexing mechanism, and a precision-ground universal tool rest.

And four speeds, to handle any kind of wood (and plastic and metal).

All of which make it possible for you to make just about anything imaginable. Symmetrical, elliptical, helical. Beaded, chamfered, tapered. Whatever.

Of course, what goes into this lathe goes into every lathe we make, including our \$179.99*

with half a century of experience and on-the-job performance.

What that buys you is as good as you could ever want, short of actually having our big industrial equipment.

Namely, some impressive features, regardless of price. And the three things there are no substitute for in any tool, regardless of who makes it.



10-inch model.

And into our radial-arm saws, table saws, band saws, jointers,

Accuracy. Power. Durability. With us, they're not just words. They're a reputation. The

drill presses, wood shapers and so on, on down to our 3/8-inch drills.

Real engineering. The kind that makes them unique. The kind that only comes

stuff that great moments are made of.

You can depend on it. *Rockwell. It's the same name industry's been depending on for 50 years.*



Rockwell International

*Manufacturer's suggested retail price.

IMPORTS & MOTORSPORTS



Opel Rekord for Europe offers five 4-cylinder gas engines or a 2.1-liter diesel. Four.

Jewel of an Opel

Working in wind tunnels is now mandatory for automobile stylists, and for Opel the need for good aerodynamics resulted in a really breezy new car—the Rekord. The fashionable wedge is for my money the best-looking family car on the road today (in Europe, that is—GM says it has no plans to bring it here).

The design of this successor to last year's Rekord (styled in 1972) started with the search for better mileage through aerodynamics (indeed, a 10-percent decrease in drag compared to its predecessor gives a 5-percent improvement in fuel consumption and a 5-percent increase in top speed) and resulted in other advantages as well. To wit: Driving characteristics were improved by the lower lift at the front axle and better resistance to sidewinds. And the wedge shape boosts trunk space to over 15 cu. ft. It's a swell wind that blows up more room in the boot.

1978 Celica Liftback

Don't be fooled by the funny fender mirrors (compulsory in Japan)—this car *will be* exported to the United States, and should be in Toyota showrooms by the time you read this. Toyota's lineup for '78 will include a brand-new Celica. The wide B-pillar carries the

New Celica Liftback in Japanese trim, with two fender mirrors required in that country.



Celica nameplate and the long, fast-back, rear-quarter windows provide good visibility in the traditional "blind spot." Remember, our photo is a pre-preview shot from Japan and we'll be following up with more on the Main-Street Toyotas.

TVR for two

This little teacup of a sports car, in case you don't recognize it, is the TVR 2500M. A 1977½ model, it flaunts over a dozen engineering and styling changes, so any hesitation you may have had in pinpointing the marque is understandable. The redesigned front spoiler scoops up more air for the radiator and the bumpers are repositioned.



TVR is a two-seater English sports car.

Therefore, there's a new hood. Enameled chassis and suspension parts add a touch of class, taillights are changed, soundproofing is added and there's a new differential and improved instrumentation. Price is "improved," too: You'll tender 10 grand for the car, but it gets lots of fun per mile.

First sporty diesel

It's the first time any auto manufacturer has powered a sporty, personal-car model with a diesel engine. The Mercedes-Benz 300CD coupe may be an historic first, but when it comes to getting your \$20,000 worth in rocketing away from traffic lights, "the first shall be last."

The five-cylinder diesel coupe is slow getting off the line—but only if you expect it to meet the traditional standard of performance for this type of machine. Actually, the three-liter diesel offers a beautiful balance of performance and econo-



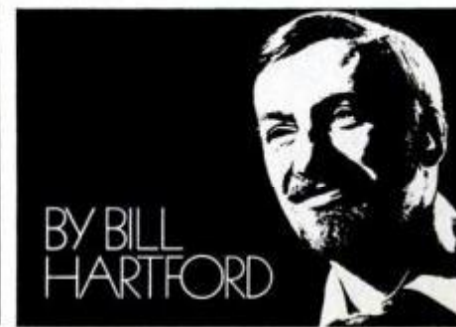
New Mercedes coupe has engine choice.

my, and now it's in a coupe that has been exquisitely styled off the recently introduced M-B intermediate sedans (see *You've Come a Long Way, Diesel*, page 132, Jan. '77). People may laugh at a paltry 77 hp in such a car, but the last laugh is the owner's—at the fuel pump.

For those who won't forsake the pizzazz of power in their sporty car, Mercedes has a second coupe in its '78 line—the 280CE. It's exactly the same as the 300CD, but has Mercedes' dohc, gasoline Six under the hood—the same engine as the 280E and 280SE models. With this powerplant, horses double to 142. The new coupes bring the Mercedes-Benz '78 models up to 11. **PM**



Coupe: slightly lower, shorter than sedan.



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HARTFORD

V.O.

The Standard of Giving.



Give **Seagram's V.O.**
Bottled in Canada. Preferred throughout the world.

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A SMARTER WAY



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Panatela "separates."

Coordinated sportswear in fabrics and colors so perfectly matched, you can wear them as a suit!

Fine dress slacks for under \$21? A beautifully constructed three-piece suit for under \$100?*

It's easy — when you buy Panatela's "coordinated separates."

Separates, because every garment has the fashion strength to stand alone. Handsomely.

Coordinated, because our fabrics and dyes are so precisely controlled that our slacks, sportjackets, and vests always go together. You'll never end up with slightly mis-matched colors. You'll never have to worry about the tiny blue line in a plaid not quite

working with the solid blue in a jacket.

There's no waiting for alterations, either. Our separates are ready to go, the minute you buy them. And you'll find that the complete range of sizes in our separate slacks and jackets allows you to choose the outfit that exactly fits your proportions.

If you want to expand your wardrobe without exhausting your budget, look into Panatela separates. It's the new, smarter way to buy clothes from Levi's Sportswear.

*Exact prices may vary from store to store.



Quality never goes out of style.

THE PM GARAGE

CAPSULE REPORTS ON NEW AUTO PRODUCTS BY THE EDITORS

Better than chewing gum

I started using Loctite Lock n' Seal on my license-plate bolts, which were always loosening. Now I use the liquid lock washer in many other ways. You can try it with the 6-cc tube shown here (\$2.35). There are also 24 and 36-cc bottles (\$8.35 and \$12.30). Woodhill/Permatex, 18731 Cranwood Parkway, Cleveland, Ohio 44128.—*B.H.*



Liquid lock washer is handy in garage.

Dashboard digital

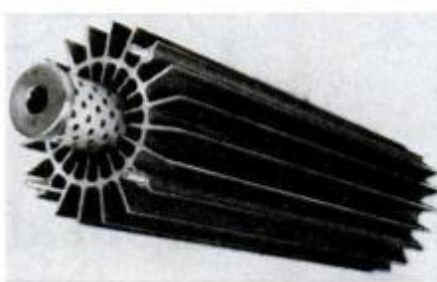
My old Volvo has no clock, but I'll fix that when I mount this 12-volt, electronic quartz LED digital unit. The Travelin' Time LED-1 face is 1 1/8 x 2 1/2 inches and the 3-inch-deep unit comes with dashboard-mounting hardware. H and M buttons on the face set the hours and minutes. Sparkomatic Corp., Milford, Pa. 18337.—*B.H.*



Digital 12-volt clock mounts in dash.

Be good to your transmission

It's no secret that under-hood temperatures have soared in recent years, and the higher the temperature, the greater the threat to the life of your automatic transmission. Another threat is grit that acts like a grinding compound and can cause premature slipping, seal leaks and band and clutch failure. Additional cooling and filtering for longer automatic transmission life are



Kleen 'n Kool is filter/cooler in one.

claimed for a heat sink/filter device from Halo Products. The Kleen 'n Kool installs in the line between radiator and transmission and mounts to floorboard, frame or gravel deflector. The \$40 Model 1075T weighs a pound, is a foot long, has a 3-inch diameter and comes with all fittings. Halo Products, 1538 MacArthur Blvd., Oakland, Calif. 94602.—*B.H.*

To your health!

You shouldn't wait when it comes to safety while you work around your garage. You may have safety goggles, jack stands and other equip-



Dust mask is a must for any dirty job.

ment, but do you have—and use—a dust mask? It's a must for do-it-yourself auto refinishing, including sanding and grinding, and should be used in any dusty situation, even sweeping a dirty garage. The Auto-Pak dust mask from 3M lists at \$1.98 and protects your lungs from nontoxic dust and particles. You'll find this lightweight, comfortable mask at most hardware, home center and auto parts stores.—*B.H.*

Vulnerable auto lock

Here's a car lock that looks good in the catalog but turns out to be of dubious value in real life. It's an extensible steel bar with a U-shaped

bend in each end and a lock in the middle. It stretches or shrinks so you can lash your steering wheel firmly to the brake pedal.

So far so good—that part works fine. But when I put the bar to the acid test, namely challenged it with a hacksaw, I found that it took only two minutes to cut it in two. And I made that cut through a section that contained the inner slide in an



Unistop locks steering wheel to brake.

outer sleeve. Six inches farther down, a cut through the sleeve alone took only one minute.

So if you're looking for a safeguard for your car, this one—called Unistop—might prove a discouragement to thieves without a hacksaw, but it's not the best way to protect your car against theft. Too bad it's not made of a harder steel.

Unistop costs \$17.95 plus shipping and handling from Wilem B. Haan, Inc., 10305-07 Santa Monica Blvd., Los Angeles, Calif. 90025.—*M.L.*

A plug for mopeds

If you beat the second-car syndrome by springing for a new moped this past year, you should know by this time that these machines don't give a free ride. They, too, need Saturday mechanic maintenance. Spark-plug replacement is the job you'll do most often so it pays to keep a spare plug on hand. Champion has developed a plug that fits all mopeds and is displaying it in a handy blister pack. The L-89CM plug, listed at \$1.62 is designed to stay hot enough to resist fouling at idle and slow running yet transfer heat away from the tip fast enough to stop preignition.—*B.H.*

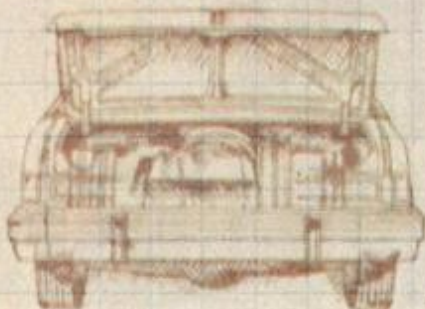


Moped plug.

The right way to design a family car is to begin with the family.

Oldsmobile Delta 88. The car that puts first things first.

The 88 trunk is designed to pack in what your family can pack in.



The 88 makes economical as well as mechanical sense with excellent mileage for a family-size car.

Generous headroom and legroom in back mean a comfortable, enjoyable ride. For everyone.



It goes without saying that cars are built for people. But Oldsmobile decided you get a much happier set of results when, instead of building for people, you build around them.

That's the idea of the Olds Delta 88: your family first.

Your family prefers sitting stretched out to sitting scrunched up. So try our head and legroom up front and in back. Olds 88 has always meant "roomy car", and our 88s for '78 keep the faith.

Your family needs a trunk that really packs it in. The new Olds Delta 88 gives you 20 cubic feet of trunk space.

When you and your family hit the road, you don't want to feel it. Computers helped us to select the proper combination of springs and shock-absorption rates, to help cradle all of you on the roads you drive.

And you don't want our car

free-wheeling with your money. Delta 88 puts fuel to work and keeps it there. 25 mpg in highway tests, 17 in the city, 20 combined, according to EPA estimates with standard 231 V6 engine and automatic transmission. Your mileage depends on how you drive, your car's condition, and its equipment. (EPA estimates in California are lower.) The Delta 88 is equipped with GM-built engines produced by various divisions. See your dealer for details.

Oldsmobile Delta 88. The family car we build by beginning with the family.

Oldsmobile
Delta 88
Can we build one for you?

THIS COUNTRY NEEDS MORE AIR CONDITIONING REPAIRMEN. NOT MORE ENGLISH PROFESSORS.

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ALL OUTDOORS

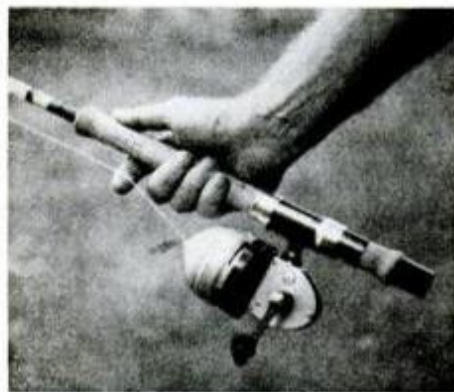
HERE'S PM'S PICK OF THE YEAR'S BEST GEAR

In December we like to look back over the hundreds of products examined and field-tested during the year to pick the very best. Many deserve recognition as outstanding new accessories or established aids for outdoorsmen; some could make good Christmas gifts.

For fishing

A remarkable rod and reel combination from Shakespeare tackle has been called to our attention by Vince Vella. Shakespeare's notable new Ugly Stik and Graflite rods and blanks, Mag-Lite handles and President II reels are well known, but the firm also has an outstanding Wonderod and Wondereel outfit combining advantages of open and closed-face spin casting plus fly-rod balance.

The Wondereel 1810 looks like a closed-face spinning reel, but has no thumb button on the back. It



Shakespeare Wonderod and reel make an unusual spinning combo that has the balance and simplicity of a fly rig.

mounts at the bottom of your Wonderod just as a fly reel would and you grip the comfortable cork handle with your full hand, the line running over your forefinger for easy control. To cast, the reel is cranked backward about an eighth of a turn. This frees the line just as you would by pushing the thumb button or flipping over the bail of conventional spinning reels. Cast with your forefinger feathering the line and stopping it when it's right on target. The ingenious system isn't new but is simplicity itself and deserves special attention. It lets

you concentrate on fishing without time out for the mechanics of the reel.

Also of fishing interest is a bright new orange glove from 3M called a Gotcha Mitt. A textured palm makes fish-holding a lot easier. We gave Plano Magnum tackle boxes a good workout this year, and they scored extra points when we discovered their lure separators are cleverly molded to store 35-mm slides equally well.

For RVs

Recreational vehicles are designed for travel and camping comfort; several new products make this even easier. Advantages of a citizens band radio that keeps you in touch, alert and often amused are no secret, but recently we have been looking for the best CB/AM/FM stereo combination, and right now our vote goes to a Clarion CB hooked up through the hi-fi speakers of the new Panasonic component system for cars. It has a standby setting that lets the radio or tape cartridge play along until a CB message comes through. Then the set preempts and gives you the information from some good buddy.

All CB controls are built into the Clarion mike; the set can also act as a scanner if the channel selector is held down. Perhaps because of limited space inside a camper, the Panasonic's four coaxial and "sound pump" speakers produce sound that seems better than just about any we've heard from home installations. Mount the Panasonic tuning controls in the dash, however. Their only disadvantage is that, while you're driving, they are very hard to read and adjust when mounted below the instrument panel.

For travelers, Rand McNally has been expanding its guides for campgrounds, parks and scenic vacations here and abroad and deserves special credit for its latest efforts. Many make useful additions for the reference library aboard an RV. And for special help in time of need on the road, the RV Dealers Assn. has just published its first *RV Service and Repair Directory*, a state by state list of dealers, giving their addresses, phone numbers, services available, and even if they will make "house calls" at your campsite. Suddenly need fixed a balky refrigerator, generator, LP system or sewage drain? If you've

sent \$7.95 to RVDA, 3251 Old Lee Hwy., Fairfax, Va. 22030, and have this directory stowed with your toolkit, you can look up your nearest camper service dealer stop in minutes.

The best finish protection we've found for an RV used year-round is Star Brite car polish. Like many van campers, our model is part metal, part fiberglass, and Star



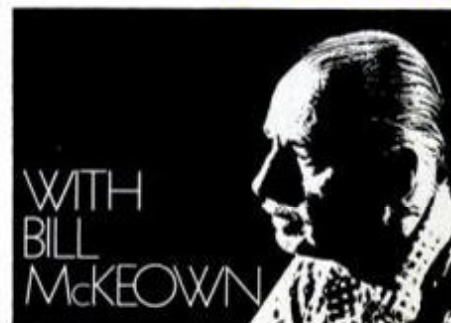
Camper's compact combi-tool cutter is the Charter Arms Skatchet. Buck Knives' handsome Hunter's Axe is at right.

Brite seems designed to keep both shiny and protected from the elements.

For outdoor photos

There is no all-purpose camera (or RV, boat, gun, tent or fishing rod), but a couple models undergoing staff test deserve special notice. The new Minox 35EL is probably the smallest, lightest, quality full-frame 35-mm camera around. It looks almost old-fashioned as you fold down the miniature front cover to expose the sharp f/2.8 lens. But the results are modern all right, and a built-in meter automatically adjusts for exposure. At 8 ounces including film, the tiny unit won't weigh down a pocket and fits neatly into any backpack. It doesn't look

(Please turn to page 24)



Merry Smoothness.



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IF YOU WANT TO CARRY

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THE 1978 VW BUS.

If you've let the size of your family drive you into a car you can't afford. Or, if you've been squeezing the fun out of your family in a car that fits your budget and nothing else, you've missed the Bus. The 1978 Volkswagen Bus.

ROOM AND COMFORT.

The '78 Bus gives everyone in your family the elbow room they

need to relax in comfort. In fact, it gives you up to 14 elbows room. With still enough room left for your luggage, dog, or just about anything you want to get away with.

The Bus gives you 70% more room inside than most full-sized domestic station wagons. And practically as much room as a van.

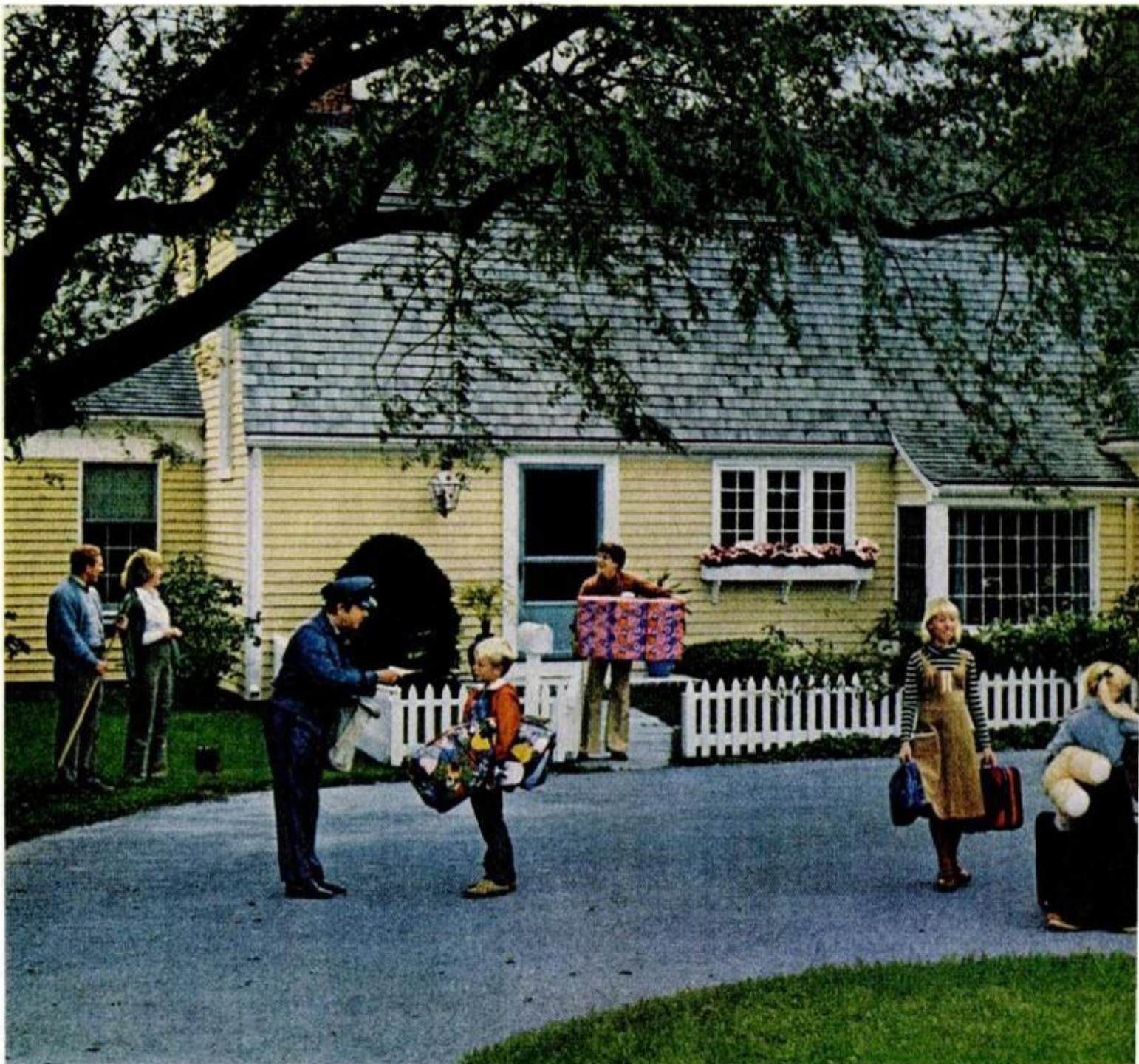
So when you want to uncramp your family's style nothing compares to the Bus for room and comfort.

VERSATILITY.

The Bus' rear hatch and big sliding door mean you can use your Bus like no other vehicle.

One minute you're carrying the Little League team. And the next you're doing some really big league hauling.

Yet because the Volkswagen Bus is shorter than most cars, it's parkable in spaces that regular station wagons have to pass up.



THE MOST FOR THE LEAST,*

DO TAKE THE BUS.

ECONOMY.

The '78 VW Bus costs only a little more to buy than the average domestic sedan and less than most big station wagons. And to run, it's out in front by miles. The electronic fuel-injected 2 liter engine is not only powerful and responsive, it's also a fuel-saver. It helps the Bus deliver an estimated 25 mpg on the highway, 17 in the city with standard transmission in the 1978 EPA*

tests. (Of course your actual mileage may vary depending on where and how you drive, the condition of your Bus and optional equipment such as an automatic transmission.)

DRIVEABILITY.

Your '78 Bus has full independent suspension on all four wheels and radial tires to give you a smooth ride down the roughest street. It has 10 inch power assisted disc brakes for quick short stops. For excellent

road handling and fun driving nothing beats the '78 VW Bus.

So if you want to fit your family into something a little bit more comfortable, bring them to your Volkswagen dealer now. You'll find that the 1978 Volkswagen Bus not only fits comfortably around your big family, it also fits comfortably around your wallet.



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*More than any other station wagon in the world.



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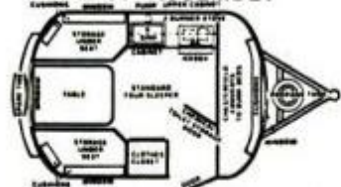
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Now, factory built, or in kits. Light weight, compact trailer that's easily pulled by large or small cars. Sleeps 4, only 13 ft. long, 950 lbs. 85 lb. tongueweight, fully equipped. Fiberglass construction. Ideal for fishing, hunting, camping, business. Kit form—assemble in about 60 hours, no special tools, with easily followed illustrated manual.

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ALL OUTDOORS (Continued from page 20)

like it would take extensive rough treatment; all it does is take excellent pictures without any fuss for about \$200.

One of the most rugged cameras is the underwater Nikons that works equally well above the surface and, after a dusty day, can be cleaned by just holding it under a faucet. In spite of its heavier (1-pound, 12-ounce) weight, heavy (\$485) price, and manual guess-focus settings, it would be best of durable sports cameras if it had a built-in exposure meter. Nikon tells me it has no plans to add one, however.

For underwater breathing, our staff testers have been diving with the new Poseidon Systems Cyklon 300 regulator and report it is not only easier to use but has been found to operate dependably upside down and in all other positions they have tried—something that some scuba regulators fail to do.

For camping

I've always rated a Swiss Army knife as an all-around outdoor accessory, but recently quality specialty knives that can handle heavier cutting chores have been introduced by several companies. The last few months we've been traveling with a superior hatchet, the Buck 106 Hunter's Axe, a big brother to the fine Buck sheath knives. It is small, light and easy to carry in its fitted leather belt case. With one-piece construction, it looks like it will last forever.

For a small multipurpose tool, the Skatchet, from Charter Arms, fits easily into a pack and can be used for a knife or hammer. Screw a branch into the threaded socket in the bottom and it becomes a hatchet, pruning hook or mini-ax.

Pack gear is becoming more versatile with luggage bags designed to take shoulder straps or convert to backpacks. Eddie Bauer has a Flight Pack that fits under an airline seat and can be carried with hand straps, or rigged for carrying on your back while your hands are free for other duffel. Frostline sew-it-yourself kits have an Overnighter convertible that can switch from handbag to rucksack.

Royal Red Ball is introducing for fishermen a Lunker wading shoe that we find comes ashore to become a comfortable camp and hiking boot as well. The mesh uppers allow water to flow out easily, and the Lunkers can be worn over hip-waders, socks or just bare feet.

And for a rubber hiking boot to keep the water out, the new Red Ball

Waterdog is ankle high with the newly popular padded collar and a traditional hobnail cleated sole. Inside any boot, a new imported slipper-shaped oversock they call a Bama Sokket is claimed to wick away sweat while making uninsulated boots warm for winter wear.

Keeping the outdoors in its place from the ground up is easier with Versa Tarps. You won't rate a ground cloth as a favorite accessory until you've spent a few weekends at muddy campsites and unpacked plastic sheeting that has torn since you last saw it. But Versa Tarp, produced by Griffolyn in Houston, Tex., is almost impossible to tear—even when punctured. In five sizes from 6x8 to 12x20 feet, it's plastic and waterproof, has one green side plus a white side that can double well as a photo reflector. During this year we tested them on boat, helicopter, RV, 4WD and snowmobile camping trips. They can keep wind, rain, snow or mud where it belongs. We recommend them.

Special credit is due this year to the Coleman Company for upgrading some of its products already standard in the camping field. Automatic shut-offs on catalytic heaters and an automatic ignition system with a blower purge cycle of 15 seconds before fire-up of their RV furnaces make safe equipment even safer.

And for an extra pocket when your hands are already full, we like L.L. Bean's Belt Pack, and its fisherman's Tackle Bags to carry extra photo gear, a rain jacket, binoculars or whatever.

For boating

Our votes for the top boats of the year go to seven we checked over or tested. Crestliner's 24-foot Jim Wynne-designed 2455 Crusader, powered with Volvo's new light diesel proved outstanding on an open-Atlantic endurance run. The Wellcraft Sunrunner was as impressive as the Wellcraft plant at Sarasota, Fla., the finest fiberglass boatbuilding facility we have seen. For sliding over the rocks that hide in white water, Coleman's new plastic canoe seems unbeatable and undentable. When an inflatable seems the most useful choice, we rely on our little Pack Raft and a Pyrawa kayak. The greatest of offshore racing machines are still Don Aronow's Cigarettes, and this year Bernie Little not only won the national unlimited championship with his *Miss Budweiser* hydro, but finished second in the offshore circuit with his first entry, the 35-foot *Cigarette Natural Light*. **PM**

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The Ford
in your future.



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**Fairmont Wagon: designed for an excellent combination
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Fuel efficient. For today's kind of driving, good gas mileage is more important than ever and Fairmont's EPA mileage ratings are excellent... 29 MPG highway, 19 MPG city... with available 3.3 litre engine and manual transmission. Your actual mileage may vary according to how and where you drive, your car's condition and optional equipment. California ratings are lower.

Space efficient. Fairmont has almost 90% of the passenger space of most large wagons and is rated at 84% of their cargo space. (Based on EPA interior volume index.)

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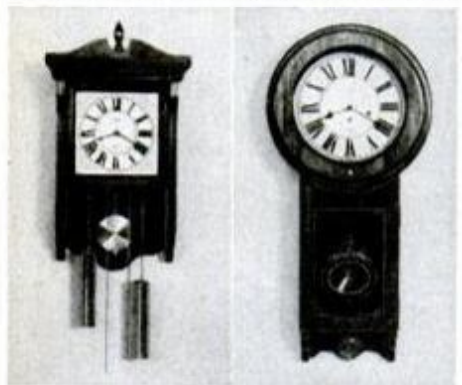


Big bat rack

Pipes? No. It's aluminum tubing undergoing inspection at Alcoa's baseball bat plant. The metal clouters, after some early problems when they first appeared in the '30s, have since proven more durable than wood. Today they come in various alloys to meet toughness requirements of users.

Modern antique clocks

Electric movements drive new old-look clocks. Dutch Hood (left): \$110. Regulator: \$245. Harris & Mallow, 651 New Hampshire Ave., Lakewood, N.J. 08701.



From fuel to flowers

More than 5000 gas stations in West Germany failed due to fuel prices. An owner in Essen converted to flowers and garden supplies and business is booming.

Super suction unclogger

Powerful new vacuum pump "bombs" drain blocks, opens them in five seconds. Two-pound tool is \$15. Mash International, Box 1705, Kansas City, Mo. 64141.



Paste down a parquet floor

Tougher vinyl floor tile with vinyl composition base comes in several patterns including parquet. Stylistik is self-adhering. Armstrong, Lancaster, Pa. 17604.

Learn from NRI at home and at York Institute.

Start a career in Air-Conditioning, Heating & Refrigeration.

Well over a hundred thousand new technicians will be needed in the field of air-conditioning, refrigeration and heating by 1985. NRI can train you at home in your spare time for one of these career jobs.

Master course includes your own Air-Conditioner System for training

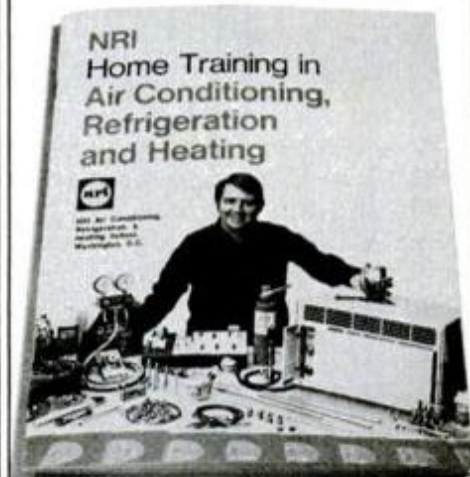
NRI's Master Course in Air-Conditioning, Refrigeration and Heating comes with a window air-conditioner for hands-on experiments. You get bite-size lessons, fine professional instruments and expert instruction every step of the way. A Circuit Demonstrator, Control Simulator, tubing and joint-making demonstrator, leak detector, and system analyzer are included.

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No other TV/Audio home study school puts prices in its ads. Why?

Maybe it's because they can't match these values

NRI will give you complete TV/Audio service training with a solid state 25" diagonal color TV and a 4-speaker Quadraphonic System for hundreds of dollars less than the combined tuition cost of courses at another school. Only NRI gives you a choice of five ways to learn, starting as low as \$445 with convenient, inexpensive time payment plans.

NRI pays no salesmen. We buy no outside "hobby kits" for our experiments and training kits. We pass the savings on to you, giving you the top educational value available anywhere.

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Only NRI gives you a choice of five courses in TV/Audio servicing. Each comprehensive course features bite-size lessons, special reference texts,

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11 kits with Quadraphonic Stereo and B/W TV...\$550

or low monthly terms

A complete course in B&W and Color TV Servicing, including 48 lessons (18 on color TV), 10 special reference texts and 11 training kits. Kits you build include 4-speaker Quadraphonic System, solid-state volt-ohmmeter, CMOS digital frequency counter, electronics Discovery Lab, plus a 12" diagonal solid-state black & white portable TV to build and use. At each assembly stage, you learn theory and "Power-On" application of that theory in typical solid-state TV sets.

11 kits with 19" diagonal color TV...\$880

or low monthly terms

The course includes 42 lessons and 4 reference texts plus kits and experiments to build a superb solid-state 19" diagonal color TV receiver... complete with cabinet, and engineered specifically for training by NRI's own engineers and instructors. This handsome set was designed from the chassis up to give you a thorough understanding of circuitry and professional trouble-shooting techniques. You build your own solid state volt ohmmeter, CMOS digital frequency counter, and experimental electronics Discovery Lab.

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or low monthly terms

The ultimate home training in Color TV/Audio servicing with 48 bite-size sessions, 10 reference texts, and 14 training kits... including kits to build a 25" diagonal color TV, complete with console cabinet; a 4-speaker Quadraphonic Center; a wide band, solid-state, triggered sweep, service type 5" oscilloscope; digital integrated circuit color TV pattern generator; a CMOS digital frequency counter, and an electronics Discovery Lab. This gives you both TV and Audio training for hundreds of dollars less than the tuition cost of TV and Audio combined from the next leading school.

This Master Course combines theory with practice, using the "Power-On" stages for experimentation and learning. Building NRI's equipment will give you the confidence and ability to service any color TV or Audio unit on the market. And you'll have a magnificent TV and quadraphonic system for years of trouble-free performance.

Advanced Pro Color with 19" diagonal color TV...\$665

or low monthly terms

An advanced Color TV Servicing Course for experienced technicians, 18 lessons, 5 new "Shop Manuals", and NRI 19" diagonal Color TV receiver with cabinet.

SCIENCE WORLDWIDE

Energy nosebleeds in houses

Using sensors and infrared techniques, a Princeton University study group under resident engineer David Harrje has discovered unsuspected sources of heat loss in average development homes. Besides the usual "underinsulated attic," warmed air was found to escape through the attic via the shaft for the plumbing waste stack, up the flues of packaged fireplaces and stoves with similar open shafts, or through improperly dampered, concentrically spaced metal stacks. "Where dampered flues were directed into masonry chimneys, there was no measurable loss," Harrje reports.

The study, conducted in a Twin Rivers, N.J., development of homes featuring standard construction and insulation, has not yet been published. But Harrje revealed to PM several interesting results. "We found," he says, "that with modest retrofitting . . . anyone can effect an energy saving of 25 percent or more. By insulating water heaters, we saved \$30 a year on electrically heated units, and \$15 on the gas type. But the big savers involved sealing the waste stack shaft and flue shafts, and increasing attic insulation. In all, we spent \$150 for materials and \$250 for labor—and our fuel savings last winter came to \$150."

At that rate, the original \$400 investment would be more than recovered within three years—after which all savings would be money in the bank!

How to drown—and survive

People who drown in cold water are not necessarily dead—even if they have been under water for as long as 30 minutes. That's the conclusion of a recent study by Dr. Martin J. Nemiroff, a University of Michigan diving medicine specialist.

He reports that in 13 cases considered to be true "cold water drownings" (in water below 70°F.) nine victims were revived without suffering brain damage or other ill effects (one after 38 minutes' submersion in a frozen pond). All had gone beyond the four-minute oxygen deprivation limit, after which irreversible brain damage is generally thought to occur.

What saved the survivors, according to Dr. Nemiroff, was the acti-

vation of an automatic response—called the "mammalian diving reflex"—combined with the coldness of the water. It's the same reflex that allows seagoing mammals to stay under water for as long as 30 minutes. It reduces the blood supply to the skin, muscles and other tissues and reserves the remaining blood oxygen for the brain. Cold water, says the researcher, also reduces the oxygen needs of tissues.

Creating a tornado in a tube

Even among unconventional energy systems, Dr. James Yen's "tornado tower" must be regarded as novel. The tower itself is stationary, open at the top and has adjustable vertical vanes through which wind enters. The inflowing air spirals toward the center to form a vortex and move upward at accelerated speeds. As it swirls toward the opening at the top, the air spins a turbine to generate electricity.

According to Dr. Yen, a researcher for Grumman Aerospace Corp., tornado towers can be built small



Dr. Yen and his new twist on wind power.

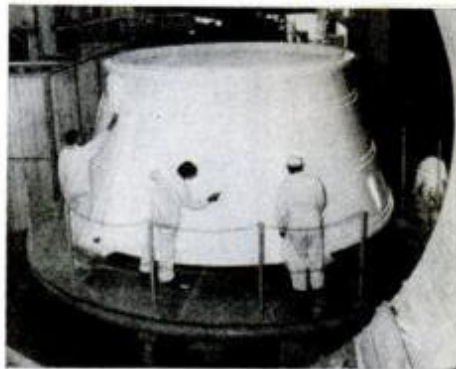
enough to provide power for a single home or large enough to energize an entire community. Preliminary studies indicate Dr. Yen's system is capable of producing considerably more power than conventional wind turbines of similar size. In the laboratory model shown in the photo above, smoke is used to trace the airflow.

Shuttle unit readied for tests

The first big skirt tailored for the solid-propellant Space Shuttle rocket is now undergoing tests at the Marshall Space Flight Center in Alabama. Fabricated from 3-inch

aluminum, the 5-ton skirt is 17 feet, 6 inches in diameter at its base and stands 7 feet, 1 inch high.

Since it will take two big rockets to provide lift-off thrust, two skirts are needed. After the boosters burn out and separate from the main space vehicle, they must survive a



Technicians check "hang" of new skirt.

fall and parachute drop of 27 miles. Following recovery in the ocean, they will be used again on other Shuttle missions.

Scope spots heat in space

It's so sensitive it could detect a hot flatiron on the moon. That's how scientists describe the capability of a new heat-sensing telescope recently installed atop 9665-foot Jelm Mountain in Wyoming. Designed by University of Wyoming scientists, the instrument has a 92-inch mirror to collect infrared energy from space. A computerized sensing mechanism "reads" the signals and converts them into a contour chart of heat intensities that resembles a topographic map.

Bare facts on blood pressure

It's possible there are more benefits from nudism than readily meet the eye. Results of a recent American Heart Assn. study indicate that residents of a Maryland nudist camp have a much lower incidence of high blood pressure than occurs among the general population. **PM**



BY
JOHN F.
PEARSON

THE NEW-SIZE MALIBU WAGON

Chevrolet's new friend of the family.



NEW SIZE. Trim exterior dimensions make this tidy new wagon easy to maneuver, easy to park.



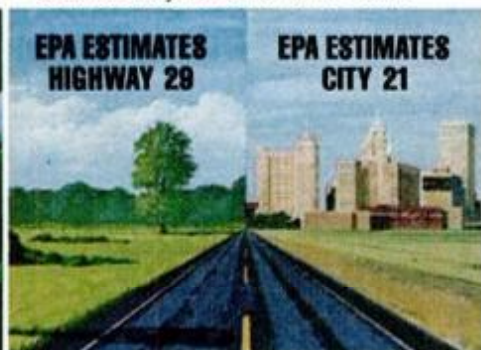
ROOMY. Generous interior swallows good-size loads. Rear seat is easy to lower and raise.



NEW HATCHGATE. Top lifts up like a hatch, bottom drops down like a gate. Easy to operate.



EASY LOADING. Load space is easily accessible even if somebody parks too close.



EPA ESTIMATES
HIGHWAY 29

EPA ESTIMATES
CITY 21

EFFICIENT. Thanks to its new weight-saving design and efficient new V6 powerplant, the new-size Malibu Wagon conserves fuel admirably. EPA estimates are 29 mpg highway, 21 mpg city with standard 3.3 litre (200 Cu. In.) V6 engine and manual transmission. *Power train not available in California.* Your mileage may vary depending on how and where you drive, your car's condition and available equipment. (Malibu is equipped with GM-built engines produced by various divisions. See your dealer for details.)



HANDY PLATFORM. Gate helps support long or heavy items as you load, unload.



OUT OF SIGHT. Underfloor storage for your valuables. Handy on trips, or anytime.



ODDS & ENDS. Additional space in cargo area sidewalls for small items. Lockable lid available.



SEE WHAT'S NEW TODAY IN A CHEVROLET.



'78 FORD PICKUPS. TOUGH ALL OVER.

A new Ford Pickup is built tough from the ground up. Ford's exclusive forged steel Twin-I-Beam, extensive corrosion protection, big-cube V-8 options, all-welded cab, and double-wall box are just a few of the reasons.

But what makes a new Ford even tougher to beat are this year's new options like • Synchronesh 4-speed overdrive transmission for highway driving (not available on F-350 models) • Good-looking, comfortable new Lariat interior • 40-channel CB with concealed transceiver, single AM/FM/CB antenna, and all controls in the removable mike • New tilt steering wheel for your most comfortable position.

Take a look at all the new Fords. You'll find them tough all over. And *more* than just tough.



93 out of 100 of all Ford Trucks registered over the last 12 years are still on the job. (Percentage based on cumulative total registrations as of 7/1/76.)

FORD
FORD DIVISION



PM WORKBENCH

PM EXAMINES PRODUCTS AND SERVICES

More about heat pumps

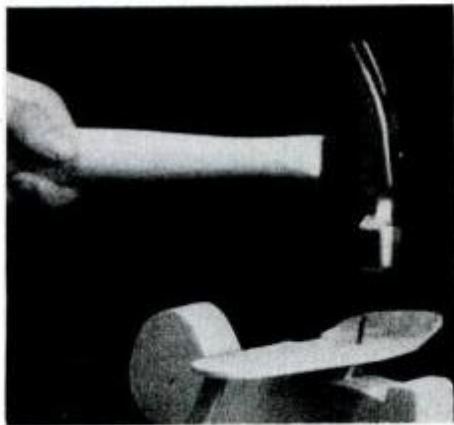
Will a heat pump help you save on heating and cooling costs? According to a new booklet from the Air-Conditioning and Refrigeration Institute (ARI), the answer depends on the type of heating and cooling systems.

The ARI says the cost of operating a heat pump will always be less than that of an electric furnace-central cooling system because the heat pump (which is electrically driven) collects heat that already exists in cold outdoor air. In comparison, an electric resistance furnace turns electricity directly into heat on a one-to-one basis.

The conclusion is that a heat pump can supply 1½ to 2½ times more heat than the energy it uses. For a free ARI booklet, send an addressed No. 10 envelope to Dept. HP, ARI, 1815 North Fort Myer Drive, Arlington, Va. 22709.

Cabinetmaker's hammer

All serious woodworkers need at least one lightweight hammer. One



10-ounce hammer—great for light tasks.



Warning on handle lists dos and don'ts.

of my favorites is the Little Pro from Vaughan & Bushnell, Hebron, Ill. 60034. Available at hardware stores for less than \$8, the hammer is a high-quality, comfortable-to-use tool.

Better log splitting



Use bit side of splitter on medium logs.



On large logs, wedge in indentation.

Log splitting goes a lot faster if you work with the right tools—in the right fashion. This kit from Woodings-Verona, Verona, Pa. 15147, includes a log splitter



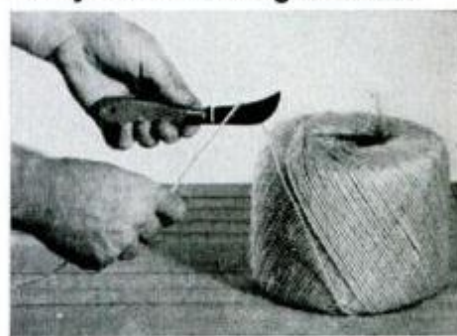
Wedge is driven with hammer end of head.



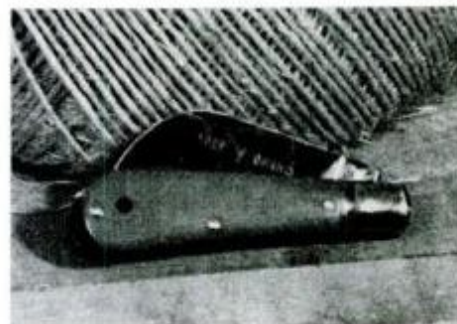
Splitter and wedge that come in the kit.

and wedge. Small logs can be split by simply striking with the splitter as in photo at left. Large-diameter logs are indented with splitter, then finished off using the wedge and hammer end of head. The kit costs about \$25 at hardware and department stores.

Utility knife with bright handle



Knife features keen 3-in. hawkbill blade.



When folded, knife has hefty look.

Tree Brand knife comes in a red case to help prevent loss—a lanyard hole gives extra insurance. About \$9.50. Boker, the Cooper Group, Apex, N.C. 27502.—Harry Wicks, *Home and Shop Editor*

If you've come across a new product with some special features, let us know about it. Write to PM Workbench, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.



Come to
Marlboro

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

Lights: 12 mg "tar," 0.7 mg nicotine av. per cigarette, FTC Report Aug '77
Kings & 100's: 17 mg "tar," 1.0 mg nicotine av. per cigarette, FTC Report Aug '77

Country.



Marlboro Lights, Longhorn 100's and famous Marlboro Red—
you get a lot to like.

CAR CLINIC

SOLUTIONS FOR MECHANICAL HEADACHES

BY MORT SCHULTZ



Hail DeSoto

Will you please help me keep a fine 1955 DeSoto running? The car is equipped with its original V8 engine and automatic transmission, and has been driven only 78,000 miles. It needs a carburetor, which I can't get. I can't rebuild the unit, either, because I can't get a gasket set. Can you help?—Ivo V. Pennington, Pennington's Garage, Wauwata, Neb.

I have the name of one company that has what you need. Write or call Garton's Auto Parts, Fifth and Vine Sts., Millville, N.J. 08332 (609-825-2011). Reference numbers for that carburetor are Model No. BBD2178-SA and part No. 1613077.

Fact noted—recorded

In reference to your advice to Fred C. Smith of Appomattox, Va., in the August 1977 Car Clinic, you may not be aware that the Gabriel Shock Absorber Div. of Maremont Corp. is also in the business of manufacturing and distributing MacPherson cartridges. Our suggested list price is \$39.30 each. We also have available to the dealer an import service manual which outlines specific procedures for the removal of struts from the imports that use them. Driveway mechanics seeking this information should ask a Gabriel dealer for a look at his import service manual or perhaps photo copies of the pages referring to his vehicle. We do not have a consumer version of this manual.—Charles H. Zeiler, Maremont Corp., Chicago, Ill.

The fact that Gabriel also manufactures replacement cartridges for the MacPherson suspension will be of interest to many readers. Thanks for the information.

Poor pores

I'm at my wit's end with a 1970 Chevrolet Nova. When the engine is warm, I pump the accelerator three or four times and the engine starts promptly. But if the car is parked overnight I have to pump the ac-

celerator about 15 times to get the engine started. Mechanics have adjusted and readjusted the automatic choke, and the engine—a 307-cu.-in. V8—has been tuned up. I've even had a new fuel pump installed that the car obviously didn't need. Now I'm told the camshaft under the distributor may be loose. I'm skeptical about investing more money on a problem that no one seems to understand without getting your advice. Please help.—Kevin McKeogh, Brooklyn, N. Y.

I won't bet my life on it, but it's worth a wager of a few dollars to pin the blame on what is commonly called a "porous bowl." This refers to the possibility that over a period of downtime, when the engine isn't running, fuel is draining out of the carburetor bowl. The fact that you have to pump the accelerator an excessive number of times to get sufficient fuel to start the engine points to this. The fact that you have to pump the pedal three or four times when the engine is still warm also verifies the condition. The engine should start when warm without need for pumping.

A "porous bowl" often results from an ineffectively sealing needle

valve. The problem might be caused by a damaged needle valve, a damaged needle valve seat, or a defective or improperly adjusted float, so I would concentrate my efforts in this area—even replacing the entire bowl, if necessary—before pulling a camshaft.

Spotlight on alternator light

I recently purchased a used 1972 Ford Mustang for my wife. It is a sound car, but one thing is making her skittish. The alternator warning light is acting erratically. It stays on, it goes off, it flickers—you never know why at any time. The battery is in good condition. I'm thinking of having the alternator replaced to relieve the problem and make my wife more comfortable driving the car. Will this solve it?—Robert Stedman, Montreal, Que.

I doubt it. The cause of the problem, which is an oldie and applies to all Ford and Mercury models of that era with alternator indicator lights, is probably corroded terminals in the wiring connector that clips to the voltage regulator terminals. There was a factory-advised solution, which I've dug out of my files:

Remove the connector from the regulator and check for corroded terminals inside the connector. If only slight corrosion is present, clean it off by running a piece of fine sandpaper inside. Then inject universal joint lubricant (CIAZ-19590-B) in the terminal. Hook the connector back up securely.

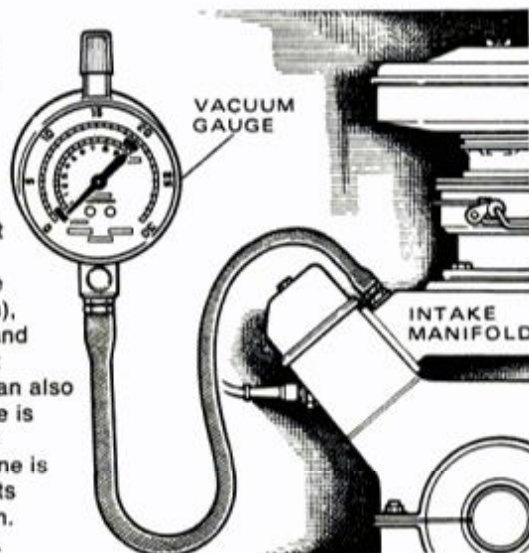
If one or more terminals show excessive corrosion, it or they should be extracted from the connector by depressing the retaining tang inside the connector with a paper clip or small screwdriver and

(Please turn to page 40)

Vacuum gauge—rah! rah!



Let's hear it for the versatile vacuum gauge, one of the most valuable test instruments the driveway mechanic can have. It can indicate a multitude of woes, including wrong valve timing, valve problems (burned, sticking, broken), improper carburetor adjustments and vacuum leaks that hamper efficient operation. Many vacuum gauges can also test fuel-pump pressure. The gauge is usually connected to a port on the engine's intake manifold. The engine is started, and the way the needle acts tells you of a particular malfunction. Get a gauge. It's money well spent.



BE A



JOHN KOLIELNIK
(Los Angeles, Cal.)
"Now that I'm a locksmith, I've increased my salary by at least \$175 a week. Even earned \$550 before completing the course! I think the Locksmithing Institute is the best!"



HARRY PROVART, JR.
(Duquoin, Ill.)
"Locksmithing Institute has the best course that money can buy, and my instructor was tops. Earned \$200 while training . . . since then I've earned \$350 spare time."



IDEAL F. BALDONI II
(Riviera Beach, Fla.)
"Enrolled because I eventually want to be self-employed. As a result of my training, I've assumed locksmith jobs my company formerly hired outside people to perform."

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Add to YOUR INCOME—even double it with easy spare-time earnings. Cash in on the nationwide shortage that demands hundreds more trained locksmiths. Quickly step into a big pay opportunity, full- or part-time job or start a high-profit shop of your own! Even earn as you learn.

EARN EXTRA MONEY RIGHT AWAY!

You can quickly qualify as a skilled locksmith. Age, education, even minor physical handicaps don't matter in this ever-growing trade. So easy to learn—it's easy, it's fun, it's just like a fascinating new hobby!

Study at home as little as one hour a week. All special professional tools, supplies, including files, tweezers, cylinders, door handles, assemblies, gauges, pins, springs, extractors, picks, wrenches, and different kinds of locks and keys—even key machine—supplied to you! Gain practical experience by doing real jobs

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Locksmithing



CAR CLINIC

(Continued from page 36)

pulling the terminal free. Cut off the corroded terminal and replace it with a female snap-on terminal (D20Z-14474-F).

The repair isn't especially difficult to do, and you should be able to handle it yourself. Get parts from a Ford or Mercury dealer.

What a blow

My 1971 Datsun 240-Z has never had a brake job. The rear drums are aluminum alloy and have apparently corroded and seized where they contact the steel lug bolts and axle hub. I have tried solvents and a wide wheel puller to free the drums, but with no success. Do you have any hints on how to remove the drums without using the local dealer's remedy of the "big hammer"?—George Chanatry, Winter Park, Fla.

The local dealer's remedy will destroy the drums. My remedy is a "little hammer" and big patience. Tap lightly around the edge of the drum, use more rust-busting solvent, attempt to free the drum, and then keep repeating this procedure until the drum finally breaks free.

Your experience is valid testimony for removing drums periodically (like once a year) to inspect linings and clean and lube lug holes and bolts.

The Clean Air Act and you

I have received many letters asking about emission controls and the law. The one that predominates is: "How can I (not a mechanic) legally remove emission controls from my car?"

To find out for sure what the facts are, I sought an answer from attorneys for the Environmental Protection Agency. The following statements made by Meyer Scolnick clarify the situation. Mr. Scolnick is the director of the enforcement division of EPA in region II. He is located at Federal Plaza in New York City. Here's what he says:

"The Clean Air Act of 1970 requires automobile manufacturers to meet certain emission control standards. In addition, manufacturers and dealers are prohibited from removing or rendering inoperative any devices installed on a car to meet those standards. This prohibition may soon be broadened to include anyone who makes a substantial part of his livelihood by repairing automobiles.

"In addition, many states have laws controlling the operation and registration of autos, which re-

Do your own carburetor servicing

When a carburetor starts giving a sign it's been in service too long and needs a face-lift, think about overhauling the unit yourself rather than replacing it with a new one. You can save as much as \$50. Trouble signs include gasoline leaking from the carburetor and a sudden loss of gas mileage. Overhauling the unit requires that you remove the carburetor from the engine, breaking it down to its major assemblies, cleaning it by immersion in carburetor cleaner (basket system shown here is the easiest way), and reassembling it using new gaskets and other parts that wear out most frequently, such as the accelerator pump and needle valve. See your automotive parts dealer for information concerning a cleaning and overhaul kit for your particular model.



quire that they be equipped at all times with the emission control equipment originally installed pursuant to federal regulations, and/or prohibiting the removal or alteration of such equipment. Other states have tailpipe emission limitations which could only be met if the car is equipped with its original pollution control system. In many cases these state laws and regulations have become part of the federal law, enforceable by the U. S. Environmental Protection Agency through their inclusion in the State Implementation Plan (required by the Clean Air Act) for the attainment of national ambient air quality standards.

"We have recently become aware that at least two companies in the United States have published manuals instructing citizens in how to remove emission control systems. One of these companies recently ran an advertisement offering the manual for sale, and promising greatly increased gasoline mileage. We have referred the matter to the Office of the New York State Attorney General, which may wish to seek an injunction barring sale of the manual in New York.

"Since so many states (the number may be as high as 35 or 40) have one or more laws related to automobile emission control systems, and since the information offered by such advertisements is an inducement to citizens to violate those laws, your magazine might consider refusing to accept such ads for publication, should they be sent to you.

"We hope you will also carefully think over the advisability of informing your readers that in many states removal of emission control systems is illegal."

I want to add to Mr. Scolnick's remarks that although it may be possible to bend the law and explain

how to remove an emission control, it won't be done in *Car Clinic*. If it isn't technically illegal to do so, it would certainly be morally wrong. So please—no more mail on this.

SERVICE TIPS

■ We said a few months ago that Chrysler Corp. was just about ready to issue an improved accelerator pump cup for the Carter two-barrel carburetor used on 225 and 318-cu.-in. engines. Well, it's here. The new cup is supposed not to swell as the old one does. Thus, "vehicle drivability and reliability" should be improved. This means that hesitation-on-acceleration problems, for one thing, will be reduced. The new pump is available under part No. 4094866. The package you get will include the pump cup (colored blue) and pump plunger spring.

■ This tip comes to us from Paul Hilts in the PM office in Chicago. Seems that Paul has a new VW Rabbit (gas engine) that dealt him a low blow not long ago following a 50-mile drive. He couldn't get the engine to restart. It was plain dead, so he called a VW garage and was told to jiggle the fuse box. Sure enough, the engine started. We figure this is a good tip for VW Rabbit owners to keep in mind, just in case they find themselves in the same hairy situation.

■ Champion Spark Plug Co. suggests that starting sprays in cold weather can be effective aids in emergencies, but "if not used properly, they can be extremely dangerous." Most sprays contain highly volatile, flammable substances, including ether, that are aimed directly into the carburetor with the air cleaner removed. If too much is used, there's a chance of backfire through the carburetor. To avoid possible severe burns, keep your hands and face away from the engine. **PM**

GOT A PROBLEM WITH YOUR CAR?

Just ask Mort about it. Send your question to the Car Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. While letters cannot be answered individually, problems that are of general interest will be published in the column.

You're gonna love our Great Little Car. Mazda GLC 5-Door Hatchback.

Great little piston engine. Great little goodies. Great little price.



Introducing the Greater Little Car. The GLC Deluxe 5-door Hatchback. \$3594**! A roomy new Deluxe GLC in a whole line of roomy GLCs for 1978.

The GLC 5-door is for those who believe the only thing better than a GLC hatchback with three doors is a GLC hatchback with five.

It has GLC's split rear seat, standard. Which lets you take a back-seat passenger along, along with two weeks' groceries or golf clubs or luggage or what have you. Both seats folded down reveals a plushy carpeted deck. Very nice.

There's a nifty little button under the dash that electrically unlatches the hatch. (You may open the hatch from the outside, too.)

It has three transmissions to choose from. 4-speed is standard, while easy automatic and frugal 5-speed are available.

There's simply much more than you'd ever expect in a car its size. But, for not much money. And that's the case with every GLC model: the GLC Standard 3-door Hatchback, GLC Deluxe 3-door Hatchback, and GLC Sport.

Mazda's Great Little Car is a great little car. You're gonna love it.



SPLIT REAR SEAT



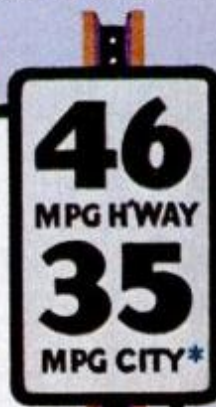
CHOICE OF TRANSMISSIONS



REMOTE HATCH RELEASE

*EPA estimates based on optional 5-speed transmission. Your mileage may vary depending on how and where you drive, your car's condition, and optional equipment. 42/33 mpg Calif.

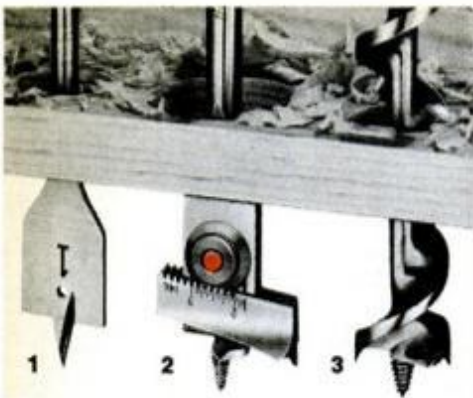
**POE Seattle prices (slightly higher in California, and other areas). Taxes, license, freight, and optional equipment are extra. GLC prices for models not shown range from \$3074 to \$3849.



mazda

GLC. Now, four great little cars in all, from \$3074.**

IT'S NEW NOW



Fast, accurate boring ... 3 easy ways!

- 1. Irwin Speedbor® "88"** wood bit for all electric drills. Spade-type head, original hollow ground point starts and cuts clean and fast in any wood. 17 sizes, 1/4" to 1 1/2". Available individually or in workshop sets.
- 2. Irwin No. 22 "Micro-Dial"®** hand brace expansive bit bores 35 standard holes 1/8" to 3". Just dial the size you need. No. 21 bores 19 standard holes, 1/8" to 1 3/4".
- 3. Irwin 62T Solid Center** hand brace bit delivers double-cutter boring action. Medium-fast screw pitch. Balanced cutting head. 18 sizes, 1/4" to 1 1/2". Available individually or in sets.



Speedbor "88" Sets
Get 6- or 13-bit sets in metal workshop organizer racks.

New Protective Plastic Pouch!

Speedbor "88" 1/4" shank wood bits for electric drills are available individually in new easy-to-store protective pouches . . . to help you care for them as you do all your other fine, quality tools.



Strait-Line® Chalk Line Reel Box.
Every serious do-it-yourselfer should have an Irwin 50 or 100 ft. self-chalking line box. Easy action reel. Leak-proof, damage-resistant aluminum alloy box fits hand or pocket.

Irwin Screw Starter

Marks, starts and threads hole for screw to enter non-metal materials the easy way, with hardly any effort. Can also be used as a "marking tool" when drilling holes. Handiest tool in years for home and workshop. Available from your hardware or building supply dealer, and home center stores. All items above are available in metric sizes.

©Registered U.S. Patent Office



Sound-controlled toy van

Kids can drive this toy van anywhere they want around the house with a wireless, sound-actuated remote control. A 4000-cycle signal from the Max Machine's hand-held transmitter clicks the steering mechanism into left, right and straight-ahead positions within a 20-foot range. The vehicle is powered by batteries and costs about \$15. Schaper Manufacturing Co., Box 1470, Minneapolis, Minn. 55440.



Cable cars keep students safe

Students at a Swiss driving school can go only as far as their teachers wish. Power from cables to their electric cars can be cut when instructors desire.



Clearing the air

Air cleaner mounts in return duct of any forced-air system to filter dust, pollen, other particles. About \$115. Research Products Corp., Madison, Wis. 53701.



Super-accurate sniper rifle has warp-free stock

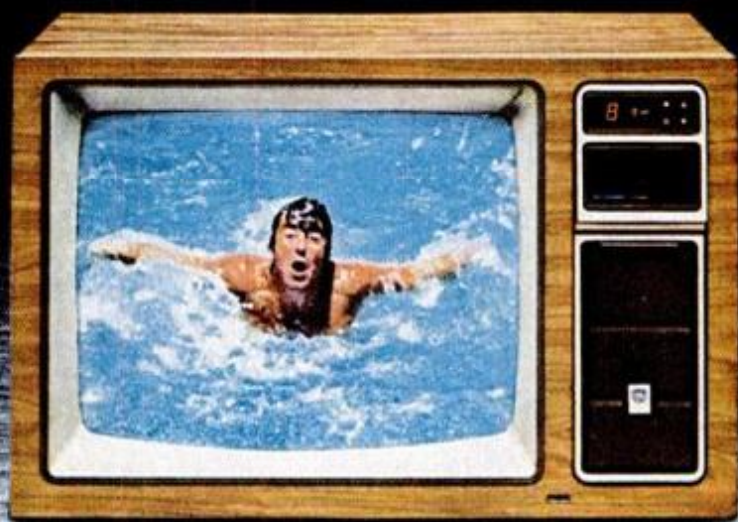
A new Marine sniper rifle, said to be the most advanced of its type, has a fiberglass stock to avoid warping. It weighs 12 pounds and has a range of 1000 yards.

IRWIN® every bit as good
as the name
at Wilmington, Ohio 45177, since 1885

This is the VIR signal that lets you see color controlled by the broadcaster.



This set can use it. It's a General Electric.



Cabinet: Walnut finish on high impact plastic. Simulated TV reception.

Inside this GE set is advanced computer-like circuitry that uses this VIR signal. To let the broadcaster automatically adjust all of the color on many programs. Flesh tones. Background colors. The entire color picture. All automatically. 60 times a second. VIR Broadcast Controlled Color. See a demonstration today.



VIR
BROADCAST
CONTROLLED
COLOR

THIS IS GE PERFORMANCE TELEVISION

GENERAL  ELECTRIC

DETROIT LISTENING POST

New automatic for GM makes

General Motors is testing a light-weight, high-mileage automatic transmission to team with its down-sized cars. It will be offered on a limited number of cars next year ('79 models), then expanded to all GM makes over the next several years. Sources that worked with GM in developing the unit say it will come close to matching a manual shift in fuel economy.

Fixed carb coming in '80

The '78 and '79 cars will probably be the last automobiles out of Detroit with adjustable carburetors. The carb is going to be made tinker-proof, or almost so.

As reported in *Wanted: a No-Tinker Carb* (DLP, page 44, Feb. '77), carmakers want to remove the temptation to tinker with the carb because adjustments made after the car leaves the factory nearly always increase pollution. The government has asked the companies to come up with a no-fiddle carb by 1980.

Want a big car? Buy now

If you want a big car, a '78, buy it now. You might not be able to get one later in the model year. Car-makers are so concerned about the government regulation that says each company's cars must average out to 18 miles to the gallon that they are taking daily readings on sales. If big cars dominate, as they did during the 1977 model year, the plants say they'll ration the big jobs.

Ford says if the scale tilts too far in favor of big cars, it will cut production "even if dealers have retail (sold) orders in hand." That may sound like a hustle to sell you a big car. It isn't. If the companies miss

the mark on the 18-to-the-gallon law, they will be socked with stiff fines. Five bucks for every car produced during the model year for each 1/10th of a mile by which a company misses the target. Not just the cars that fall below target, but every car turned out during the model run. That could add up to millions of dollars. GM and American Motors are in better shape than Ford and Chrysler to meet the mileage law, so there isn't likely to be a waiting list for GM and AMC makes.

New engines less durable?

On the subject of miles per gallon, engineers working on new engines that will power the cars of the 1980s say it may be necessary to make sacrifices in durability for the sake of improving fuel economy. "We'd like to have it both ways," a Big Three engineer told me. "We'd like to build an engine good for 100,000 miles, minimum, that would give 40 to 50 miles to the gallon. But if it comes to a showdown between durability and miles per gallon, durability will be the loser."

What are the priorities to consider in the design of a new engine? "Fuel economy would rate as No. 1," PM's source says. "Next would be durability and serviceability—six of one, half-dozen of another, call it a tie. Performance would be last. If the goal's 100 and you're assigning points, fuel economy would count for 50 points, 20 points for durability, 20 for ease of service and no more than 10 points for zip and performance."

GM improves new-car guarantee

American Motors and General Motors have put the screws to Ford and Chrysler to improve their warranties. GM rewrote its warranty for the '78 cars. GM dealers are committed to repairing "anything that goes wrong that is our (GM's) fault without charge" for the first year or first 12,000 miles. The only exceptions are maintenance parts—plugs, oil filters and similar items listed in the owner's manual.

American Motors took a step back with its warranty, although it still gives the best guarantee in the business. Last year AMC had a 24/24 guarantee (24 months or 24,000 miles) on the engine and

drive train. No charge. The company still offers the 24/24, but you have to pay an extra \$75 for it.

AMC says the only things buyers of its cars will have to pay for are gas, oil and filters. Ford and Chrysler could ignore AMC when the smallest automaker was going it alone. But when AMC and GM join forces, Ford and Chrysler will have to think about falling in line.

Buck-passing on warranties

I have a beef about car warranties I'd like to see changed. They all contain a pass-the-buck feature on certain items. Tires are the prime example. If you get a bad tire, you have to argue it out with the tire company. The car manufacturer says it isn't his obligation.

Tires aren't the only item. GM has an exclusion clause on its battery. If the battery conks out, you have to take it up with Delco—not the GM dealer who sold you the car—even though Delco is GM-owned.

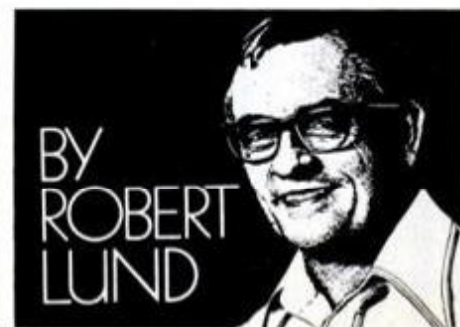
Why can't the manufacturer assume all liability for everything it puts on the car?

Aluminum: pros and cons

Aluminum weighs only about a third as much as steel and it has been making small gains every year in terms of the number of pounds used in cars, but from now on the gains may be measured in ounces. GM's Fisher Body Div. has been doing an advantages/disadvantages study of aluminum versus other metals and the result is just about a draw. The study even gets into such things as recycling, shipping costs and amount of energy it takes to produce a ton of aluminum compared with that used to turn out a ton of steel. The car companies will unquestionably use more aluminum on future automobiles. But the all-aluminum or mostly aluminum car is a will-o'-the-wisp idea. **PM**



Dodge Omni and nearly identical Plymouth Horizon—the new, homebuilt, front-wheel-drive cars from Chrysler Corp.—will be unveiled this month. PM will have a full report in the January 1978 issue.



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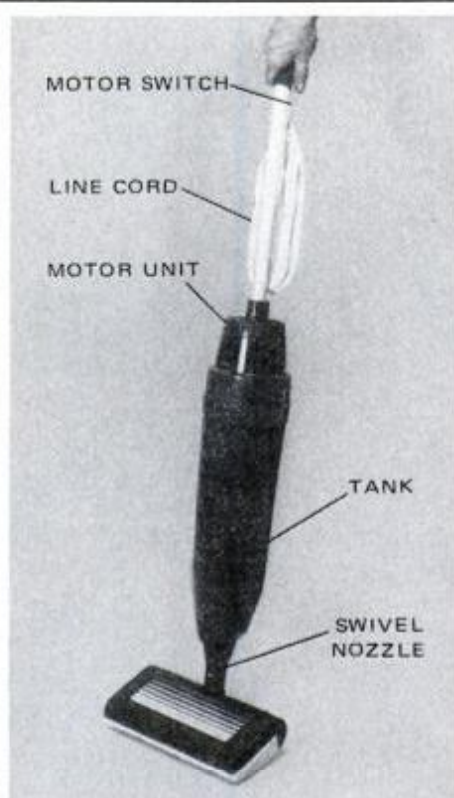
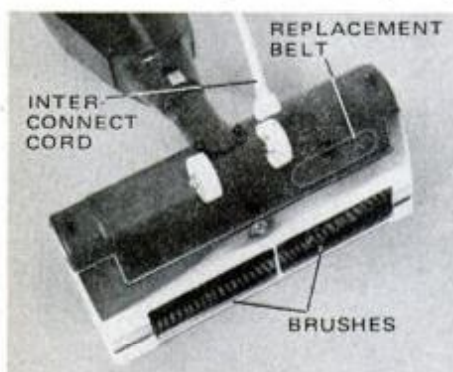
*29 of 48 menthol brand-styles, accounting for over 75% of all menthol cigarettes sold in the U.S.A. last year delivered over 13 mg. 'tar' av. per cigarette.

PM PRODUCT TEST

PENNEY'S LIGHTWEIGHT VAC

When the news about J.C. Penney's newest vacuum cleaner crossed my desk, several features claimed for it made the appliance an instant candidate for a *Popular Mechanics Product Test*. For one thing, the vac comes with two motors instead of one and, surprisingly, though it draws dirt from carpets with a fury, it is a featherweight at 10.2 lbs.

One motor in the housing delivers the vacuum power while a second one in the powerhead (foot)



provides the power to drive a set of brushes (photo, far left) designed especially for loosening dirt in carpets. A second set of brushes sweeps dust into the machine.

Out of curiosity, I used the vacuum in my shop several days and found it rates Penney's claim that it effectively vacuums almost any surface: I even used it to suck sawdust from a sanded countertop before applying Formica.—H.W.

SPECIFICATIONS

Powerhead lightweight vacuum

Motor: 120 V., 60 Hz., 5.2 amps.
Line cord: 18 ft.
Maximum power: 560 watts
Dirt storage bag capacity: 245 cu. in.
Brush speed: 4000 rpm (minimum)
Weight: 10.2 lbs.
Price: \$60
Warranty: one year
From J.C. Penney, Inc., 1301 Ave. of Americas, New York, N.Y. 10019.
Vacuum available at local Penney stores and through catalog.



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These days, every body's into a different look. A look that fits. And the one billfold for that look is the Body Billfold. Because the Body Billfold is made of leather so soft and flexible you'd think it's alive. Without all the lumps and bumps that can come between you and the look you're looking for. So no matter what shape you're in, every body fits a Body Billfold.



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Travel Light. A scant 6.5mm thin. And just 2 inexpensive hearing aid batteries mean you'll never need a special French connection or a British adaptor or any other bulky transformer. You won't have to burden yourself with extra batteries, either.

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\$1995 Complete with case.

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- And it's so much more... for so little money

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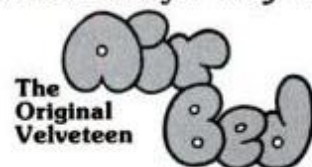
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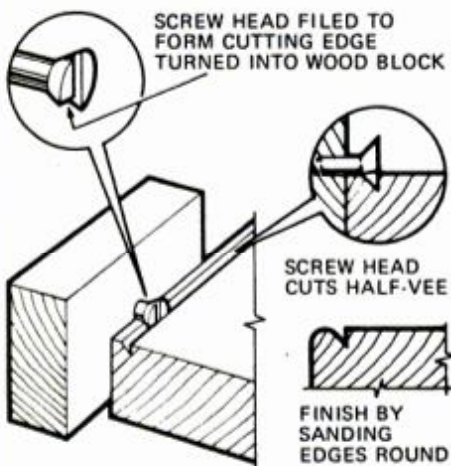
HOMEOWNERS' CLINIC

QUESTIONS ANSWERED

Cut a decorative border

I have no suitable power tool, but I'd like to cut a decorative edge on some molding. Is there a simple way to do it with hand tools?—Martin Weeks, Bangor, Me.

You can cut an edge bead on straight or slightly curved pieces with a simple tool. The drawing shows how it can be done with an altered flat-headed screw turned into a small block of wood. File the screw head to form a sharp cutting edge as shown, then turn it into the wood. The block will guide you in cutting the bead uni-



formly.

When the cut reaches full depth as determined by the size of the screw, round the outer edge of the molding to form the bead. Use various sizes of screws to form beads of different sizes.

Power vs. wind-driven vents

I've considered both power and wind-driven roof vents to remove hot air from my attic. Can you help me decide, naming the advantages of both?—Dennis Miller, Bridgeview, Ill.

The best choice between wind and power-driven ventilation systems depends largely on the type of roof construction on your home (and in other cases, whether ventilation is planned for an existing home or for a home under construction).

Both the wind and power-driven systems need fresh air intake vents as well as hot or moist air outlets.

With a natural (wind-driven) ventilation system it's important to have properly positioned ventila-

ors to take maximum advantage of the natural airflow. There are several placement areas for ventilators, but the combination that's often most efficient is ridge ventilators (outlets) located along the ridge of the roof with undereave vents (inlets). Since installing a ridge vent is a fairly big job, this wind-driven system is most often put in when homes are being built and the roof is under construction. There are other areas where vents can be installed to work efficiently. These locations will depend on the roof construction, such as directly in a sloping roof or at the end of a gable.

Power ventilation systems with undereave vents and a power ventilator exhaust positioned on the rear slope of the roof are very effective and fairly easily installed in existing homes. You must pay energy costs to run them. On the other hand, they can cut airconditioning costs.

A ventilating contractor can tell you what type of wind-driven system your roof needs. Weigh its cost and proposed efficiency against the cost and efficiency of a power-driven system.

Mobile home energy savers

What can a mobile-home owner with central air, gas water heater, gas oven and underpinning do to save money on energy? Is it possible to add insulation to a mobile? Are there new roof coverings to help reflect heat?—Edward R. Renick, Jacksonville, Ark.

Your mobile, if of standard construction, is already fully insulated according to accepted practice. However, you mention "underpinning," but don't describe it. I'd look there for cold-air leaks that could admit cold air under the floors. I'd also check the fit of all windows. I know of no practical roof coverings at a price that would be offset by heating or cooling savings.

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. Letters cannot be answered individually, but problems of wide interest will be discussed in this column. For more home repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send orders to PM, Dept. HCG, Box 1014, New York, N.Y. 10019.

Gurgling plumbing

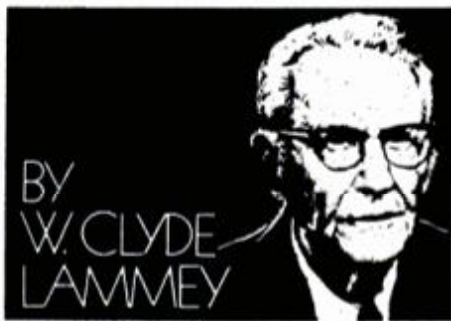
Our plumbing is all copper tubing (piping). When either the bathtub or lavatory is drained, there's an increasingly loud gurgling sound. Is a pipe or vent running up through the roof the solution? There's no such vent in the system at this time.—Mrs. J.B. Schian, Saginaw, Mich.

If the system is not vented, as you say, it should be. In fact, the building code requires that all plumbing fixtures be vented. Otherwise, water draining from the tub or lavatory can create, in effect, a vacuum which would cause the "gurgling" noise you describe. Even if there were proper venting, whole or partial vent clogging by leaves or other debris would create the same effect. In this case, you should have your local plumber check the system.

Match new and old brick

I recently built an addition onto my house. The new brick veneer color doesn't match the original. Spraying water on the new work matches the brick, but when dry the new ones are lighter. Is there some way, some type of a coating perhaps, that would give a permanent match?—Alex Petro, Long Valley, N.J.

Were I faced with the problem, I would apply a coat of clear masonry sealer to one or two of the new bricks and allow them to dry. If they match, there you are. If not, then I would add a bit of conventional outdoor paint used on wood (a red pigment) to the sealer and try again on several bricks until I attained a satisfactory color match when the sealer is dry. In either case, be sure the bricks to be treated are dry and clean. After that it's simply a matter of trial and error. **PM**



There are times you just don't compromise.



You probably know as well as anyone that the wilderness can be unforgiving. Rarely gives second chances.

So, the question becomes whether an off-road vehicle should be a converted pickup, like a Blazer. Or, one designed specifically for the wilderness from the very start, like a Scout.

The differences are obvious.

The Blazer is stuck with the width of the pickup. Whereas the Scout is 9½ inches narrower. So there's less chance of getting stuck in a tight spot. But still has room for 5 man-size men plus all their gear.

The Blazer inherits the turning circle of the pickup. Whereas Scout remembers those dead end trails with a 3'-8" tighter turn.

Then there's a lower center of gravity than Blazer. A 12-degree better approach angle. Selective 4-wheel drive with all power teams. We could continue into next week. But why belabor things when you're starting to get the idea.

That the Scout is every bit as uncompromising as the places you want to take it.

Scout® leads the way.

There's only so much an ad can tell you about this much machine. So we're offering you free brochures with full information telling how all Scouts lead the way. Check the one you're interested in and we'll get it to you, pronto.

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| <input type="checkbox"/> Scout Traveler® | <input type="checkbox"/> Scout® Towing |
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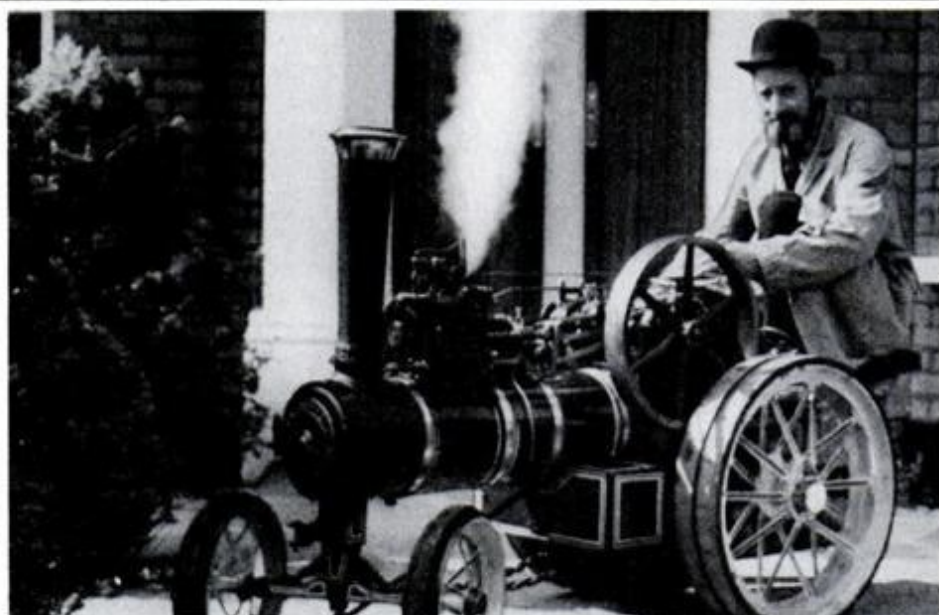
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*1⁰⁰ each handling charge.

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- Three Rotary Strippers - *30.50 ppd.

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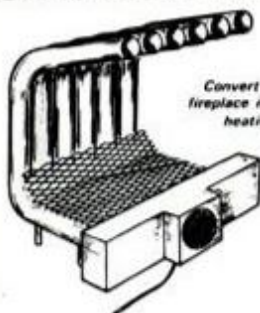


Tractor steams at 6 mph

This steam tractor, about 1/3 scale, is toting children around a London suburb. The model, found in a dump, was restored by Anthony Falconer and goes 6 mph.

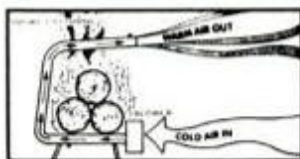
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The quietly operating blower on this unit will increase your fireplace's heat output by up to 60,000 BTU's. The expanded steel grate will accept three or four 6" diameter logs, and contain the fire within the basket. Heavy gauge welded steel construction insures many years of economical operation.



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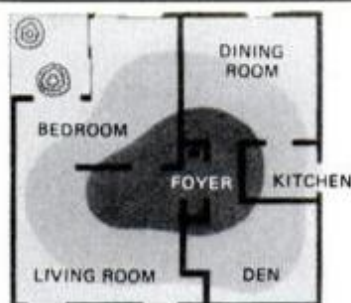


Quick key change

Fast-switch capo (string clamp) for guitars lets pick-a-little players hold strings and change key with one hand, simplifying chord structure. \$5.95, Pickers Pal, Box 633, Van Nuys, Calif. 91408.

Kitchen mill in a kit

Grind your own flour in a mill you assemble. Test unit produced 1200 pounds in 25 hours. \$139. Excalibur, 5711 Florin-Perkins, Sacramento, Calif. 95828.



Electronic watchdog

Radar burglar alarm, with solid-state plug-in circuitry and battery backup, can be set to protect any home area where a thief may pass, sounding off bells. Gard-Site is \$330 at J.C. Penney stores.



Kodak's newest, lowest-priced instant camera.

It's simple. The Handle™

The instant camera with a gift for brilliant color. From Kodak.



Say "Merry Christmas" with The Handle™—the simple Kodak instant camera that turns out beautiful instant prints with brilliant color by Kodak.

See pictures develop before your eyes in minutes—protected by an elegant textured Satinluxe™ finish. Nothing to focus. No timing, no peeling, no mess. Simple? Yes. But more. Bright, brilliant instant color by Kodak.

NOW SAVE \$10 on Kodak instant cameras and film. See your photo dealer for details.



Note: Kodak instant cameras use only (PR-10) Kodak instant print film.

Kodak gifts say: "Open me first" ...to save Christmas in pictures.



APPLIANCE CLINIC

QUESTIONS ANSWERED BY PAUL MANN

Pooling our resources

What besides a bad door seal allows an undercounter dishwasher to leak?—Dewey W. Wood Jr., Dunn, N.C.

Here you go, Dewey:

- Split in the spray arm (inspect and replace if necessary).
- Out-of-line door (check for equal clearance on all sides and firm locking; make needed adjustments).
- Loose or damaged water-feed hose (check and tighten or replace).
- Leak in the tub (replace).
- Very high water pressure (reduce pressure by partially closing the water valve and test).
- Loose joints on the waste line (check and tighten if needed).

Kill a watt, or not

My wife says that leaving a television set on with the volume turned down for periods of 15 minutes or so every so often as she performs some chore is less harmful than turning the set on and off frequently. She contends that frequent on-off switching hurts the picture tube. I say that her practice wastes electricity. Who's right?—Andrew R. Cosetta, Riverside, Calif.

Hold it, pal. You're not going to get me in the middle of a husband-wife dispute. I'll give you the facts. You decide who's right:

Fact: Frequently turning a TV set on and off does not harm the picture tube. Saying that it does is an old wives' tale. It may put some stress on the on-off switch, but even that's debatable.

Fact: The electricity you save turning a TV set off whenever you leave a room is infinitesimal. Even with today's high price for electricity, the cost of operating a TV set is low. According to the General Public Utilities System, the monthly cost of operating various types of TV sets seven hours a day is as follows (cost is based on a rate of 4.8 cents per KWH):

- Black-and-white (tube): \$1.44.
- Black-and-white (solid state): 58 cents.
- Color (tube): \$2.88.
- Color (solid state): \$1.92.

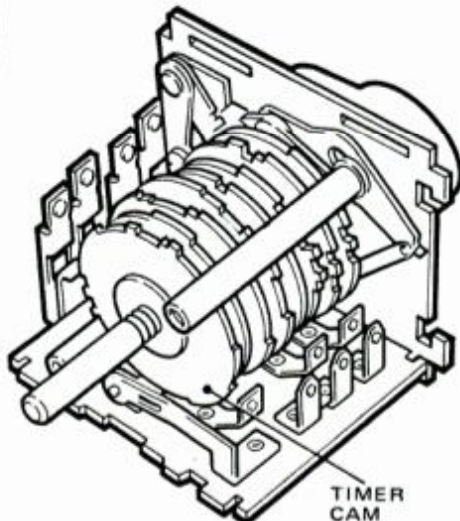
Cam can't

I own a Whirlpool two-speed washing machine. When it switches from "wash" to "rinse" cycle, the knob pops up and the machine stops. When I press the knob down, the

machine starts again and completes all cycles without incident. What causes the knob to pop up?—C. Seaffide, Staten Island, N.Y.

Probably a defect with the timer is causing the knob to pop up since the knob is attached to the timer. Timers are simply a number of switches ganged together and controlled by individual cams, (see illustration). These cams are turned by an escapement powered by an electric clock-type motor. Basically, the cams open and close switch contacts to control the sequence and timing of the machine's cycles.

If the knob is popping up at the same moment during each operation there can be a weakened timer part causing the malfunction. You are overriding the trouble as you manu-



Typical Timer

ally push the knob back down. The weakened part could be a cam arm, cam follower or spring.

To correct the trouble would probably necessitate replacing the timer. After you learn the price, you may decide to take the trouble to push the knob back in place.

In hot water—again

I am writing in reference to a letter appearing in the June 1977 Appliance Clinic from Mr. George Kresina of the Cleveland Electric Illuminating Co. His comments were undoubtedly based on Professor Goldschmidt's tests at Purdue University. These tests are obviously faulty, since they recommend the water heater be off only 10 hours daily.

Actually a consumer will have adequate hot water if the water

heater is on only three to four hours a day.

We have just completed the only study ever made in the field wherein a meter was actually put on an electric water heater in consumers' homes and a study made to determine the difference between usage with and without a timer. The tests showed that the participants saved

SERVICE TIP

Black and Decker Manufacturing Co. has voluntarily recalled about 40,000 No. 8209 Type 1 weed and grass trimmers. The trimmer is sold with an unassembled two-part handle that consumers must assemble prior to use.

Tests have indicated that consumers could damage the insulation surrounding the electrical cord when assembling the handle. Such damage could result in serious electrical shock.

Consumers are urged to stop using the No. 8209 Type 1 trimmer and return it to an authorized Black and Decker service center (as listed in the classified pages of your telephone directory).

Trimmers subject to recall will be modified to a No. 8209 Type 2 model at no cost to the consumer. All No. 8209 Type 2 trimmers incorporate an additional safety feature to safeguard against any future possibility of electrical shock from this problem.

Consumers who require additional information should call collect to Black and Decker, 301/828-2955 between 8:00 a.m. and 5:00 p.m. E.S.T.

an average of 208.7 KWH per month. This would result in monthly savings of \$10.02 based on the national average electric rate of 4.8 cents per KWH. Since the cost of a timer installed by an electrician should be no more than \$59, the pay-back to the consumer on this basis is less than six months. Enclosed are copies of our results.—James C. Miller, president, Inter-matic Corp., Spring Grove, Ill.

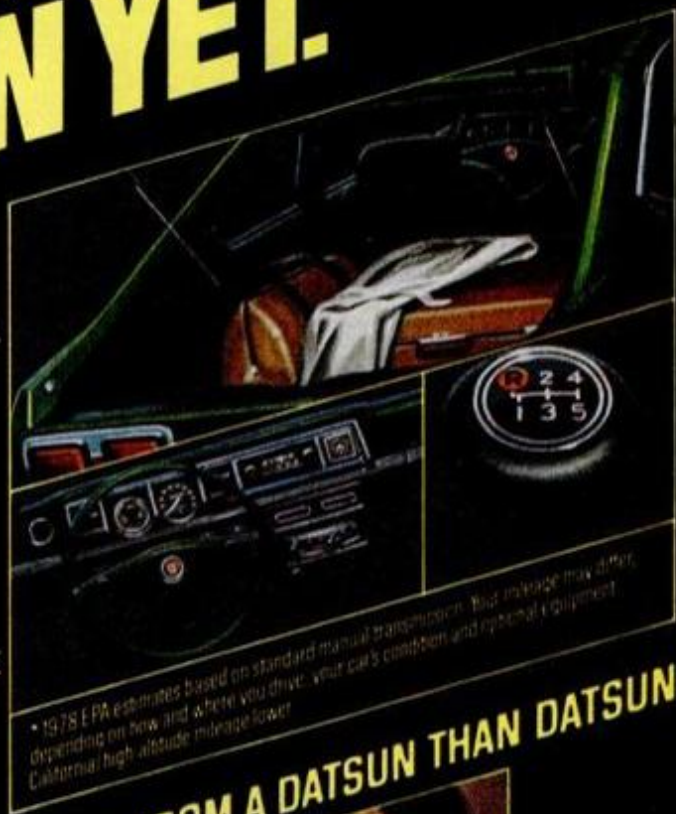
If Mr. Miller is correct, and the five case studies from him indicate that he is, installing a timer that permits the water heater to function only three to four hours a day will save money without any inconvenience. **PM**

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 discussed in this column.



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Hubert, North Carolina 28529

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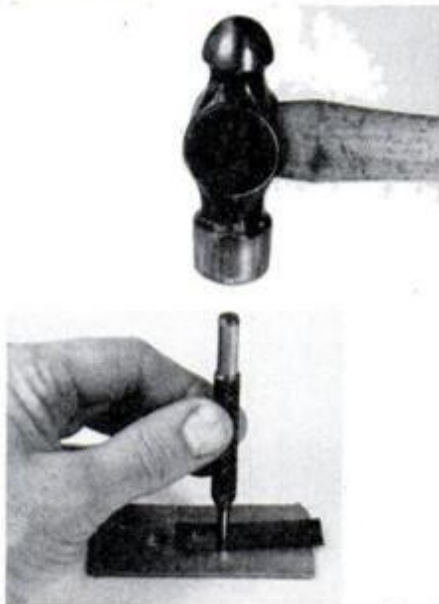
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HINTS FROM READERS

Making holes in hard metal

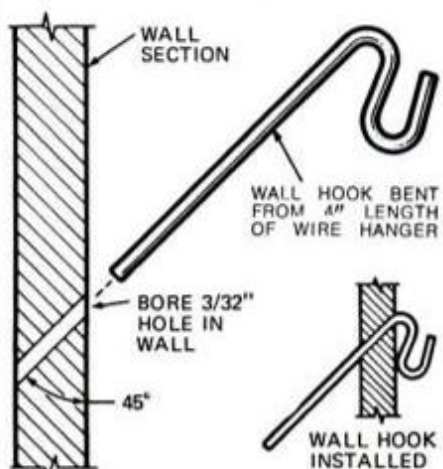


Use a punch to make holes in hard metals such as spring or stainless steel that can't be easily drilled. Rest the metal on a block or lead sheet. Give the punch a single blow with a heavy hammer. This works on square, triangular, pear-shaped and other odd-shaped holes as well.—*Kenneth Wells*

Mark paint level on can

When you're finished painting, draw a line at the paint level on the outside of the can to show the amount of paint left for the next job.—*Elizabeth S. Daniel*

Improvised wall hook



Make a simple but effective wall hook from a 4-in. length of coat-hanger wire. Bore a $\frac{3}{16}$ -in. hole at an angle in the wall. If you hit a stud, you can insert a nail instead of the hook.—*Alex Hess*

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YOUR MOTORCYCLE:

If you like working on bikes, why not make a living at it?

There are more than a dozen motorcycle mechanic schools in the country—maybe one of them is for you.

by Clifford Gromer

When motorcycling was young and dealerships were few and far between, most riders had to be their own mechanics. The early bikes were cantankerous and required much attention. If you weren't mechanically inclined, you more often than not ended up walking.

Today things are quite different. There are about 10 million motorcycles in the United States (including nonregistered off-road machines) and an estimated 15,000 qualified motorcycle mechanics—one mechanic for every 750 motorcycles.

Training is part of the answer. Courses in motorcycle mechanics are available at some high schools and junior and vocational colleges. Being part of the public education system, these programs usually are inexpensive. Specialized private schools also offer courses at a much higher cost.

One such school, the American Motorcycle Institute in Daytona Beach, Fla., offers a 12-week residence mechanics course which will tap your wallet for \$1395 (a \$95 lab fee is included). You can expect to pay another \$25 or so per week for a motel room. Meals are also extra.

The course at AMI includes classroom instruction which covers basic motorcycle theory and extends to personnel and industrial safety. The laboratory phase of the course includes a dead-engine lab where two- and four-stroke engines are torn down and reassembled. Another lab has running engines mounted on stands. Here students practice carburetion adjustment, ignition timing and troubleshooting techniques. A frame and suspension lab demon-

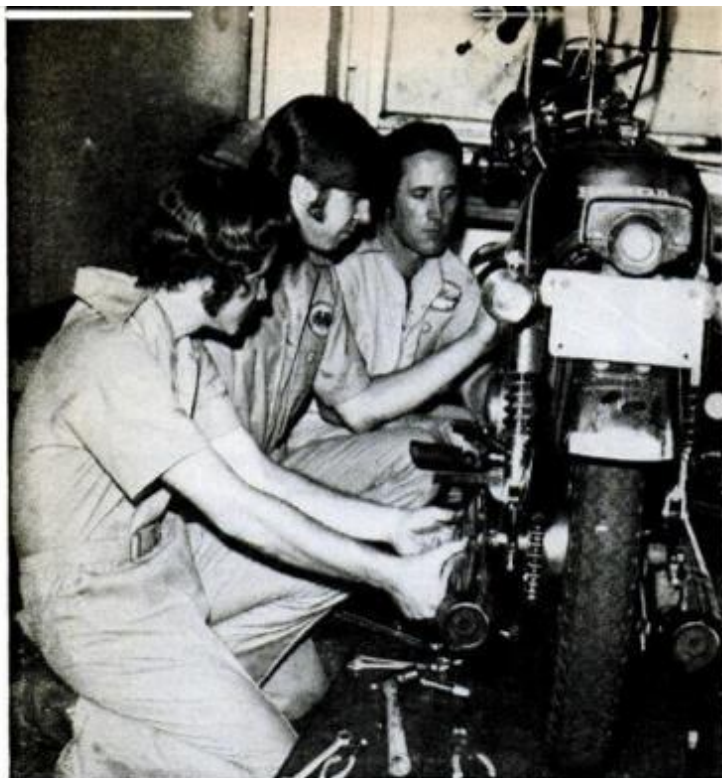
strates fork and swing-arm rebuilding. Use of micrometers, vernier calipers and dial gauges is demonstrated in a measurements lab. A wheel lab teaches tire changing and wheel spoking. Students also learn machine shop operations using a boring bar, valve grinders and a hydraulic press.

Two other program alternatives are offered by AMI: a six-week residence course combined with a home-study correspondence course that costs about the same as the 12-week program; and a 64-lesson all-correspondence program which combines motorcycle mechanics and dealership management training. The price tag on this is \$995.

A caution

A word of caution here on *any* motorcycle *correspondence* course: You cannot learn how to use special tools or equipment without hands-on experience. The only way to learn how to work with your hands is to work with your hands—not reading about working with your hands. You can learn much from a correspondence course, but you won't become a mechanic.

There are several schools like the American Motorcycle Institute. But because no uniform standards exist for motorcycle mechanic instruction, the quality (and value) of these courses can vary widely among schools. Several factors separate the good schools from their "so-so" counterparts. Instructors can make or break a school. They must be competent, know their subject and have good rapport with students. Classes must be of reasonable size.



At the American Motorcycle Institute in Daytona Beach, Fla., students get "hands-on" training in all systems of the bike.

Physical facilities can aid or detract from the learning process. For example: Are the motorcycles elevated on lifts or benches or do students have to sit on the floor to work on the bikes? Are there sufficient teaching aids such as audio-visual equipment? Are bikes and components current models and is the supply adequate? One item that is often overlooked is the availability of a placement service. What effort, if any, does the school make in finding employment for its graduates? This is important because unless you're taking a mechanics course simply as a hobbyist, all the preparation in the world is worthless unless it pays off in a job.

Check 'em out

How can you weed out the poor schools from the better ones? This is difficult for a layman, but there are general evaluations you can make. As a rule, go with a school that has a large faculty. This way, if one or two teachers are duds, you still can learn from the others. It pays to visit a school before enrolling. Check out the facilities and sit in on a class or two. Talk to the students and get their impression of the school. If they think that the school is a ripoff, they won't hesitate in telling you about it.

Read all fine print in the enrollment contract very carefully—especially where it concerns extra charges for lab fees or equipment. Most important is the school's refund policy if you drop out of a residence or correspondence course. You could

(Please turn to page 60)

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PM-12

YOUR MOTORCYCLE

(Continued from page 58)

be in for a bad shock if you don't know exactly what you're signing.

It would be nice to think that you can walk out of one of these schools with a diploma and land a mechanic's job. It usually doesn't happen. A lot depends on the supply and demand of motorcycle mechanics in your area. If you happen to catch a dealer short-handed at the height of the season, he probably would put you on doing simple mechanical work whether you had a diploma or not.

What dealers primarily look for is work experience and tools. If you have a basic knowledge of motorcycles and a complete set of tools but no formal training, you'll most likely get the job over the man who has just a diploma. Most schools prepare you for a position as an apprentice mechanic. It takes years of experience to progress to the journeyman level. Dealers do not have the time, nor can they afford, to train you. If you're lucky, you'll be sent to a factory service school for concentrated study on selected models. This type of training is very salable to a dealer when you look for another job.

One last word about motorcycle mechanics schools, and it applies to any type of school. You can go to the best school and learn nothing, and you can go to the worst school and learn something. It all depends what *you* put into the program. **PM**

FACTS ABOUT SCHOOLS

American Motorcycle Mechanics School

2840 North Halsted St., Chicago, Ill. 60657 and 13700 N.W. 19th Ave. Miami, Fla. 33054. Types of instruction: Resident, resident/correspondence, correspondence night courses, and other options. Length of resident training: Minimum 4 weeks, maximum 12 weeks. Tuition: From \$550 for basic home-study course to \$1190 for full advanced courses.

American Motorcycle Institute, Inc.

1445 Skytrooper Rd., Daytona Regional Airport, Daytona Beach, Fla. 32014. Types of instruction: Resident, resident/correspondence, correspondence only. Length of course: 12 weeks, resident: 6 weeks, resident plus correspondence. Tuition: \$1395, either plan. Includes books, shirts and tools. \$595 for mechanics correspondence course only. \$995 for mechanics and dealer management combined correspondence course.

Denver Institute of Technology, Inc.

2250 South Tejon; Englewood, Colo. 80110. Type of instruction: Resident training, day or evening. Length of course: Day, 300 hours, eight hours per day for seven and a half weeks; night, 300 hours, four hours per night, Monday, Tuesday and Thursday for 25 weeks. Tuition: \$1250; lab fee, \$100; books, \$25.

Hutchinson Area Vocational Technical Institute

200 Century Ave. Hutchinson, Minn. 55350.

Length of course: 11 months, approximately 1620 hours. Tuition: Residents of Minnesota under 21, free; residents of Minnesota over 21, approximately \$550 (\$2 per day); nonresidents, approximately \$1350 (\$5 per day).

International School of Motorcycles Inc.

14427 South Western Ave. Gardena, Calif. 90249.

Type of instruction: Resident course. Length of course: 5 months. Tuition: \$1045 for the Advanced Motorcycle Technology course. (There are also an evening course, a hobbyist's course, and a course for women.)

Los Angeles Trade Technical College

400 West Washington Blvd., Los Angeles, Calif. 90015.

Type of instruction: Resident course. Length of course: 2 years. Tuition: Free to California residents; \$34 per unit for nonresidents (60 units needed for graduation).

Michigan Career Institute

14486 Gratiot Ave., Detroit, Mich. 48205.

Type of instruction: Resident training, day or evening. Length of course: Day, 12 weeks (8-12 noon), 240 hours. Tuition: \$960.

North American School of Motorcycle Repair

4500 Campus Dr., Newport Beach, Calif. 92663.

Type of instruction: Correspondence. Length of course: Can be completed in approximately 350 hours, according to school's brochure. Tuition and other charges: \$489 to \$525, depending on financing arrangements.

Pasadena City College

1570 East Colorado Blvd., Pasadena, Calif. 91106.

Type of instruction: Resident, day. Length of course: Two years, 1400 hours (motorcycle courses along with other courses required for degree). Tuition: Free to Pasadena-area residents; California residents pay no tuition, but are subject to a number of restrictions; Nonresidents, \$2280 (\$570 per semester).

Pinellas Vocational Technical Institute

6100 154th Ave., North Clearwater, Fla. 33520.

Type of instruction: Resident training, day or evening. Length of course: One year, seven months. Tuition: No tuition for residents, but about \$500 in fees and books for the entire course; nonresidents, \$100 tuition (\$50 per year).

Rogue Community College

3345 Redwood Hwy., Grants Pass, Ore. 97526.

Length of course: Two years, full time. About 1800 hours. Students are in class 25 hours per week. Tuition: \$660 for resident in district (county); resident in state approximately \$1300; nonresident, approximately \$3000.

Scott Community College

Belmont Rd., Bettendorf, Iowa 52722.

Length of courses: 11 months, approximately 1620 hours. Tuition: Resident, \$540; nonresident, \$840.

Standard Technical Institute

3435 Broadway, Kansas City, Mo. 64111.

Type of instruction: Combination resident/correspondence. Length of resident training: 4 weeks. Tuition: \$1395 (includes tools and home-study lessons).

Technician Training School

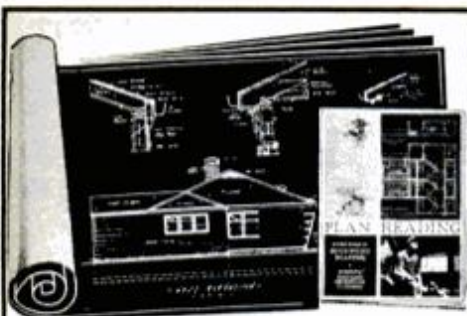
1000 Island Ave. McKees Rocks, Pittsburgh, Pa.

Type of instruction: Resident course: 8 months. Tuition and other charges: \$1600.

Texas State Technical Institute

James Connally Campus, Waco, Tex. 76705.

Type of instruction: Resident training. Length of course: One year (four quarters), approximately 1500 hours instruction. Tuition: Residents of Texas, \$240; nonresidents, \$960.



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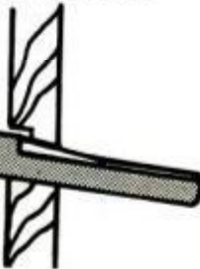
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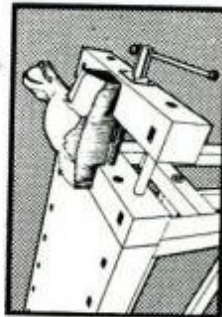
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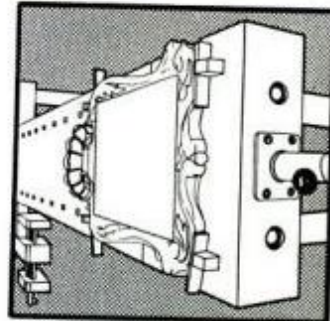
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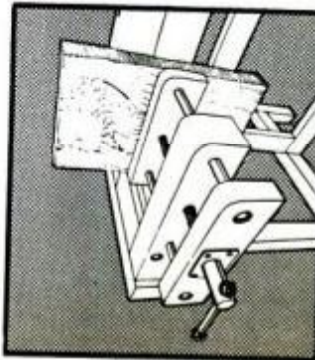
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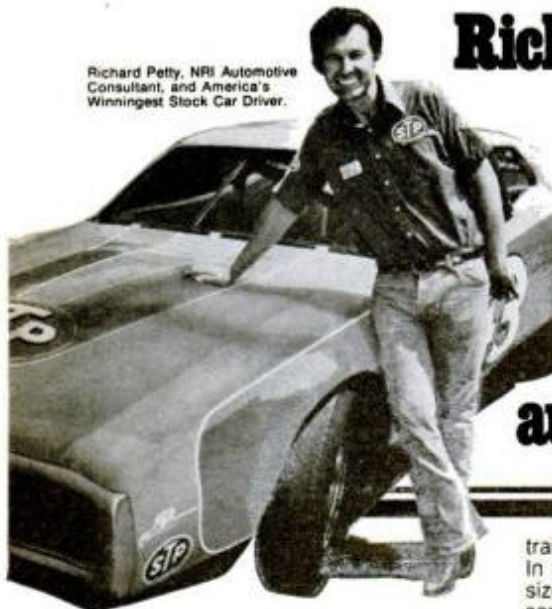
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Pictured is just some of the professional equipment included in NRI's Automotive training programs.



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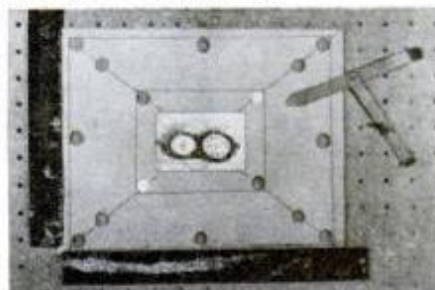
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You can make a simple holder for five or six filters from the plastic cases that the filters come in. Just glue the top of one case to the bottom of the next one, building a stack. (The cases with true screw threads rather than friction closures work best.) You'll be able to identify and remove any single filter without exposing the others to dust or possible fingerprints.

Make a separate stack for each filter diameter you use, and add to it as you buy filters.—*Lane Sander*

Borderless copying



How do you hold a borderless print when you want to copy the full image? I made a panel with openings through which masking tape grips the back of the print. The panel is heavy cardboard; 1/2-in.-dia. holes were punched but could be bored. Outlines of common print sizes were inked on the front. Poke tape through the holes so that it won't produce dimples on the print surface.—*Walter E. Burton*

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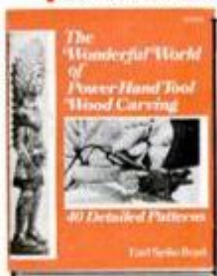
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First automatic-focus camera

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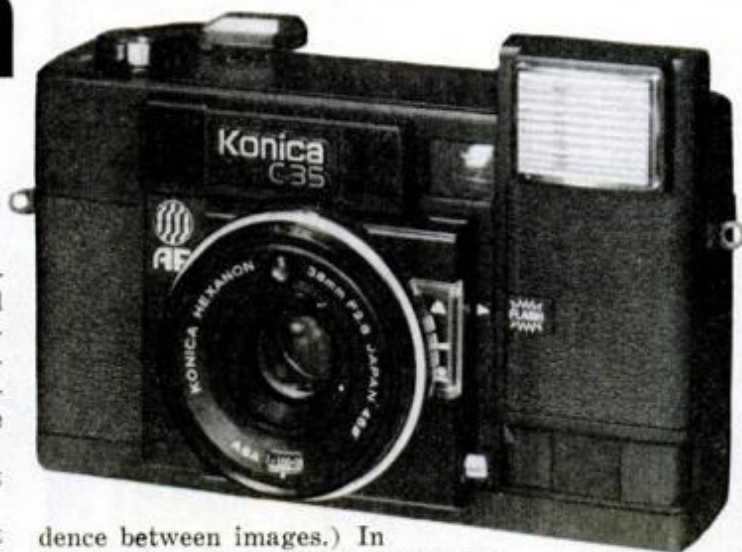
Want a camera that does everything for you except aim and trip the shutter, but uses an adjustable lens for maximum sharpness? Want a camera that completely automates flash and won't be thrown off by room conditions?

You'll be able to buy it next spring.

From advance information, it looks as though the Konica C35AF should be a perfect snapshot and grab-shot camera. It will be the first camera on the market with built-in automatic focus, and it's being aimed right where it's needed: at weekend-and-vacation photographers who want better pictures than the sometimes-blurry snapshots they've been getting with fixed-focus lenses.

Konishiroku Photo has scored its coup by being the first camera maker to put to use a device that's been available for a couple of years.

Honeywell, Inc., announced its Visitronic Auto/Focus module in 1975. The module works like a conventional rangefinder, but replaces the human operator with an integrated circuit that compares images seen from two positions and tells the camera when they are most alike. (The IC divides each of the images into five strips, measures the brightness of each of these, and signals the closest band-for-band correspon-



Autofocus windows flank Konica name; indicator to right of lens shows distance set. Camera has pop-up, automatic flash 38-mm 1/2.8 lens.

dence between images.) In effect, it's automatic triangulation to determine the distance to the subject.

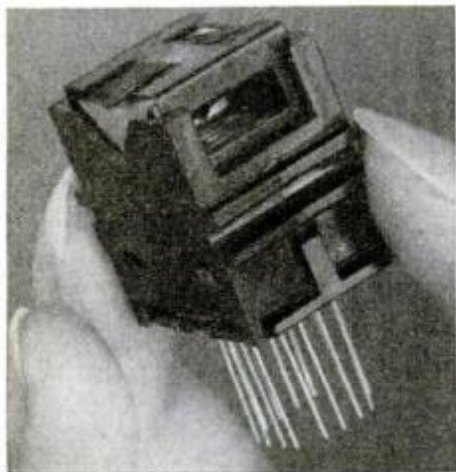
What Konica has done is to design a way to use the module output to set lens-to-film-plane distance without the complexity and expense of solenoids or servomotors. Technical information was sketchy at press-time, but the scheme is one of using the module signal to stop lens travel at the correct focusing distance. The lens is not moved by shutter-release pressure, but is cocked with the shutter by the rewind lever. This method of shifting focus to use the Visitronic output was predicted here nearly two years ago (see *Coming: New Cameras That Focus for You*, page 96, May '76). On release, it travels from the close-focus position (3 feet, 4 inches) until it's arrested by a mechanism similar to the trapped-needle setup that Konica uses for shutter-preferred exposure automation.

You'll know what the C35AF is focusing on, because there's a bright outline in the viewfinder of the module's 10° by 10° field of view.

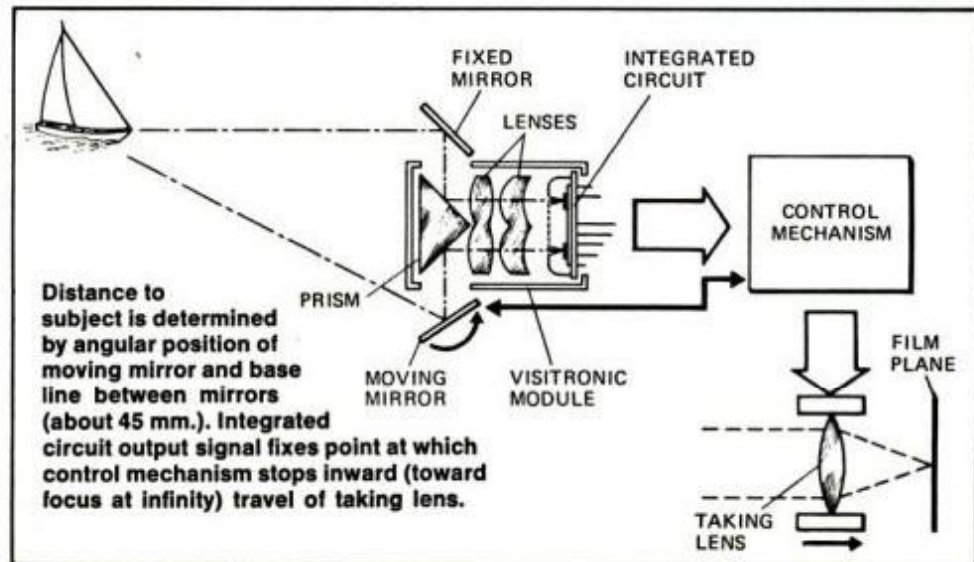
Focus automation is further exploited in this camera with built-in, fully automatic electronic flash—the correct aperture, determined by the focused distance, is set for you.

It may be possible to fool the automatic-focus system—shooting a small-figured, geometric wallpaper pattern, for instance—but probably not when shooting people or scenery, the usual snapshot subjects. Actually, the system may do better than you or I can do with a conventional adjustable-focus camera—especially when shooting fast and with moving subjects. Besides, not everyone's visual acuity is really good enough for sharp manual focus.

The C35AF is expected to carry a list price under \$250. Konica Camera, Box 1102, Woodside, N.Y. 11377. —Stephen Walton



Visitronic module is brain that compares images from two viewing positions.





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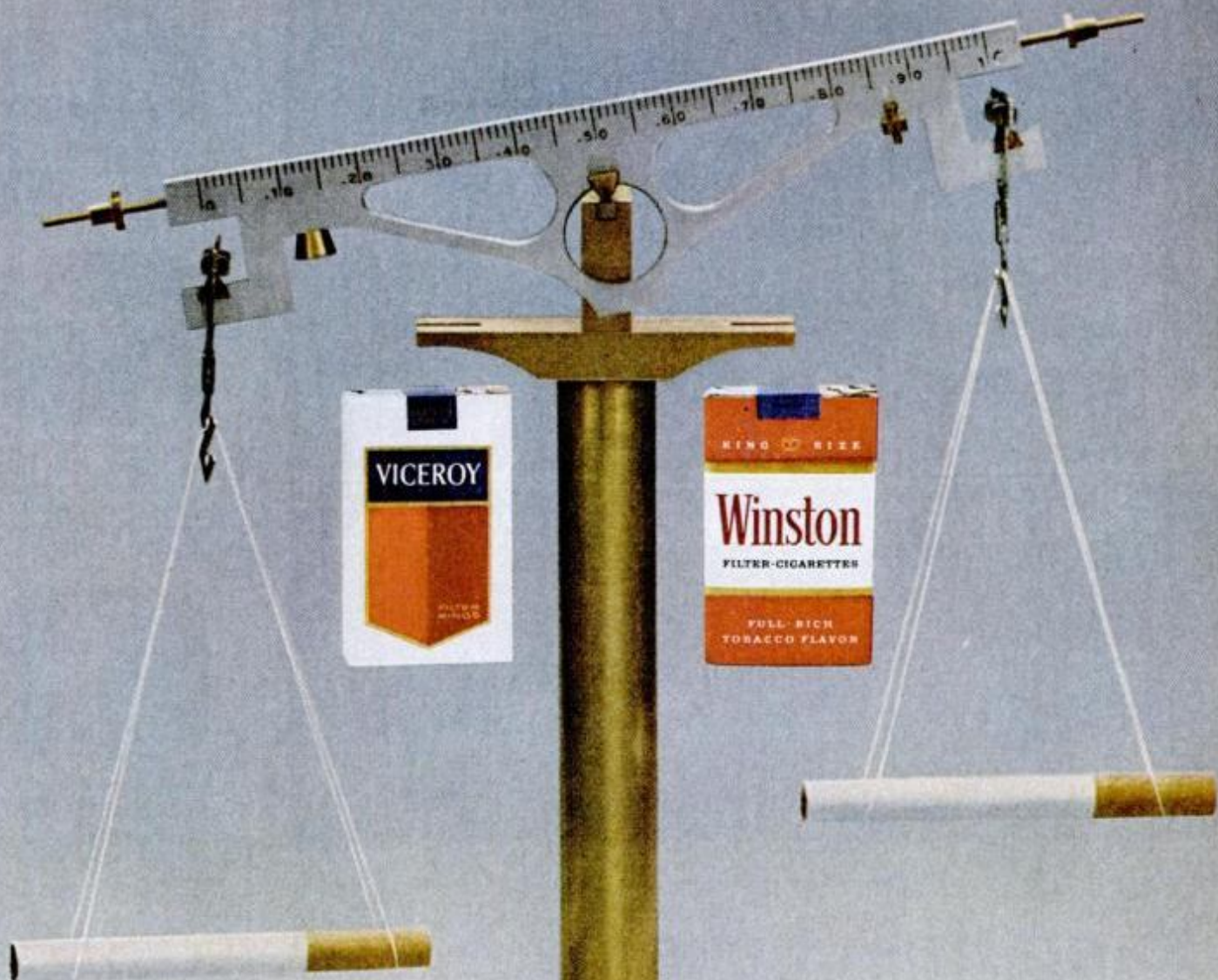


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A close-up photograph of Brad Pitt with a cigarette in his mouth, making a peace sign with his hand. The background shows a beach and ocean. The word "Viceroy" is written in large white letters across the bottom of the image.

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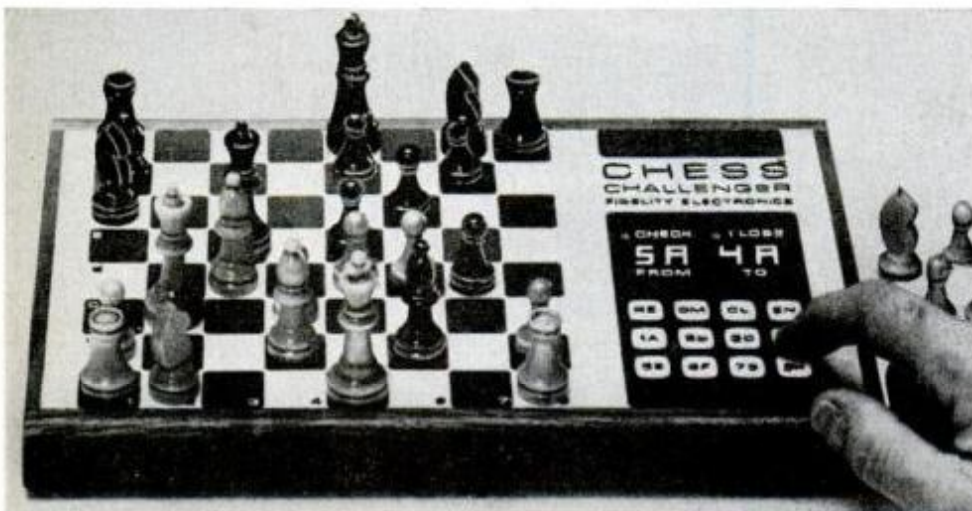
level to challenge experts while teaching beginners. Average players beat it 25 to 70 percent of the time.

You talk to the computer via a keyboard. It talks back in red LEDs above the keys. The board has special lettering you use to key plays into

the computer. Moves even include castling and en passant!

The set, with wooden pieces, is available from Chafitz, 1055 First St., Rockville, Md. 20850. It's also in the fall catalog from Heath Co., Benton Harbor, Mich. 49022.

It's wired and tested and plugs into 110-volt a.c. Great for learning and practicing, it even can tune and sharpen the game of an expert.—*Judy Curtis*



Instant chess partner is Chess Challenger, a computerized board by Fidelity Electronics.

CHECK
Lights when the computer has you in check

FROM Window
Displays the position of the piece you want to move (your starting position)

RESET
Starts the game—will cancel memory

Double Move
To be used for Casting and for En Passant

Keys
Designates Rank and File board moves

I LOSE
Lights when computer admits defeat and is in checkmate

TO Window
Displays the new position to which you have chosen to move your piece

ENTER
To enter your move into the computer

CLEAR
To clear an unwanted move before pressing enter

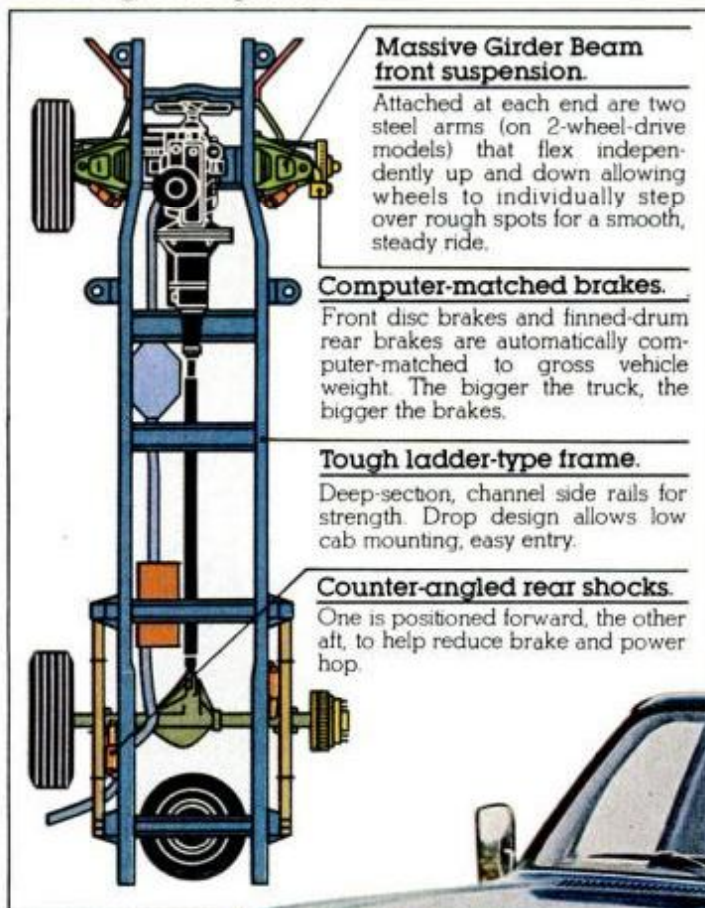
KEYBOARD

CHECK	I LOSE		
5A	4A		
FROM	TO		
RE	DM	CL	EN
1A	2b	3c	4d
5E	6F	79	8H

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Tough ladder-type frame.

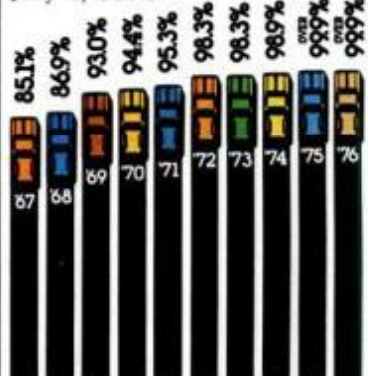
Deep-section, channel side rails for strength. Drop design allows low cab mounting, easy entry.

Counter-angled rear shocks.

One is positioned forward, the other aft, to help reduce brake and power hop.

Built to last. Look at the record.

95.7% of all Chevy trucks, in the ten most recent model years recorded, were still on the job. This is based on the latest available industry model year registration statistics through July 1, 1976.



F. L. Polk & Co., July 1, 1976. 1977 statistics not available.

Maintenance, a Chevy strong point.

For the standard Chevy 6, under 6,001 lbs. GVWR, recommended service intervals under normal driving

conditions are 30,000 miles between spark plug changes, 7,500 miles between oil changes, 15,000 miles between oil filters, 30,000 miles between air cleaner elements and 7,500 miles between chassis lubes.

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Rescue from the heart of a typhoon

Crewmen of a downed bomber are saved from a raging sea in a daring feat by nuclear subs fighting 40-foot waves.

by Capt. Charles Barton,
USN (Ret.)

Capt. Leroy Johnson, pilot of *Cobalt 2*, a B-52G of the Strategic Air Command, taxied into takeoff position at Andersen Air Force Base, Guam. It was past 4:00 a.m., July 8, 1972. Two other planes in the flight already were airborne.

Airman Daniel Johansen, gunner and, at 21, the youngest member of the crew, felt the power surge, the runway bumps, then liftoff.

Lights dropped away in the pre-dawn darkness as the aircraft headed seaward above the surf that crashed against Guam's precipitous northeast coast. Crosswinds from local showers burbled over the cliff, tossing the plane, an indication of bad weather throughout the Western Pacific.

Three tropical storms were on or near their flight path. The nearest would grow into Typhoon Rita—a storm they'd come to remember.

As the bomber climbed through 20,000 feet, Johansen's headset came alive. "I've lost airspeed readings." It was the captain.

"It's out over here, too," replied his 25-year-old copilot, Lt. William Neely III. "Johansen, come forward and give us a hand."

The gunner unstrapped and went

With Typhoon Rita building up to a full-scale blow, the B-52G died at 30,500 feet. Six crewmen hit the silk to experience a night of horror.



'This rescue . . . the ultimate test of skill and courage . . .'

to the flight deck. The pilots looked worried. Johansen read out corrective actions from the manual. It called for more power. But even when this was applied, Cobalt 2 still dropped behind the other planes.

Capt. Johnson leveled at 30,500 feet, let the aircraft pick up speed in a short descent, and engaged the automatic pilot, with "altitude hold." A few minutes later the plane began to shake. Suddenly the autopilot disengaged and the nose pitched down. The rate-of-climb indicator pegged out at 6000 feet per minute *down*, and the altimeter began to unwind.

Crew must bail out

The pilots struggled for control. Johnson snapped orders. "Everyone to your seats."

Maj. Ronald Dvorak, 35, the electronics warfare officer, watched Johansen climb back in his gunner's seat. "Strap in!" he yelled at him.

The shaking increased violently, and the angle of the plane approached a dive. The gunner struggled to hook up for ejection. His throbbing head and pounding heart muffled the interphone. Then came the order:

"Everybody out! Bail out!"

Johansen armed his ejection seat and saw Dvorak eject. He pulled his own trigger and shot through the open hatch, somersaulting through space. The chute opened with a jolt. It looked small.

He was swinging wildly. The risers which attached the chute to him were twisted. He pulled them apart and his body spun as they unwound. Sharp snapping sounds came from the left, then the right. Fear jolted Johansen. He thought the risers were breaking! He grabbed frantically to keep from falling, but it was only the sound of tack lines breaking free. As he stopped spinning, the chute blossomed. He felt faint.

Aircraft ends in fiery crash

Now he lowered his survival kit on its retaining line so it dangled 10 or 15 feet below and helped dampen the swinging. He inflated his life preserver and looked around. Low in the night sky, he saw the running lights of their aircraft, then a brilliant flash as it struck the sea. The flare lighted the chutes of at least three other crew members below him. He tried to steer toward

Submarines are built to perform submerged; on any surface they wallow. In Typhoon Rita's 40-foot waves, they faced nearly insurmountable odds to save lives.







Chief torpedoman of the *Barb*, Jon Hentz, receives the Navy and Marine Corps Medal for heroism. He swam a line to survivors.

them without success. He blinked his flashlight, but no one responded. At the last moment he unsnapped the covers from the parachute canopy releases and crossed his arms through the risers to prevent falling from the chute prematurely. As he neared the raging sea, he could hear and see huge waves, their crests blown to spray on a stinging wind.

The moment his feet touched the water, he pulled the canopy release rings and plunged feet first beneath the surface. His chute blew free. He surfaced and swam to his raft which had automatically inflated. Once in it he lay back to calm himself. The luminous dial of his watch read 5:25. It would be daylight soon. He felt okay; nothing had broken, and he hadn't swallowed water. But the weather was getting worse.

Troubles plague chutists

Using his flashlight, he opened his survival kit and made several distress calls on the radio. He shot off one flare which made a brief mark in the dark predawn. Nothing happened. He put out a sea anchor and the raft rode better. Patches of plankton fluoresced as each wave broke.

Lt. Kent Dodson, 25, the navigator, was having trouble. The sight of their B-52 exploding in the dark had hypnotized him and delayed his preparation for water entry. Just as he reached for the release rings a strong gust yanked the chute. He hit the water swinging and a great, rolling wave tossed him into his shroud lines, which snared him like a fishnet. Time and again he slipped below the surface.

Luckily, Dodson was a strong

swimmer. Struggling for breath, he slashed line after line with his pocket knife and finally fought free. He climbed into his raft and lay panting for an hour, recovering. One line he'd cut was to his survival kit.

With daylight, the sea increased and the wind drove a stinging rain. Dodson could see rescue aircraft, but without signaling devices had no way of making contact. Eventually a C-97 buzzed him. He'd been spotted.

That night the waves, wind and rain built higher. Dodson fought to keep his raft from overturning. He was exhausted. "Good God," he thought, "Is this the end?"

Nuclear subs ordered out

On the morning of July 8, the nuclear fast-attack submarine USS *Barb* was in Guam's Apra Harbor completing repairs on a hydraulic pump prior to a six or seven-week Marianas patrol. News of Typhoon

Rita was no worry. The big sub would sail submerged and untroubled below the raging surface. That's what everyone thought.

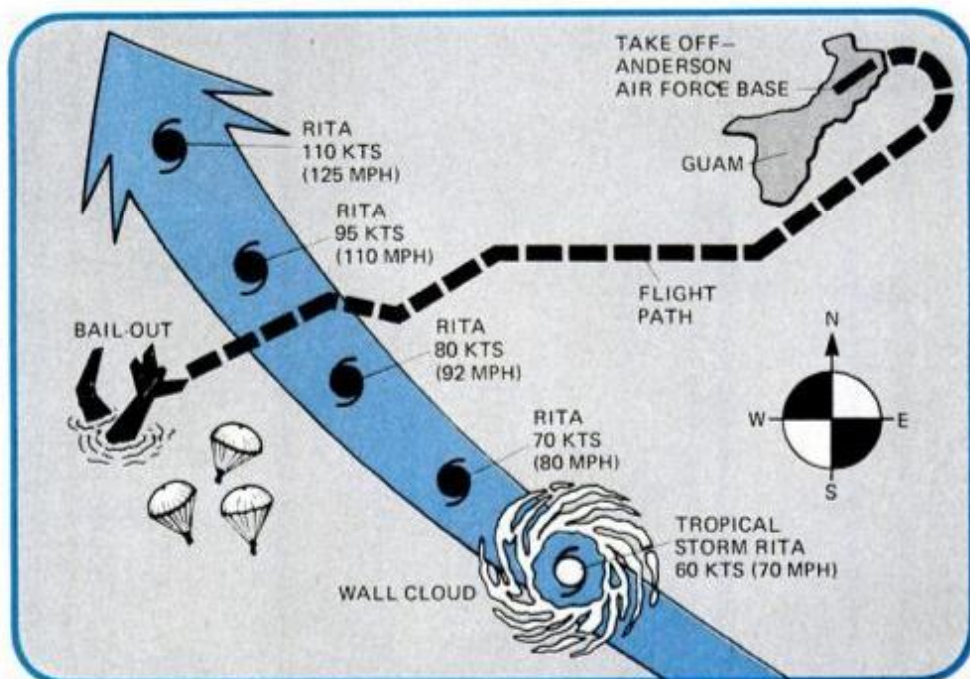
Instead, from the Joint Search and Rescue at Agana, orders were requested and issued to the *Barb's* skipper, Commander John Juergens: "B-52 down vicinity 12-07 north, 140-20 east . . . three of six crewmen sighted by rescue aircraft . . . Proceed best speed . . ." An hour later a similar "operational immediate" went to USS *Gurnard*, a sister sub inbound from Japan.

Within an hour the *Barb* slipped past Apra's harbor jetty, entered deep water and nosed under.

Lt. Cmdr. Mike Rushing, engineering officer who would be officer of the deck during the rescue attempt, had been up for 36 hours supervising the repairs. Now he slept.

Cruising submerged at flank speed,

(Please turn to page 158)



Path of Typhoon Rita and course of ailing B-52 (dotted line) are shown in map above. The plane went down directly in the path of oncoming storm, which grew as it swept past the survivors who had parachuted into the sea. At left is USS *Barb*, arriving in Apra Harbor, Guam. B-52 copilot Neely is on bridge, in flight suit.

Updated bazooka, Dragon missile launcher (upper right) destroys tanks far beyond range of earlier weapon. Four-barrel FLASH (lower right) hurls fire bombs, replaces highly dangerous backpack flame thrower.



The modern GI Joe: You've come a long way, buddy

Today's foot soldier, compared to his World War II-Korean counterpart, uses fewer weapons, yet packs three times the firepower.

by Mort Schultz

Today's GI is up to three times more effective in combat than his counterpart of World War II and Korean days. I know—because I've just spent exhaustive hours working out with troops of the 82nd Airborne Division at Fort Bragg, N.C., firing weapons I found hard to believe. I learned about this new revolution in field arms in a curious way. I started out thinking about my Army

New hand-held M60 machine gun can be fired from hip by one man, needs no support team, is far deadlier than older submachine guns and automatic rifles.

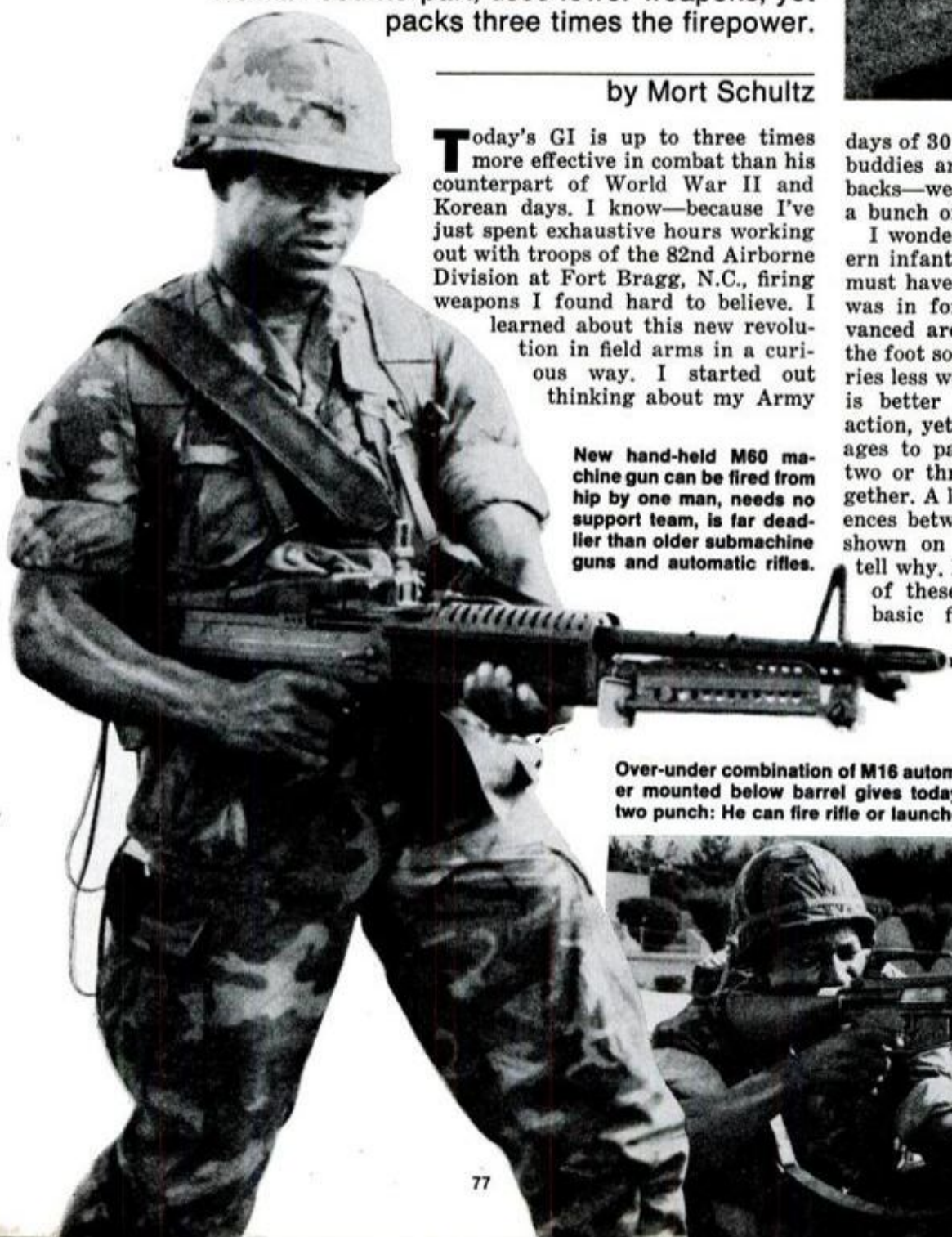
days of 30 years ago and the load my buddies and I used to carry on our backs—we were burdened down like a bunch of packhorses.

I wondered: What about the modern infantryman and all the gear he must have to lug? At Fort Bragg, I was in for a real surprise: So advanced are the new field arms that the foot soldier of today actually carries less weight, uses fewer weapons, is better protected against enemy action, yet—with all this—still manages to pack more punch than any two or three of us old Joes put together. A look at the dramatic differences between old and new weapons shown on the following pages will tell why. For a quick check on some of these differences, I chose five basic field weapons—as nearly

(For a pictorial guide to old and new weapons, please turn page, text continues on page 146)

PM art (overleaf): Adolph Brotman

Over-under combination of M16 automatic rifle with grenade launcher mounted below barrel gives today's infantryman powerful one-two punch: He can fire rifle or launcher separately or both together.



TYPICAL FIELD WEAPONS OF WWII AND KOREA

Basic field rifle: .30-cal. M1 was considered advanced for its time, but could fire only semiautomatically with effective range of about 300 yards—compared to today's fully automatic M16A1 with effective 420-yard range. At 9.5 pounds, it was also nearly two pounds heavier.



Browning automatic rifle (below), beloved by many as the BAR, had good firepower but was heavy, requiring barrel rest. Eventually, it gave way to light, hand-held automatics like M16A1 rifle and M60 machine gun.



M2 .30-cal. carbine (above) had advantage of firing automatically, but was not considered efficient. With 15 or 30-round clip, it looked meaner than it really was.

M20 3.5-inch antitank rocket launcher (right) was designed to pierce armor, but had short effective range of only about 50 yards, requiring a lot of guts for an infantryman to get close enough to score a hit. Familiarly known as bazooka, it has now been replaced by Dragon missile launcher.



Famed "grease gun" looked deadly, but had short effective range. It replaced Thompson submachine gun early in World War II, is now itself a relic.

Tripod-mounted .50-cal. machine gun (below) was rough to carry, required two-man crew.



Heavy .30-cal. machine gun could not be hand-held, was fired prone on bipod muzzle rest.



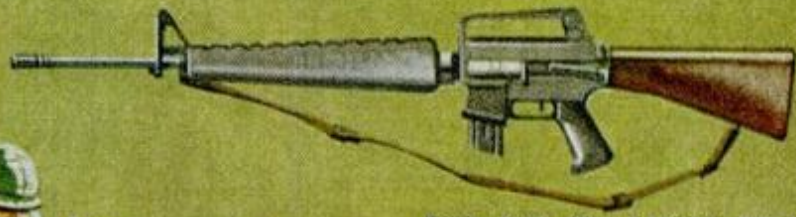
Three machine guns of the past: M3A1 .45-cal. "grease gun" (upper left), though lethal-looking, had limited accuracy, with an effective range of only about 100 yards; Browning .50-cal. AN-M2 (middle) was powerful but cumbersome, requiring two-man crew to carry and operate; .30-cal. M1919A6 (bottom) was heavy (32.8 pounds), could be fired only from prone position. All have been superseded by new portable, lightweight M60.



MODERN FIELD WEAPONS: FEWER BUT BETTER



Portable 7.62-mm M60 machine gun can be hand-held and fired from hip (left) or used in prone position with muzzle support (above). Fires up to 550 rounds a minute.



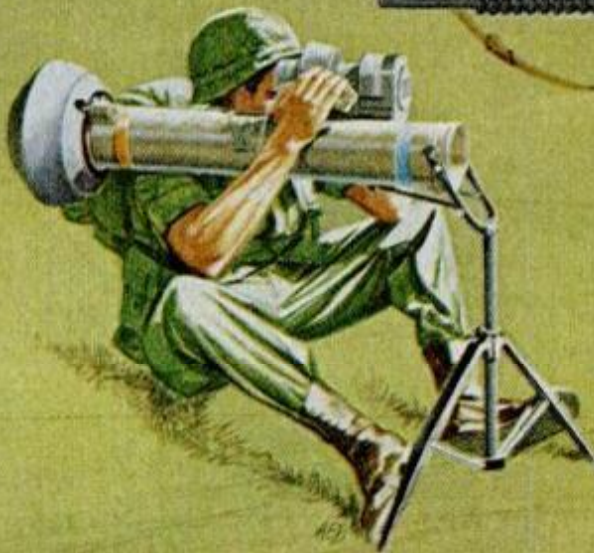
Basic field rifle: 5.56-mm M16A1 is fully automatic, has effective range of 420 yards, muzzle velocity of 3250 fps, 20-round clip—all greater than old M1. Note pistol-type trigger grip.



First aerial attack weapon for infantry use, M41E1 Red-eye (above) lets foot soldier shoot down low-flying fighters and bombers, not possible before. Launcher fires self-guided missiles using heat-seeking infrared homing system. Modern flame thrower (right) fires rockets that burst into flame upon impact, eliminating dangerous old-style backpack fuel tank. The M202A1 FLASH also has much greater effective range of 100 yards.



New grenade launcher (above) mounts under M16A1 rifle barrel instead of on muzzle, permitting it to be fired separately. Twin triggers allow soldier to spray enemy with rifle fire to pin him down and simultaneously lob in a grenade. The 40-mm M203 launcher has 365-yard range compared to only 150 yards for old rifle-actuated launcher. M47 Dragon antitank missile launcher (left) has much greater range and striking power than earlier bazooka, can knock out any tank or armored vehicle. Note ground support to improve accuracy over shoulder-held bazooka.

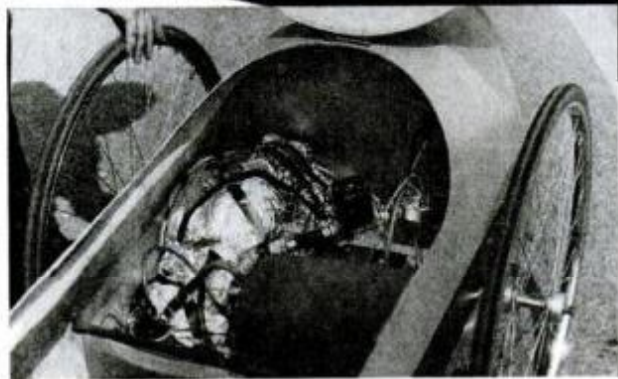


Talk about mileage... would you believe 1000 mpg?

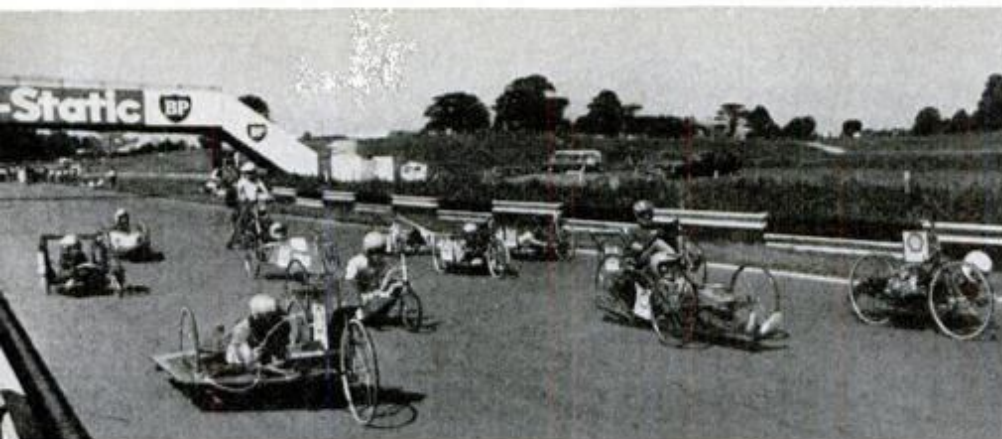
by Sheldon M. Gallager

They had this silly idea that a car could maybe get 1000 miles on a gallon of gas, so they staged a competition to find out. The event, called the Super Mileage Project, was recently held at Mallory Park near Leicester, England, sponsored by the British Shell Oil Co. The contest was open to universities, private companies—virtually anyone concerned with fuel economy—and the best performer would take home £1000 (about \$1740) in prize money.

Surprisingly, 20 entries showed up. More surprisingly, the seemingly whimsical affair proved to be no joke—two participants easily broke the 1000-mpg barrier (based on the British imperial gallon, slight-



Winners of mileage rally, students from Cranfield Institute of Technology display victory cup with sleek, torped-shaped car that logged amazing 1097 mpg. Tiny 50-cc Honda engine (left) is insulated to prevent heat loss and improve combustion.



Off and running—well, creeping anyway—are entries in Shell Oil's recent fuel-economy contest. While short on looks, they did prove long on mileage. At right is Shell's own entry that, although unofficial, topped all others with an astonishing 1298 mpg.



ly greater than the U.S. gallon). Rules were simple: Entries had to have at least three wheels, be gas-driven and maintain an average speed of 10 mph on a 10-mile course (the last rule imposed mainly to keep slowpokes from turning the event into an endless marathon).

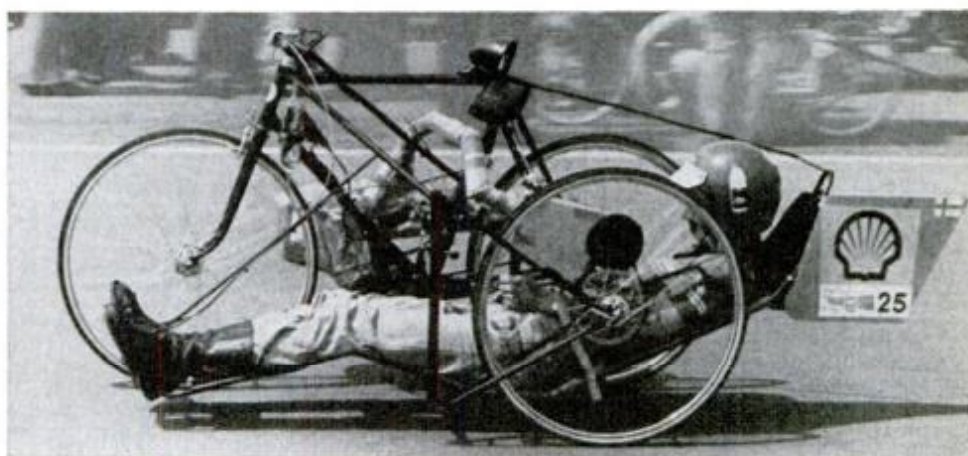
As you might expect, entrants wasted little on frills and fashion. All took advantage of the allowable three-wheel provision to minimize road friction, using lightweight, overinflated, superthin bike tires. Most chose the small 50-cc Honda moped engine, meticulously tuned to take the leanest fuel mixtures, with only one driving wheel to eliminate the weight of extra sprockets, jackshafts and differentials.

Drivers lay almost flat on their backs or belly-flopped to lower wind resistance. Most adopted the "power burst" or "slingshot" method of conserving fuel, alternately accelerating, then coasting as far as possible before accelerating again—a tricky technique calling for precise judgment to maintain the mandatory 10-mph average speed.

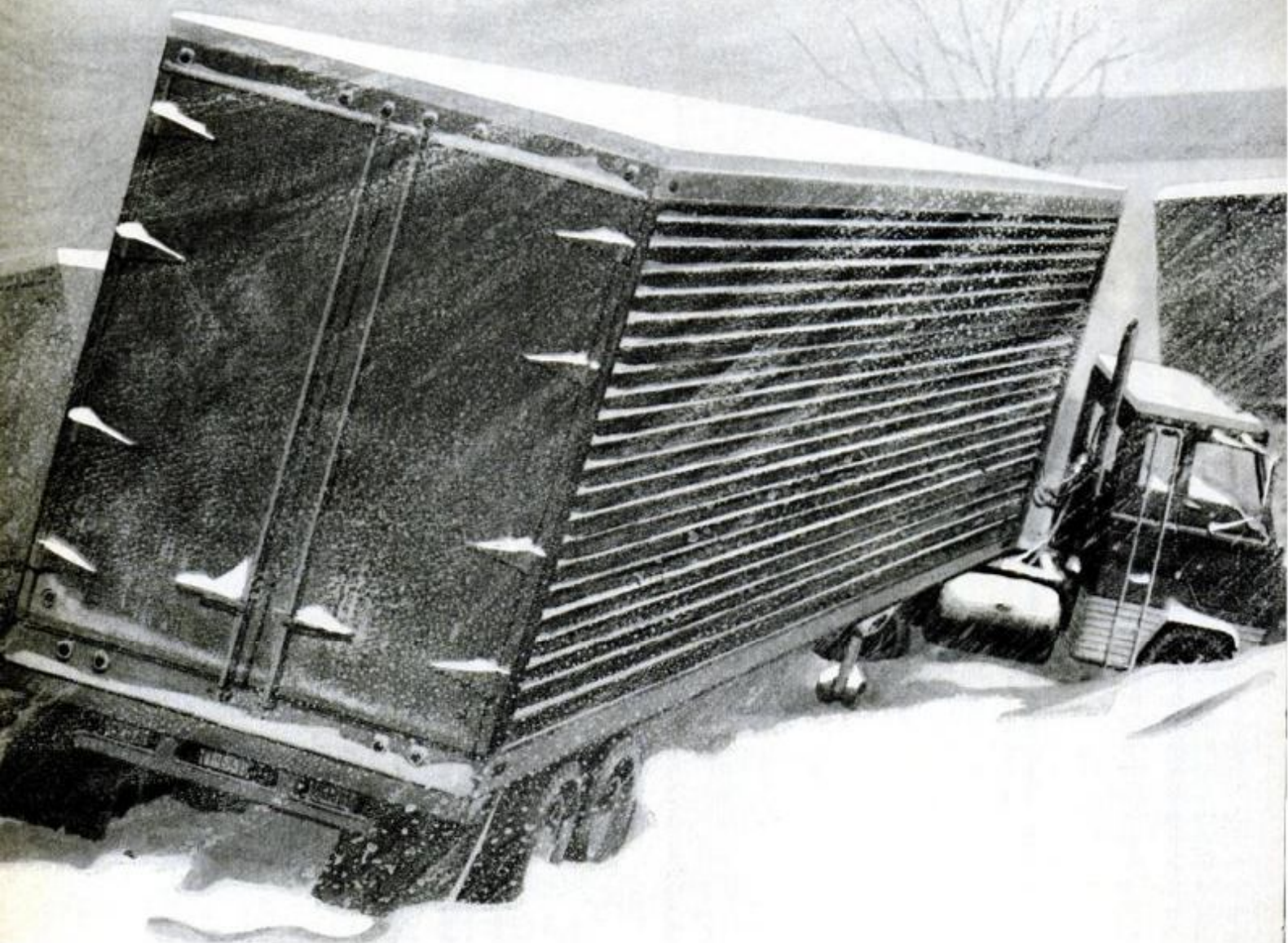
While these weird-looking contraptions bore little resemblance to true automobiles (they aren't street-legal), they did rack up impressive results. Top honors went to a team of engineering students from the Cranfield Institute of Technology with a torpedo-shaped design that clocked a startling 1097 mpg (878 U.S.). Famed bike maker Raleigh came in second at 833 mpg (666 U.S.), and a Finnish machine third with 814 mpg (651 U.S.).

An entry from Shell itself, though ineligible to compete officially, managed to outdo everybody with an incredible 1298 mpg (1038 U.S.)! Now if we could just hang on a 20-gallon tank and head for the highway, we could cross the United States coast to coast nearly *seven times* without ever stopping for gas. Well, it's a nice dream anyway.

PM



All contestants used three-wheel tricycle design permitted under rules, but could not agree on best arrangement. Most put single wheel in front (upper two photos) to simplify steering; a few went to dual front wheels (bottom photo) for better stability. Placing third, Finnish entry (top) employed unusual gas-steam hybrid drive giving 814 mpg. University of Wales tried hard with flashy drop-snoot affair (center), managing 564 mpg. Famed Hawker-Siddeley aircraft maker hit neat 699 mpg with sporty "roadster" (bottom).



With the driving skills learned from last month's winter driving story and the tips here, you'll boost your chances of getting through this winter. Next month we'll discuss how to stay alive if you do get snowbound.

by E.D. Fales Jr.

The storm was getting scary. On the back roads near Canajoharie, N.Y., we began to fishtail up hills. As usual, our defrosters proved inadequate. The windshield iced up.

During snowstorms, I use CB constantly to know what's brewing ahead. We were nearing the roaring Thruway when we began to hear the CB chatter of the 18-wheelers. Today they weren't joking. "Dunno how much longer I can hold out," one said. "There are four-wheelers in ditches all over the place. They go too fast. They spin out."

Such storms raised havoc all over America last winter—for drivers, the worst on record. Thousands of wrecks. Millions of hairy skids. Whole cities tied up.

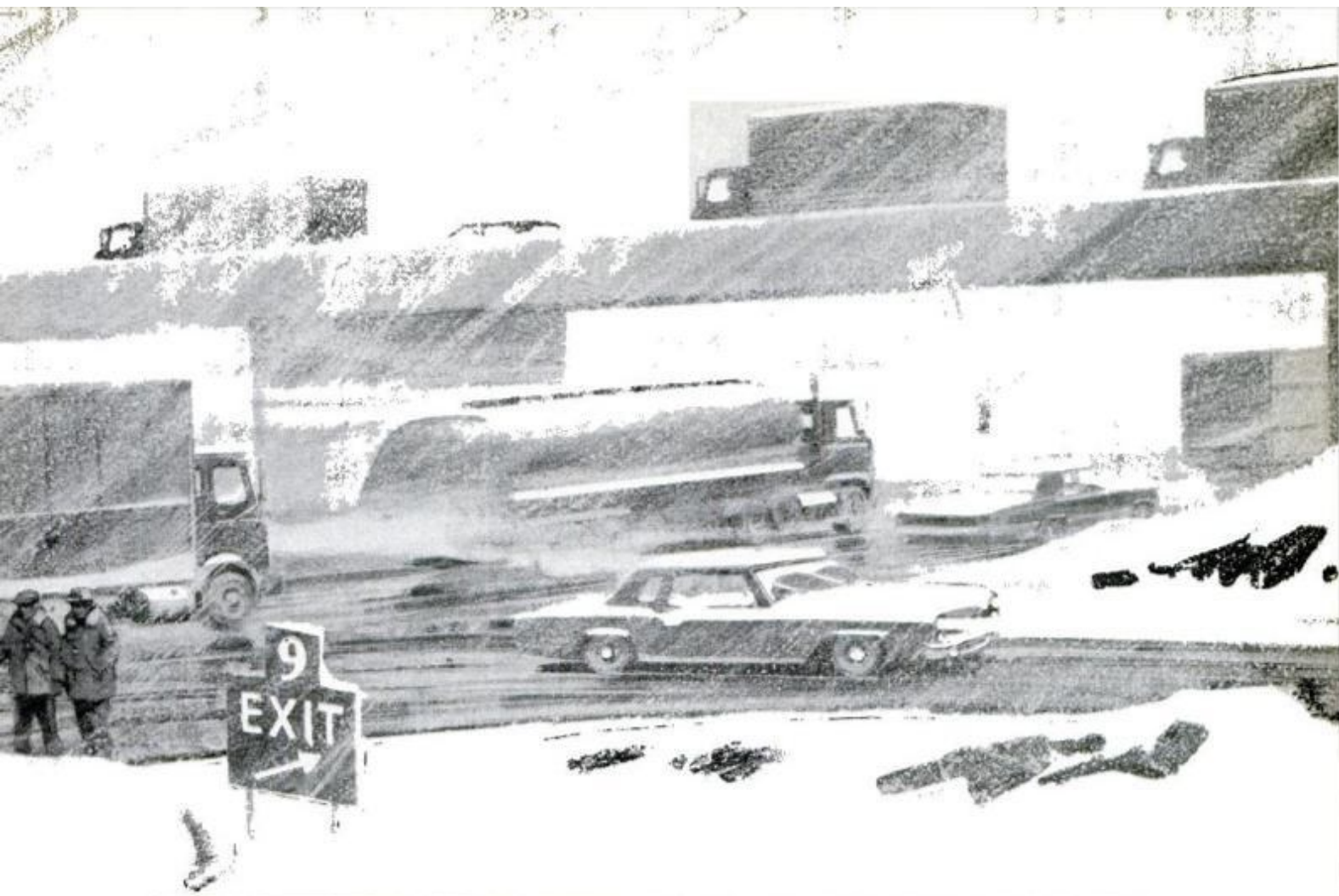
Yet, day after day, as anyone knows who goes to "deep snow country," there are drivers who somehow keep going. Do they know something the rest of us ought to know?

To find out, I'd gone to the High Rockies for tips, and now I was heading into the 1000-mile snow-storm belt that runs from Cleveland, to Bangor, Me. When we came to the Thruway, the toll girl said: "They're having a lot of trouble out there."

The trouble was *speed*. Radio reports said slow-orders were on for other big pikes. Not New York's Thruway, though. Incredibly, it was running full-speed.

A blue car tried to overtake an 18-wheeler and spun into the median. We saw the dazed couple. Another tried to overtake a semi and spun off the *right* side. Radio now reporting one man dead. Yet the wolfpacks kept roaring. This was suicide. We took the next exit. And so here's the first of 17 tips and tricks experts use to keep going in snow.

1. Get off fast pikes in snowstorms; 18-wheelers can go faster



HOW TO GO IN SNOW!

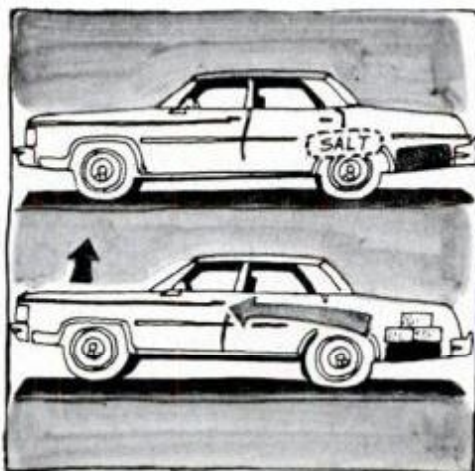
than you in your four-wheeler. Those big trucks really throw it up: If it isn't blinding clouds of whirling dry snow, it is loads of thick wet slush that load windshields and even stall wipers.

2. Easy-foot driving. "Up in this country it's 'easy-foot driving' that saves us," said a young tow-truck operator in stormy Lowville, N.Y. "City drivers come north and try to heavy-foot it through snow—using all their power. That's when we get calls." "A heavy-foot *always* wrecks you in snow," said Dave Lyng, gas-station owner.

3. Salt your tail. I'd left the rear of our car light, because the National Safety Council (NSC) argues against weight in the rear. But here we were sliding all over the place. "We *always* use extra weight for traction," said Don McIntosh, a patrol officer. His job takes him deep

into the snowy Adirondacks for New York's Department of Environmental Protection.

He opened the trunk, showed lots of heavy gear used in his work. "Must be a couple hundred pounds," he said.



3. Salt your tail with a bag or two over axle. Don't use loose weight in trunk.

My friends at NSC claim rear weight is risky because it *overbalances*. Well, properly used, it's no worse than a rear-seat passenger—and shifting a passenger back there is *one* way to gain safer traction.

Some snow-drivers swear by front-wheel drive. And some very small rear-wheel drive cars do remarkably well in snow, especially Volkswagen. But our car was an Omega, a rather heavy intermediate light in the rear.

"With intermediates and bigger cars *you need weight over the rear wheels*," one mountain mailman said. "Don't put it too far back, or it lifts the front wheels."

Almost to a man, I found, snow drivers rely on this extra rear weight—here and in the Rockies. Dangerous? "Not unless you overdo it and try to go too fast," they said. And, besides, it's a far greater danger *not* to have weight—and to get stuck or to spin."

So we added weight: two 25-

pound bags of salt. Instantly the car stabilized. As snow deepened, we added four 10-pound bags, distributed over the axle. After that we never slid, never got stuck. Total added weight: 90 pounds.

I would advise you, however, never to use cement blocks or logs or iron, as some do. If someone clobbers you head-on, all that solid weight comes flying from the back of the car, right up toward your neck. For safety, I tied a nylon ripcord around each salt bag so the bag would split open if anyone hit us head-on. Why salt? It just comes in handy sealed bags. Dry, sealed sand would be just as good. Beware of frozen sand, however!

A full gas tank also helps add weight and traction.

4. Keep moving. I talked to lumberjacks, mailmen, farmers. "It's going too slow—or stopping—that gets you stuck," they said. "We keep a moderate *even* speed—never speed up, never go too slow. Try not to stop. In deep snow, once you stop you've had it. Time traffic so you hit the lights on green."

5. Downshift before hills. In Rangeley, Me., young George Johnson told me: "We have long hills here. If you start up a snowy hill



5. Get up momentum before hills so you won't have to apply power and spin out.

in high you'll have to downshift. This speeds up your rear wheels. Now you fishtail! We always downshift *before* the hill—to keep even traction on the way up."

Right and wrong techniques on a steep, snowy hill are shown in the accompanying illustration: B will make it because he built up about 5 extra miles-per-hour of "give-away speed" before he hit the grade. A is in trouble because he "belted" his engine and used more power when his car met tough going on the hill.

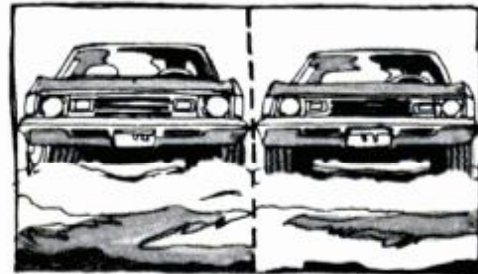
6. Never spin wheels. Even for a second. All drivers stressed this. Amateurs spin wheels, and *it's spin-*

ning that digs you in. If wheel spin starts, stop it instantly before dig-in begins. Now (if safe) back up and try again—in the same groove.

7. "Momentum-blast" through drifts. If you hit a deep drift (or a snow-plow "cast"), don't try to power through. You'll dig in. Feed power carefully—*beforehand*—then let momentum do the dirty work. (Then stop to clear snow from your radiator—or risk a boilover).

8. Straight-wheel attack. It's turned wheels, drivers told me, that defeat novices. Snow builds against them. "We keep our wheels *straight*, avoid sharp turns," they said. So keep those wheels straight! It's one of the most important tricks of deep-snow driving!

In the accompanying illustration, the car at left is in trouble because



8. Turned wheels act as snowplows and bog you down; keep them pointed straight.

turned wheels (1) "plow-snow," (2) build a wall of resistance and (3) can stall or even spin you (if you wallop the gas).

The *straight* wheels of the car at right (1) cut an easy track, (2) eliminate much tendency to fishtail or spin, and (3) open a trail for the rear wheels to track.

9. The corner-drift. If traffic is moving, even the slightest rear-wheel drift can be dangerous. But under proper conditions, a controlled drift *can* get you around impossible deep-snow turns. To keep wheels fairly straight, said Lake Placid's Dave Jarvis, another conservation officer, some drivers *understeer* on sharp turns. Then they kick the gas *just a trifle*. Properly done, this drifts the rear wheels out a few inches, puts you in position to finish the curve with little wheel-turn. Don't try this unless you know how to drift, or have practiced in a safe snow area.

It's wrong when going into a sharp curve, to cut your wheels real hard because they get blocked by snow, and the car either spins or stalls. It's better to barely turn the wheels then carefully feed a *little* more gas.

This tends to spin the rear *very slightly*, induces a very slight, controlled rear-end drift to left. Now the *engine has done the steering* and, with front wheels straight, you're able to proceed in deep snow.

10. The windshield trick. Again and again our windshield iced. The wipers became icebergs. In storms this means you can't see—and in



10. Windshield wipers clogged up with ice may be flicked clear with left hand.

snow *that's* sure disaster. In the Rockies, some drivers stuff a couple of empty matchbook covers in the crack between the hood and cowl. This widens the crack so *warm* air is fanned back off the engine up through the crack and over the windshield. But it was too dangerous to stop to try that—or even to clean the windshield—so I kept going. Driving cautiously with one hand, I opened the window and *reached* around the corner post with the other. On each sweep I let the wiper run smoothly over two fingers, then gave it a slight *flick* to let it snap back against the glass. Immediately the blade cleared itself of ice. Now I clawed ice off the *glass*, then resumed safe speed. *It always works*, if done with good judgment.

11. The instant-recovery trick. My search also took me to Hopkinton, Mass., where Dr. Nathaniel Pulling and other experts teach skid dynamics at a big test track run by Liberty Mutual. There I learned a priceless trick: *When you start to skid on snow (or even glare ice) release your brakes!*

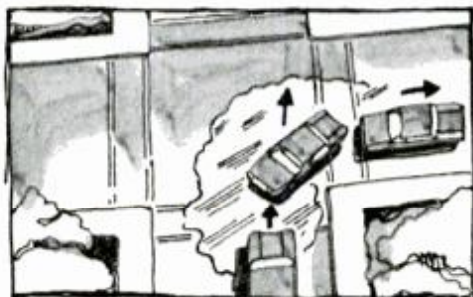
It's the best way I have found, in years of snow-driving, to regain control. It must be employed within fractions of a second—before a skid converts to a spin-out. Instantly, your car recovers. Front wheels that are trying to slide off a road will snap back in line so fast the recovery forces will actually *jolt* the car.

What happens, Dr. Pulling and skid expert Gil Drake explained, is this: In a skid, most drivers frantically lock brakes. This only makes a skid worse. Locked wheels won't steer. They'll slide.

But when you release brakes, wheels regain a surprising amount

of important *lateral friction*. Even on ice, they quit skidding sideways and insist on rolling straight ahead.

"Instant recovery" works best at slow speeds (and I certainly assume you won't be driving fast on slick stuff). Most damaging winter skids take place below 25 mph—and that's when recovery can be most dramatic. Whether it will work at, say 45 or more, frankly, I can't say and until I can get a test pad bigger than Hopkinton's I'm not about to find out. Some recovery forces have got to be present even at 50 to 55 if—first—the skid has not progressed into a spin, and—second—if your front wheels are not too sharply turned. Even in a 20-mph skid, you must act before a spin gets started. And you must turn your wheels back so they aren't cocked more than a few degrees—perhaps 15° or less.



11. Regain steering control by releasing brakes, especially in slow-speed turns.

Try it some time on glare ice (or slick slushy snow)—and in a perfectly safe place. You'll be as astonished as I was how well it works.

So remember! If you skid into a turn on ice, release brakes. Car will now steer. If you brake for a corner turn but hit ice, you'll start to slide straight ahead—perhaps right through an intersection.

12. **Creeper runaway.** Beware of the "creeper runaway" on ice: a new hazard that affects many automatic-transmission cars, because today's engines *idle faster*.

You apply brakes lightly on ice, to stop without skidding, at a traffic light. (1) Your front wheels lock up and slide because (2) your rear wheels, powered by the automatic-transmission, now *overdrive their own brakes* and keep on pushing! Especially dangerous on hills, down-sloping driveways or side streets!

13. **Passing spin.** Beware of the "passing spin." To avoid this, good snow drivers hold speed down and are wary about overtaking other cars (on super-highways especially).

A driver who starts to pass hits snow in passing lane; as he applies power to pass, he spins out! Often

the right-hand lane has been swept dry and clear by traffic . . . and is safe. But the passing lane is usually snowier, with alternating drifts and ice paddies.



13. Passing spins occur when drivers move out from dry lane to icy passing lane.

14. **Traction tips.** Let's say you lack traction to get up a snowy hill—or even to move on level road. At Vermont's Snow Valley, John and Scott Fitzgerald, who run the famous ski resort, showed how some drivers get up a long hill there.

"They put someone in the trunk," John said. "It has its risks but often it can prevent a spinout—which could be a *greater risk*."

I've seen this done in a storm on Colorado's 11,000-foot Loveland Pass where a car ran with trunk open and the driver's girlfriend huddled with the spare tire! I wouldn't want any friend in there. (I prefer those salt bags!) But I have to admit it worked. And near Fryeburg, Me., a 250-pound lumberjack helped get my car out of a drift by sitting in the trunk.

15. **The block and tackle trick.** In Lake Placid, officer Dave Jarvis, who patrols the wild "Ice Box" country (where temperatures hit minus 40° F.) showed how some drivers get unstuck. He rigged a light block and tackle to a tree and moved his car a few inches. This got the rear



15. Block and tackle may move car just enough to give tires a fresh bite.

wheels out of a hole they melted (warm tires quickly melt in). And that was enough. He easily backed a few inches—then came ahead.

16. **Cut a leveler.** In the Western Adirondacks, officer Don McIntosh showed another trick. We drove into a drift, stalled. From his trunk he got a sharp ax, felled a stout hardwood sapling. Then he removed a hubcap. Shaping the tree butt like a wedge, he jammed it against the lug bolts, and levered the wheel up a few inches. Under the tire I now threw a small mattress made only of many *small twigs*! Then he lowered the car—and drove out.

For a fulcrum, he used two two-by-eight-inch boards, each 18 inches long. One he laid flat for a base. The other stood vertical.



16. Stuck car can be levered up slightly using sapling with an appropriate fulcrum.

"I always carry the boards," he said. "But if you don't have them, all you have to do is stand your spare tire in the snow and use *it* for a fulcrum. He did it, too! The deep snow held the tire upright, and the long tree levered across it nicely. It was the neatest trick of the week.

17. **Ramps.** Good for getting unstuck: Some snow-pros use metal ramps (available in auto stores). Ram them under rear wheels, then back up a few inches. Now car goes *downhill and ahead!* **PM**

Electronic stethoscope amplifies heartbeat (and car-engine noises) some 10,000 times. This one costs about \$130 from Edmund Scientific.



Transistorized blood pressure machine from Edmund Scientific doesn't need a stethoscope to read systolic and diastolic pressures (below, left). But the convenience will cost you \$125.

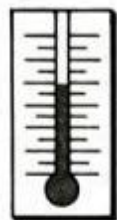


CONTRACTING HEART
EMPTYING

RELAXING HEART
FILLING



SYSTOLIC



DIASTOLIC

New irrigators for spraying and flushing ear, nose or throat were invented by Dr. Murray Grossan of Los Angeles for use with Water Pik to provide gentle pulsing action.



New era in health care: Medical devices you use at home

Armed with stethoscopes, blood-pressure machines and other medical gear, self-care advocates are measuring heartbeats, checking blood pressure, even treating delicate ear, nose and throat problems. How are they doing? How do doctors like it?

by Kenneth Anderson

Last fall a Boston TV station ran a solid week of self-care shows on how to be your own family doctor. It was followed by a weekly health program on how to deal with common health problems, from acne to diabetes.

A new educational program in Boise, Idaho, sponsored by an outfit called Healthwise, Inc., has begun to issue manuals and videotapes for town officials to use in promoting self-care to local groups. New York City has just opened a new medical library for nonprofessionals. And in Inverness, Calif., a new magazine was launched this year. Its title: *Medical Self Care*.

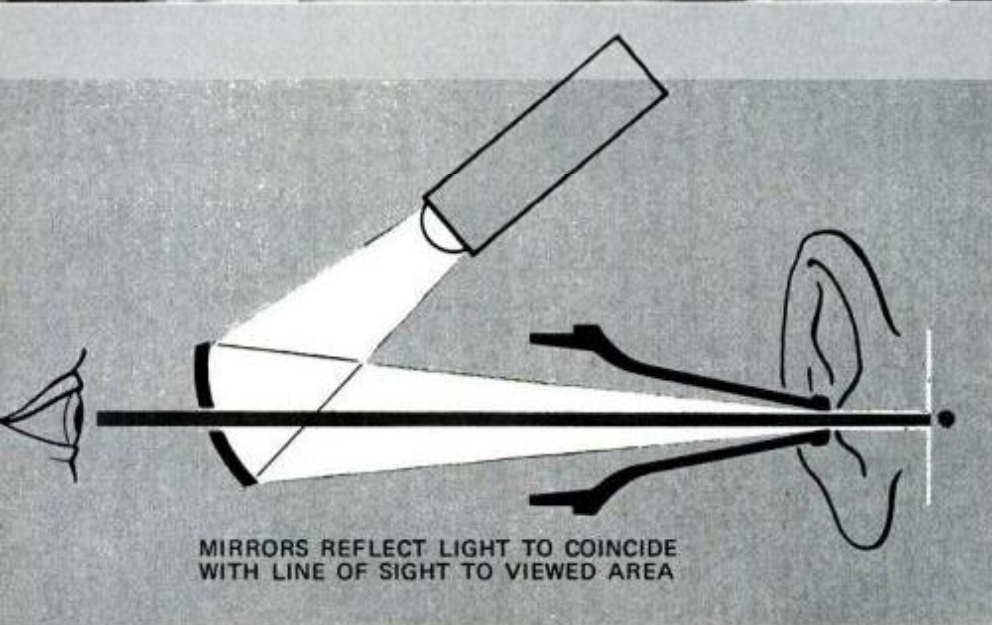
During the past decade more than 600 books have been published with titles like: *Talk Back to Your Doctor*, *How to Be Your Own Doctor*, *Consumers Guide to Medical Care*.

Material, защищенный авторским правом

Mini-optical systems use mirrors to reflect light evenly to ear canal in new otoscopes (see diagram below). The unit shown is made by Hotchkiss.



For sterile procedures in the home, distilled water often is needed. This home unit is from Edmund Scientific Co.



Earplugs, useful in some self-care applications, now have valves so canal stays open to the air. These are made by Norton.



What's going on? For one thing, medical costs in this country have leaped, according to *Business Week* magazine, from \$12 billion in 1950 to more than \$146 billion in 1976. Health insurance has responded with soaring premiums and declining benefits. People are far more knowledgeable about medical problems and physical ailments than they used to be, and no longer stand in awe of graduate degrees and starched white ring-collared jackets as they did in our parents' day.

Some self-care can be good

The interesting thing is that most good doctors are in favor of the trend; it relieves them of a lot of detail so they can devote their time to serious cases. Many of them are helping to educate their patients in self-care.

While the medical profession does not encourage self-diagnosis by laymen, it apparently does not object to a certain amount of self-care as long as it does not endanger the health of the person. Guidelines recommended by the American Medical Assn. (A.M.A.) for deciding when professional medical aid is needed include: (1) when complaints seem too severe to be endured; (2) when apparently minor symptoms persist for more than a few days; (3) when symptoms return repeatedly; and (4) when in doubt.

In recent months, people lacking professional medical training have been acquiring stethoscopes (pulse and heartbeat listening devices), sphygmomanometers (blood pressure machines), otoscopes (ear canal viewers), electronic thermometers, biofeedback equipment, and some de-

vices that even most doctors don't have in their offices. These instruments are available to anyone from medical or surgical supply stores or from certain mail-order houses.

Other instruments, such as electrical devices for therapeutic purposes like the battery-powered stimulators used to relieve low back pain, are available only to licensed physicians. Some doctors are concerned that untrained people will make misleading diagnoses from data obtained with stethoscopes or sphygmomanometers, because they are only a part of a complex puzzle. An amateur physician could easily draw wrong conclusions.

Checking blood pressure

On the other hand, a layman who can learn to monitor his own blood pressure with a sphygmomanome-



Biofeedback equipment, demonstrated at the American Medical Assn. convention this year, showed people could start or stop toy train by thought impulses.

ter may be less likely to suffer from the effects of hypertension, much as a person who checks his body weight daily on a bathroom scale is less likely to suffer the hazards of obesity. Many doctors, in fact, recommend that patients who are possible hypertension candidates purchase their own blood-pressure measuring equipment and learn how to use it properly.

Sphygmomanometers for measuring blood pressure are easily obtained at prices ranging from about \$12 for a simple, basic outfit including a stethoscope, pressure cuff, air bulb, and spring dial gauge, to around \$140 for a solid-state electronic instrument with an LED flasher to indicate blood pressure levels. For the very, very rich, there are completely automatic units with self-adjusting pressure cuffs to fit any size arm, digital readout of data, and pushbutton controls.

However, the fancy electronic devices may not promise any greater accuracy than the old-fashioned mercury-column devices that range from \$40 to \$60 and are still used by many practicing physicians.

The equipment is not difficult to operate, but there are a few tricks involved in obtaining accurate readings. A quickie course from a family

physician or his nurse can get you off to a good start. The doctor can provide advice regarding the size of pressure cuff needed to fit your arm. A blood pressure reading can be 8 or 10 points too high or too low because of the amount of fatty tissue in the arm.

Instruments commonly used to measure blood pressure work indirectly by stopping the pulse in an artery. The term sphygmomanometer, in fact, is derived from a Greek word, *sphygmos*, which means, literally, to stop the pulse. A "manometer" is a pressure gauge. The kind of sphygmomanometer you buy, like the models usually found in a doctor's office, "stops" the pulse by means of a rubberized pressure cuff fastened around an arm or leg. Actually it is an airtight bag secured with Velcro or other fastening devices. The cuff is inflated by pumping air into it with a rubber bulb until the air pressure restrains the pressure of the blood in a major artery, thereby stopping the pulse in that limb.

How pressure testers work

The pressure cuff acts as a tourniquet (and can, in a bleeding emergency, be used as one). Therefore, the procedure can become uncomfortable if the blood flow is interrupted for more than a moment. Checking blood pressure should be done quickly, smoothly and careful-

ly, along with pulse counts as accurate as possible.

If you own a watch that counts seconds as well as minutes, you possess a device originally designed as a medical instrument. An English doctor, Sir John Floyer, is credited with inventing the watch with a second hand in 1707. It was known as the "physician's pulse watch" because, as the name suggests, it was used to measure the pulse rates of patients.

Before Dr. Floyer's second-counter, physicians measured pulse rates against pendulum clocks or by the flow of sand through minute glasses.

The convenience of the watches quickly caught the fancy of everyone, and the physicians benefited. Watch owners learned to count pulse rates of family members and transmit them to busy country doctors.

The sphygmomanometer usually is used with the aid of a stethoscope. The bell or diaphragm is positioned on the artery below the pressure cuff. If you listen carefully, the sounds of blood flow through the artery can be heard as the pulse is nearly forced to stop. In practice,



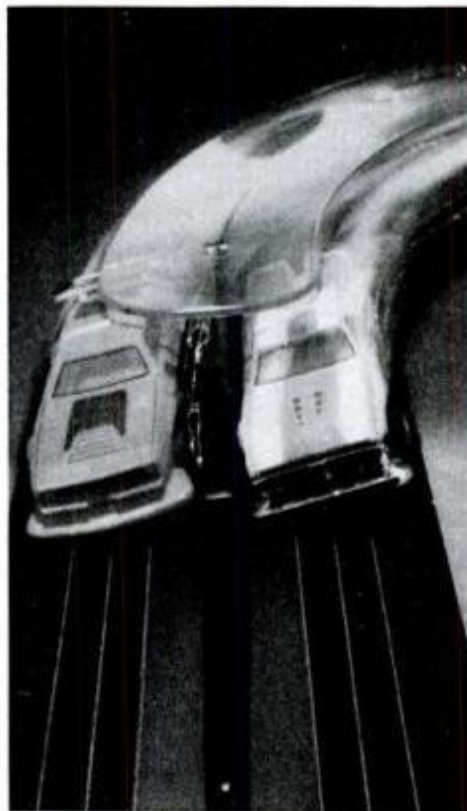
Sphygmomanometer (blood pressure tester) with electronic readout, also demonstrated at AMA convention, enabled visitors to try it out on themselves. Many did.

the pressure in the cuff is pumped rapidly up to a reading about 20 or 30 millimeters above the point where the last sounds of blood pulsating through the artery can be heard through the instrument. Then the air is released slowly through the bulb valve at a rate of two or three millimeters per second.

When the first dull sound of pulsating blood is heard, the level of blood pressure showing on the manometer should be noted. This is the *systolic* blood pressure. Then, as the cuff is deflated further, still at a gradual rate, a second point will be noted where the last muffled sounds of blood flow are heard. This point is recorded as the *diastolic*

(Please turn to page 178)

IT'S NEW NOW



Slotless car racing challenges driving skills

Model racing cars zip around the track without aid of slots—they can change lanes, pass and zigzag. Lanes have three rails bringing electricity to brass conductors under cars. A passing button on controller alters current, allowing movable front wheels to steer into other lane. High-speed T (left) prevents cars from jumping track when taking tight curves at top speed. Sets from about \$29.95 to \$59 at stores handling Lionel.

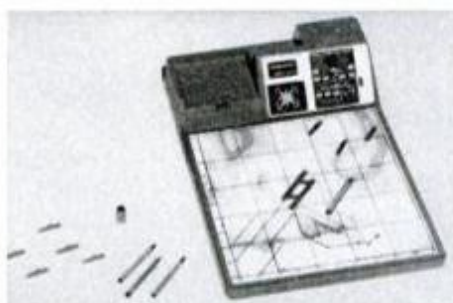
Transfer print images

Have a favorite printed picture? You can transfer it to a T-shirt, or almost any fabric, with a new iron-on kit. Transparent sheet picks up ink impression from paper, is heat-bonded to cloth. About \$3.98 in craft shops. Sangray Corp., 2318 Lakeview Ave., Pueblo, Colo. 81004.



Mini alarm clock

Compact 4-ounce battery-power alarm clock is 4½ in. long, costs \$25 plus \$1.25 shipping. Paula Johnson Imports, 312 Ninth Ave. N., Seattle, Wash. 98109.



Computer sub chase game

Command a destroyer pursuing a hidden computer-controlled sub. Logic circuits, digital readout supply tracking data. Code Name: Sector is \$40. Parker Brothers, 190 Bridge St., Salem, Mass. 01970.



Swiveling razor follows face

A spring mechanism allows the cartridge of the ATRA twin-bladed razor to pivot 20° upward or downward. Hand moves in one straight stroke, while the razor head adjusts to the contours of the face, keeping the blade close to the skin. Retail price: about \$4.95 from Gillette.

Piggyback planes

Flying one airplane atop another, as NASA did to launch the Orbiter last August, is 'old hat.' Planes were playing piggyback in World War I.

by Richard Dempewolff

Stacking Space Shuttle Orbiter *Enterprise* on top of a Boeing 747 was more than a spectacular stunt. According to NASA officials, it solved the problem of "trying to make a part-time airplane out of a full-time spacecraft."

Early plans had called for strap-on jet packs that would fly Orbiters like airplanes from the West Coast factory to the launch site at Kennedy Space Center. But huge quantities of fuel would have had to be carried; the 3000-mile trip would have required a series of hops, and multiple takeoffs and landings would have imposed a hazard. So, spacecraft design engineer John Kiker at Johnson Space Center resurrected an old concept—"composite" planes (piggybacks)—to ferry Orbiters around and launch them for landing and handling tests.

Actually, aviation history is studied with composites. One of the first—a Bristol Scout perched on a Felixstone three-engine seaplane—was rigged by the British in World War I as a means of getting the Scout high enough to intercept German Zeppelin bombers attacking England. The stack made a success-

ful test flight on May 17, 1916, but never was put into action.

Some 20 years later, more composites showed up. During the '30s, the Russians hitched a Sukhoi 1-4 fighter to each wing of a Tupolev TB-1 bomber. The smaller planes helped the heavily-loaded bomber on takeoff, then detached at target.

Another British stack showed up in the late '30s, involving a small four-engine, twin-hull *Mercury* atop the giant flying boat *Maia*. *Mercury*, heavily loaded with fuel and mail, was lofted and carried part way on long trips before separation, thus extending range. In July 1938, this piggyback delivered mail and newspapers from Foynes, Ireland, non-stop to Montreal. The unique rig operated between Southampton and Alexandria, Egypt, until World War II, when *Mercury* went to work for a Dutch seaplane squadron. A Luftwaffe bomb got *Maia*.



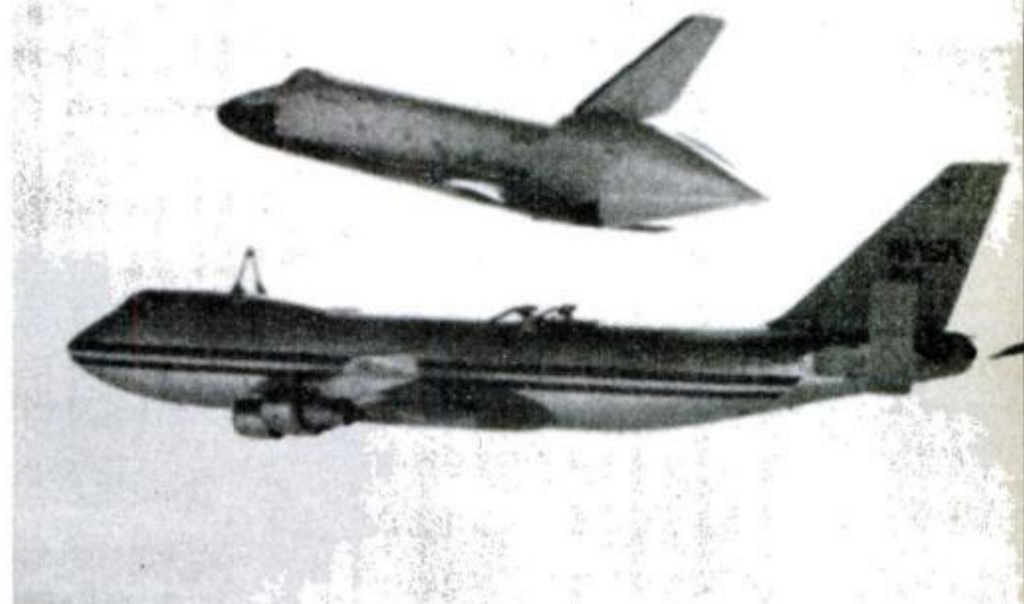
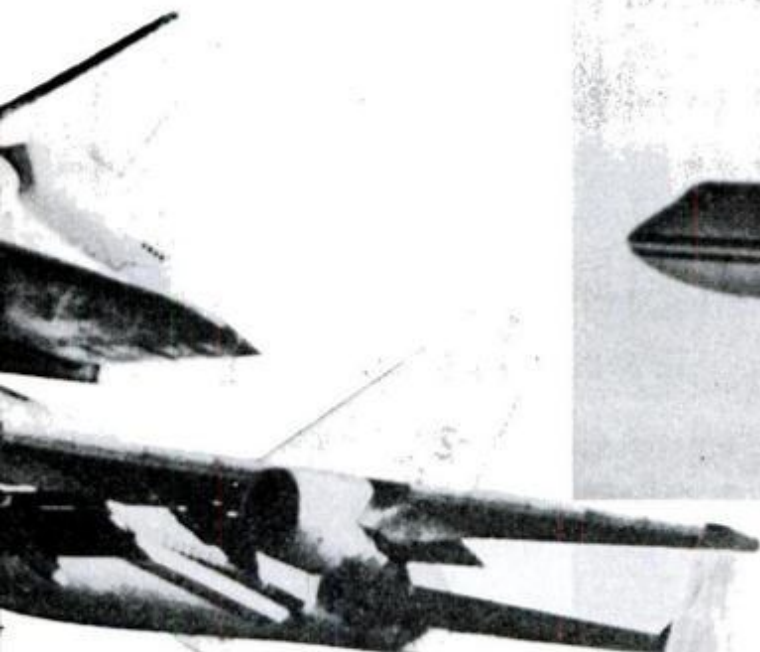
The Nazis knew a good thing when they saw it. In 1944, they put together a composite called *Mistel* (mistletoe). It was an unmanned Junkers 88 loaded with four tons of explosive. The mother plane, a Messerschmitt 109, or Focke-Wulf FW-190, rode atop this dynamite keg. The pilot flew the stack to target, separated, and got out of there. Some 150 *Mistels* were built. Allies captured 125 of the JU88 bottom halves when Nordhausen fell.

After the war, France latched on to the piggyback concept in order to get its Leduc 010 ramjet plane up to speed so the engine would function. Two Leducs were built and tested. Both crashed.



Britain's Short-Mayo composite used a "mother" flying boat, *Maia*, to carry smaller, heavily loaded seaplane *Mercury*, on takeoff and part way on trip to increase range of little plane on ocean flights.

By perching Orbiters atop Boeing 747s, NASA provided them with a free ride from factory to Space Center, plus a test launcher.



The United States had better luck, boosting its Navajo ramjet missile to speed and altitude on the back of a special launch rocket about the size of the old Thor.

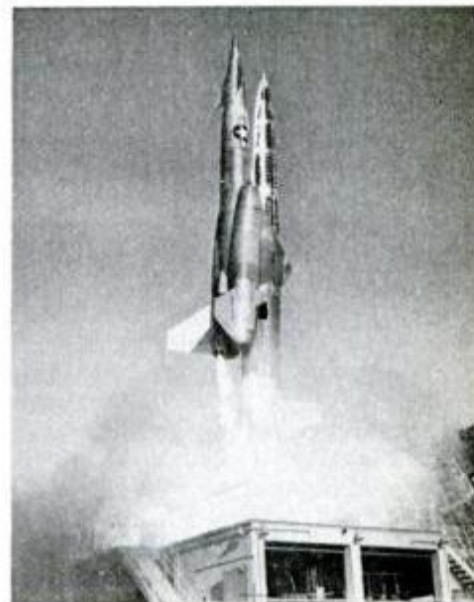
More recently, the U.S. Air Force and NASA have experimented with "piggyback" composites, releasing and retrieving parasite planes like the Bell X-1, X-2, and other experimentals, from the underside of bombers. In the '50s, a squadron of B-36s was equipped with "skyhooks" for launching and retrieving F84-F fighter planes. As the range of such jet fighters increased, the colorful composites were phased out once again—until the Orbiters came along, that is. **PM**



France stacked its Leduc ramjet plane on a four-engine bomber as a means of getting the ram up to operational speed. Two of the sleek planes were built, but crashed in tests.



An unmanned Junkers 88 (bottom) helped up by a Messerschmitt 109, was a German composite. The JU88 actually was a four-ton bomb. The 109 unhooked at target and left.



Our ramjet Navajo missile was piggybacked to speed on special launch rocket.

Game in progress: Mind Reader, a number-guessing challenge loaded by cartridge into Fairchild Channel F game system.



Atari, best known for Pong games, offers its Video Computer System with 14 to 50 game variations per game cartridge.



APF M1000's lift-out remote controllers have both joysticks for action and keypads for question-and-answer games.

You're sitting alone in your den, feet up. Turn Two is coming up fast, with a slower car right on the best line and moving to the outside. Should you slow down to take him on the inside, or sit behind him through the turn, accelerating after the apex to blast by him?

Or will you try to better your record at "Breakout" with its tantalizing possibility of really high scores? But the paddle gets smaller and smaller and the ball gets English on every shot . . . intense concentration is necessary, eye-hand coordination almost beyond mortal ken . . . but maybe this time . . .

Yes, there's more to TV games now than just bouncing a square ball around and making pinging noises. The new generation of video games is arriving, programmable microprocessor games run by the same tiny integrated-circuit chips that make microcomputers possible and are now showing up in controls for everything from microwave ovens to CB rigs. The word "programmable" is significant—it makes a virtually unlimited variety of games possible. The programming is accomplished instantly when you plug a solid-state ROM (read-only memory) cartridge into a game unit; the cartridge, in effect, completes a machine designed for the game you want to play. Most car-

New TV games: Livelier, smarter

Programmable microprocessor video games use computer brains to put more excitement into play, add extra features.

by Dave Sagarin

tridges hold more than one game, and several variations on each game are usually available.

These plug-in cartridges have a lot of room for program complexity, so the games can be more challenging than the original slam-the-ball-around type. Individual skill levels can be set, so that players of unequal ability can compete fairly.

Atari's Blackjack offers House or Casino play, with one or two decks in use. Several makers offer doubles versions of the old paddle games, and there's more color and sound to add life to the action. In the skill games—shooting at targets or driving through traffic, for example—your robot opposition is smarter now, reacting to your moves or varying motions to throw off your aim.

The competitive games keep score

and can vary scores depending on the skill level chosen and how quickly or cleanly you react. The cursor—that square ball—in some games can "feel" a surface, bouncing differently depending on the paddle's direction of movement and velocity, simulating top spin or English, and coming off faster or slower depending on how hard it was hit.

Controllers

As the photos above show, there's more than one way to give input to a games microprocessor. Your driving, shooting, paddling or thinking ability can show up on the screen via a joystick, keypad, trigger, knob or wheel. Each manufacturer has made a choice of controllers based on the games he's got and those he expects to offer in the future. Some picked joysticks for

Материал, защищенный авторским правом



With RCA's Studio II control, keys mean directions of motion as well as numbers.



Game cartridge for Telstar Arcade system is small triangular object at top.



Bally Professional Arcade has built-in calculator, using TV screen for display.

realistic analog control, while RCA tells us they chose keypads because they feel joysticks are too easily broken under heavy—kid—use. Keypads are fine for numerical input, and give lots of different buttons to push to initiate actions, but they can't give the feel of continuous control. Then again, joysticks or rheostat knobs alone won't do if part of the justification for buying a unit is providing educational games for the youngsters.

Some makers will offer different controllers with different games, packaging them with the ROM cartridges, but you may be paying a premium for the controllers this way. In any case, you're well advised to try out different systems, playing the games you think you'll like, before you make a purchase decision.

Playing with the government

Because these units all connect directly to your TV set's antenna terminals, they put out a VHF signal modulated with game information. That VHF signal introduces the possibility of interference with broadcast TV. Consequently, enter the Federal Communications Commission, which must grant "type approval" to devices like these before they can be sold. All the manufacturers listed in our table *expect* to have type

Games without TV

If there's no TV set near you, you can still play. Several manufacturers are offering a variety of tabletop and hand-held electronic games.

Three little goodies from Mattel, Auto Race, Football and Missile Attack, look like crosses between pocket calculators and some of James Bond's weapons. They provide displays of computer-controlled opponents for you to steer past, run around or attack, plus sound effects.

Comp IV from Milton Bradley is a number-guessing game, and the same company also sells a semielectronic version of Battleships, the old pencil-and-paper favorite.

Parker Brothers' submarine-pursuit game, Code Name: Sector, has a plotting board, with an electronically hidden sub for you to locate, fire at and destroy.

Other microprocessor-based, non-TV games are likely to follow.

What's ahead?

The Bally unit is already being sold as the first block in a home-computer system, under the name Bally Home Library Computer, and other manufacturers tell us they're actively considering offering keyboards and the added random-access memory needed to turn their game units into true microcomputers.

Computer hobbyists have already reportedly figured out how to open up the Fairchild machine and make it into a full-blown computer. Working from the other direction are the software fans who are writing more and more game programs for existing microcomputers. Even a small computer can conduct games much more sophisticated than present TV games; chess-playing programs are available, as are shrunk-down versions of the space-battle games played fanatically wherever people can sneak time on big machines.

We've come quite a distance in only three years. One major feature I think we'll see in the *next* TV-games generation is still greater realism in display and complexity of strategies. For example: Instead of "racing cars" that are little boxy shapes, we'll get perspective views of cartoon-like cars; and instead of instant direction changes in response to controls, we'll get motion that's affected by inertia, traction and slip-streaming.

We'll be able to keep lifetime stats on individual players and replay key moments—your 1000th home run, or when you broke the lap record. Another possibility is instructional interaction, so that a tricky backgammon play can be held for a mathematical analysis of the position, and fast-action events can be replayed in slow motion, to show you what you did wrong or right.—D.S.

approval of their units by the time you read this, but some had not yet obtained it as we went to press, so you shouldn't be surprised if one or two don't make it to dealers' shelves in time for Christmas.

The problem is actually twofold: the FCC is apparently badly backed up in testing games because of the large number appearing at the same time, and the units themselves are hard to stabilize against frequency shifts caused by handling and shipping.

The alternative would be games

putting out only a video signal, eliminating the VHF and the need for FCC approval. But that would require TV sets wired to accept a pure video input, and there's been no stampede among manufacturers to add such a feature to home sets.

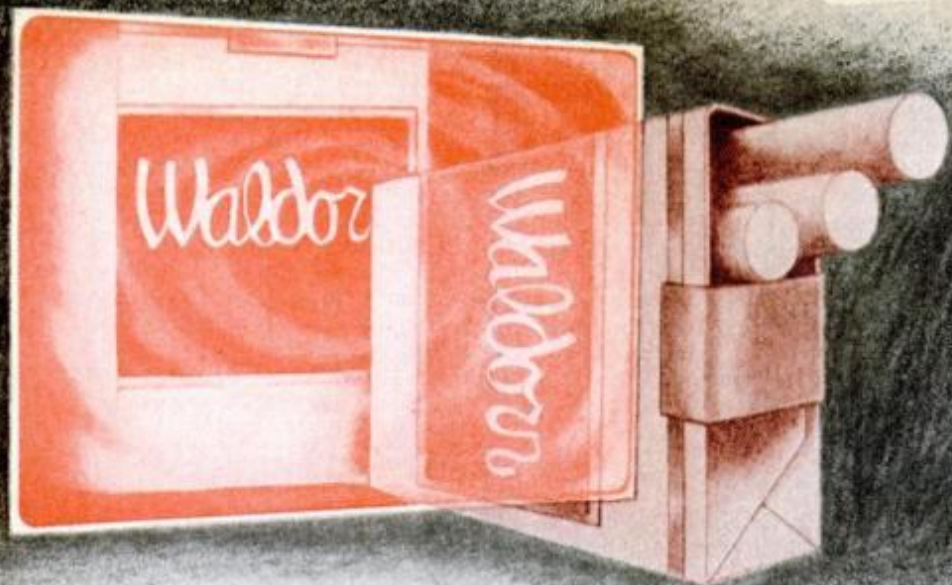
Pricing

The prices we show are the manufacturers' suggested list prices, rounded to the nearest dollar. As with all toys, deep discounting will be the rule, and list prices represent a maximum. **FM**

VIDEO-GAME SPECIFICATIONS

Game Name	List Price	Comes With	Cartridge Price	Cartridges Available	Manufacturer
M1000	\$180	1 cartridge	\$20	6	APF Corp., 444 Madison Ave., New York, N.Y. 10022
Video Computer System	\$190	1 cartridge	\$20 ¹	9	Atari, Inc., 1265 Borregas Ave., Sunnyvale, Calif. 94086
Professional Arcade	\$299 ²	2 games built in	\$20	3	Bally, Inc., 2640 West Belmont Ave., Chicago, Ill. 60618
Telstar Arcade	\$125	1 cartridge	\$20	3	Coleco Industries, 945 Asylum Ave., Hartford, Conn. 06105
Channel F	\$170		\$20	15	Fairchild, 4001 Miranda Ave., Palo Alto, Calif. 94304
Studio II	\$150	4 games built in	\$15, \$20 ³	10	RCA, 30 Rockefeller Plaza, New York, N.Y. 10020
Tournament 2711	\$150	4 games built in	\$20	4	Unisonics, 1115 Broadway, New York, N.Y. 10010

Notes: 1. Indy 500 game with special controller is \$40. 2. Built-in calculator uses TV display. 3. Depends on complexity.



New taking-display system permits images to be magnified to 10 times life size (or more) without loss of three-dimensionality. Adjustment of optics varies image's position with respect to plane of window—it can be several feet in front of or behind it.

Holography gets closer to your neighborhood theater

Big-screen viewing and dramatically enlarged images—**with full holographic 3D**—are now realities.

Holography won't replace conventional movies or TV next week, but one small company's recent progress gives it some of the versatility that an entertainment medium needs.

The drawing above isn't a prediction of 1987-style holography—it's a display system that exists now. I've seen it. Flat photos can't do it justice, but the drawing shows what the viewer sees. Spacial Images, Ltd. (213 West 53rd St., New York, N.Y. 10019) has overcome two of holography's major limitations: image size and "window" size. Previous techniques couldn't show a cigaret pack any larger or smaller than life-size, no matter how large the plate. Mort Siegel and Rudy Manheim of Spacial Images showed me cigaret packs 10 times larger than life-size, in full 3D.

There's no theoretical limit to the size of a hologram, but the cost goes up fast. A plate the size of the Spacial Images' window costs \$400, while the 70-mm film the company uses costs only 50 cents an exposure. And

the window—something like a Fresnel lens—can be much bigger than the one I saw; 6½ by 8½ feet is entirely feasible, I was told, at a cost of about \$10,000.

How do they do it? Siegel and Manheim aren't giving out any details up to now, but the total process involves special geometry for image reduction in the hologram-making setup, then more optics in the display system to enlarge the image, project it through the window and locate it in space.—*Stephen Walton*



Hand shows size of 19½ x 24½-in. window. Image projects several feet outward.



Co-inventor Rudy Manheim with display setup: low-power (2-mw.) laser at left, drum carrying six 70-mm holograms at center, box of optics at right. Viewing window is located at end of box opposite the drum.

WHAT'S HOLOGRAPHY?

Briefly, holography is exact recording of the way wavefronts of light are reflected by an object. The recording—hologram—when properly lighted, reconstructs these wavefronts exactly. The result is a three-dimensional image—not the kind that's made up of two flat images (an anaglyph) and viewed with colored or polarized glasses, but a view of the original object as though the hologram were a window. Holographic im-

ages require no glasses, remain three-dimensional no matter how you tilt your head, are perfectly sharp from front to back, let you see behind objects as you change viewing position (parallax), and can extend forward beyond the "window" plane.

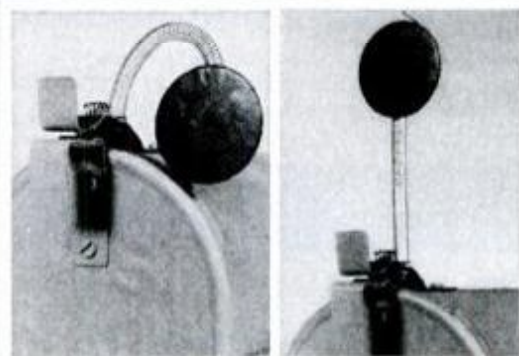
All holograms are made with coherent laser light. Some can be viewed only under laser illumination, while white light is practical for others.

IT'S NEW NOW



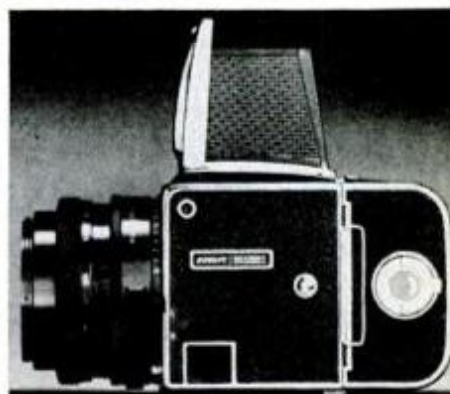
Hover-plane

Odd-looking craft developed by VFW-Fokker in West Germany is the latest in ground-effect ships. The X-114 can fly and leap over obstacles, according to its developer. It seats six, cruises at 90 mph with a maximum flying time of 20 hours over a range of about 1200 miles. The craft uses inflowing air to form a cushion beneath itself and to reduce drag as it skims along at speed a few feet above either land or water. When hills are ahead, it takes to the air.



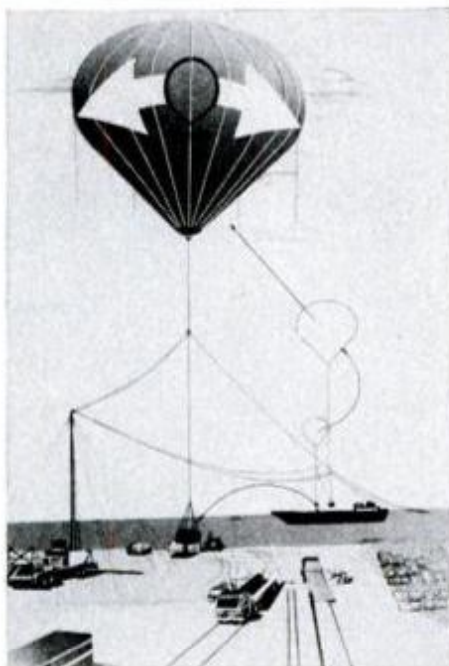
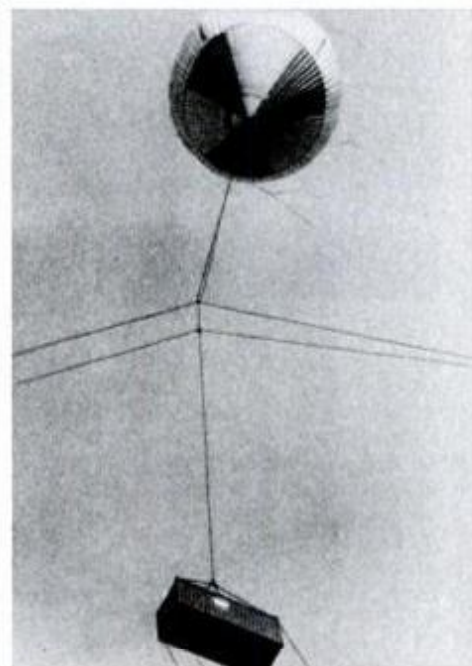
Did the mail come?

When the mailman opens your rural letterbox to deliver the incoming mail, he trips a trigger that allows a large fluorescent orange disc to pop above the top of the box where it can be easily seen from a door or window in the house. If it stays down, you'll know that no mail arrived, so there's no need to trot out the driveway for a look. Price is \$3.50 from Save-A-Trip, 2784 Copp Rd., Niles, Mich. 49120.



Focal plane shutter for SLR

Now a single-lens reflex camera features a focal-plane shutter with speeds to 1/2000 second. Hasselblad's 2000-FC has electronic flash to 1/500 second. \$2100 up. Braun North America, 55 Cambridge Pkwy., Cambridge, Mass. 02142.

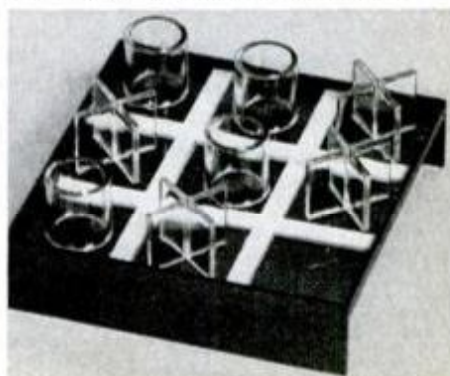


Ship-loading 'skyhook' flies cargo to freighters

Helium-filled balloons, first used to lift huge timbers from slopes in the Pacific Northwest, now will see service in offshore cargo loading of ships. In shallow or congested ports, a ship can stand off while the tethered Skyhook lifts cargo from a pier on rigging that swings it to a freighter's deck. It's being used in Yemen.

Tick-tack-toe in full round

Tabletop tick-tack-toe now comes in a new package—molded plastic (smoky for base; clear for playing pieces). It's \$6.95 from Paula Johnson Imports, 312 Ninth Ave. N., Seattle, Wash. 98109.



Little import outboards join the big leagues

Tests show they're good, but have they got what it takes?

by Bill McKeown
BOATING EDITOR

Are outboard owners, like photographers, swinging toward gear with foreign names? Already, brands like Volvo-Penta from Sweden; Honda, Suzuki and Yamaha from Japan; Seagull from Great Britain, and Carnitti from Italy are mixed in along the waterfront with Evinrude, Eska, Johnson, Mercury, Clinton, Chrysler and others.

It's no secret that some of these little mills from overseas are made with dependable craftsmanship and can push a light hull right along with good fuel economy. Often they offer moderate-speed action at a slight price advantage, though at present no import goes enough above 100 hp to compete with our big muscle machines.

For our spot checks, we tested two with Japanese innards and American names—the Mariner, a line like Mercury that is a division of Brunswick Corp., and Spirit, marketed by Arctic Enterprises. Both are now available in some states; both are intended to go into national distribution. Both, like other imports we have tested in the past, proved to be good performers with emphasis on rugged workhorse qualities and lower rpm and speed.

But performance may not be the payoff. Overseas builders have been used to selling to the commercial fisherman or back-country boatman who does his own maintenance and repairs. Americans expect corner service station service for their cars and boats. Outboard importers in the past have failed when they set up no parts and service network. Shop the imports—if they offer what you want, from a dealer you can trust. **PM**

MARINER



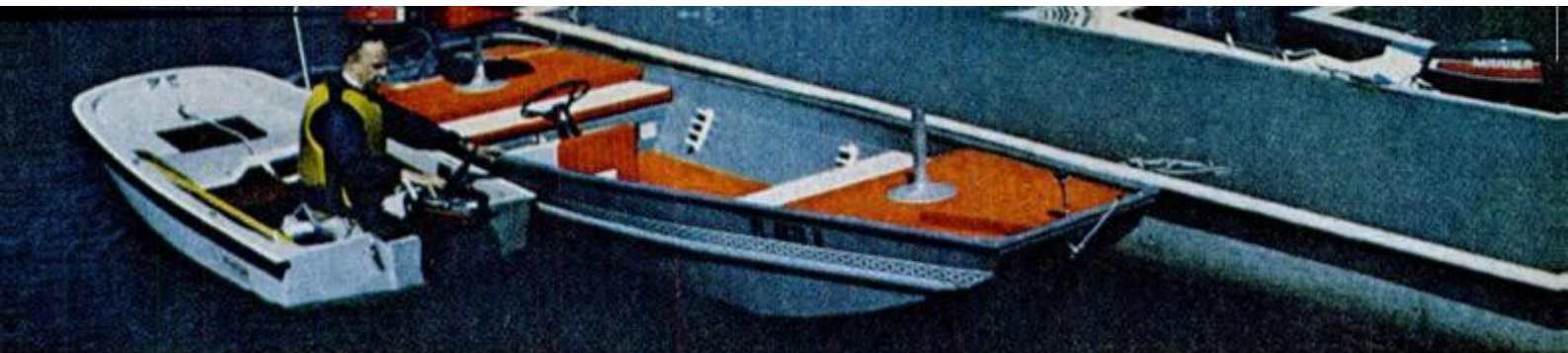
Plenty of performance is packed into the Mariner 14-outboard line that now runs from 2 up to 140 hp and is soon expected to be available nationally. At Brunswick's Florida marine test base, we pushed this little Fletcher runabout to a healthy 41.4 mph through the quarter-mile traps with a Mariner 60-hp motor.

SPIRIT



PM photos: Jim Elder

Spirit provides a pick of nine horsepower ratings, plus accessories ranging from a backpack motor cover-toter (left) to a Heavy Hauler trailer for your boat as well. The 4.5-hp unit (above) mounts convenient extra shear pins inside a flip-down door in the cowl enclosure. A camouflage-color protective cover is also available for this and other small models. Horsepower range includes 2, 4.5, 5, 9.9, 16, 20, 25, 50 and 65. The larger motors provide the popular options of electric start, long and short shaft lengths, and CD ignition with surface-gap sparkplugs that decrease fouling and lengthen plug life. Anti-electrolysis zinc anodes are standard on all Spirit models.

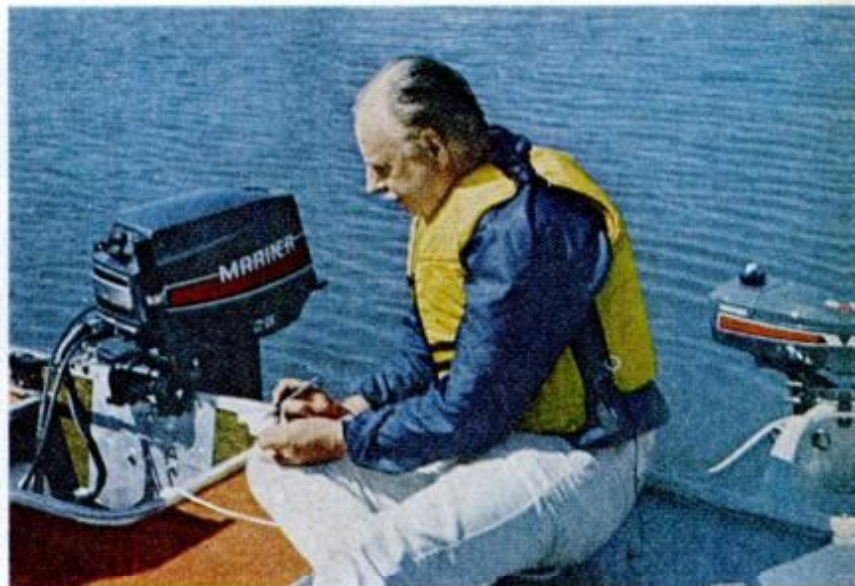


Pick a pram or dinghy, bass or johnboat, runabout or utility—a Mariner power range is designed to fit it.

PM photos: Gene Wagner



Under a hood with American styling, the Japanese motor shows good engineering from both sides of the Pacific.



Two models proving popular in the Mariner line are the 28-hp workhorse (at left) and the little 2-hp (right) for small craft.



Topping out at 65 horses, the newest and biggest of the Spirits offers a long shaft, electric starting, emergency stop switch and lively performance from the Suzuki mill installed under the hood.

Providing power for Coleman's slick new canoe, a Spirit 2-hp mill has enough push to speed the canoe along or even flip it.

Midrange models in 15-inch and 20-inch shaft lengths showed good acceleration during runabout performance tests. For the larger engines, a rubber slip clutch replaces shear pin holding prop choice.



New shapes and styles for RV camping

Added inside comforts, outside colors accent the latest rigs.

by Bill McKeown
OUTDOORS EDITOR

Hi-top Swinger Sport Van from Georgle Boy has 6-foot, 2-inch headroom, cab-over and convertible dinette bunks to sleep four.



Holiday Rambler's 32-foot motor home for '78 offers rear or center bath, icemaker,

microwave cooking, garbage disposer, color TV, roof deck with artificial turf.



A MTP Half Cab from Minnesota Truck Products, Cokato, Minn., converts a Chevy Blazer, GMC Jimmy, Dodge Ramcharger or Plymouth TrailDuster to a short-box pickup for part-time work.



Americans aren't about to give up the advantages of mobile camping, but they're now shopping more selectively. RV manufacturers, as a result, are building in more fuel economy, more conveniences and appliances, more comforts in a compact package.

PM's preview of the new models for next year shows a number of rigs developed from vans. Champion, in its Trans-Van, has found a way to drop the floor inside the back door so that there is standing headroom in the rear galley. Fleetwood's Santana Surfer mounts a picture window in the middle of the left-hand side. Cobra's Supreme Series van conversion provides the expansive looks of a capped van in a newly styled raised-roof model sleeping four adults. A full-sized cab-over bed fits over the driver's seat.

Interior fittings are becoming more elaborate, and a number of smaller minihomes now include miniature bathtubs and shower arrangements. Four-wheel drive and diesel engines are additional options, with heavy-duty suspension. **PM**

New Santana Vancampers (left) and van conversions (right), like the Surfer, Chuckwagon and Station Wagon by Fleetwood, have four-wheel drive and chassis options from Dodge, Chevrolet, Ford and GMC.



vantage of Starcraft's '78 Galaxy camper trailer featuring a galley that hinges out.



Customized colorful vans join the camping recreational vehicle big leagues with the Winnebago Hustler below. Additional models include Continental VII, Chaparral and Sportsman's Den vans with plush interiors.

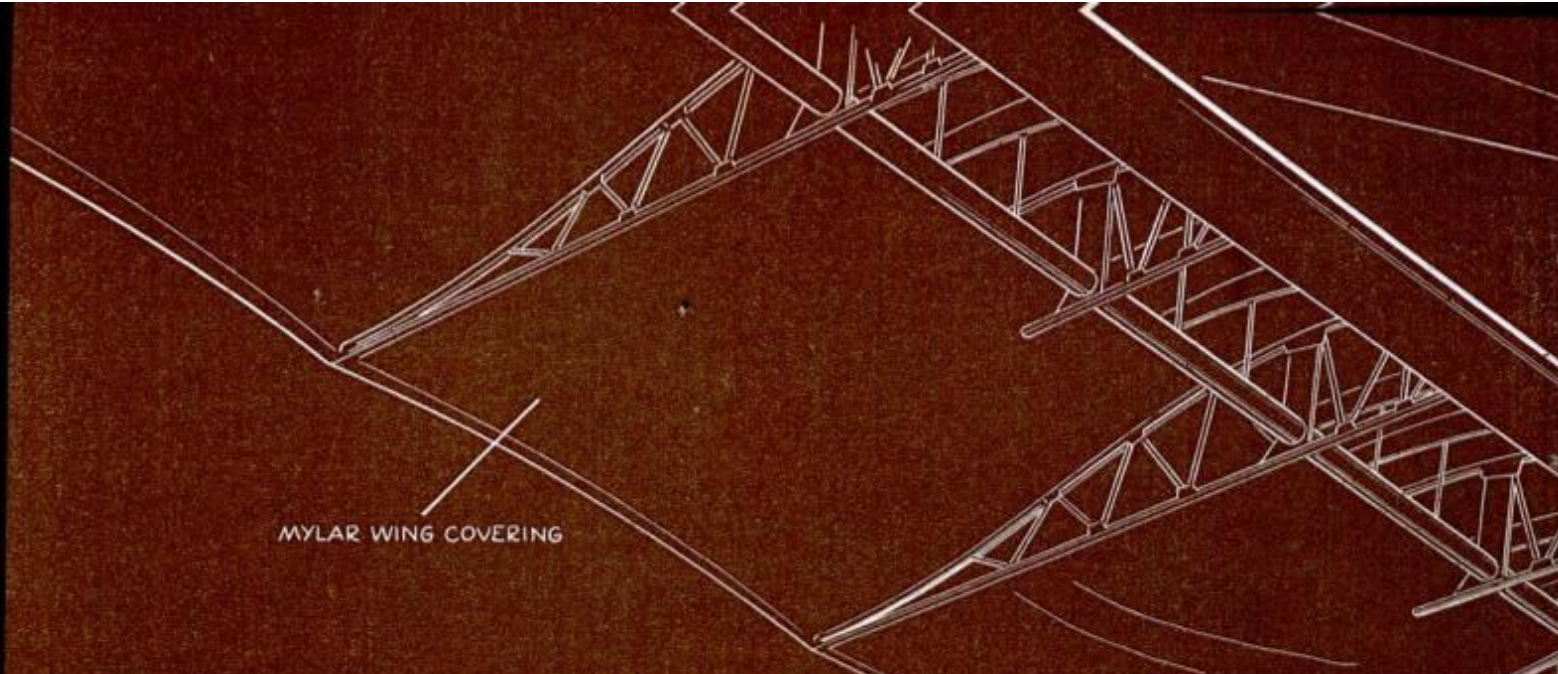


With the low lines of a van, yet standing headroom in the rear galley, the Trans-Van by Champion provides for easier garaging.



Newest from extensive line of Fleetwood Enterprises are Jamboree Rallyes, 17 to 22 feet, sleeping five.

Материал защищен авторскими правами



MYLAR WING COVERING

EXCLUSIVE PILOT REPORT: **I PEDALED THE MILE TO AVIATION'S BIG PRIZE**



They said it couldn't be done—and for nearly 20 years it wasn't. Now an American team has captured the long-sought \$87,000 award for the first practical man-powered flight. Here pilot Bryan Allen, shown at left, gives an exciting first-person account of the record-breaking feat.

by Bryan Allen
as told to James Joseph

My heart was pumping 90 rpm . . . and so were my feet, with bike racer's cleated shoes clamped to pedals that, through a chain drive, were spinning the prop behind me.

Just ahead loomed the course's final marker. Suddenly, a voice punched through the sweltering cockpit's plastic-film skin:

"Ten feet . . . Climb to 12! CLIMB!"

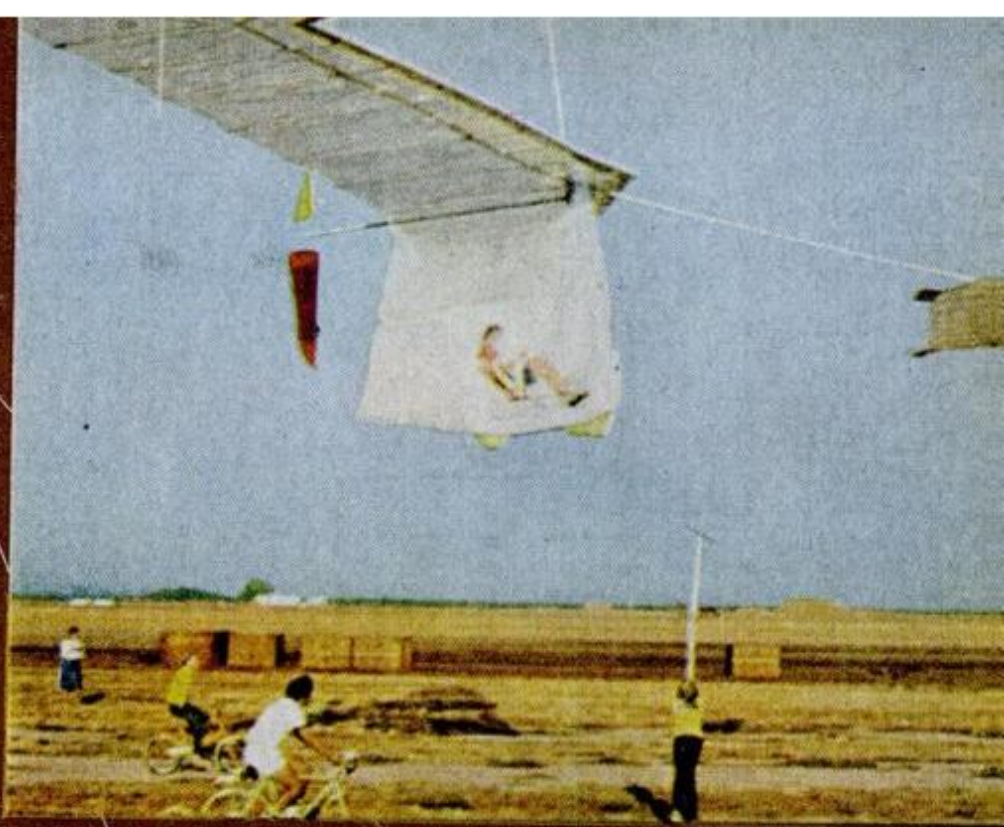
My outrider, bicycling on the ground there below me to call out my altitude, was warning me. To make it . . . to pass over that final 10-foot marker, I had to climb higher . . . another foot, two feet . . . better three.

Those final sweat-soaked moments were a blur of sound and motion . . . as, with the chain drive's

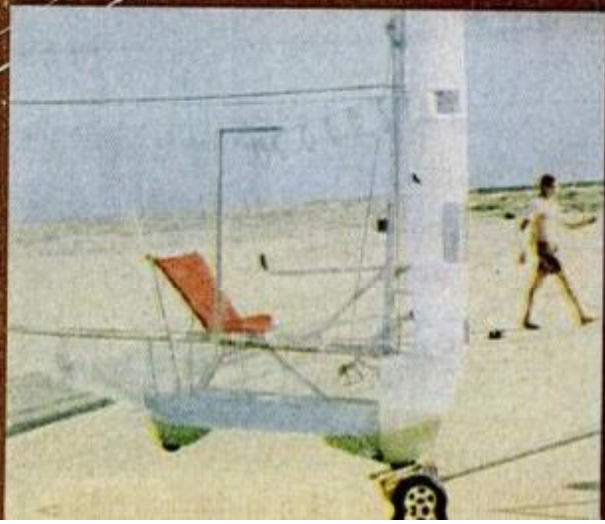
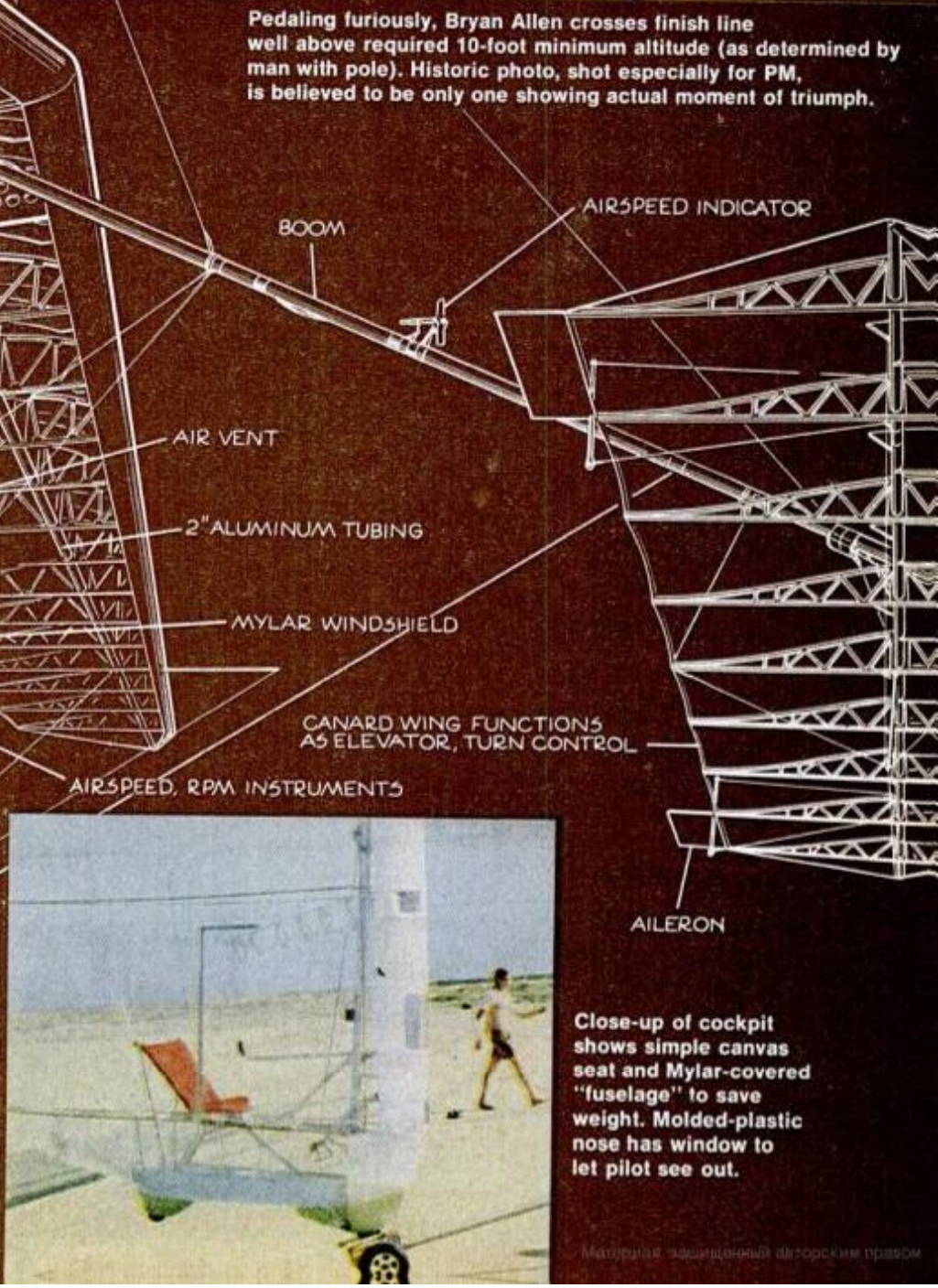
loud whirring around me and the pedals' clacking now an eerie drumbeat, I speeded up my pedaling . . . from 70 rpm to 75 . . . to 80 . . . past 85 to 90 rpm. Now the prop behind me, geared with a 19-percent step-up, was turning 107 rpm. I saw the marker was coming on fast. Quickly, with my left hand, I shoved the control stick up. Out front, through the clear-plastic windshield, *Gossamer Condor's* control airfoil—22 feet long and shaped like a wing with two big flaplike ailerons hinged to its trailing edge—tipped upward. Gently, *Condor* lifted. We were climbing . . . gaining a foot, then another . . . altitude enough to clear that final marker.

"We're going to make it. Wow!" I said to myself, scarcely believing

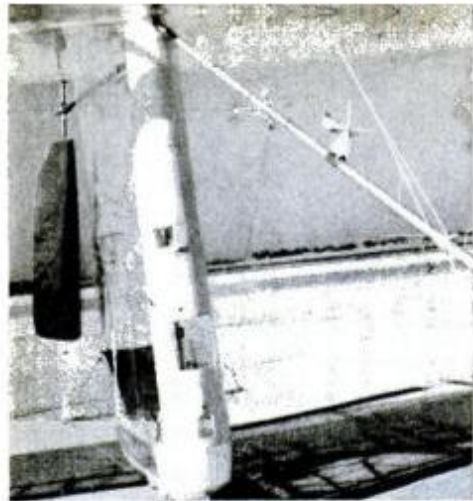




Pedaling furiously, Bryan Allen crosses finish line well above required 10-foot minimum altitude (as determined by man with pole). Historic photo, shot especially for PM, is believed to be only one showing actual moment of triumph.



Close-up of cockpit shows simple canvas seat and Mylar-covered "fuselage" to save weight. Molded-plastic nose has window to let pilot see out.



Slimness of fuselage—only 20 inches—is emphasized in head-on view. Opening above windshield is air intake to cool pilot.

it. I was almost too exhausted, in those final triumphant seconds, really to understand: *Gossamer Condor* and I were but a wing's length from history.

Suddenly we were over it. With two feet to spare, at least, we cleared the marker. Man, for the first time in all history, had flown far enough under his own power to achieve a meaningful feat.

During the 6-minute, 22.05-second flight, beginning just after 7:30 a.m. on Aug. 23, 1977, the huge but fragile *Gossamer Condor*, its enormous 96-foot wingspan belying its featherweight 70 pounds, had passed over the mile-long figure-8 course with 10-foot-high markers at the ends. There,

on a Shafter, Calif., airstrip, it had made two full 180° turns and finished, as it had started, propelled solely by its man-pedaled 12½-foot pusher prop.

A long-held dream comes true

Even as I eased up on the pedals and pointed *Gossamer Condor* to a victorious landing (afterward there would be champagne, TV cameras and press interviews), I was struck by what must be one of history's rarest paradoxes. Thirty years after USAF Capt. Charles Yeager first flew faster than the speed of sound (1947); eight years after Apollo astronaut Neil A. Armstrong became the first

(Please turn to page 164)

AND THEN THERE WERE SOME THAT DIDN'T MAKE IT . . .

Dozens of attempts have been made down through the years to produce and fly a practical man-powered aircraft, but few succeeded—and none until the *Gossamer Condor* achieved the ultimate goal of winning the elusive, long-standing Kremer prize. Some of the daring but dubious challengers are shown here.

One of the most promising contenders was the British *Jupiter* (upper left, below). With the huge wingspan and graceful lines of a high-performance glider, it had a pedal-driven pusher prop above and behind the cockpit. While it reached "colossal" altitudes of 30 feet, it had difficulty turning, was sensitive in wind, and failed to fly the required one-mile distance. It made a number of valiant tries, survived several crashes but never quite attained victory.

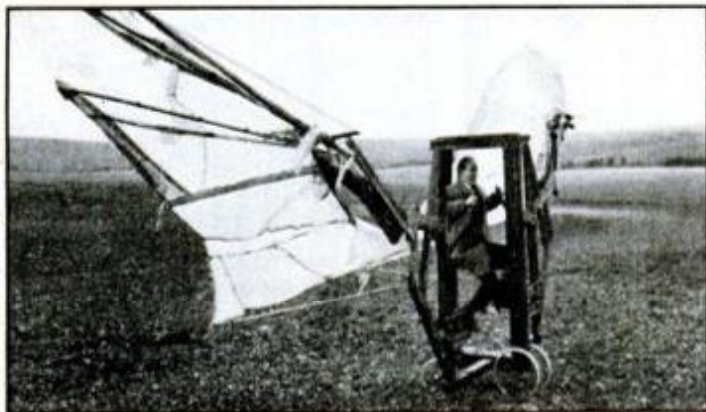
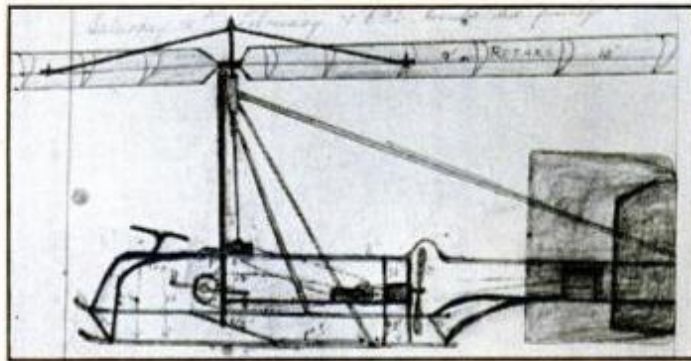
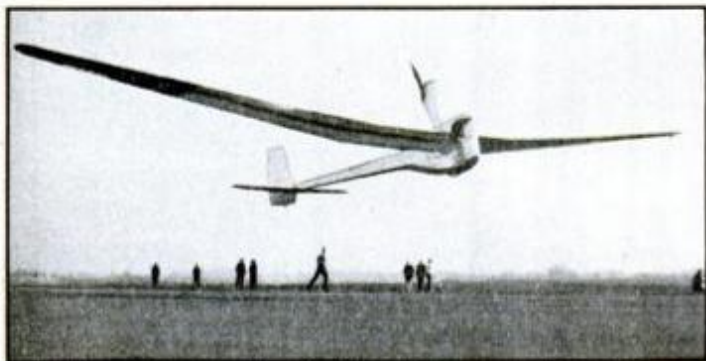
No man-flight contest would be complete without wing-flappers, and there

were many of these to be sure. The two here were designed by Mike Dolling of Swindon, England. He hasn't as yet had much luck but still insists there is a future for man-powered planes that fly like birds, wagging their wings instead of spinning propellers. At lower right, Mike's son comes to a violent, though harmless, end while attempting a precarious downhill launch. Muscle power just wasn't enough, he reports, to move the hinged wings up and down at a suitably brisk rate. At lower left, Mike himself sits at the controls of his later batwing model—more efficient, he believes, than bird-shaped wings, a deduction some birds might think questionable.

By madly pumping handles—like those on old-fashioned drinking wells—Mike flaps the weird-looking, multi-jointed bat wings through a complicated arrangement of levers, cranks,

pushrods and pivot links. On its first "flight," the contraption did a neat wing-over onto its side—unfortunately without leaving the ground. Still, Mike is convinced the rig will eventually fly.

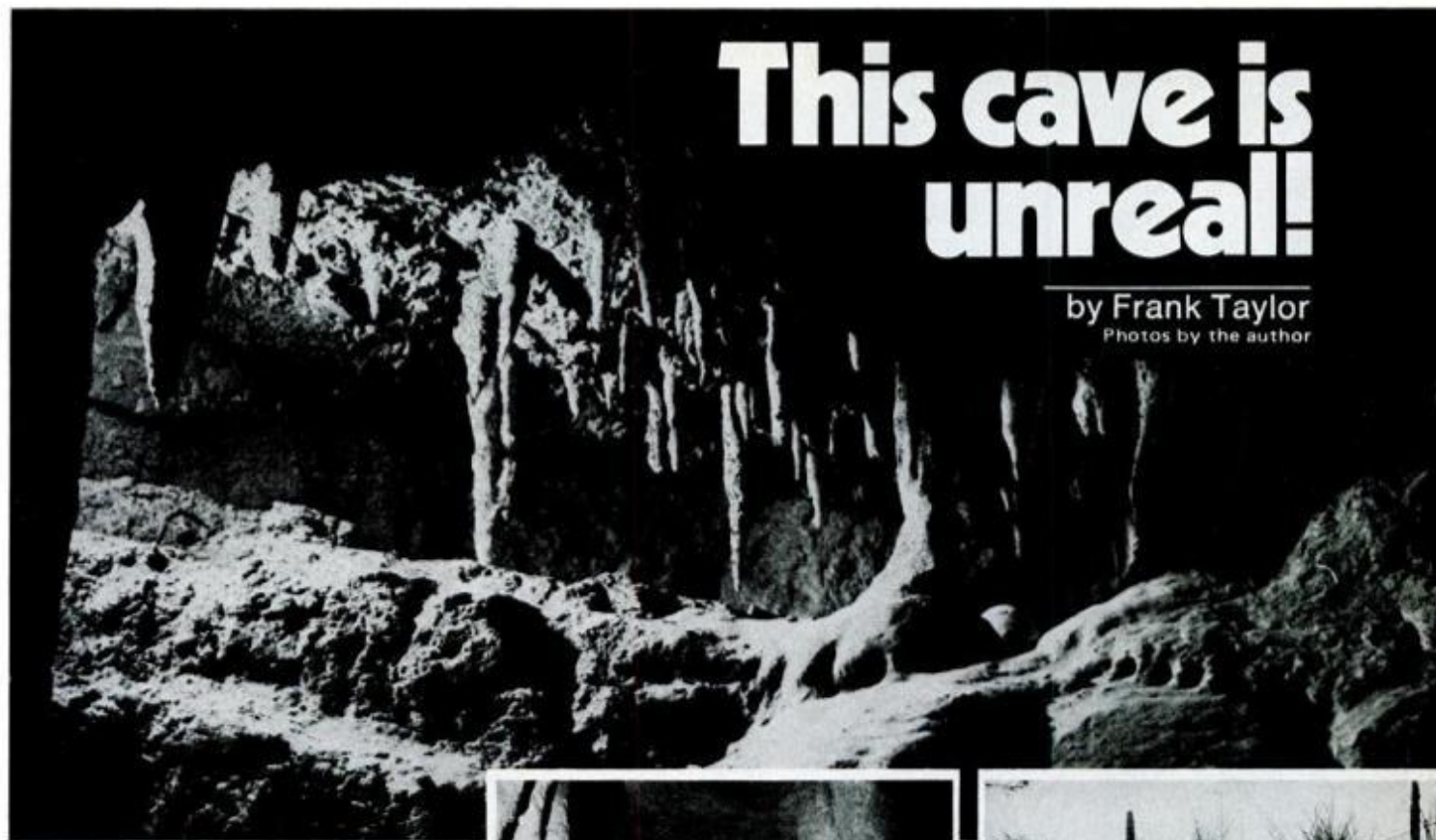
But the award for the most ambitious scheme should probably go to a Rhodesian inventor who came up with the pedal-powered helicopter shown in the drawing at upper right. Called the *Limba VI*, it sports a rotor for lift and a prop for forward propulsion, both powered through a somewhat vague chain drive. There's also a rather mammoth rudder, presumably to offset rotor torque as well as provide directional control. (The "VI" in the *Limba VI* name stands for the sixth in a series of similar designs of which all five previous versions proved predictably unspectacular.) So far as is known, No. VI has yet to get off the drawing board, let alone the ground.



This cave is unreal!

by Frank Taylor

Photos by the author



They're all here—everything you'd expect in the weird subterranean world of a mammoth cavern. Dagger-tipped stalactites hang from above. Stumpy stalagmites grow up from the floor. Water drips dankly from the roof. Salamanders scurry among the ancient remains of prehistoric creatures and caveman campfires. Rushing streams spill into glistening pools, while darkened passages lure daring explorers.

It's a strange, spectacular wonder, but strangest of all is that it's not real—it's entirely man-made. Located in desert wilderness near Tucson, Ariz., the artificial cave is the latest addition to famous Arizona-Sonora Desert Museum and Stephen House Congdon Memorial Earth Sciences Center. Why *build* a cave? Museum curators wanted one as an educational exhibit, but none existed nearby. Also, by constructing their own, scientists could incorporate many more features than would be found in any one natural cave.

The main chamber is 25 feet high by 30 across with a labyrinth of additional rooms and twisting trails stretching off in all directions. Wire mesh, crumpled foil, plaster, fiberglass, Styrofoam—even soda straws and pipe cleaners—are among materials ingeniously used to create the eerie, unearthly effects. So authentic are the results that an early group of visiting geologists refused at first to believe the cave was not real—and a few with picks even tried to take home samples! **PM**



Cave entrance, nestled into a desert wash (above), is built up of genuine limestone; interior is simulated limestone to match that of a natural limestone cave. At left, youngster explores one of many deep, dark, exciting passages in subterranean maze. The man-made cavern took two years to complete, cost about \$1 million.



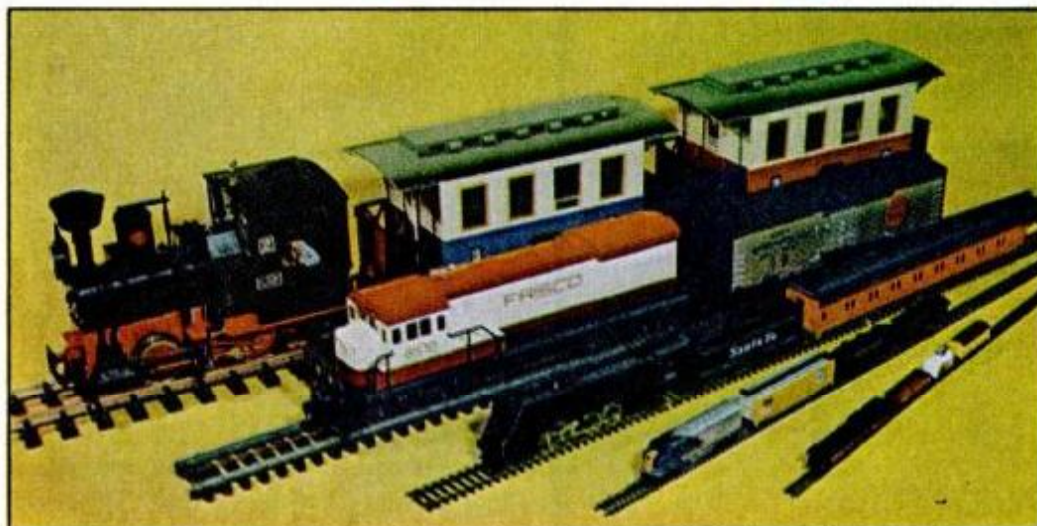
Working with meticulous care, museum artists carve realistic stalagmites from Styrofoam (left) and shape plastic compound around soda straws to form stalactites (right). Hidden behind removable wall panels are pumps for water control, wiring for floodlights.



Transistorized throttles like this TAT IV pioneered by electronics expert Linn Westcott provide smooth starts and stops, separate brake controls, many other advanced features.

Photo: Linn Westcott

ELECTRONIC MODEL *Highballing the way*



New electronic controls work with any model-train gauge. From left to right are G, O, HO, N and Z. For more on gauges and how to pick the best size for your needs, see page 106. G-scale equipment shown here is from Frederick and Nelson, Seattle, Wash.; rest from Dow's Hobbies, also Seattle.

PM photo: Ken Brooks

Sophisticated train controls are bringing new fun to an old pastime with a fascinating array of new equipment you can add to any layout; you can even run 10 trains on one track.

by Don W. Hansen

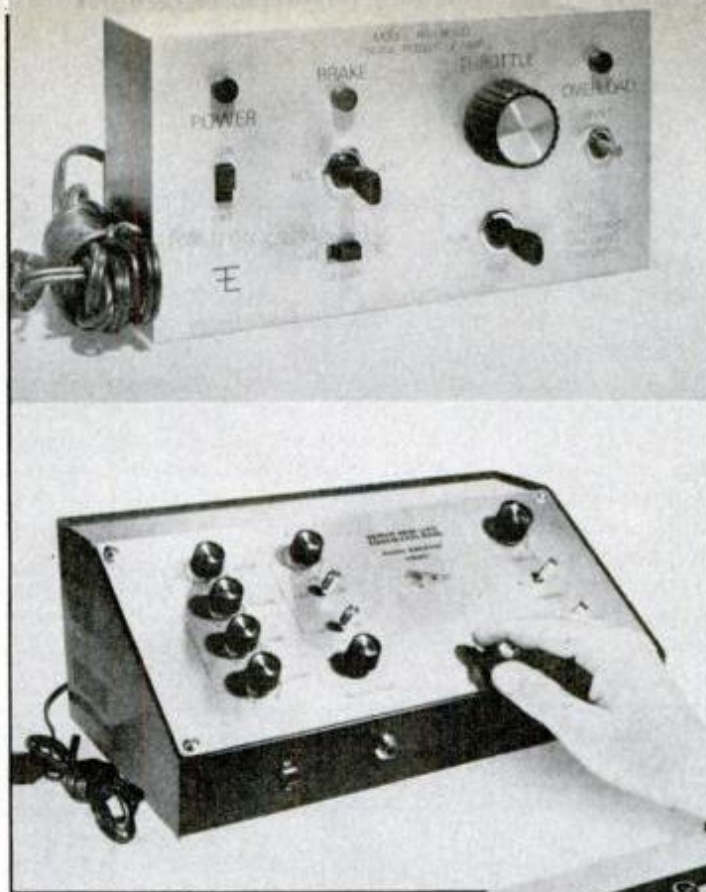
Imagine you're an engineer in the cab of a real locomotive. You advance the throttle to get underway, but there's a lag as the engine strains to overcome the friction and inertia of the massive load you're pulling. Slowly, almost imperceptibly, you start to move, then gradually gain momentum as you accelerate to running speed. You back off on the throttle, set it to "cruise" position and glide gracefully over the rails. Nearing an upcoming stop, you ease on the brakes well ahead—you know it takes a long distance to halt the hurtling mass of a mighty freight or passenger train. Slowing progressively, you come to a smooth, controlled stop at the desired point.

That's real railroading. Over the years, model railroading has achieved a high degree of realism in *appearance*, but it has lacked the same degree of realism in *operation*. Trains lurched ahead in jerky, jackrabbit starts when you applied power, then came to sudden, abrupt stops when you cut power. Lights would brighten as speed increased, dim as power was

RAILROADING: to a new hobby

reduced, then go out altogether when a train stopped. Track signals were more for decoration than actual operation. To run more than one train on the same track, you needed elaborate block-control systems with complex switching arrangements you had to remember to handle manually. Model trains simply didn't run, behave or sound like real trains.

Now electronic controls have changed this. Transistorized throttles simulate realistic inertia and momentum effects for smooth starts and stops. Sophisticated power packs provide separate braking controls in addition to speed throttles. Constant-intensity lighting keeps lights burn-



Photos:
A. L. Schmidt

Luxury-loaded Heathkit (right) offers many handy features: slide-type speed selector, five-position brake, direct or inertia control, both pulse width and frequency settings, separate switches for track, train and loop reversal, remote-control unit.

Smartly designed self-contained controls like these are typical of new transistorized units that combine basic power supply with many slick operating features. Fyffe control (upper left) has pulsed d.c. to simulate realistic inertia, throttle, independent brake, direction selector, and power and overload indicators. A sloped-panel model (at lower left), from Pacific Fast Mail, includes sound controls for whistle, bell and engine chug effects plus throttle and direction selector. Accessory walk-around remote handheld control is also now available.

ing brightly regardless of train speed. Sound generators add bells, whistles, horns—even the chuff and hiss of a laboring steam locomotive. Automatic "command" control systems make it possible to operate up to 10 trains on a single track. And there are other intriguing electronic gadgets: remote-control "walk-around" throttles that let you run a train from any point around a layout, speed indicators that convert scale mph into true prototype mph, track signals that really show whether a track is occupied or not.

The result is that electronics has added a whole new dimension to model railroading—in fact, has cre-

ated a whole new hobby by opening a new area of interest for those fascinated by the magic of electronics.

At the same time, you don't have to be an electronics expert to understand and appreciate the benefits of these new controls—any more than you have to be an electronics expert to enjoy your home TV or hi-fi sets. The systems discussed here are available in ready-made, off-the-shelf hardware, with complete instructions for easy hookup and use. For those who wish to progress into more advanced build-your-own circuitry, there are many fine books at hobby shops and bookstores.

In picking a control, be sure to

study its features and applications carefully—they vary widely in the type and number of conveniences offered; some may suit your needs, some may not. Prices, for instance, range from under \$20 for a simple, no-frills transistorized throttle up to \$300 or more for super-sophisticated units.

Some controls will operate all of the five major model railroading gauges currently in use (see the accompanying article on gauge sizes and how they compare), while other controls are designed for one or two particular gauges. In general, the larger gauges require power packs capable of handling larger current capacities. By far, the greatest number of controls on the market are de-

signed for the three most popular gauges: O, HO and N (they may not have the capacity for larger ones).

Know the power you'll need

In judging a power supply's capacity, don't be confused by statements such as "has power to run six trains." A claim like this is absolutely true, but can be misleading. It means exactly what it says: It has the *power* to run six trains, but it won't *operate* six trains by itself. For this you'll need as many separate throttles (cab controls) as the number of trains you want to control independently.

Most power packs come with one throttle built in. A few—like Model Rectifier's Dualpack—offer twin-cab

(two-train) control, while others provide output connections for adding extra throttles. One interesting transistorized controller—Autopulse from Troller—merely plugs into the a.c. accessory outlet on most power supplies to give another throttle.

Some control systems come in component or modular form—in separate pieces for individual installation. They don't provide a single, self-contained enclosure, but are handy for mounting in your own customized control panel because you can select the units you need now and install additional features later.

Realistic engine sounds

Most sound-generating controls—those that supply bell, whistle and

How to pick the best track gauge for your needs

If you are a newcomer to model railroading, picking the right gauge size for your needs can involve a number of factors—some obvious, some not so obvious. Four of the most important considerations are: 1. Available space. 2. Size and complexity of layout anticipated. 3. Degree of realism and craftsmanship desired. 4. Ages and interests of those who will operate the system.

The main pitfall to avoid is getting locked in on a gauge that will limit you in the future. Many beginners do exactly what you might expect—buy a so-called "beginner's set," often for a child. In time, the desire to expand a layout or get into more elaborate detail may prove the original choice to be wrong. In this respect, model railroading is different from other recreational activities. In most hobbies, it's easy to expand your scope and skills merely by adding new equipment—you don't have to wonder whether you chose the right size to start with. In model railroading, size is all-important to the ultimate enjoyment of the hobby.

Space is perhaps the biggest single consideration. The larger the gauge, the less railroading you'll get in a given

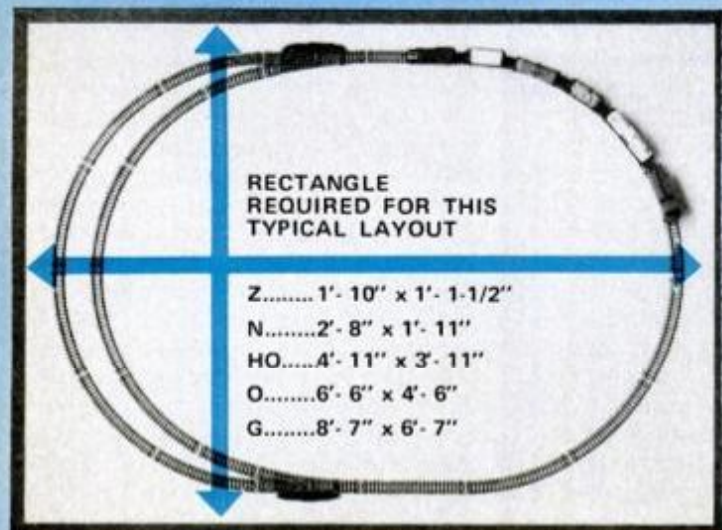
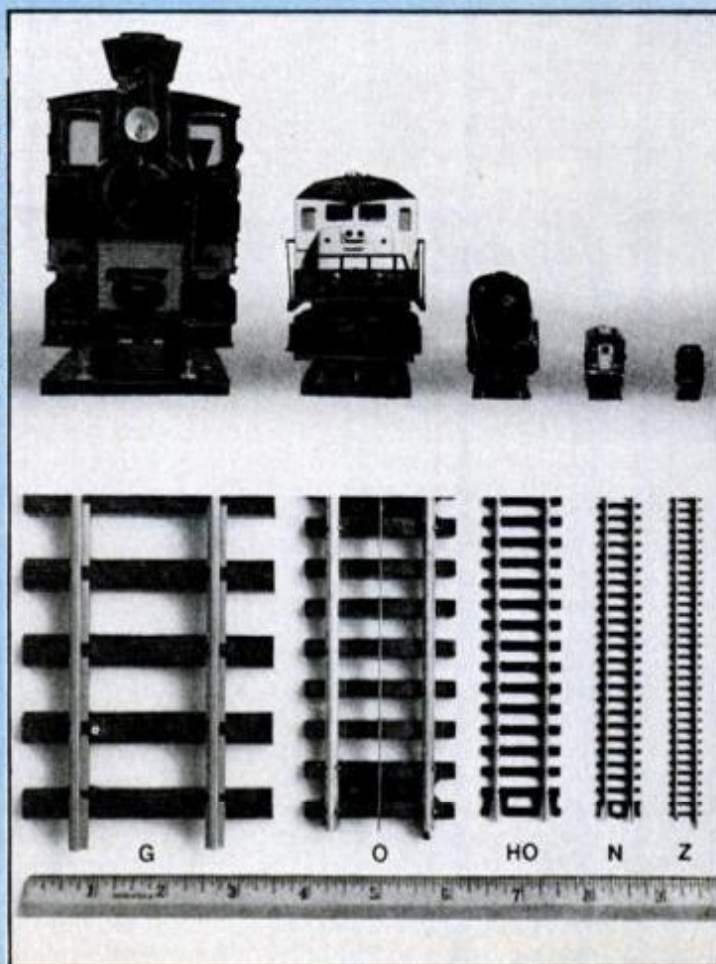
amount of area. Big gauges do have their place, however. If all you want is a simple circle-around-the-Christmas-tree type of layout for a youngster, they're easily handled by small fry and entail minimum investment. They're also fine for the craftsman who's more interested in superbly detailed display models than operational layouts.

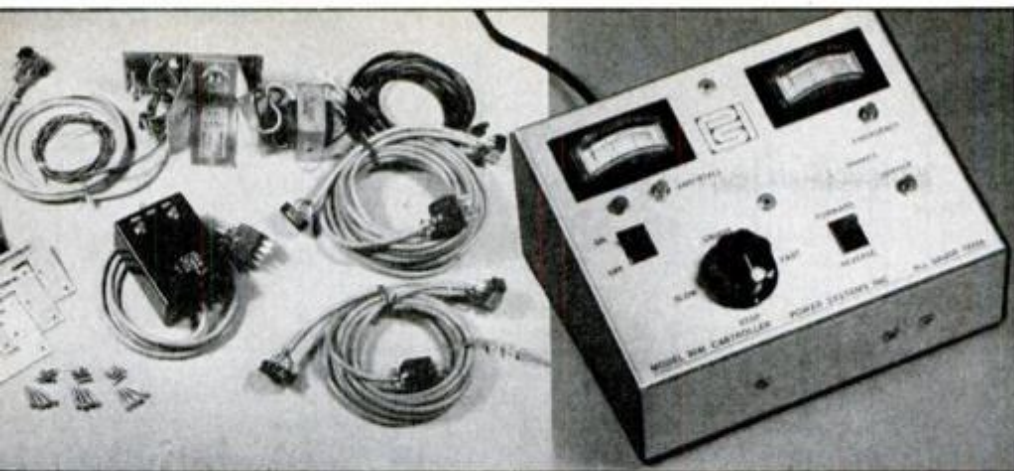
There are five major model railroading scales. Starting with the biggest and working downward, they are G, O, HO, N and

Z, with the middle three the most dominant. There are other scales—S, OO and TT—but these are mainly of interest to scratch-builders as they offer little or no ready-made equipment. For our discussion here we will stick with those gauges for which commercial equipment is easily available over the counter, ready to run.

Incidentally, there is a technical distinction between the terms "gauge" and "scale" that should be made clear. Scale is the proportional ratio between the size

From large to small, five popular model-train gauges are seen at right. Sizes range from G-scale (biggest with 1 3/4-inch track width) down to tiny Z-scale (17/64 inches). Photos depict equipment about one-third actual size. Diagram below gives minimum space needs for a simple oval layout in all five gauges.





Some power packs are available in component form for mounting in homebuilt panels. This Power Systems model comes either way—in cabinet (right) or as sepa-

rate parts (left), including remote walk-around throttle. Parts are handy for customizing a control center, let you easily add throttles, switches, other features.

chuff effects, for instance—are primarily designed for layouts built around steam-locomotive operation. If you're mainly into diesels and electrics, they may not be for you (although some units do offer diesel horns, turbocharger whine, brake squeal and several other general sound effects that are suitable for virtually any model railroading operation).

Fyffe, for example, offers a basic single-cab transistorized throttle control for \$99.95, including a continuous 3-amp., 12-volt output—enough to handle all d.c. locomotive requirements. Their sound generator unit, including one throttle and a variety of sound effects, goes for \$299.95—a significant difference in

of the prototype and the size of the model, such as 1:22 for G, 1:43 for O and 1:87 for HO. Gauge, on the other hand, designates the actual spacing between the running rails on model track, such as 1¾ inches in G-scale down to 17/64 inches in tiny Z-scale. While the two terms are often used interchangeably without great harm, it's wise to at least be aware of the difference—some buff is bound to call you on it if you misuse the terms. Here's a quick rundown on the five most prominent scales . . . or, er, gauges . . . whatever:

■ **G-Scale**, the giant of the group, is a British creation now offered in the United States. Its size and cost limit it to those for whom space and money are no object, or to those who want only a few masterly crafted display pieces. Its charms lie in its magnificent detail and the fact that it can be laid outdoors, rambling picturesquely through stately gardens and over woodland brooks. It is not, however, for the typical basement or playroom layout.

■ **O-scale** offers two-way possibilities—you can go either simple or elaborate. In off-the-shelf hardware, it is the most toylike of the five and is frequently the choice for children. It's moderately priced and easy for small fingers to handle, but its size—still large by comparison to other gauges—limits it to fairly simple layouts. On the other hand, for the skilled craftsman who wants to modify existing equipment or build his own, O-scale's spacious dimensions permit the creation of awesomely handsome reproductions.

■ **HO-scale** (half-O) is the hands-down favorite for a number of reasons. Its intermediate size—big enough to provide good detail, yet small enough to fit in limited space—makes it appealing to both beginner and buff. Equipment ranges from inexpensive ready-to-run train sets, through kits for building your own, up to exquisitely hand-crafted all-brass masterpieces costing hundreds of dollars.

HO offers the widest variety of locomotive types, rolling stock, layout accessories, compatibly scaled scenery and scratch-builders' supplies. It's an ideal

gauge for father-son operation because it can be handled by a reasonably nimble youngster, yet provides the realism and sophistication necessary to satisfy an adult enthusiast. By far the choice of most serious model railroaders, it outsells all other gauges by a wide margin.

■ **N-scale**, a relative newcomer from Europe, is still limited in the type and variety of equipment it offers, but is slowly growing in popularity. Despite its size—

smaller than HO—many of its items are beautifully detailed. Its main appeal, however, lies in lots of railroading in limited space at relatively low cost. Piece for piece, it's the least expensive of all five gauges.

■ **Z-scale**, so tiny a standard paper clip won't fit between its rails, is so far exclusively European in origin and character. Its jewel-like quality is a watchmaker's

(Please turn to page 176)

HOW MODEL RAILROAD GAUGES COMPARE

DESIGNATED GAUGE OR SCALE	G	O	HO	N	Z
PROPORTIONAL SCALE	1:22	1:43	1:87	1:160	1:220
DIMENSION BETWEEN RAILS	45 mm. 1¾"	32 mm. 1.26"	16.5 mm. 0.65"	9 mm. 0.35"	17/64"
STRAIGHT TRACK-SECTION LENGTHS	300 mm. 600 mm.	12" 4"	9"	5"	4-3/8"
RADI OF SECTIONAL CURVED TRACK	125 cm. 155 cm.	24"	15" 18" 22" *	9¾" 11" 19" *	5¾" 7¾"
AVAILABILITY OF LAYOUT ACCESSORIES (right-of-way)	FAIR	FAIR	EXCELLENT	GOOD	POOR
AVAILABILITY OF LAYOUT ACCESSORIES (city or country)	POOR	POOR	EXCELLENT	GOOD	POOR
TRACK COST PER LINEAL INCH (approx.)	31½¢	6½¢	5¢	4¢	14¢
SWITCH COSTS (remote control) (approx.)	** \$30	\$7	\$6	\$5	\$16
AVAILABILITY OF LOCO AND CAR PARTS AND KITS	POOR	FAIR	GOOD	POOR	POOR
AVAILABLE STYLES	EUROPEAN ONLY	AMERICAN ONLY	WORLDWIDE	AMERICAN AND EUROPEAN	EUROPEAN ONLY

* Longer flexible track sections available.

** Costs will vary according to type of retail outlet.

Note: Cost-ratios of locomotives, cars and equipment are roughly proportionate to track and switch cost-ratios.

cost depending on the type and number of sound effects you want.

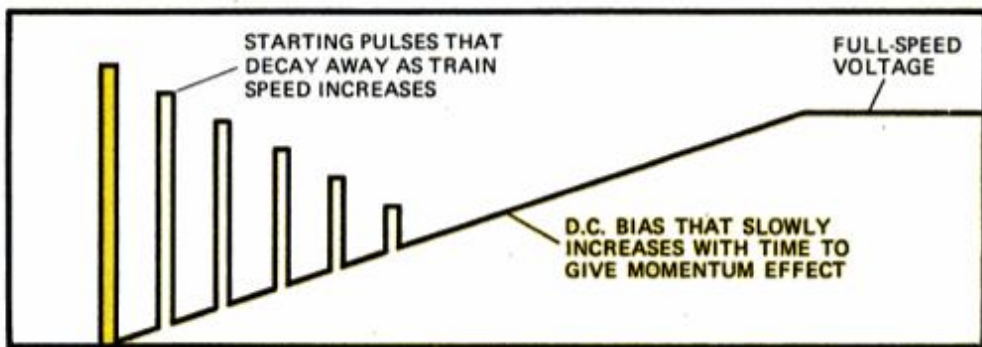
One feature you may want to check when purchasing a train control is the number of reversing switches it supplies. Most power packs offer at least one reversing switch, usually marked "forward" and "reverse." This refers merely to whether a train is moving forward or backing up. It does not take into account the fact that a train can be progressing eastbound or westbound (clockwise or counterclockwise, depending on your layout plan). A control needed to set up this situation, generally known as a *track direction* switch, is different from a forward-reverse switch.

Reversing switches are important

While the purpose of reversing switches is merely to reverse the polarity of current going to the track, it is useful to have separate switches to control different functions. An eastbound train backing up would require the same track polarity as a westbound train moving forward—but the two would be doing completely different things, and trying to handle both with the same reversing control would obviously be awkward and difficult. The object is to have separate controls for separate operations—even though both may do exactly the same thing.

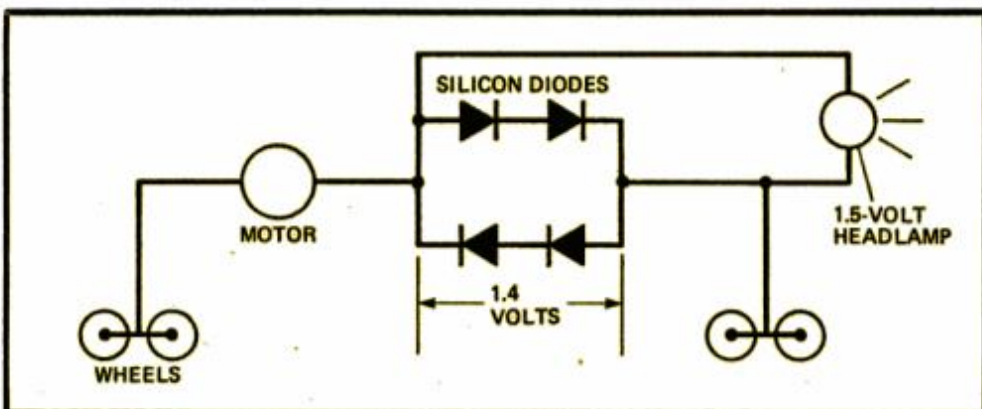
Watch out for reversing loops

Another control you may want to look for is the so-called "reversing-loop switch." Ultimately, in almost any model-train layout, you will eventually encounter what is called a reversing loop. Reversing loops are very sneaky. They crop up at the most unforeseen places and often aren't detected until a red light on your control panel flashes suddenly,



Action of typical transistor throttle is diagrammed above. Starting current is applied in pulses (vertical bars) to over-

come friction, provide smooth, nonjerky starts. As speed increases, pulses decay away, locomotive motor runs on pure d.c.



Constant-intensity lighting is made possible by silicon diodes that feed steady voltage to headlamp—just enough to keep

it lit—regardless of track voltage. All voltage above this level is "dropped" across engine motor to control speed.

indicating you have a short circuit.

What happens is that, whenever you have a curve of track bending back on itself, you have created a reversing loop. If you make a rough sketch on paper, it won't take long to discover why this occurs. Mark one rail "plus" for positive and the other one "minus" for negative. As the loop doubles back on itself, it's easy to see that what was formerly the negative rail suddenly meets up with the positive rail of the opposite side of the loop and vice versa—in other words, a dead short. The answer, depending on your own layout, is an isolated section of track within the loop itself or within the track following the loop that can be changed in polarity to match that of the oncoming train before disaster strikes.

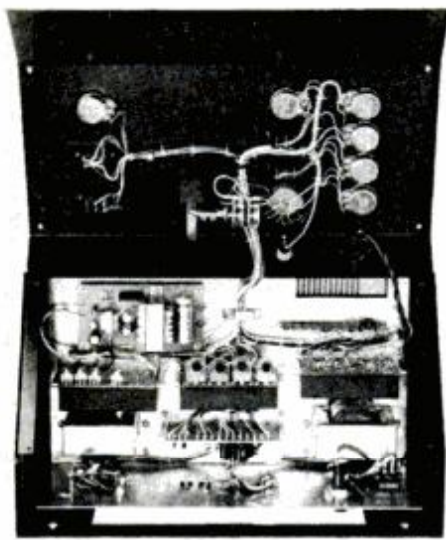
Reversing-hoop switches are easy to add at any time—they're just double-pole, double-throw switches wired to reverse track polarity when their toggles are thrown—but it's nice to have at least one as part of your basic power pack to control main-line reversing-loop problems.

Heath's kit-built power pack (for \$79.95) offers all three reversing switches—for forward-reverse, track direction and loop reversal—along with other controls such as multi-position braking (service, emergency and release) and a separate plug-in walk-around portable throttle controller. If you're interested in

walk-around throttles, check if they are or will be available; some are here; some are being advertised as "coming."

Probably the most popular electronic circuit used by model railroaders is the transistor throttle, which is superior to a conventional rheostat-controlled throttle because

(Please turn to page 170)



Complexity of modern electronic controls is typified by maze of wiring in Pacific's whistle-bell-hiss-chuff sound generator.

SOURCES FOR ELECTRONIC CONTROLS, PARTS AND KITS

- Alphatronics, Box 17, Alpha, Ohio 45301.
- Barney and Associates, Inc., 103 West Fifth Ave., Pittsburg, Kans. 66762.
- Caldera Enterprise, 2481 36th St., Los Alamos, N.M. 87544.
- Fyfe Electronics, Box 178, Laguna Beach, Calif. 92652.
- Heath Company, Benton Harbor, Mich. 49022.
- Janssen Enterprises, Box 7206, Menlo Park, Calif. 94025.
- Loggers Supply Co., 69 Northbridge Dr., St. Joseph, Mo. 64506.
- Mars Models, Inc., 10414 Northfield Rd., Northfield, Ohio 44067.
- Model Rectifier Corp., 2500 Woodbridge Ave., Edison, N.J. 08817.
- Modeltronics, 14000 Long Ridge Rd., Los Catos, Calif. 95030.
- Pacific Fast Mail, Box 57, Edmonds, Wash. 98020.
- Power Systems, Inc., 56 Bellis Circle, Cambridge, Mass. 02140.
- Raytronics, 14293 Esther Dr., San Jose, Calif. 95124.
- Scott Hobby Systems, Box 2117, Stamford, Conn. 06906.
- Tri-Delt Electronics, Box 7403, San Diego, Calif. 92107.
- Troller Corp., 3910 West Montrose Ave., Chicago, Ill. 60618.
- Walthers, 4050 North 34th St., Milwaukee, Wis. 53216.

How to protect your car against the cold

You'll breeze through the winter if you do the right things to immunize your car against the deep freeze just around the corner

by Mort Schultz

A study done by the Champion Spark Plug Co. tells us that the number of engine starting failures reaches a peak in winter.

Big deal. Any school kid could have told you that.

But do you know that almost consistently the number of winter starting failures in severely cold Quebec, Canada is less than it is in the warmer southern Atlantic states? Well, it is.

How come? Canadian cars aren't any hardier than ours, so the answer must lie with the fact that 43 percent of the drivers in Quebec are giving their cars a prewinter tune-up, while only 20 percent of the drivers in the southern Atlantic states do the same.

Across the board, the Champion study shows that, where maintenance is practiced, the starting trouble is lowest. In New England, for example, 32 percent of those surveyed winterize their cars and 22 percent have starting failure. Conversely, in seven states taken as a group—Minnesota, North and South Dakota, Missouri, Kansas, Iowa and Nebraska—25 percent of the group surveyed perform prewinter maintenance and 26 percent of them have trouble.

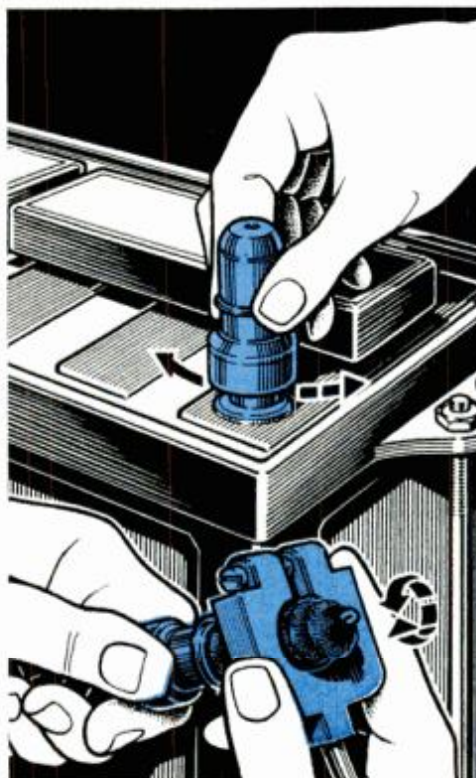
Trying to avert a mechanical problem is just one reason for winterizing a car. Another is to minimize hazards to safety.

To try to touch all the bases in this article—so you don't miss anything when you go to work winterizing your car in the next week or two—we have literally charted a course for you to follow by listing what should be done. Information accompanying each task will allow you to do the work more competently or more easily.

Of course, you may not have to do everything we suggest. It depends



Use charger, if necessary, to bring your battery up to full charge for winter starting.



Your battery can't deliver if terminals and posts aren't clean. Use a wire brush.

on what services you had done in the last couple of months. For instance, if you've just tuned up the engine, you shouldn't have to do it again. However, going into winter with an ignition system which hasn't been serviced since last winter is inviting trouble.

Battery checks

- Replace a battery that is cracked or has eroded terminals.
- Before testing with a battery hydrometer, add water if the electrolyte level is low and give the battery a high-rate charge for 30 minutes or drive the car for a few hours.
- A difference of .050 or more specific gravity points between high and low readings signifies a bad battery. Replace it.
- Remove the battery and scrub it with diluted ammonia or baking soda solution. Flush with water, being sure the vent caps are tight and covered with tape. Clean the battery carrier, too.
- If the battery shows less than full charge (that is, an overall specific

gravity of 1.260), charge it on a slow-rate charger.

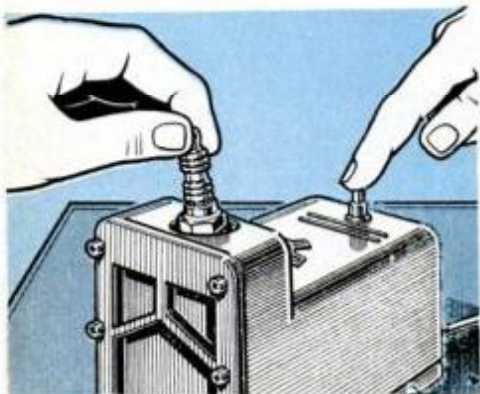
■ Ideally, a sealed battery should be load-tested to determine its condition. However, in the absence of a 300-amp. load tester and voltmeter, refer to the battery's built-in charge indicator, which provides an indication of battery condition.

Service battery cables

■ Replace cables having split or frayed insulation or badly eroded terminals.

■ Disconnect cables using a terminal puller, if necessary. Clean terminals with a wire brush.

■ Reinstall cables, tightening terminals to posts securely. A chief cause of hard starting is improperly secured terminals. If you have a problem getting a terminal to bottom on the battery post, place a wrench socket of suitable size over the terminal and *gently*, very gently, tap the terminal down until it won't go any more.



Sparkplugs should be checked for wear, sand-blasted clean and gapped for winter.

Clean or replace sparkplugs

■ Sparkplugs with worn electrodes, broken insulators or damaged shells should be replaced.

■ Sparkplugs with minimum electrode wear can be cleaned, regapped and returned to service.

Replace distributor parts

■ Replace any part—cap, rotor or coil—that shows damage or a sign of damage. "A sign of damage" would be a trail of carbon inside a distributor cap, which signifies a crack.

Servicing the distributor

■ If you have to replace breaker points, replace the condenser, too.

■ If new points aren't needed, pass a fine-cut ignition file through the old points one time to clean them before setting gap.

■ An oily smudge on contact points may indicate a clogged PCV system that has caused vapors to be forced into the distributor.



Remove the distributor cap and rotor and clean and inspect them thoroughly.

■ Make sure that the condenser and primary wire insulation is in one piece. A bare wire can ground out and bring the engine to a dead stop. See that wires are secured firmly to terminals.

■ If your car has electronic ignition, it has no points and condenser. Setting dwell is not necessary. Setting ignition timing is.

Examine secondary cables

■ Replace cables if insulation is cracked, split or brittle.

■ Make sure that cables are firmly seated in the distributor and coil towers and on sparkplugs. "Though lack of contact is involved in most road calls, the problem in most cases is loose wires rather than a defective system," FoMoCo says.

Service air and fuel filters

■ Shine a light inside the air filter. If the filter is very dirty, replace it. If it's not too dirty, dislodge particles by slamming the filter on a hard surface.

■ Replace the fuel filter as often as this is stipulated in your owner's manual.

Set automatic choke for winter

■ Do this only if the engine becomes hard to start when the weather turns and all other bases have been touched. If the choke is adjustable, turn it one notch at a time to the



Clean or replace the distributor points and replace the condenser as necessary.

"rich" side. See if starting gets better.

Service the cooling system

■ Drain and flush, if necessary.

■ Inspect hoses and test the radiator pressure cap.

■ Add ethylene glycol antifreeze in the proportion necessary to bring protection against freezing in line with the lowest anticipated temperature in your area. *Important:* Use top-quality antifreeze.

■ Inspect drive belts. Replace if cracked or frayed. Adjust if necessary to bring them to adequate tension— $\frac{1}{4}$ to $\frac{1}{2}$ -inch play when pressed midway between pulleys. (For more details on cooling-system-upkeep, see *Saturday Mechanic* for Aug. '77 and Sept. '77.)

Lubricate

■ Change oil, if necessary. Drivers in most of the country should select a 10W-30 or 10W-40 motor oil. Where temperatures are consistently between 20° and below 0° F a 5W-30 motor oil may be necessary. If you decide to use a single-viscosity oil and your owner's manual says to use 10W because of the low temperature where you live, avoid sustained high-speed driving.

■ Grease the chassis and body points. Shoot some powdered graphite into door locks to try to avert frozen locks.

Get tires in shape

■ Mount snow tires (are they in good shape?), storing the tires you've removed in a clean, dry, cool and closed area away from water, petroleum products, electric motors and heat sources. Place tires on their sidewalls on a flat surface—don't stand them on the tread. Place white sidewall tires whitewall-to-whitewall, one on top of the other to protect the white rubber. If tires remain mounted on wheels, reduce inflation to 12 to 16 p.s.i.

■ If you buy new snow tires and want metal studs, now's the time to get them. The depth of the stud holes molded into winter tire treads and the lengths of studs are carefully matched. In even a few miles of travel, tire treads wear enough, and fill with enough dirt and grit, to disrupt the stud hole-stud relationship. Only new or newly retreaded tires should be studded, if the law in your state permits studded tires.

■ If snow tires were not mounted in storage and are to be put back on wheels, the assemblies should be balanced.

■ Maintain recommended air pressure and check it often. Do not re-

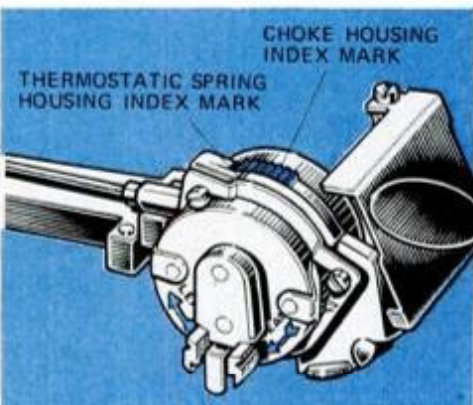
duce inflation pressure to increase traction. Goodyear says that this is a fallacy "for underinflated tires get less of a grip on slippery surfaces."

Test brakes

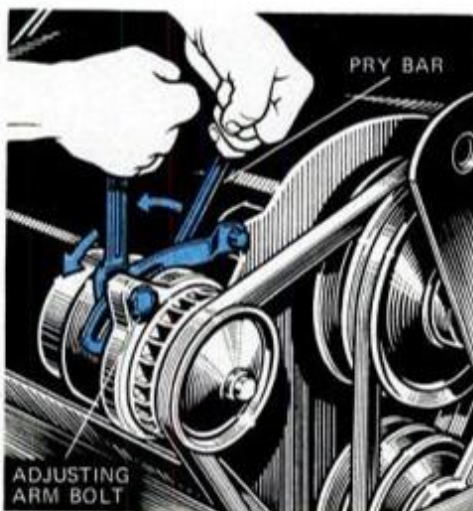
■ See that the fluid level in the master cylinder is no less than $\frac{1}{4}$ inch below the top of the reservoir's lip.

■ Test the hydraulic system for leaks by pressing down on the pedal with the engine running. The pedal should be firm and not fade.

■ If lining (pad) thickness has not been examined in 12,000 miles, remove one front wheel and one rear wheel and do it now. You should



Choke adjustment is especially important in the winter for proper cold starts.



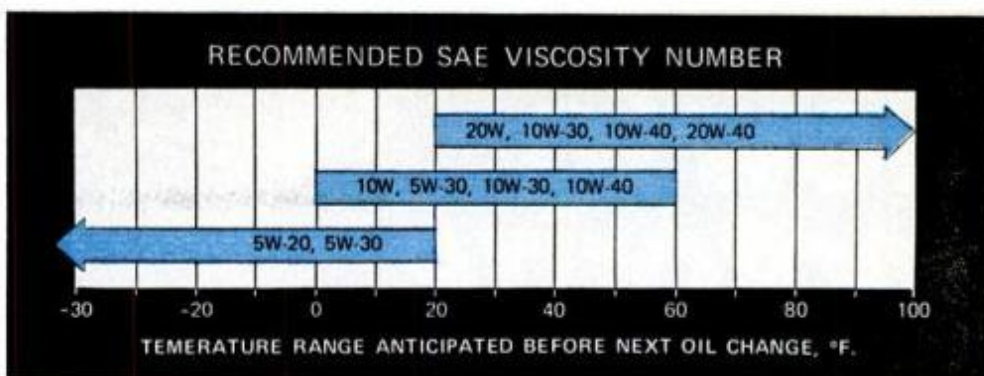
Proper drive-belt adjustment is necessary for generator or alternator operation.

have no less than $\frac{1}{32}$ inch of lining thickness left. *Important:* If you have to replace the linings (pads) of one wheel, replace the linings of the other wheel on the same axle. Failure to do this will result in unequal braking.

Check visual equipment

■ Replace windshield wiper blades if the rubber feels flabby rather than firmly resilient or if blades don't sweep water cleanly away.

■ Make sure the windshield washers



Multi-viscosity motor oils cover wide ranges of temperature as indicated by this chart.

work and that nozzles are aimed to squirt water over the area swept by wipers. Nozzles may be bent to aim them properly. If nozzles are clogged, clear the stoppage with a thin piece of wire.

■ Fill the windshield washer reservoir. If your area is subjected to freezing temperatures, the fluid you use should be an antifreeze type. *Caution:* Make certain the label on the container of antifreeze you buy assures you that the product is harmless to paint. If it doesn't, don't use the product.

■ Check to see that all lights and warning signals are working. If one isn't, find out why and fix it.

■ Are defrosters working properly?

■ Test the horn. It may be needed to get you out of a sticky situation one of these winter days.

Other checks to make

■ The exhaust system should be in good shape. There should not be any evidence of holes or rust. Accidental carbon monoxide poisoning cases are more numerous in winter than at any other time.

■ See that the heater works and throws out enough warm air to make you comfortable.

■ Get winter emergency equipment out of storage and into your car if it isn't already there. This should include a good ice scraper, shovel, extra emergency flares and tire chains (if you use chains). *Important:* If you place extra weight in the rear to attain better traction, make sure it's placed over or ahead of the rear axle. According to Goodyear: "Weight behind the rear axle can reduce vehicle stability and front-wheel traction."

Some extra cold-start tips

Once your car is all checked out and ready to go, chances are in your favor that the engine is going to start. But there's always the possibility of a sudden, severe cold snap that could hamper starting. Here are a few extra tips that may help the situation:

■ Don't pump the accelerator pedal.

Doing so will send raw gas into the cylinders that will tend to flood the engine on a cold day.

■ If the engine does flood, turn off the ignition key. Hold the accelerator pedal to the floor (do not pump it) and turn on the ignition, cranking the engine in five-second bursts. Don't overdo this since you don't want to add a dead battery to your trouble. If the engine won't start



Windshield-washer fluid must be winterized for lowest anticipated temperatures.

after a reasonable number of five-second bursts, allow it to remain idle for 5 to 10 minutes. Then try it again.

■ If the weather is severely cold for a sustained period (like it was last year), a 75 or 100-watt light bulb kept burning under the hood will help keep the temperature of the battery high enough so it will provide a good kick in the morning.

■ If you live in really cold country and oil tends to gel overnight so engine cranking is sluggish, you should use a dipstick heater. The heater slides into the dipstick tube and is plugged into house current.

■ Whenever you start a car, keep all lights and accessories turned off. The engine stands a better chance of getting going if it doesn't have to share current with other parts.

How to motorize your bicycle

Turn it into a 'moped' by adding a friction-drive helper motor.

by Bill Hartford
AUTO EDITOR



Photos by the author



BikeBug engine from AquaBug International mounts on Schwinn Suburban 10-speed in a few steps (see facing page).

Ever try to pedal a moped? You can do it, but it's difficult—and surely it isn't any fun. The chain-driven, 50-cc moped is—make no mistake—a mini motorcycle meant to go with gas, and if that's all you want, fine. But if you enjoy bicycling pleasures too, the way to go is 10-speed with a helper motor.

There's nothing new about motorized bicycles. The first "moped" goes back to 1904 (see *Detachable Cycle Motor*, page 1136, Nov. 1904, or check the photo of this machine shown in our 75th anniversary issue, page 73, Jan. '77).

The idea of using an add-on motor seems to capture the imagination of each new generation of pedalers. Indeed, this century has seen many types of bicycle motors come and go, and has seen the bicycle itself—the most efficient form of transportation known—refined to the point that any normal, healthy rider can gobble up an unprecedented number of miles per calories.

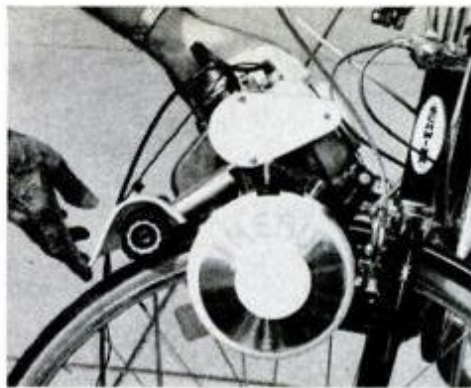
The bike

For our "Project Moped" we started with a Schwinn Suburban 10-speed. For upright riding position, comfort and versatility, we selected the women's model with tourist handlebars. It's a '76 model so doesn't have the Shimano Front Freewheeling (FF) system of the '77s. (Don't motorize an FF machine because it would be annoying to have the chain-wheel revolving constantly.)

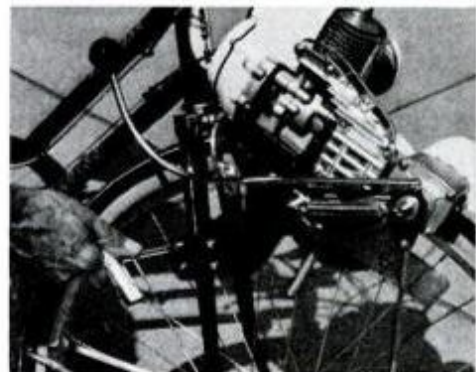
The \$150 Suburban with front and rear caliper brakes was our choice, but any bike will accept the front-wheel-drive motor we installed.

The motor

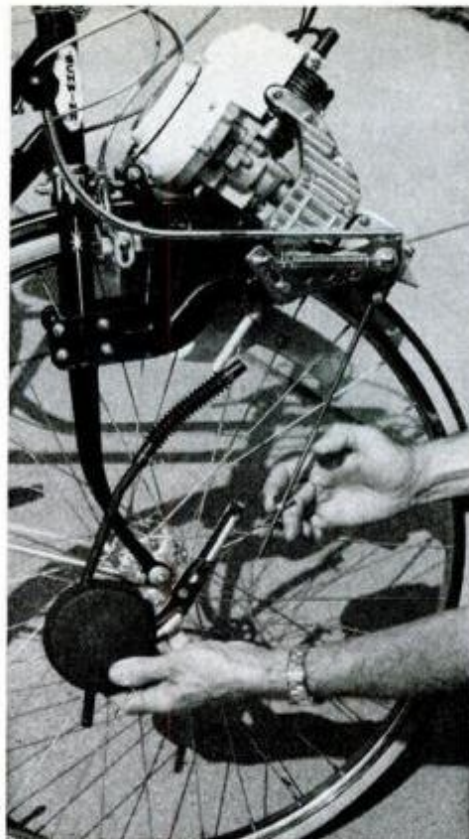
Designed to clamp onto the front fork of your bike without interfering with the front fender or brake calipers, the BikeBug is an impressive 22-cc engine and drive unit. We ordered the BikeBug QBM-23 engine from AquaBug International, 100 Merrick Rd., Rockville Centre, N.Y. 11570 (\$170). Another QBM-23 dis-



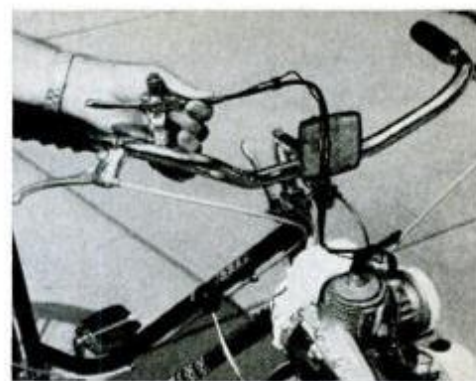
Slip motor into position with clamp brackets over the front fork of the bike.



Tighten the rubber-faced clamps on the front fork with the tool provided.



Support rod adjusts the roller $\frac{1}{4}$ inch over tire and also positions muffler.



Clamp throttle lever/kill switch to the handlebars in a convenient position.



Fill fuel tank with liter of gas/oil mix (25:1) and then get ready to ride!

tributor is TAS Industries, 12728 N.E. 15th Pl., Bellevue, Wash. 98005.

The high quality of the BikeBug is apparent as soon as you unpack it. An example of well-thought-out design is the rubber-faced fork clamps (I thought for sure I'd have to fashion my own from an old inner tube). Instructions are thorough.

We mounted the air-cooled motor in a few minutes, as shown, topped off the tank with a liter of gas/oil (25:1)—good for 50 miles, easily.

Underway

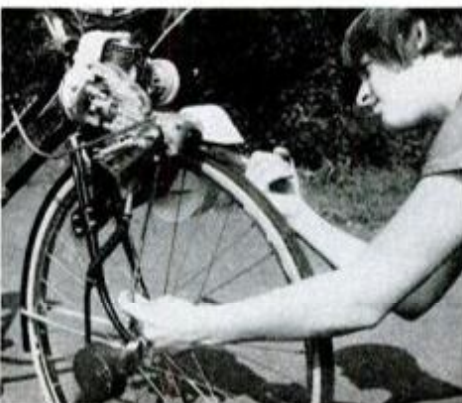
Pedal up to a few miles per hour, pull the engagement lever to drop the driving roller against your front wheel and—*voila!*—you're on your way. With 1.39 cu. in. putting out .8 hp, you can cruise about 15 mph. (We don't plan to do it, but if you remove the governor, engine power is boosted to 1.2 hp and top speed to 24 mph.)

At first we were alarmed at how rapidly the grooved rubber drive roller was wearing, but it is designed to shape itself to your tire quickly and then wear itself instead of the tire. It never slipped or spun during our tests which included pulling a Can-nodale Bugger bicycle trailer with two kids on board. The BikeBug puts an extra 15 pounds on your front fork, but is easily manageable.

With 150 miles under power on our Project Moped we're convinced that there's no better way to go *motoring* and *pedaling*, too. **PM**



To start the BikeBug, lift the engagement lever which lowers the rubber drive roller against your front tire. Engine starts with throttle at idle; choke is automatic.



Wingnut on support rod adjusts roller on wheel. Replacement rollers are \$12.50.



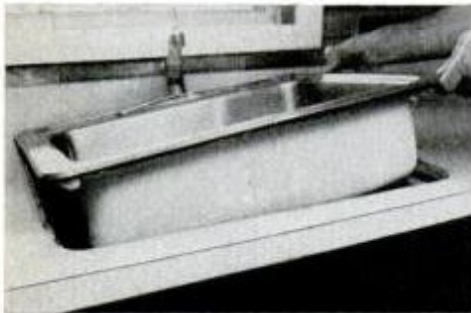
The sign doesn't say anything about bicycles not being permitted, does it?

A new ceramic-tile countertop... right over the old one

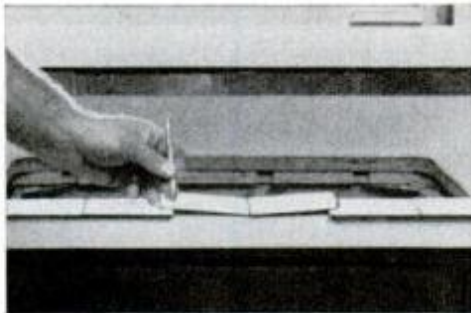
A tiled kitchen countertop, the kind that's popular on the West Coast, is a real touch of luxury. It's not as hard a project as you might think, because the tile can be installed over existing high-pressure plastic laminate.

Materials used were 4¼ x 4¼-in. matte-glazed Tuscany ceramic tile in pure white (it's not advisable to use a "bright" glazed tile—it will scratch too easily), nonsanded grout in Renaissance Brown and AO 1800 adhesive—a type that's suitable for tile application over a variety of surfaces and offers prolonged resistance to water. All are products of American Olean Tile Co., Lansdale, Pa. 19446.

The water-cooled saw and hand cutter are specialized, expensive tools—they are priced in the neighborhood of \$150 and \$425, respectively. But they can be rented by the day, and if you rent either one, the job will go faster. **PM**



1 Start by removing sink (and any other drop-in fixture) from the counter.



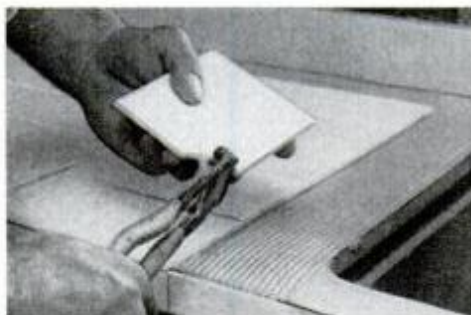
2 Lay out edge tiles with full pieces in corners; adjust center widths.



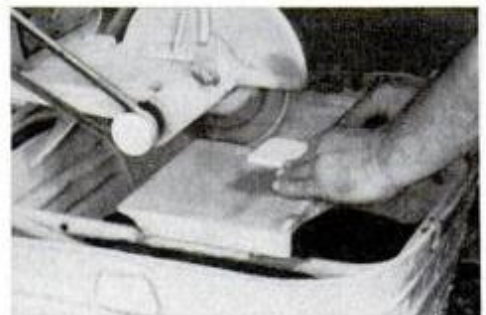
3 Apply suitable adhesive (see text) and spread it evenly with a notched trowel.



4 Install tile along edge with ¼-in. overhang so it will top off edge tiles.



5 Use nippers to shape tile to irregular contours such as sink corners.



6 Make straight cuts for opening edge with water-cooled saw or hand cutter.



7 Install additional tile, cut to meet edge wherever it's necessary.



8 Tiles on backsplash exceed its height by ¼-in. to allow for edge tiles.



9 Strips for backsplash top can be made with hand cutter, shown scoring tile.



California-style tile countertop has dark grout for crisp but warm look. Technique also camouflages stains.

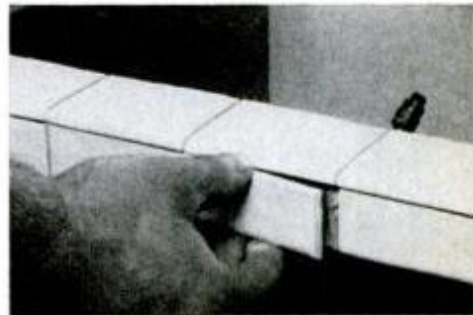
PM photo: Bob Golden



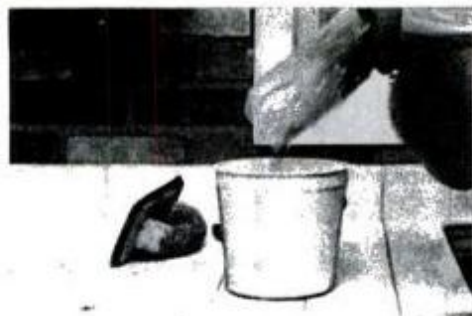
10 Scored tile breaks cleanly under pressure on both sides of cutting line.



11 Strips butt against the backsplash tiles to form a square corner.



12 Edge tiles adhere better if you let adhesive air-dry for a few minutes.



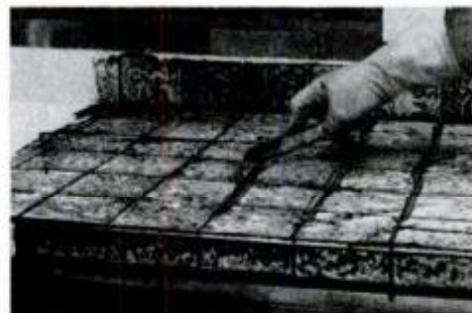
13 Next day is best for grouting. Start by pouring dry grout in mixing pail.



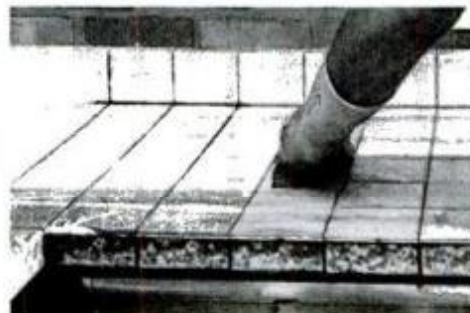
14 Then mix the grout with water according to manufacturer's directions.



15 Spread grout liberally over all tiled surfaces with a rubber-faced trowel.



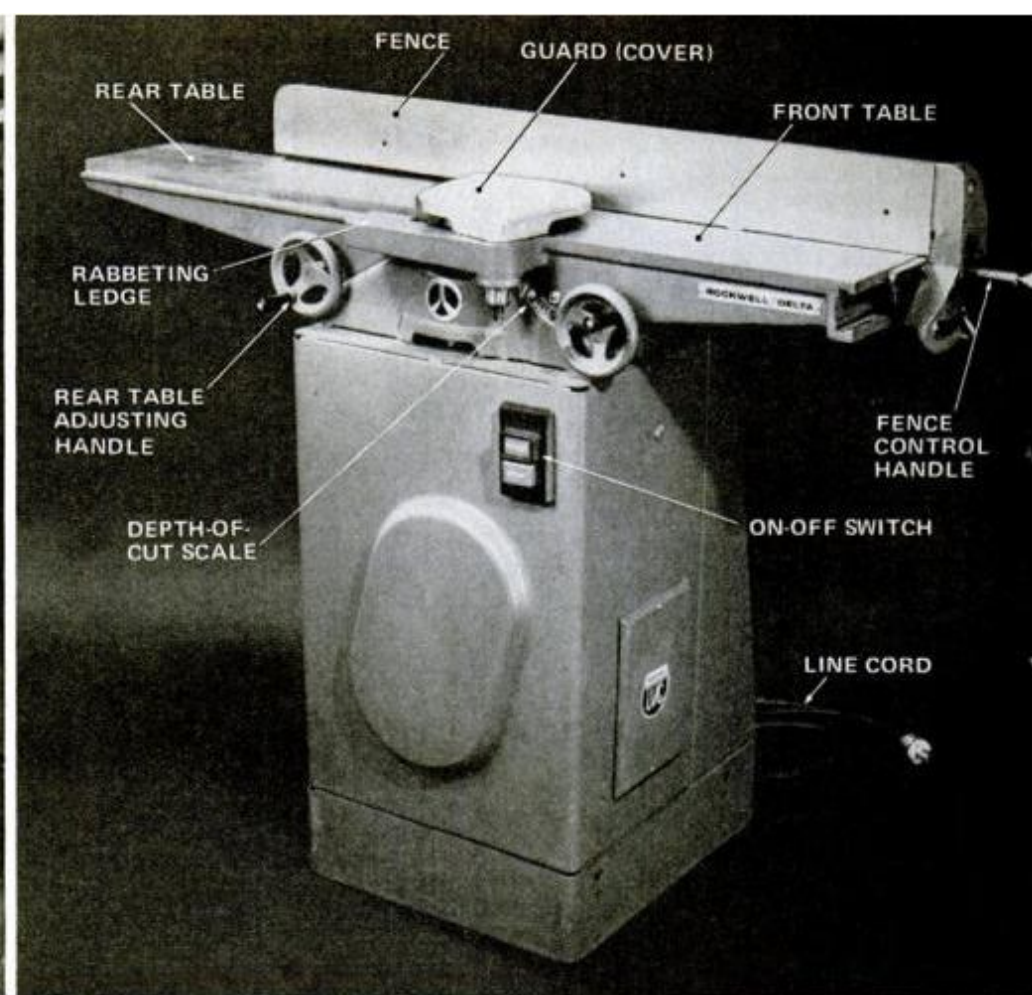
16 Strike joints—press grout into them—with a wood or plastic striking tool.



17 After short wait, wipe excess grout off tile surfaces with a wet sponge.



18 Polish tile with a clean, dry cloth, then reinstall sink and job is done.



Jointer, with its principal parts named above, can save hours for furniture builders.

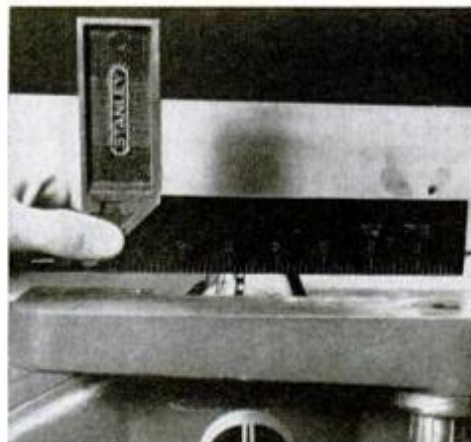
How to use a jointer

Sooner or later, a serious woodworker has to buy a jointer and learn to get the most from it. Here's how.

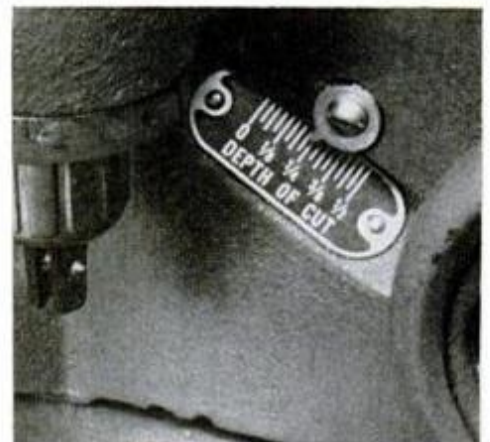
by Harry Wicks
HOME AND SHOP EDITOR

In simplest terms, a jointer is really nothing more than a motorized plane. The difference is that a hand-plane job which might take 15 arm-wearing minutes can be accomplished on a jointer in a minute or so—and, in all likelihood, with a far smoother finish.

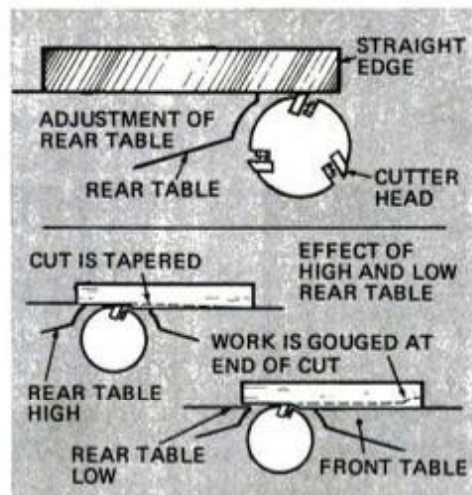
Your degree of success with a



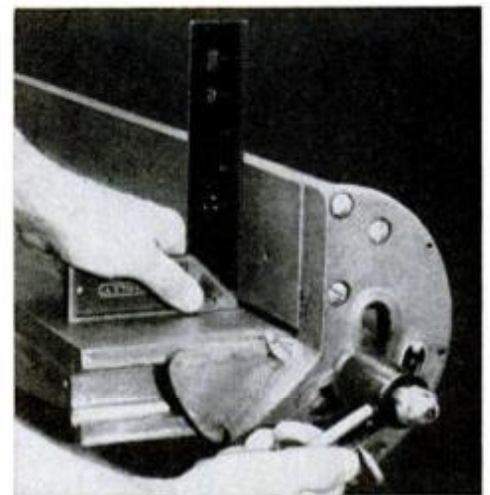
Accurate work is assured when the rear table is level with the cutterhead knives.



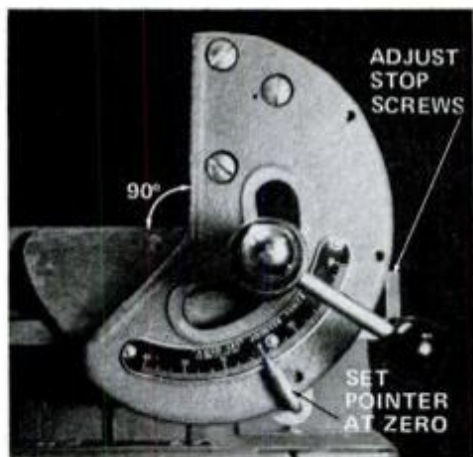
Depth-of-cut scale should be checked periodically to make sure it is accurate.



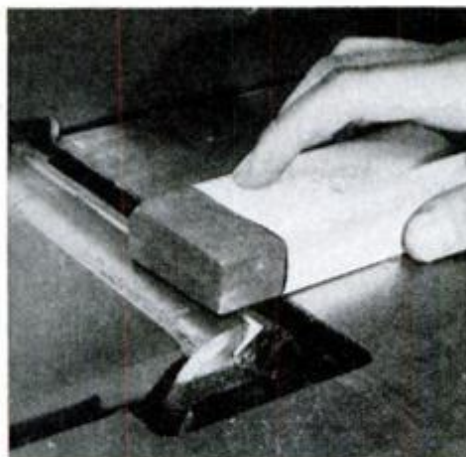
Workpiece will be ruined if the rear table and cutterhead knives are not aligned.



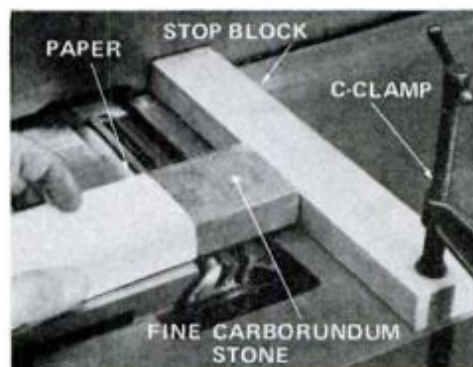
Fence should be locked at exactly 90° to table and pointer on scale set to 0°.



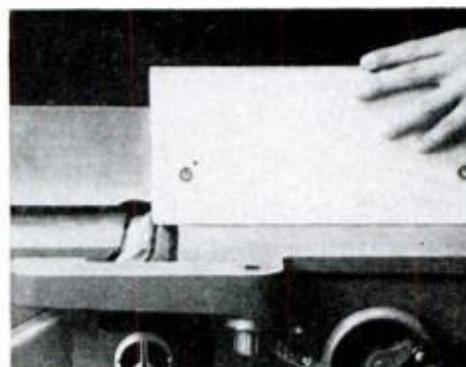
Fence on this jointer has stop screws which permit a fast change to 45° angle.



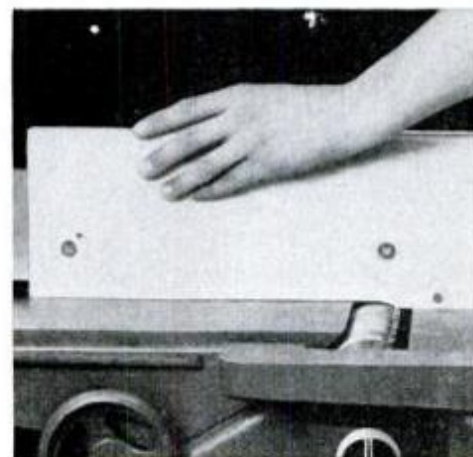
With plug pulled, blades can be honed as shown; belt must be clamped to stand.



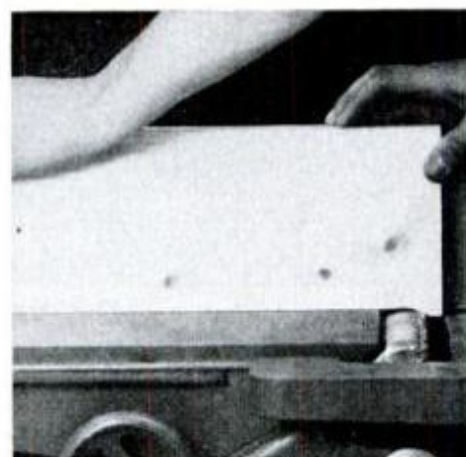
Blades are jointed with cutterhead revolving; for safety, stop block is a must.



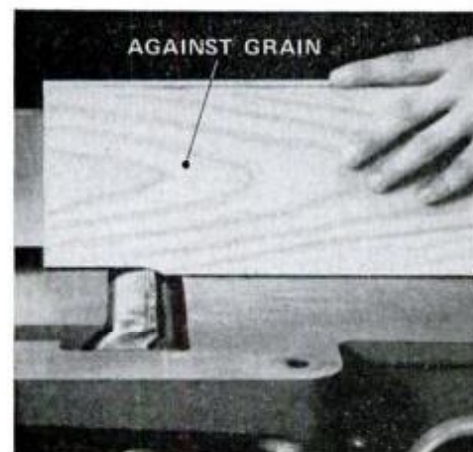
At start of cut, both hands should be over front table pushing the board forward.



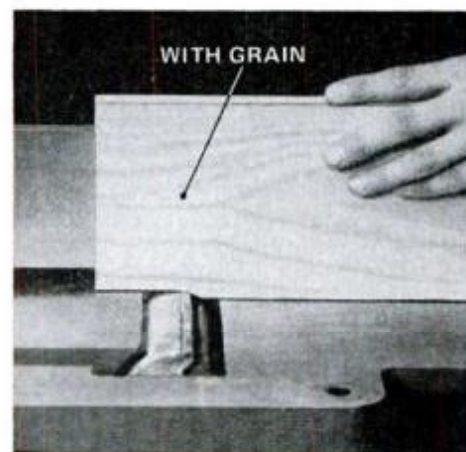
After stock passes cutters, left hand is repositioned on board over rear table.



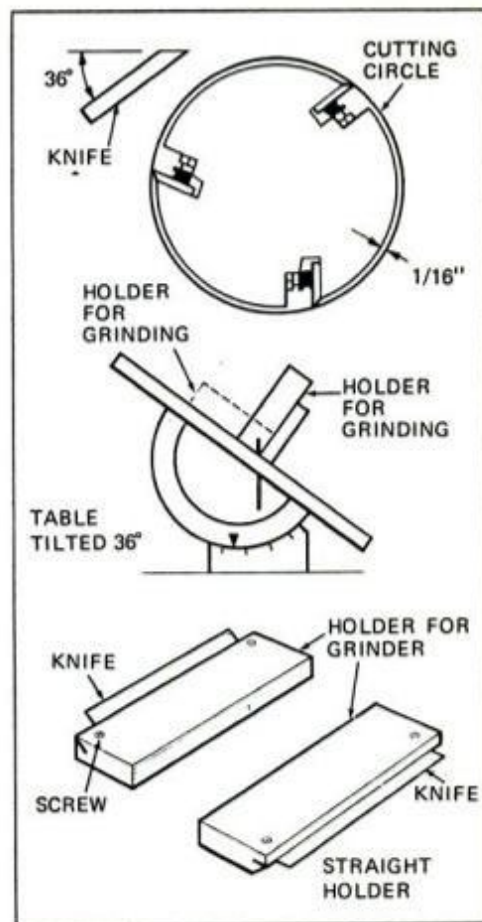
Right hand should be kept at rear of the board to prevent any chance of kickback.



Board fed against its grain will result in an uneven, often splintered, edge.



Determine board's grain before jointing. Going with grain gives smoother edge.



To grind blades at 36° angle, run a saw kerf in a block of wood as shown above.

jointer will depend mostly on two important points:

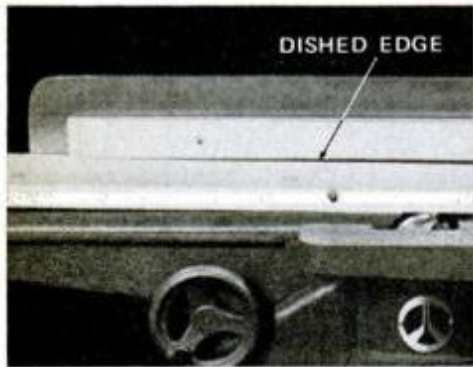
- Whether you keep the tool in adjustment and cutters sharp.
 - Whether you use it properly, observing all safety rules when you do.
- As with all power tools, failure to do either may well result in damage to the operator or workpiece or both.

Be advised that for photographic clarity—so that readers will be able to see clearly the cutter-workpiece relationship for the various cuts—we have removed the cutterhead safety cover. In actual use, however, *never use a jointer without its safety devices in place.* The cover, in fact, is spring-loaded to assure its snapping against the workpiece to keep the cutter knives covered.

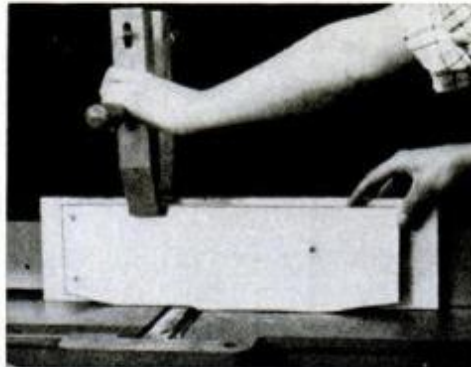
Jointers for use in conjunction with the table-saw motor are available, but many woodworkers opt for a free-standing jointer with its own motor. Jointers are sold by the size of stock they will handle—that is, a 4-in. jointer will plane a piece of wood up to 4 in. wide. Though a 4-in. jointer will be adequate in many home shops, most woodworkers prefer laying out a couple more bucks initially and pick a 6-incher. The 50-percent increase in capacity usually means that you also get a machine with more power as well as the ability to make deeper cuts.

There are, basically, two methods

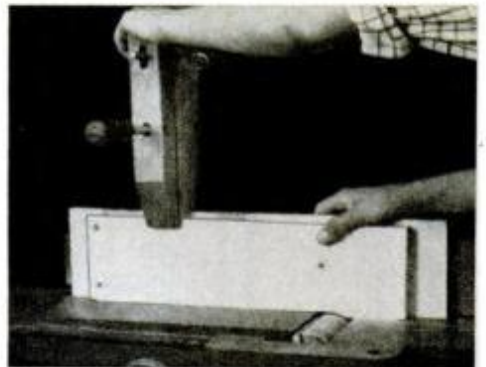
DISHED EDGE



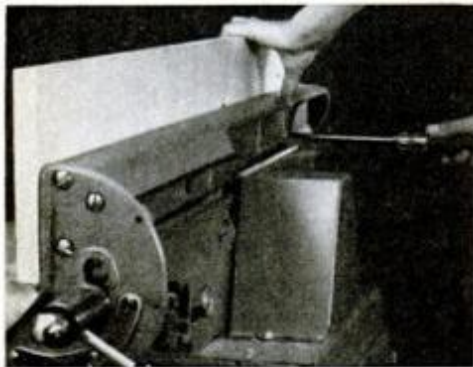
When possible, joint the dished edge of a board—it is less likely to kick back.



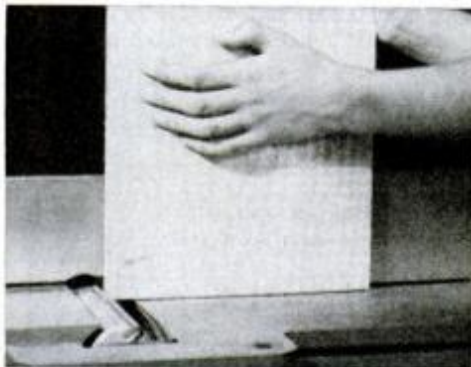
Board with an uneven edge can be jointed safely by clamping it to a straight board.



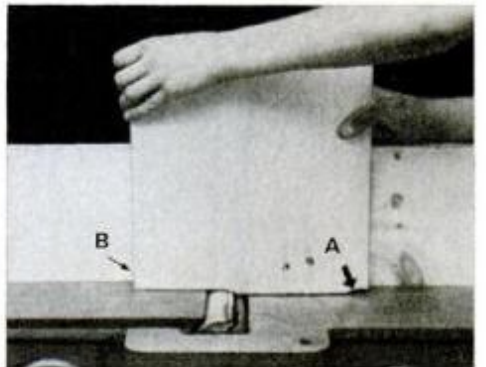
After several passes, the uneven edge will be straight, and square to surface.



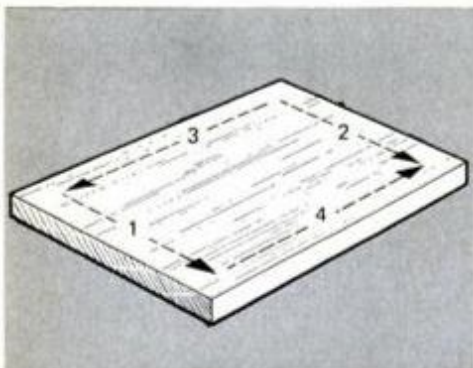
When you have a wide board or an end grain to joint, add an auxiliary fence.



To assure even pass on end grain, make a short cut into the first corner (see A).



Rotate board and feed corner B into cutters and complete cut through A.



This is the proper sequence when all four edges of a board are to be edge-jointed.



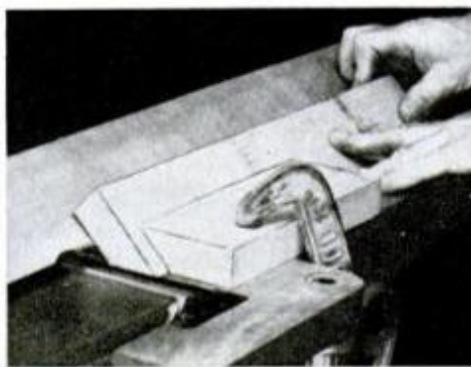
Bevel edge is jointed by tilting the fence in or out, then locking it firmly.



Safe way is to align board for jointing, then clamp-fasten a stop board as here.



A board jointed with fence tilted out has a tendency to pull away from the fence.



Here it's better to clamp stop block to table so board can't move laterally.

of feeding work into a jointer's spinning cutterhead. The first is to start the board in with both hands over the infeed table and in front of the cutters. As soon as a sufficient length of board passes over the cutters, the left hand is moved to the leading edge of the board over the outfeed

table. When the board nears its end, the right hand is also moved to the rear of the cutterhead. The important point to remember is that the hand over the outfeed table is the one that should exert the downward pressure. The other hand (in front of the blade) is used to push the

board forward not down. Both hands should be used to keep a constant pressure against the fence.

The second method is to place both hands at the front of the board to start the cut—one hand slightly in front of the other—and keep the hands in this position through the cut. Some may have mental reservations about passing the hands directly over the cutterhead, but as long as the board is wide enough—and all safety guards are in place—there really isn't any danger. Keeping the hands set in this manner is the most positive way of preventing a kick-back—the biggest danger on a jointer. I also prefer using this method whenever possible because it is considerably faster.

Jointer adjustments

Before the jointer can be expected to turn out 100-percent-accurate

Материал, защищенный авторским правом

work, all adjustments should be checked and corrected if necessary. The rear (or outfeed) table must be precisely aligned with the cutterhead knives or serious mistakes will be made on the workpiece (see photos and sketches on page 116).

With the power cord removed from the wall outlet, rotate the cutterhead until one of the cutters reaches the highest point of its cutting circle. Then, using a metal straightedge, align the rear table with the cutter. Check the cutter-table relationship at both ends and center of the cutter knife. This will reveal whether the knife is improperly mounted in the cutterhead. Repeat the alignment check with the other two cutters. If a knife is discovered to be out of alignment, loosen the setscrews holding it and realign the cutter knife.

The depth-of-cut scale should also be checked periodically for accuracy. To do it, mark a board for a $\frac{1}{8}$ -in. cut and adjust the front table to make an exact cut. Make the cut and then check the board with a ruler to assure that the cut was exactly $\frac{1}{8}$ in. Then set the pointer on the depth-of-cut scale to read $\frac{1}{8}$ in. and lock it in place. Repeat the test after setting the pointer to make certain it didn't slip during the screw-tightening process. Generally speaking, the depth-of-cut scale will require a realignment each time that the cutters are sharpened.

The fence-angle scale should also be checked for accuracy. How to do it varies from one brand to another because of different features offered by various manufacturers. A manufacturer's booklet of adjustments (as well as use instructions) comes packed with every jointer; do take the time to read and understand the one that comes with yours.

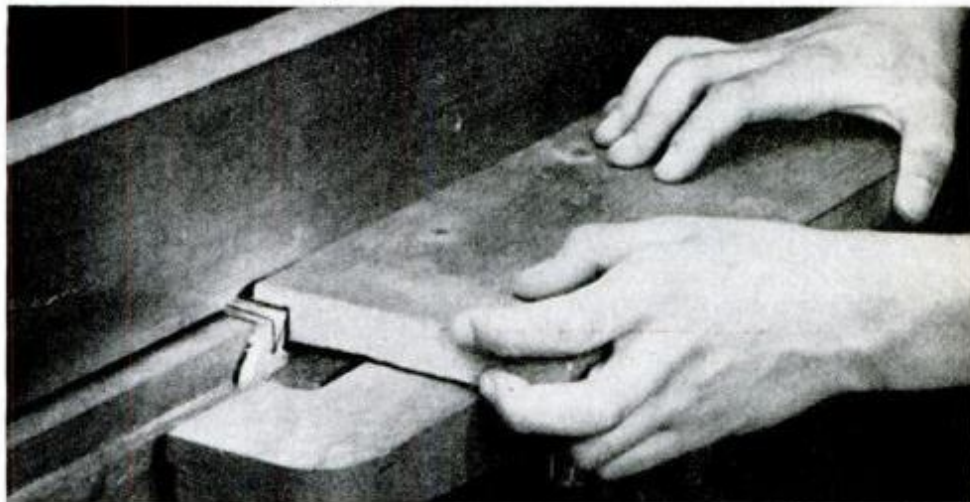
Keep cutters sharp

Occasionally, your cutter knives may require grinding. Because the knives are so narrow, it is necessary that you make a holder such as the one shown in the drawing on page 117. To make it, set your saw arbor to cut at 36° and saw-kerf a board as shown. The knife can then be inserted in this slot for grinding. If the knife is not held snugly, use screws through the jig's side to hold it so.

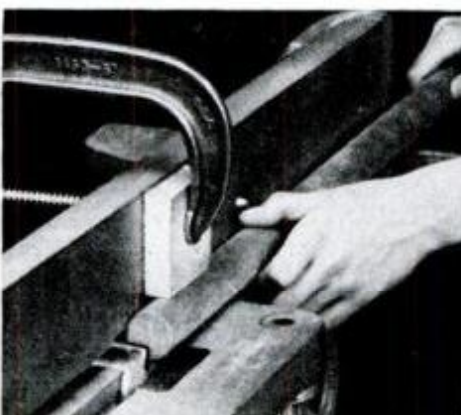
To grind the knife, adjust your grinder's toolrest to the required angle and clamp on a stop block to serve as a guide. This guide assures a straight pass across the knife blade. Work each knife in turn using a light cut for each pass. Do not make heavy cuts on steel or it will

(Please turn to page 181)

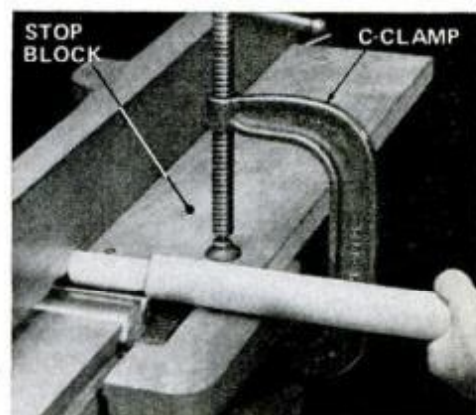
Advanced cuts on a jointer



To cut a rabbet, fence is moved and front table lowered to produce desired rabbet.

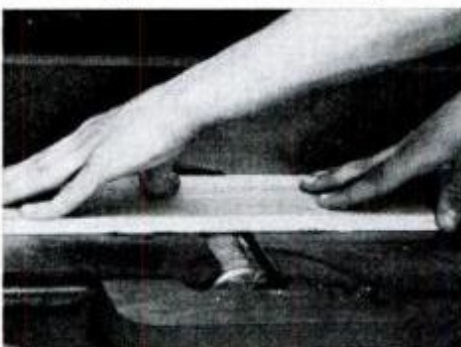


Round stock can be rabbeted using a hold-down after the fence and cutter are set.

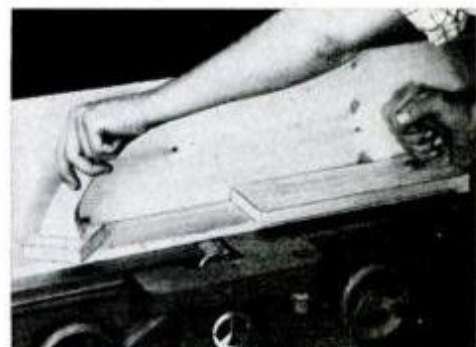


Tenon is created by rotating round stock against cutterhead—use safety devices.

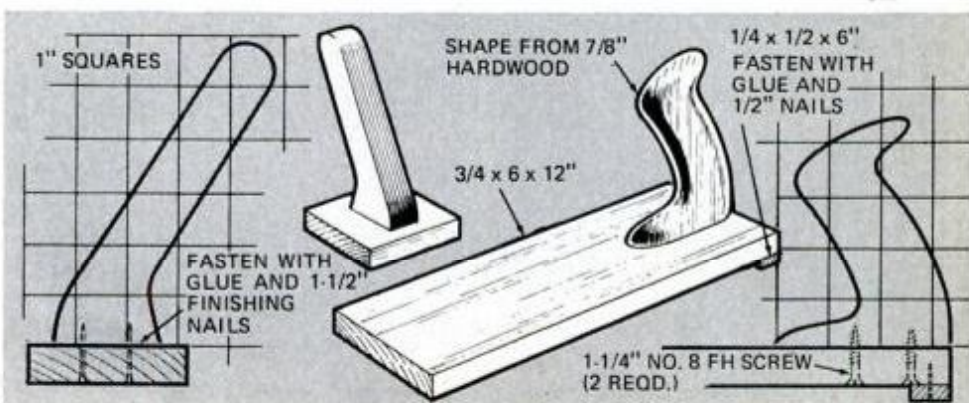
Planing thin stock safely



Never push thin stock through like this. Use pushers or move hands to rear.



Use of pusher sticks is a good safety habit to practice. These are shop-made.



Good-sized pusher board is of nominal 1-in. pine; hand-shaped handle of 1-in. oak.

WORKSHOP MINI-COURSE

WORKING WITH STAINS

Though all steps in refinishing are important, none is more so than the final sanding you give the raw wood. Here are tips that will save you time and labor as well as assure professional-looking results:

■ Always try to sand with the grain. If you must sand across the grain, do so with a very fine paper and use light pressure.

■ Use a rigid backup block. An eraser is a handy tool for this purpose—its other (soft) surface can be used later to sand between finish coats.

■ To extend an abrasive paper's useful life, tap it lightly on workbench so that dust clogging the coating will fall away.

■ Between sandings with various grits, thoroughly dust or vacuum the work.

Basically, there are six stains—penetrating resin, water, pigmented (oil) wiping, NGR (nongrain-raising), padding and varnish (or lacquer) stains. All of them do what they are supposed to do; the important difference is how they are worked. Pigmented oil stains are

the best choice for beginning finishers, so the discussion here will be limited to that type. Though some may argue that an oil stain hides too much grain, it gives you a great deal of control and working time. In fact, any time you think too much grain has been hidden, simply wipe the still-damp stained surface with a turpentine-soaked rag. If you decide a stain is too dark after it has dried, lighten it by sanding with 180-grit or finer sandpaper.

When staining softwoods, you can assure an even color tone by first sealing the wood with a coat of one-lb.-cut white shellac (thinned 50 percent with denatured alcohol). Allow the sealer coat to dry overnight, then rub lightly with double-O steel wool; dust and wipe with a tack rag before staining.

If you would rather not use a sealer—but do not want the end grain to absorb a greater amount of stain and turn darker than the surface areas—first give the end grains only a coat of boiled linseed oil.



Final sanding on raw wood is with 180-grit paper. Eraser is good backup block.



Next, thoroughly dust the piece using a clean brush saved for finishing projects.



Wipe with tack cloth after dusting; commercial cloths are under 50 cents.



Tack cloth wiped across all surfaces picks up minute particles of dust.



Apply boiled linseed oil to end-grain surfaces to equalize stain absorption.



Working just one surface at a time, put on oil stain with bristle brush or rags.



After 5 to 10 minutes, wipe off excess stain. Last wipe should be with the grain.

You can apply oil stain with rags or brush, but the latter is neater. Allow stain to set five or more minutes, then wipe off excess with clean, lint-free cloth. Make certain that final wipes are with the grain to avoid streaks.—*Harry Wicks, Home and Shop Editor*

Adjustable candlestand keeps the light held high

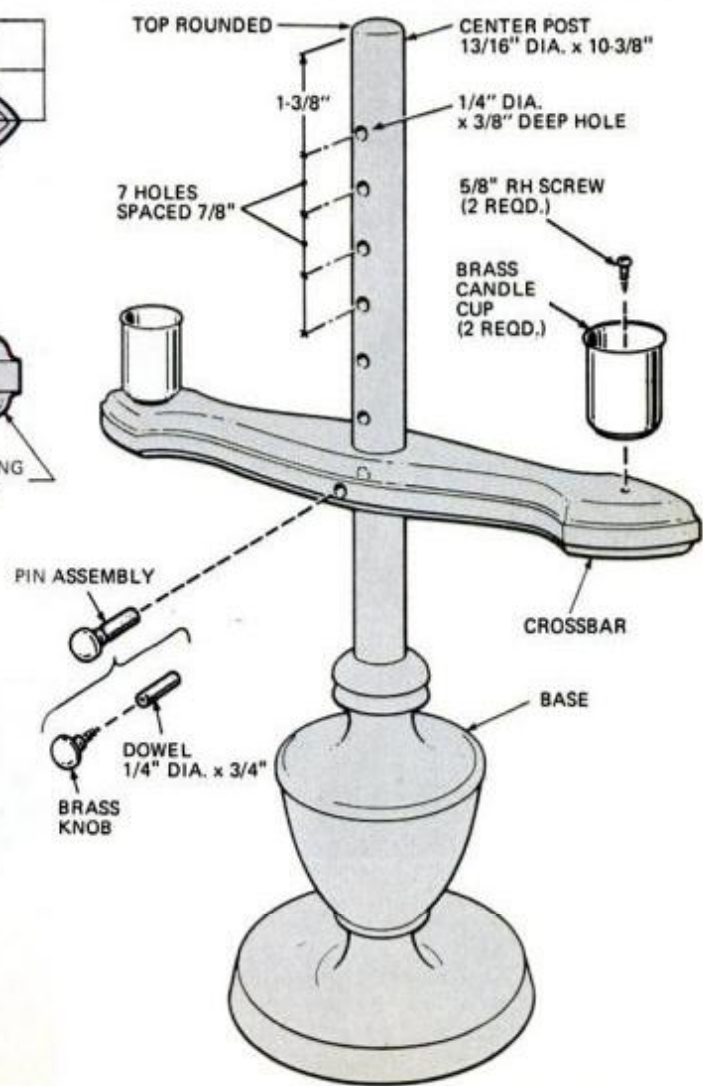
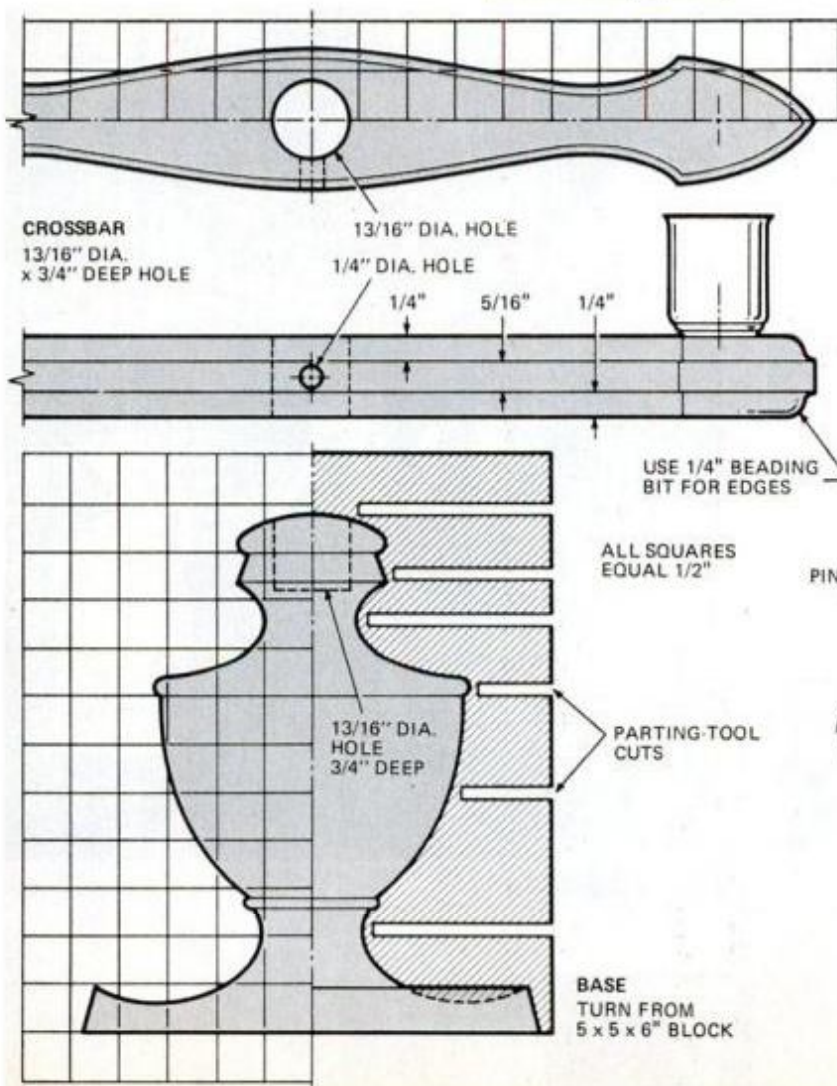
Close-grained, handsomely figured cherry is ideal for this unique, adjustable candlestand, but you can use any hardwood you like.

Start by gluing up stock to form a 5x5x6-in. block for the base. After trimming off corners with the bandsaw, shape the block to a rough cylinder with the gauge. Then use calipers and a full-size drawing to make the initial cuts with a sharp parting chisel, to the depths shown in the drawing. The resulting grooves will guide you in forming contours. Remove excess stock with the gouge, then follow up with round-nose, diamond-point and skew chisels to shape the final contours. With the base still on the lathe, sand it with 220-grit abrasive paper, apply a coat of sanding sealer, and then sand lightly with No. 400 finishing paper. Apply a satin-finish top coat such as Constantine's Wood-Glo or Wipe-On ZAR semigloss. Re-

(Please turn to page 130)



As candles burn down, candlestand's crossbar can be raised to keep light widely distributed over the surface of the table.



Decorations for your Christmas tree from 'round the world

Christmas is a time of gaiety and festivity in all lands where it's celebrated. Nowhere is this more apparent than in each country's Christmas trees with decorations made of shiny materials and painted in bright colors. Here's a look at the Christmas trees of five countries where many of us have our roots. While these countries have strong international ties, their Christmas decorations are worlds apart. They're made according to native customs and crafts as well as materials available.



SWEDEN

After the Christmas Eve smörgasbord, Swedish families gather around the tree to open gifts brought by *Jul-Tomte*, the Swedish Santa Claus. The tree is decorated with wood-curl hearts, straw stars, flag streamers, pipe cleaner skiers with nut heads and the Tomte himself.



GERMANY

The first Christmas trees are said to have originated in Germany. Here they're decorated with candles, wood angels and toys, gilt pine cones and walnuts and the Little Prune Man who has prune legs and arms, raisin feet and hands, a fig body and walnut head.



DENMARK

In Denmark, Christmas is the greatest celebration of the year. Red and white woven paper hearts, Danish flags and wooden figures decorate the tree. The Danish *Nisse*, a friendly barn elf who looks over pets and livestock, is one of the figures.



MEXICO

In Mexico, Christmas is a religious observance, but the American influence has brought Christmas trees to parts of the country. Brightly colored metal ornaments, small piñatas and paper flowers typify Mexican decorations.



POLAND

The Polish Christmas is known as the festival of the star, marked by the first star in the sky on Christmas Eve. Paper stars, roosters, angels and small *Dziady* (old men) symbols of wheat tied at one end and signifying health and wealth decorate the tree.



Easy-make decorations for an old-fashioned Christmas

Christmas complete with all the trimmings is most enjoyable when those pretty trimmings don't take the entire holiday to make. These festive ornaments will give you time for cheer.



Brightly painted holiday candle holders are made of wood rings, crescents and spandrels available at hobby stores.



Striking window hanging looks like stained glass, but is made of easy-to-craft colored acetate and painted wood rings.



Glowing free-form stars made of laminated pine add warm Christmas spirit to a buffet or other party table.

The delicate look of cut glass is easily duplicated in clear plastic as in the Santa and deer Christmas-tree ornaments.



The angel is etched with a plastic scriber that looks like a pen. Frost area is painted with solvent or sanded.



Ornaments that glitter as they turn are made in short order with balsa wood and colored defraction trim.



Simple square knots make the texture of this tree wall hanging. You might add a big red bow to the bottom of the tree.



New 15-ft.-wide flooring such as Congoleum's Colony Square, \$9.75 per sq. yd., eliminates need to seam or align patterns.

Flooring by the roll: A quick put-down

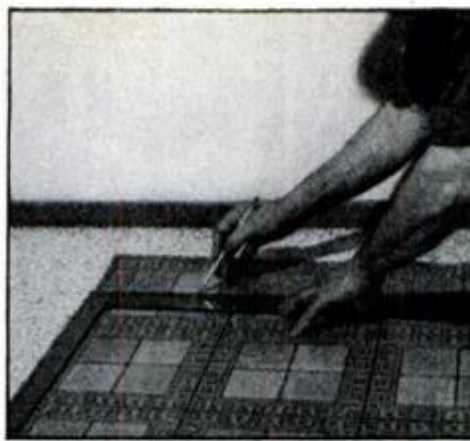
Transform a room with cushioned vinyl flooring at do-it-yourself savings.

If you can take accurate measurements and handle a utility knife, you can cover a floor in your home with cushioned sheet vinyl and get professional-looking results. With the new 15-ft.-wide sheet flooring, you can do almost any floor without having to seam pieces. Here's how:

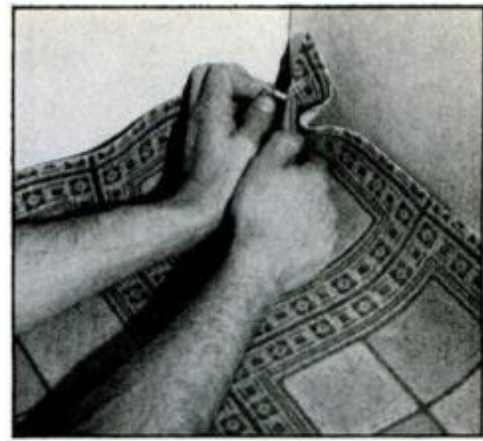
Take along your floor measurements when you shop for flooring. To do the job, you'll need a metal straightedge, utility knife, carpenter square, metal tape measure and push broom. A crowbar and hammer help remove molding; a screwdriver fits flooring around trim. Metal trim at



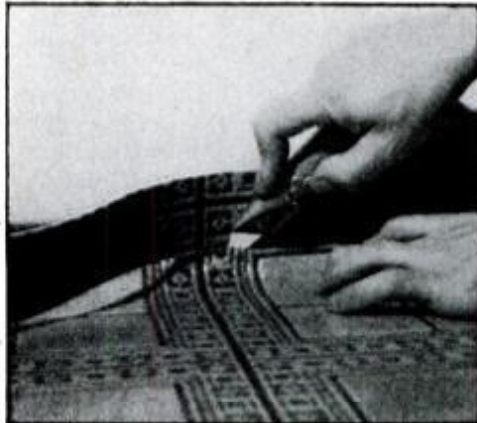
To "relax" the flooring, roll it, backing side out. Roll it once from each end.



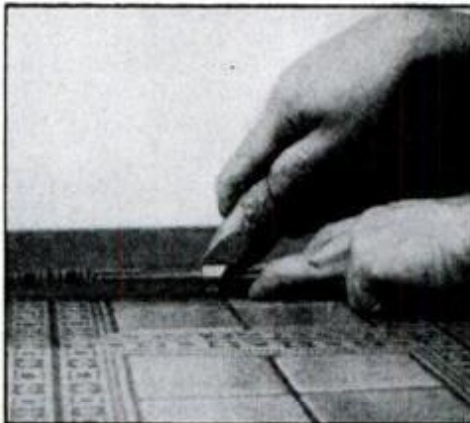
From the flooring's butting edge, mark off three other edges, and cut piece oversize.



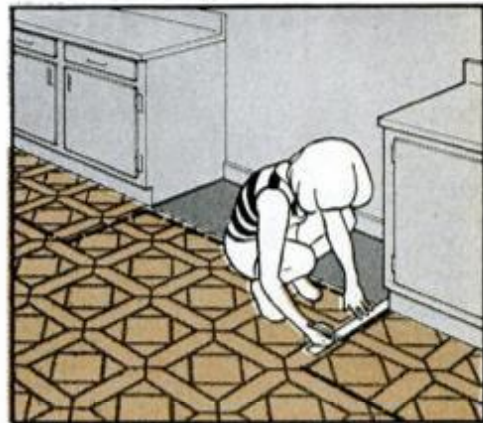
Flooring will overlap the walls. Make corner safety cuts so vinyl lies flatter.



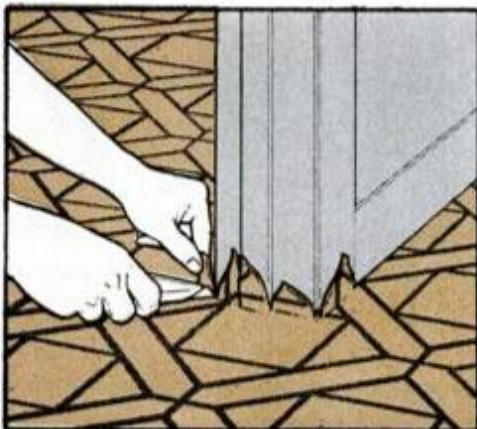
Gradually trim down the excess flooring, testing for a neat fit as you work.



Press a metal rule into the floor-wall angle. Use a sharp blade for final trim.



To fit flooring into nook, outline the shape on the vinyl; cut on the line.



To fit around door jamb, make vertical slits at inside and outside angles of trim.



Holding screwdriver flat, press vinyl into the angle of the floor and doorway trim.



With sharp utility knife at a 45° angle, carefully trim off the excess flooring.

doorways protects flooring edges.

Good-quality cushioned vinyl can be laid over most types of flooring, provided the floor is clean and smooth. Old cushioned vinyl should be stripped off. Carefully remove floor moldings and grilles so they can be used again. Clean any wax buildup and fill any large cracks in the old floor.

Measure and cut the flooring

After the floor covering has been rolled out to relax it, butt one edge against a long straight wall. If you butt the store-cut edge, use a carpenter's square to check that it is true.

Measure the flooring in a larger room than that being covered, or work on half the floor at a time.

Using a soft pencil, mark off measurements for the butting wall on the butting edge of the flooring. Then mark off the exact outline of the three other room sides. Cut the flooring about 3 in. outside the line.

Position and fit the flooring

Position the butting edge against the appropriate wall. The extra material will overlap the other walls, so make diagonal relief (safety) cuts at corners—or at inside corners trim off crescent-shaped pieces from the

corner points. Do exact fitting later. Gradually trim excess flooring along adjacent walls until the flooring is snug at the baseboard.

You may have to cut flooring to fit around built-in cabinets or appliances. Mark exact outline of the object on the flooring and carefully cut along the line.

To fit flooring at a doorway, trim it at the walls on both sides within a foot of the jamb, bend the excess material through the opening and follow the steps shown above. (If you cut a corner wrong, hold it together with strong tape on the

(Please turn to page 142)

He bottles houses

An art teacher and ship-in-a-bottle modeler turns to building houses under glass.



Dormer windows, shutters, picket fence, landscaping—attention to them is what gives bottled houses their charm.

Turnings and gingerbread filigree on mansion are small-diameter doweling shaped with a grinder and whittled with a knife. Fireplaces and chimneys are of modeling clay, and bricks formed from oak. Special features of the house are its ornate cupola, the intricate oval window, latticework, roof spires and a multilevel roof.

Many of us have a dream house we planned in detail. For nine years, Ron Rousch, an art teacher of San Pedro, Calif., has been perfecting a system for building those dream houses in glass bottles—be they castle or cabin, mansion or Swiss chalet.

Rousch shares his building techniques here to help you become an architect in miniature:

- Keep your first project simple. It takes practice to work in a confined space with minute material.

- Avoid tinted bottles or those without smooth surfaces that distort your view and cause eyestrain.

- Plan the house before you begin so you won't run out of space at the top. A rough sketch with dimensions will help.

- Prebuilding outside

the bottle won't work. Unevenness of the bottle bottom causes a house made outside to be crooked when it is reassembled inside.

Tools needed

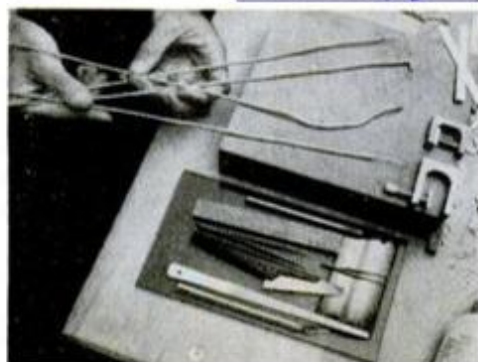
Among major tools you'll use are varying lengths of aluminum clothesline wire—some equipped with hat pins to lower wood into place and others bent into hooks for prying and lifting. Also needed are model-making knives, tweezers, small files, razor saw, clamps, sandpaper and fine paintbrushes.

Rousch uses a power saw to cut wood to workable size and a small hand saw to cut it exactly. Simulated lathe work is really small doweling rounded with a grinder and carved with a modeler's knife.

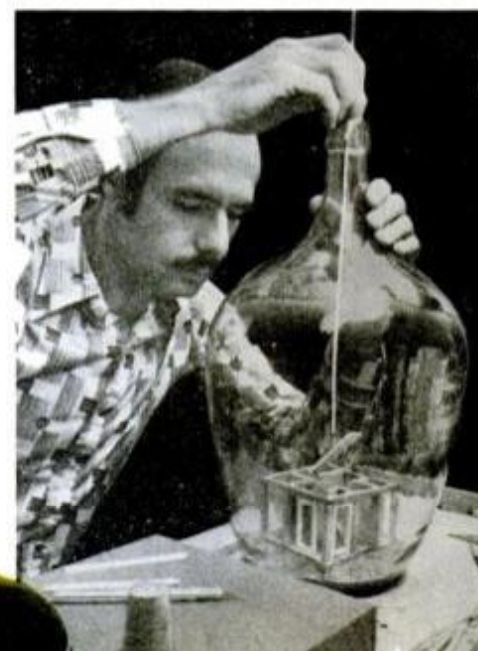
Materials required

A bottle is the first necessity. It can run the gamut from plain juice

(Please turn to page 144)



Tools the artist uses: Aluminum clothesline wire, model knives, file, tweezers, clamps, small saw and sandpaper. Below, Rousch lowers wood with a needled tool.



18 mg. "tar", 1.2 mg. nicotine av. per cigarette, FTC Report AUG. '77.

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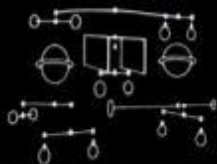
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ADJUSTABLE CANDLESTAND KEEPS THE LIGHT HELD HIGH

(Continued from page 121)

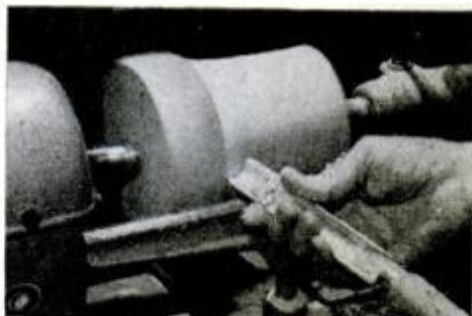
move the base from the lathe and bore a 1/16-in.-dia. hole for the post.

The post is turned from a length of 1x1 stock and is fairly critical as to diameter. Instead of trying to do it freehand, use the simple jig shown on this page. First, put a true straightedge on the outside of the toolrest by attaching a strip of 3/4 x 3/4-in. aluminum angle to the top as shown in the drawing.

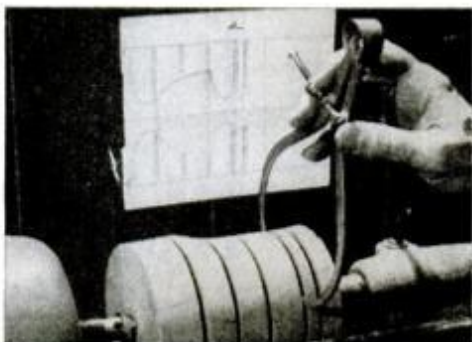
Make a nest for the skew out of scrap wood so that the leading edge is parallel to the cutting edge of the chisel. Use a small C-clamp to lock the chisel securely into the jig as shown.

Use the gouge to rough-form the post's cylindrical shape, then set the toolrest so that the attached straight-edge is parallel to the line between live and dead center points. Remove the work and adjust the skew in the jig so that it projects the right distance to make a 1/16-in.-dia. cut. Then you can simply slide the jig while holding its front surface firmly against the toolrest's straightedge. The result will be a perfectly parallel cut.

A piece of scrap wood with a V-cut down the center will support the post for boring the 1/4-in.-dia. holes for



Use a large gouge to rough-turn the round. Work from the center of the block outward to prevent splintering of the wood.



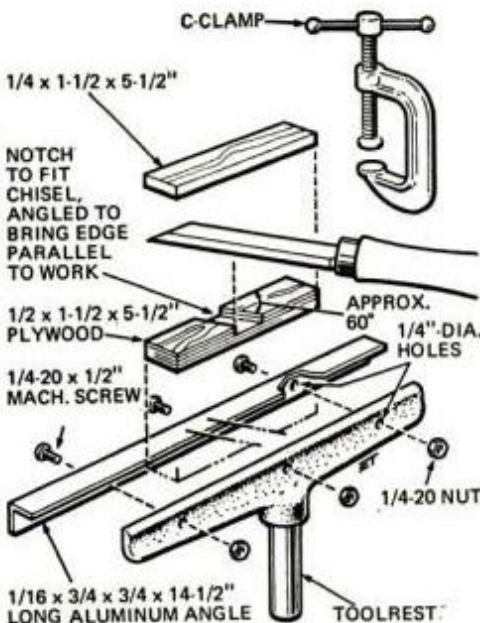
After you make initial cuts with a parting chisel, check the diameter of each groove. Allow about 1/8 in. for final shaping.



Use round-nose and skew chisels to finish concave and convex curves respectively.



Jig helps turn a post accurately and parallel. Notched block holds skew chisel at proper angle; toolrest is fitted with 3/4 x 3/4-in. straight-edged aluminum angle.



the peg on the drill press. After the holes have been bored, return the post to the lathe and sand it sufficiently to allow it to slide freely through the 1/16-in.-dia. hole bored in center of the crossbar.

Cut the crossbar to shape with a bandsaw or jigsaw, then tack-nail it through the bottom of a scrap block for edge-shaping with a router and a 1/4-in. bead-cutting bit. Finish the

crossbar and post in the same way as the base.

The solid-brass candle cups and miniature knob are available as a set for \$3.50 postpaid from Capro Craft, 9 Griggs Dr., Greenlawn, N.Y., 11740. Similar hardware, brass-plated and less expensive, is sold by Albert Constantine and Son, Inc., 2050 Eastchester Rd., Bronx, N.Y., 10461.—
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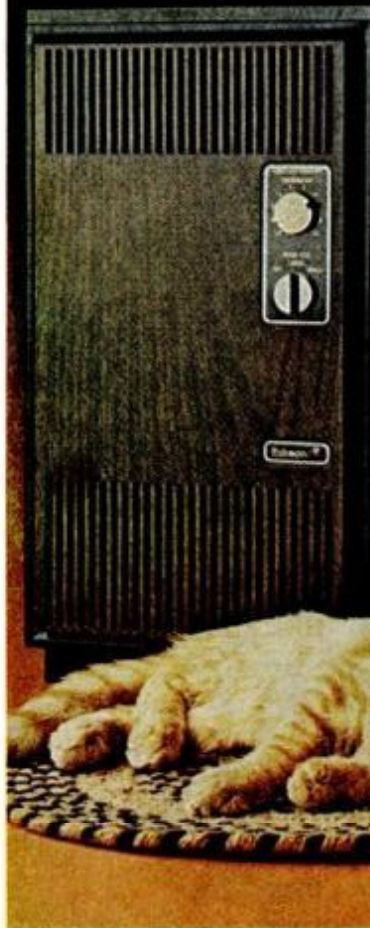
Just plug in the Edison Comfort Sensor portable electric whole-room heater.

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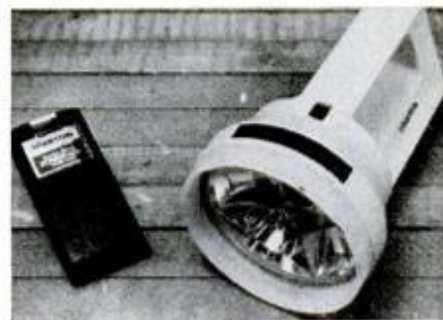
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- The light configuration that can be changed from floodlight to spotlight with a twist of the lens ring.—H.W.



Lantern is compact. The Powerpack fits neatly in underside (left). To recharge, the pack is simply removed from unit and plugged into a household outlet.

Specifications Disston Cordless Lantern

Reflector: 4-in.-dia., adjustable focus
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Powerpack No. 1000: \$16
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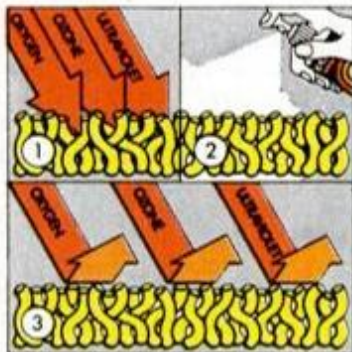
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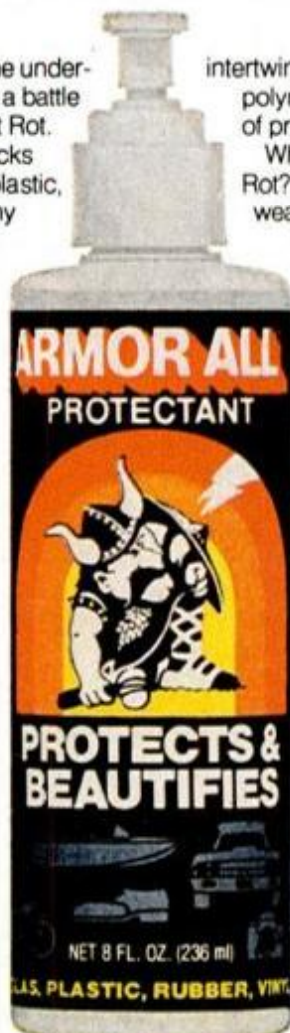


Guess which surface was a treat for Rot, and which surface was treated with ARMOR ALL Protectant.

Rot gets in your house, too. If your vinyl or leather furniture looks middle-aged, it's time for ARMOR ALL Protectant. If your favorite antique table has lost some luster, safe non-toxic ARMOR ALL Protectant will bring it right back, good as old. Appliances, luggage, shoes, and anything plastic — are all food for Rot, but ARMOR ALL Protectant starves Rot out.

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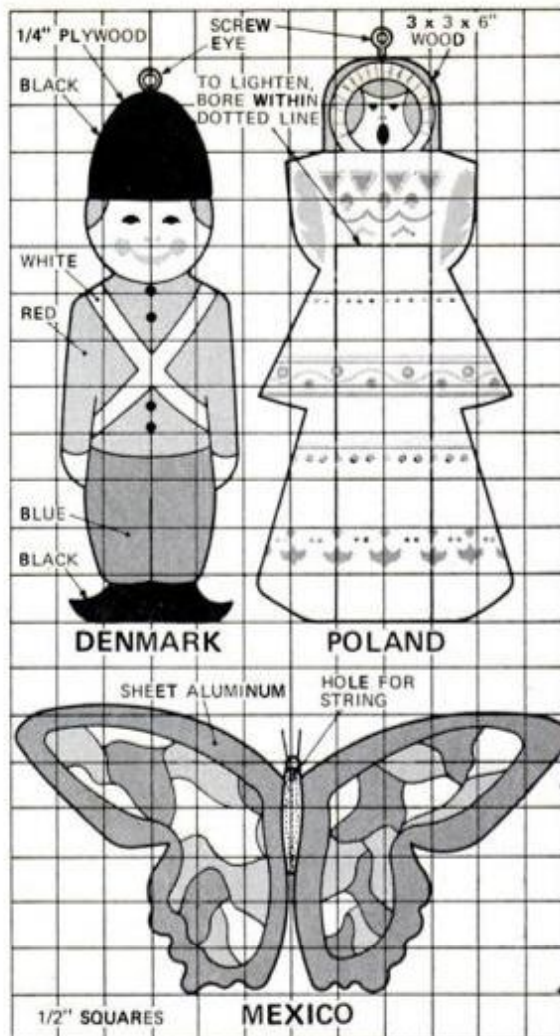
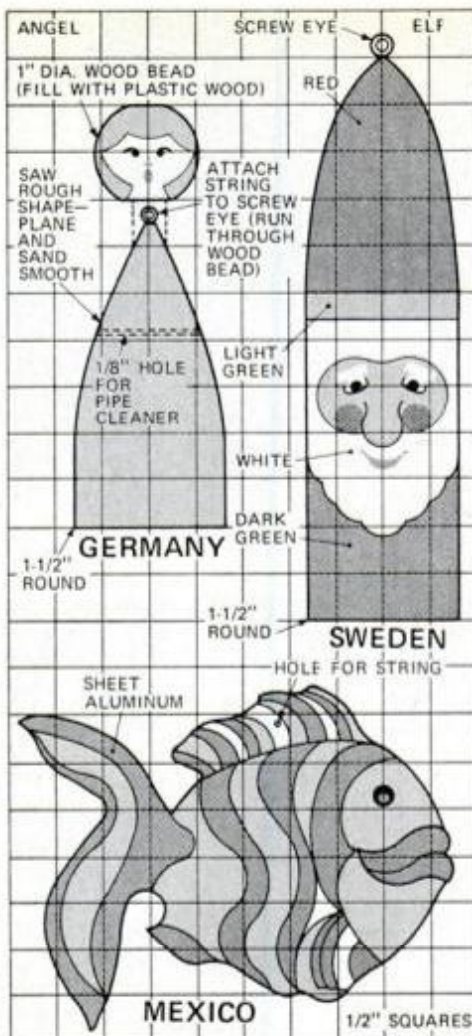
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CHRISTMAS TREE DECORATIONS FROM 'ROUND THE WORLD

(Continued from page 123)

PM color photos: Harry Hartman

Sweden—Wood-curl hearts. Materials: veneer strips or 1-in.-thick pine board, rubber bands, white glue, paper clips. Hearts shown on page 122 are made from wood trim bought at a lumberyard. However, you can make wood curls by soaking a length of 3/4-in. clear pine in water at least 8 hours, securing it in a vise and running a plane with a sharp iron along one edge with the grain. Wet each curl, roll it tightly and secure with a rubber band until dry. Shape and cut to size, apply white glue at contact points and hold curls with new paper clips until dry.

Straw designs. Materials: straw, carpet thread, white glue. Make star and other designs from dried stalks of straw. You can buy wheat from a florist supply house or find it in open fields. Cut it to 5-in. lengths, soak it overnight in hot water. Tie straw tightly with carpet thread into bundles of three. Tie, bend and glue bundles into shape.

Wood elf. Materials: 1 1/2-in. round stock, 180-grit abrasive, shellac sealer, 00 steel wool, enamel paints, screw eye. Cut a 6-in. length of 1 1/2-in. round stock. On a lathe shape the elf's cap starting about 2 1/2 in. from

an end. (If you have no lathe, see German *Angel* instructions for shaping.) Sand the shaped round smooth with 180-grit abrasive while it's still spinning in the lathe. Dust and seal with 3-lb.-cut white shellac thinned 50 percent with denatured alcohol. When dry, rub lightly with 00 steel wool. Dust and finish with enamel paints. Attach a screw eye at top and hang.

Germany—Angel. Materials: 1 1/2-in. round stock, wood filler, 1-in.-dia. wood bead (macrame bead at hobby shops), screw eye, medium-grit sandpaper, shellac sealer, 00 steel wool, enamel paints, scrap balsa wood, pipe cleaners. Mark off a 3 1/4-in. length of round, but don't cut it. Measure 1 in. from the end and taper the stock to a point by making four cuts with a sabre saw. Bore a 1/8-in. armhole through the round (see drawing). Plane, then sand to smooth conical shape. Cut off the 3 1/4-in. section. Attach screw eye to cone top and use heavy thread to hang it.

Hammer the wood bead in place. Fill bead hole with wood filler and hang until dry. Sand the wood filler smooth, being careful not to dam-

(Please turn to page 136)



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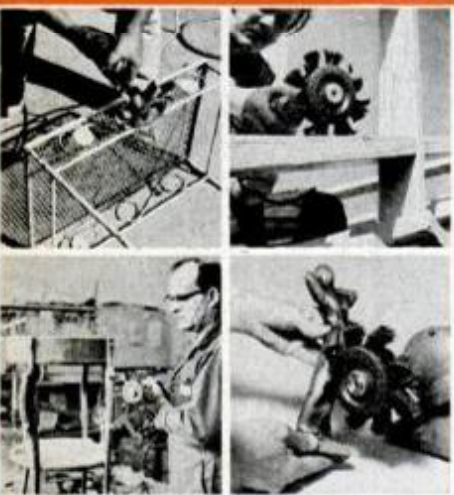
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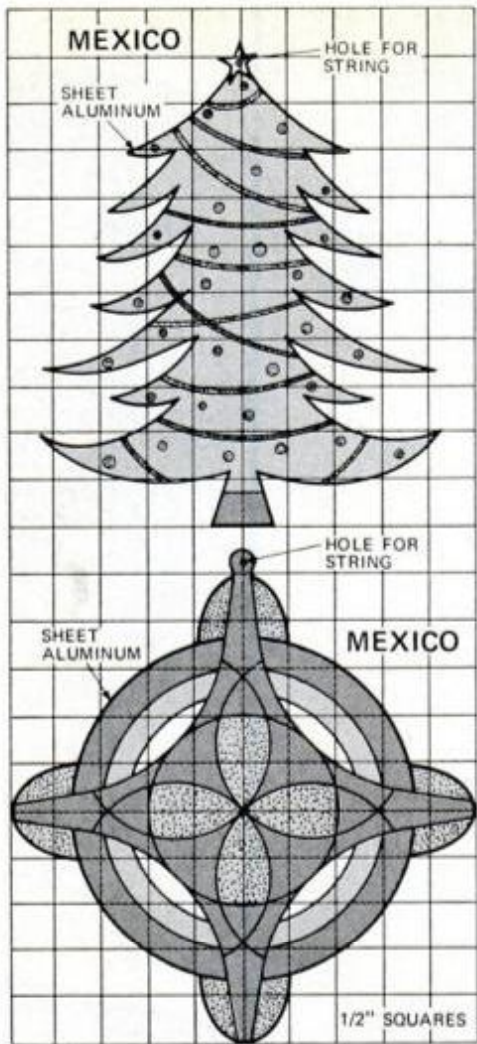
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CHRISTMAS TREE DECORATIONS

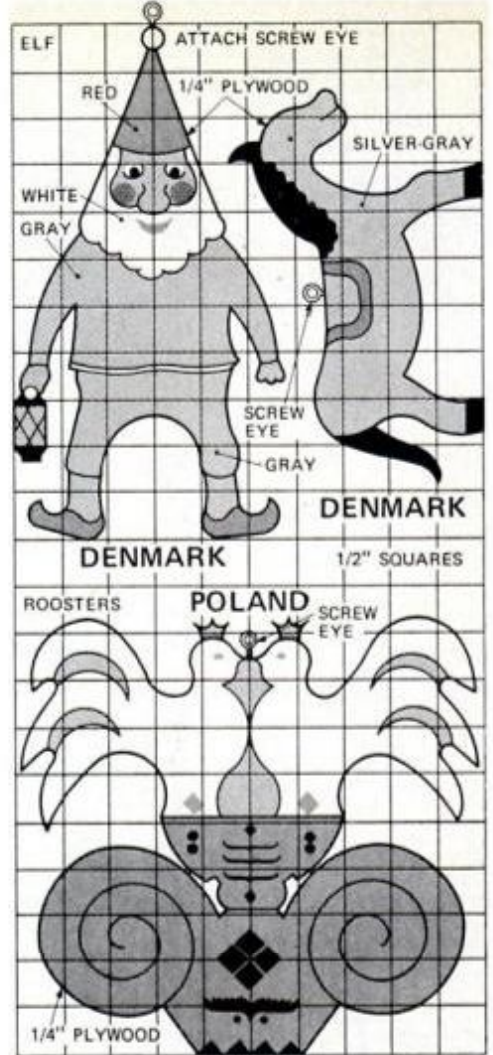
(Continued from page 134)

age the thread. Then seal the wood with thinned shellac, rub with 00 steel wool and paint according to Swedish *Elf* instructions (page 134). Glue pipe cleaner arms in place. Cut small trees or stars from 1/8-in. balsa wood, paint and glue in the angel's hands.

Denmark—Wood figures. Materials: 1/4-in. finished plywood, carbon paper, medium-grit sandpaper, shellac sealer, 00 steel wool, enamel paints, screw eye. Draw patterns (pages 134, 136) for the soldier, pony and elf full-scale and transfer them to the plywood. Use a fine sabre saw blade or Dremel saw to cut patterns. Sand, apply sealer, sand again (see *Elf* instructions again). Paint and attach screw eye.

Red and white paper hearts. These are made by cutting two half-hearts from paper with square rather than pointed ends. Cut the half-hearts from the bottom three-quarters of the way to the top in five equal sections. Weave together and glue.

Poland—Wood roosters. Materials: 1/4-in. finished plywood, carbon paper, medium sandpaper, shellac, 00 steel wool, enamel paints, screw eye. Draw pattern full-scale and transfer



to the plywood. Cut out plywood, sand and seal (see Swedish *Elf* instructions). Paint details and attach screw eye to hang.

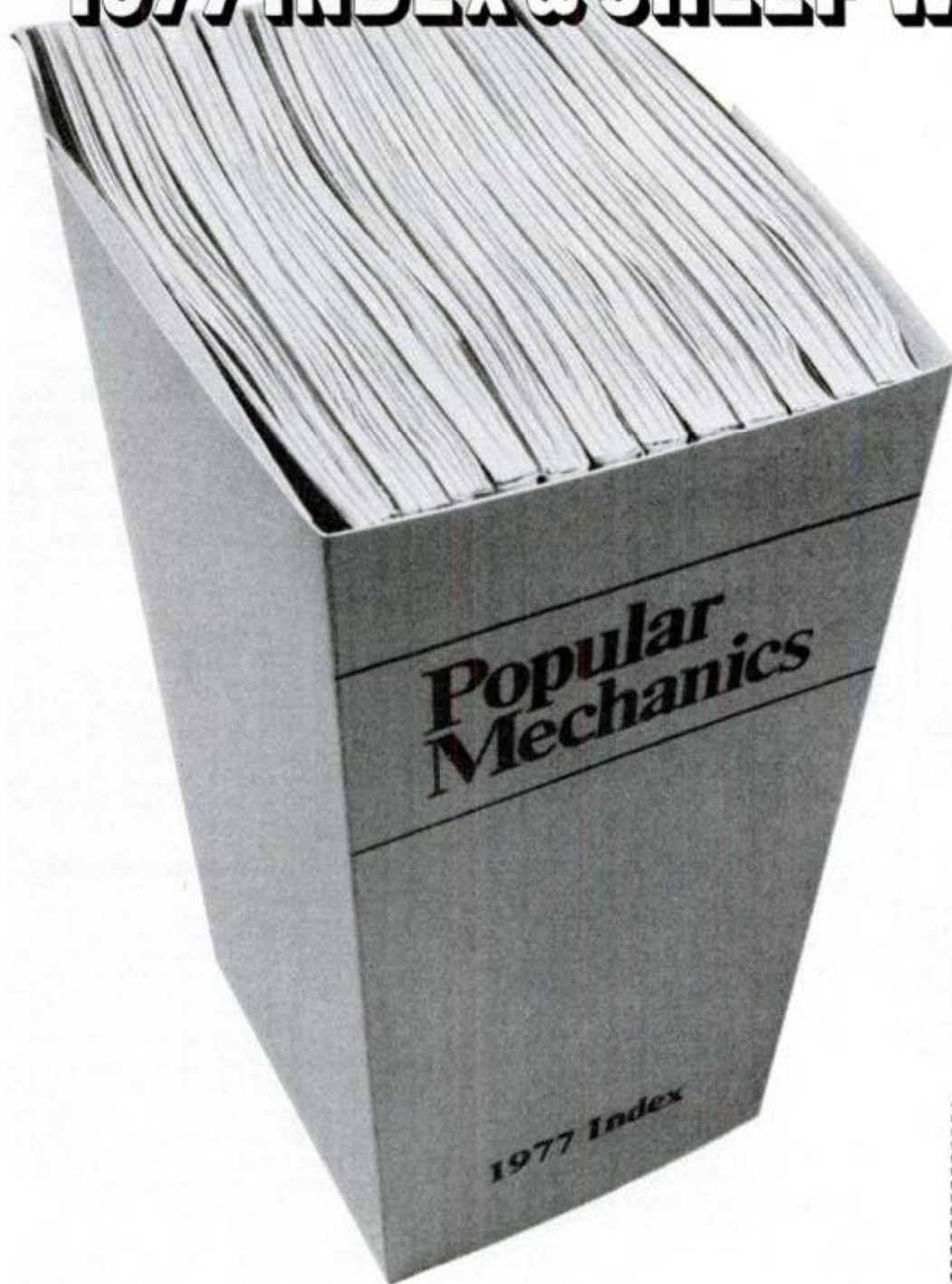
Peasant angel. Materials: 3x3x6-in. pine or oak, 180-grit abrasive, shellac sealer, 00 steel wool, enamel paints, screw eye. Shape angel on a lathe to dimensions shown on page 134. If the angel is to hang on a Christmas tree, its weight can be reduced by boring a 1-in.-dia. hole 4 in. deep as indicated by the dotted lines on the pattern. Or leave it as is for a table ornament. Sand, seal and paint.

Mexico—Metal decorations. Materials: aluminum sheet (at hobby shops or use frozen-food trays), permanent-color felt-tip pens. Draw pattern full-scale on paper and tape it to the sheet. With a modeling tool, metal stylus or knitting needle, press over pattern enough to indent the aluminum. Remove pattern and emboss the metal by making tiny dents with the tool. Cut out designs above and on page 134 with old scissors, color and punch a hole to hang.

Piñatas. Make candy-filled piñatas from paper-clip boxes or two sections of an egg carton taped together. Wrap the box with crepe paper. Then wind crepe-paper fringe around the box, gluing it as you work. **PM**

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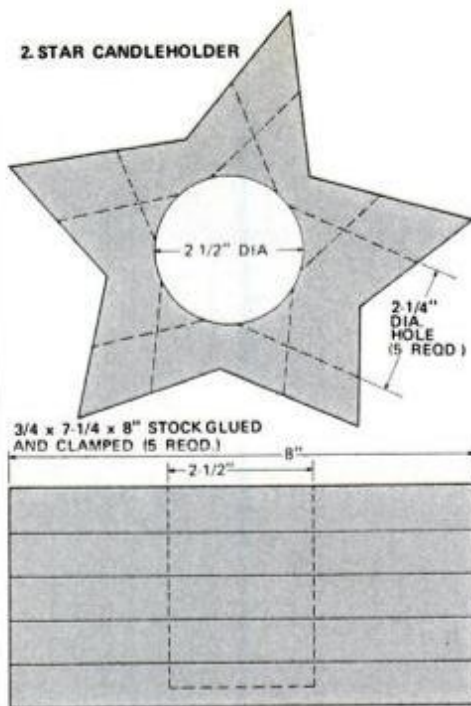
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2. STAR CANDLEHOLDER



EASY-TO-MAKE DECORATIONS

(Continued from page 125)

1. Wood-ring candlesticks (page 124)

Holders shown are made of wood sections available at craft shops.

Crescent holder

Materials: 1" i.d. wood ring, 16 crescents less than half circle with 2 to 2 1/2" o.d., metal candle spike, spray sealer, acrylic paint, white glue.

Seal and paint wood. Assemble holder upside down in small bowl, starting with ring. Glue ends of four crescents to ring. Make four layers of four crescents each. When dry, remove from bowl; glue spike to ring.

Loop-the-loop holder

Materials: 2 2 1/4" i.d. rings, 1 1/2" i.d. ring, 3 1" i.d. rings, spray sealer, acrylic paint and white glue.

Seal and paint rings. Glue two small ones together and two large ones together. Lay the medium ring on a table and glue larger ones upright on it. Glue a small ring upright inside large ones and place double small rings horizontally on large ones.

Wood-ring spandrel holder

Materials: 1 3/4" i.d. ring, 3 1 1/4" i.d. rings, 3 medium-size triangular spandrels, spray sealer, acrylic paint, white glue.

Seal and paint wood. Glue spandrels in triangular shape, corners touching. Glue large ring on top, followed by remaining rings.

Rattan holder

Materials: 2 1/4" i.d. wood ring, 2 1 1/4" i.d. rings, 3 crescents less than a half circle from 2 3/4 to 3 3/4" o.d., spray varnish, white glue.

Varnish wood. Glue ends of three crescents to large ring to form a triangle. Glue two small rings together; then glue them to crescent tops. Wood sections are from Woodring Craft, 35 West 44th St., New York, N.Y. 10036.

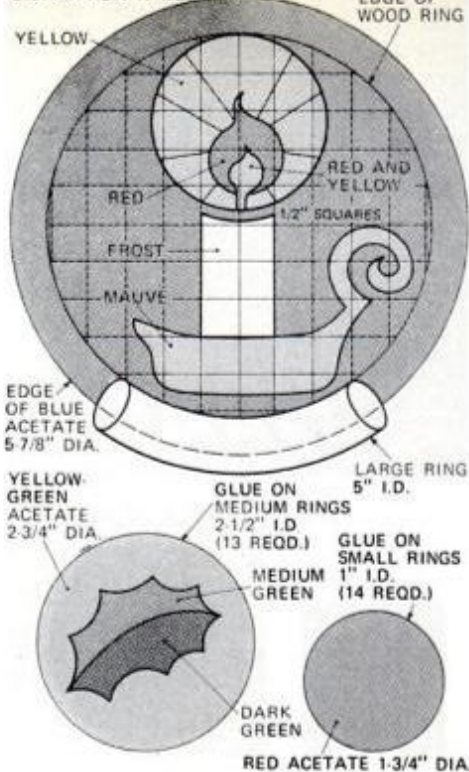
2. Star candleholders (page 124)

Materials for one star: 5 pieces 3/4 x 7 1/4 x 8" clear pine, carpenter's glue, 180-grit abrasive paper, oil stain, varnish, scented candle in cup.

Apply glue to mating surfaces of five pieces of pine and clamp. Immediately,

3. STAINED-GLASS WINDOW HANGING

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wipe off all glue squeeze-out with damp cloth. Let clamped star dry overnight. Using pattern above as guide, draw free-form star on block's top surface. Cut out star with bandsaw. On star top, mark somewhat larger dimensions than candle cup and bore its hole. Using 2 1/4" multispur bit or holesaw, bore holes through each valley junction of star. *Caution:* Be sure star is aligned perfectly and clamped securely to drill-press table.

To finish, sand lightly with 180-grit paper, dust and apply choice of stain following maker's instructions. Let stain dry overnight, then apply thinned coat of semigloss varnish diluted 50 percent with turpentine. Let dry 24 hours, then apply varnish from the can. As the candle burns, light will shine through the holes.

3. Stained-glass window hanging (page 124)

Materials: 14 1" i.d. wood rings, 13 2 1/2" i.d. rings, 5" i.d. ring, bottle liquid lead, Scotch Super Strength or model glue; Krylon spray sealer, Krylon Glossy White spray paint, one sheet each of these acetates: yellow-green, medium and dark green, red, frost, yellow, mauve, blue.

Draw design full scale according to plan above. Seal and paint wood rings. Draw and cut out the blue, yellow-green and red disc shapes and other colored acetate shapes to be in-laid. From large and medium discs, cut out areas where inlays will be placed. Glue disc shapes of acetate to underside of the appropriate rings.

Center the large ring on an 18 1/2-in. square piece of frosted acetate backing for reinforcement. Space small rings around the large one, glue to the backing and then glue rings together at their contact points. Position medium rings and glue them to backing and small rings. Arrange remaining colored acetate shapes on discs and tack-glue.

(Please turn to page 140)

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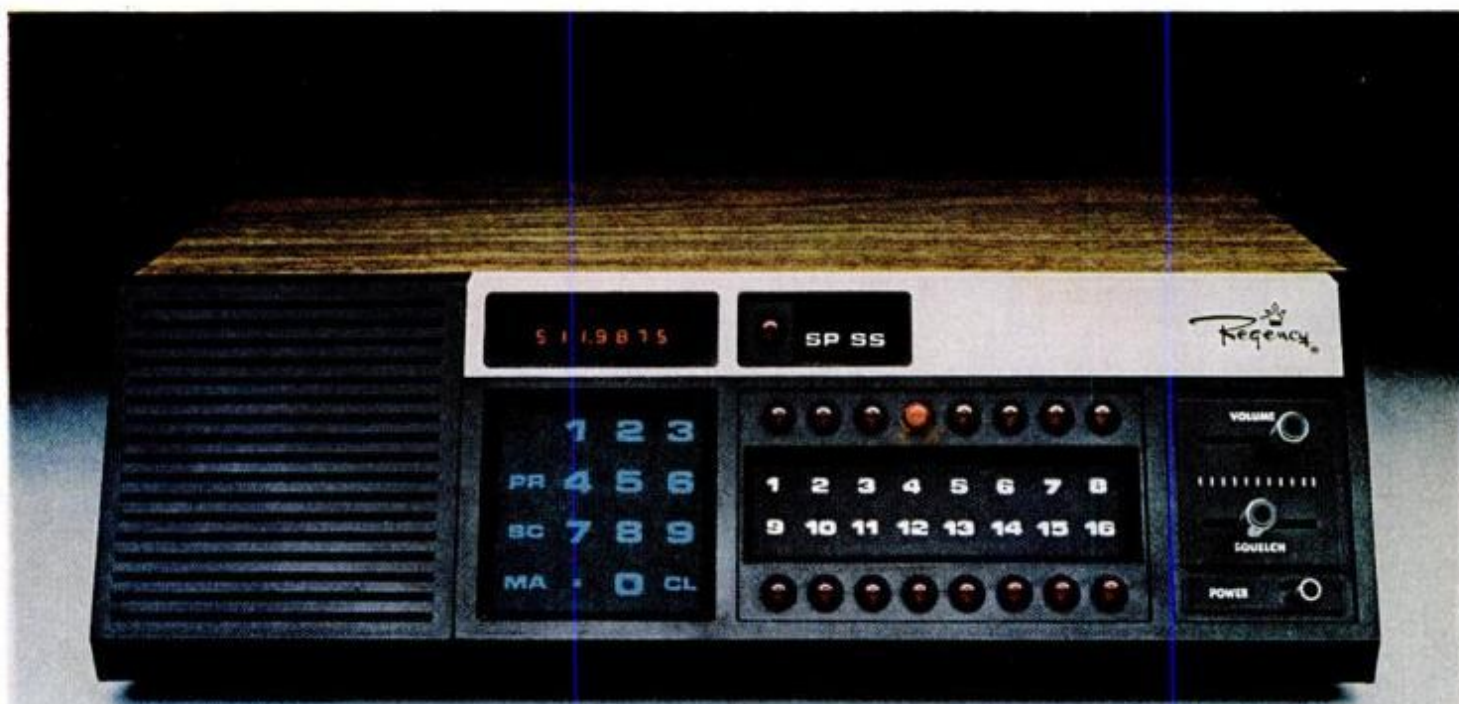
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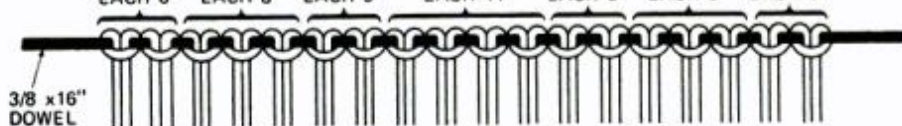
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6. CHRISTMAS TREE WALL HANGING

16 x 30" O.A.

2 CORDS EACH 6' 3 CORDS EACH 8' 2 CORDS EACH 9' 4 CORDS EACH 11' 2 CORDS EACH 9' 3 CORDS EACH 8' 2 CORDS EACH 6'



3/8 x 16" DOWEL
LARK'S HEAD KNOT

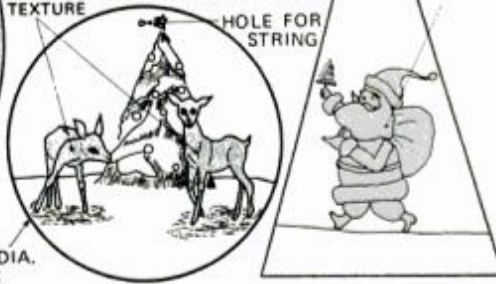
5. ANGEL WINDOW DECORATION

1/8 x 7" DIA. ACRYLIC



FOLD EACH CORD IN HALF, MOUNT ONTO DOWEL AS SHOWN
IN SECOND ROW SKIP FIRST TWO CORDS, MAKE SQUARE KNOT WITH CORDS 3 TO 6

4. ACRYLIC TREE DECORATIONS



EASY-TO-MAKE DECORATIONS

(Continued from page 138)

Squeeze liquid lead in a line around color borders. Attach cord and hang. Rings are from Woodring Craft.

4 and 5. Acrylic decorations (page 125)

Materials: 1/8" acrylic plastic such as Plexiglas or Acrylite, indelible ink marker, red and white polishing rouge.

Beginning and finishing procedures are similar for all decorations. Cut the plastic to the shapes shown with jig-saw or sabre saw. Draw design on acrylic. Etch design in plastic as described below. For the finish, polish plastic to remove ink with either red and white rouge or toothpaste on a soft cloth. Wash with mild liquid soap.

Angel

Frost border by rubbing with medium-grit sandpaper after taping off clear area. Etch outline with an X-Acto carbide-tipped scribe. Finish as above.

Deer-tree decoration

This requires a Dremel, Foredom or other hand-grinder-type power tool. Etch tree with scribe or power tool with cutter accessory—deeply for foregrounds; lightly for backgrounds. Etch deer with round steel burs in power tool. Begin with large burs and work to small burs. Finish as above.

Santa-tree decoration

Etch the entire design with large and small burs in a power tool and finish.

6. Macrame wall-hanging Christmas-tree (page 125)

Materials: 60-yd., 5-ply, 28-lb. ball of green jute twine, 2" metal ring, 20 red 20-mm large-holed wood beads, 2 28-mm large-holed natural wood beads, 3/8" dia. x 16" wood dowel, 2 yds. red cord or yarn, 18x24" Styrofoam knotting board, T-pins, white glue.

Cut the cords to size and tie them to wood dowel as shown. Begin tying by making a square knot with the first four cords. Repeat with the next four cords. Complete first row of nine knots.

In second row skip the first two cords at left and join cords three and four with cords five and six to tie a square knot as shown above. Continue along this row (eight knots), leaving two free cords at each end.

Continue this alternating knot pattern in row three by taking cords one and two (not used in previous row) and knotting them again with cords three and four. Complete row (nine knots).

In row four begin to decrease the knots by tying one less square knot every fourth row. Slip red beads on the spare two cords on both ends. In the fourth row slip beads between knots two and three, four and five, six and seven. To complete design, continue to decrease or drop two cords on both ends each fourth row. Add red bead in triangular design to accent tree shape.

At the top of the tree, secure the eight cords around a metal ring with red cord and trim. Turn the tree over and pull the beaded side cords through adjacent knots, glue and trim. Attach eight 12-in. cords in the center of the wood dowel, secure them with red cord and trim, glue large beads on the dowel ends.

7. Glittering tree decorations (page 125)

Materials: 1/2" balsa wood, acrylic spray paint, metalized film with adhesive backing (sometimes called defraction trim; available at hobby and automotive accessory shops).

Using a utility knife, cut trees, circles or other shapes out of balsa wood and spray-paint. When dry, apply shiny trim cut in small circles, squares or narrow strips. Pass a needle through the balsa to thread it for hanging. **PM**

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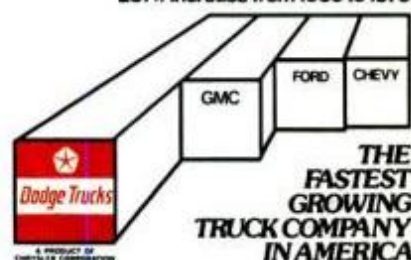
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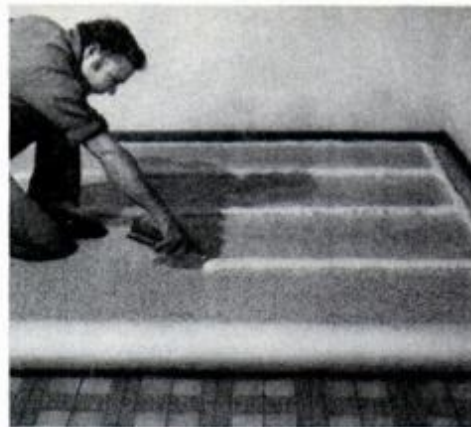
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FLOORING BY THE ROLL

(Continued from page 127)



On half the subfloor apply adhesive 2 in. from perimeter and in bands 1 ft. apart.



Roll flooring into place and expel air with push broom; work from center to walls.

underside while installing. Later, seal it with a seam-sealer recommended by the flooring maker.

When the flooring is fitted, fold or roll it back so half the old floor is exposed. Apply the recommended adhesive 2 in. from the floor perimeter and in bands 1 ft. apart on the floor. Roll flooring down on the wet adhesive and flatten it with a push broom. Repeat the process on the other half.

Installing without adhesive

Cushioned flooring can be installed without adhesive in rooms with quarter-round moulding, but allow 1/8-in. expansion gap between flooring and wall. Shim up the quarter round and nail it through the baseboards. Next day, move the furniture carefully in place. For a free booklet on flooring installation write for *Easy Does It* to Consumer Dept. A, Congoleum, 195 Belgrove Dr., Kearny, N.J. 07032.

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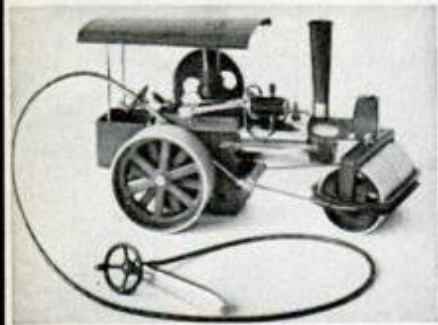
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HE BOTTLES HOUSES

(Continued from page 128)

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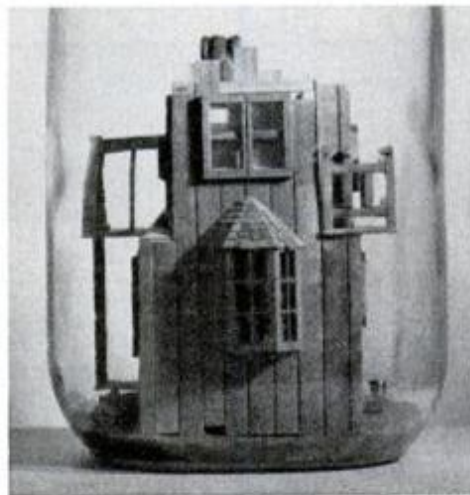
Several types of wood comprise the house. Ice cream sticks are perfect for subflooring and roofing. Walnut or fir make window frames, doors, joists and paneling. Shingles are of veneer. An open-grain wood like oak is used to fashion bricks. Balsa isn't used—it can't support material above.

You'll need modeling clay for the base, plus rocks and pebbles for landscaping or embedding in a modeling-clay fireplace. Other materials are: plastic, glass, screening, cardboard and Styrofoam.

Epoxy glue cements the house foundation to the bottle. White glue is strong enough for construction.



The subflooring and first floor uprights are in place and the fireplace is complete (above). The same construction steps are taken (below) to build the second floor.



Other materials include wood stain and quick-drying tempera.

Construction steps

First, secure four 1/2-in. corner cubes inside the bottle to the bottom with epoxy. Then place crosspieces—ice cream sticks work well—to form a square. When glue holding the blocks has dried, press modeling clay around the foundation to the desired

level. Lower landscaping rocks and pebbles on masking tape; press them in the clay.

A subflooring of ice cream sticks or other thin strips comes next, followed by the first-floor uprights. Rousch cuts one to approximate length from a master, lowers it into place with a needled wire, measures, pulls it out and cuts it to the exact length, measures again and modifies, if needed. Then he glues the piece, lowers it and twists the board free.

Once all first-floor uprights are placed, he adds horizontal pieces for window and door frames. Plastic or acrylic windows and prepainted siding finish the first floor.

One floor at a time

Unlike building a real house, Rousch finishes one floor before he moves on to the next. Each additional



Rustic houses and cabins are Rousch's favorite subjects. These wood veneer shingles are individually carved.

floor is built just like the first one.

When he reaches the top, Rousch glues rafters in place and covers them with a subroofing of flat sticks. Then he cuts tiny rectangular veneer shingles, whittles them at one end to form a wedge shape so they rest in place and glues them to the roof.

Chimneys on some houses will appear on the upper floors only, and should be built at that stage. But a full-length chimney should be erected at the subfloor stage.

Decorative touches will depend on the style of house. Once you've mastered the structural basics, there's no limit to what you can build.—
Virginia DeMoss

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equivalent as possible to those used then and now—and compared them for weight, range, efficiency and fire-power. They by no means represent all weapons designed for use in the field, nor do they take into account the vast technological improvements made in other areas of military hardware and strategy. They are confined strictly to some of the most commonly carried arms employed by the ordinary foot-weary field soldier who must fight his battles from fox-holes, hedgerows and jungle swamps—and who is still the essential element in conventional ground warfare. The five I've selected are:

WW II-KOREAN WEAPONS

■ **M1 .30-cal. rifle** (basic field rifle): weight, 9.5 pounds; effective range, about 300 yards; muzzle velocity, 2800 f.p.s. (feet per second); firing mode, semiautomatic only; feed, eight-round clip.

■ **M1919A6 .30-cal. machine gun**: weight, 32.8 pounds; maximum range, 3500 yards; muzzle velocity, 2800 f.p.s.; rate of fire, 600-650 r.p.m. (rounds per minute); firing mode, full automatic, fired from prone position on ground barrel support.

■ **M1 81-mm mortar**: weight, 132 pounds; maximum range at 45° elevation, 3300 yards; muzzle velocity, 693 f.p.s.; rate of fire, 18-30 r.p.m.

■ **M20 3.5-inch bazooka** (antitank rocket launcher): weight, 13 pounds; maximum range, 1300 yards; effective range, about 50 yards; firing mode, two-man operation, loaded and armed by helper from rear, fired by gunner from shoulder perch.

■ **M7A2 grenade launcher** (for M1 rifle): weight, 1 pound; maximum range, 150 yards; firing mode, single-shot, fired by special cartridge in rifle (rifle not usable separately with launcher attached).

Total weight all five: 188.3 pounds.

MODERN WEAPONS

■ **M16A1 5.56-mm rifle** (basic field rifle): weight, 7.6 pounds; effective range, about 420 yards; muzzle velocity, 3250 f.p.s. (feet per second); firing mode, both semiautomatic and full automatic; rate of fire (automatic), 150-200 r.p.m. (rounds per minute); feed, 20-round magazine.

■ **M60 7.62-mm machine gun**: weight, 23.2 pounds; maximum range, 2926 yards; muzzle velocity, 2800 f.p.s.; rate of fire, up to 550 r.p.m.; firing mode, full automatic, hand-held or held on ground rest.

■ **M29E1 81-mm mortar**: weight, 107 pounds; maximum range at 45° elevation, 3885 yards; muzzle velocity,

693 f.p.s.; rate of fire, 18-30 r.p.m.

■ **M47 Dragon** (antitank guided-missile launcher): weight, 27.5 pounds; range, classified but considerably greater than that of earlier bazooka, also carries much more highly explosive warhead; firing mode, one-man operation, disposable fiberglass launcher discarded after use, ground support for steadiness, improved accuracy.

■ **M203 40-mm grenade launcher** (for M16A1 rifle): weight 2.6 pounds; maximum range, 365 yards; firing mode, single shot; mounts under rifle barrel, permits independent firing of either rifle or grenades.

Total weight all five: 167.9 pounds. Weight saving between new and old weapons: 20.4 pounds.

Versatility is the key

The saving of more than 20 pounds offered by just these five modern weapons over their older equivalents is impressive but not alone the important difference. What's really significant is that each does its job more effectively, and some combine the functions of several different weapons, thus reducing the number of arms needed in the field.

Gone, for instance, are half a dozen of the "old faithfuls" we used to count on in the 1940s and '50s: the famed Browning automatic rifle (BAR), the M2 carbine, the 60-mm mortar, the .30-cal. M1919A6 machine gun, the Thompson submachine gun and the M3A1 submachine gun, familiarly known as the "grease gun" because of its similarity to the trigger-pumped automotive grease gun.

Submachine guns, in any case, were not considered basic infantry weapons and were generally issued only to airborne troops, tanker crews and some commando-type units. The average GI had to rely solely on his M1 rifle.

Even the big .50-cal. tripod-mount machine gun, the stalwart of front-line defense, is passing into history. Effective but cumbersome, it required two men to carry and operate it and generally a third to transport ammo cases and spare parts.

Two weapons take over

Incredible as it may seem, the result is that virtually all earlier machine guns, submachine guns and automatic rifles have been discarded in favor of just two new weapons—the M16A1 rifle, the basic infantry field piece, and the lightweight, portable M60 machine gun.

The 5.56-mm M16A1 rifle fires

(Please turn to page 148)

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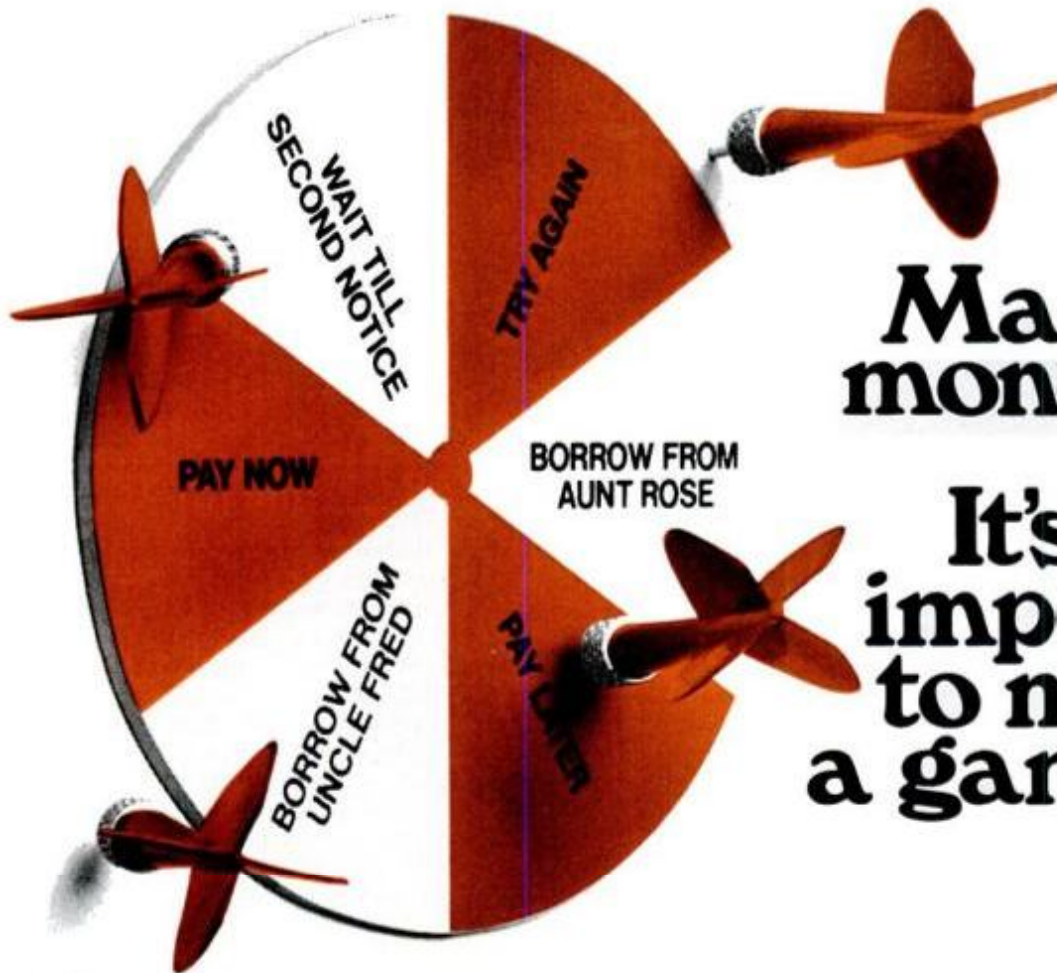
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both semiautomatically and fully automatically—simply hold the trigger back and you have, in effect, a machine gun in your hands. By contrast, the older M1 rifle fired only semiautomatically, weighed nearly two pounds more and was much less accurate. The M16A1 has greater effective range (420 yards vs. 300) and a higher muzzle velocity (3250 feet per second vs. 2800), giving it a flatter, more accurate trajectory over a longer distance. It also takes a 20-round magazine as opposed to the M1's 8-round clip, so the rifleman can get off more than twice as many shots before reloading. A pistol grip and a conventional stock permit it to be fired either from the hip—like a submachine gun—or the shoulder, depending on conditions.

The M16A1 replaces both the Browning automatic rifle and the M2 carbine. The BAR, while reasonably effective, was much heavier, weighing 20 pounds, and was operated from a prone position on a bipod barrel support—you had to set it up before you could fire it.

The M2 carbine had the advantage of firing automatically, unlike the M1 rifle, but was not very effective. It had a short useful range—scarcely 100 yards—and little killing power. In fact, many men issued the M2 carbine threw it away in combat and picked up the slower-firing but more telling M1 rifle, with its effective range of 300 yards or so.

Now compare this with today's even more lethal automatic M16A1 rifle and you can get an idea of how far modern weapons have come—and that's just the basic field piece.

Shoot-from-hip machine gun

Another highly superior newcomer to the GI's arsenal is the lightweight 7.62-mm M60 machine gun, the first of its type capable of being hand-held by one man and fired from the hip—fast-draw fashion—for use on the run. For emplacement shooting, it can also be set up on a self-contained muzzle mount that folds out from under the barrel.

At 32.2 pounds, the remarkable M60 is nearly 10 pounds lighter than the old .30-cal. M1919A6 machine gun and only a little heavier than the Browning automatic rifle, neither of which could be fired from a stand-up position. Good range—nearly 3000 yards—and a firing rate of up to 550 rounds per minute make it an awesome weapon for the foot soldier.

Three times more firepower

Just how effective is the modern GI? While it is difficult to make a

direct comparison between individual weapons of the past and present on an overall basis, taking into account all weapons used by an infantry division, today's combat effectiveness has multiplied amazingly. According to military experts at Fort Bragg, "The total firepower that a single infantry division can bring to bear on a target today equals the firepower of three World War II/Korean War divisions."

That's saying a lot. One reason for it lies in the tremendous developments made in antitank and anti-aircraft weapons—field pieces we never had in our day. A foot soldier is no longer at the mercy of armor and aircraft. In fact, after personally handling the new Dragon and Red-eye missile launchers, I would even say the reverse is true—enemy tanks and planes had better start worrying about the infantryman.

The M47 Dragon is an antitank rocket launcher that looks something like the old bazooka but is in a league all by itself. It fires a guided missile with uncanny accuracy at a range that's classified but great enough so it doesn't have the soldier looking down the barrel of a tank's cannon.

The earlier 3.5-inch bazooka, while designed for use against armor, was actually more effective against gun emplacements. It had a short range of only about 50 yards, and a soldier had to have a lot of nerve to get close enough to a tank to inflict any real damage. The Dragon, on the other hand, has a much more highly explosive warhead and can knock out any tank in existence today. Unlike the bazooka, which had to be carefully hand-loaded by a helper and fired from a shoulder perch, the Dragon missile comes preloaded in a disposable fiberglass launching tube and is easily handled by one man. The soldier merely discards the tube after each use, attaches the aiming device to a new launcher and is ready for the next shot. The launcher is also equipped with a ground support to steady it during firing.

Shooting down jets

Back in World War II and Korea, defense against air attack consisted of throwing anything and everything you could into the sky, including an occasional beer can. Even if you were lucky enough to have a .50-cal. machine gun—the main anti-aircraft weapon used by infantrymen—shooting at an enemy plane was done mostly to maintain morale. You had little chance of hitting one.

But all this has changed. With the

(Please turn to page 150)

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THE MODERN GI JOE

(Continued from page 148)

new M41E1 Redeye surface-to-air guided-missile launcher, the infantryman has his own personal, one-man antiaircraft "battery" with which he can shoot down low-flying enemy fighters and bombers—even at today's supersonic jet speeds. The launcher fires self-guided missiles using a heat-seeking infrared homing system that makes it almost impossible to miss. I can vouch for this because I tried it myself in a realistic, though simulated, exercise.

At Fort Bragg, I actually "shot down" an incoming jet approaching at an altitude of about 3000 feet at least two miles away. The interceptor had taken off from nearby Pope Air Force Base. As it came into view, I locked the Redeye's sight on it and pulled the trigger. Though the target was only a blurred streak in the sky, the electronic tracker on the trainer told me the plane was a goner—a direct hit.

Missile tracks its target

Because the Redeye missiles are self-seeking, you don't even have to be dead on target to score a kill—just put a projectile within a reasonable distance and its own target-tracking system will take care of the rest. Surprisingly, for such a sophisticated weapon, the Redeye's aiming sight is ingeniously simple. It's an ordinary optical scope, much like you'd find on a high-powered hunting rifle, except that it has three little "windows" that show up in the eyepiece—one to the left, one to the right and one in the center.

If an aircraft is approaching from your left, you sight on it through the left-hand window. This automatically shifts the launcher barrel slightly to the right, giving just the proper "lead" angle to anticipate the target's position when the missile arrives—and vice versa for a plane approaching from your right. For an aircraft moving directly toward or away from you, you use the center window.

Simple. That's what makes the Redeye such a devastating weapon for the foot soldier—he needn't be an expert at angular "deflection" shooting, as an aircraft gunner is, to use the device with deadly effectiveness.

Other weapons improved, too

Not all advances are as dramatic as these, but many others are also significant. Take the simple grenade launcher, for instance. Remember how the old type had to be fitted onto the rifle barrel and could be fired

only by a special cartridge? You couldn't use the rifle as long as the launcher was attached—you had to choose one or the other. Now a new launcher mounts *under* the barrel, has its own trigger and can be fired separately from the rifle. Thus an infantryman can spray an enemy with rifle fire to pin him down, then lob in a grenade before the enemy has a chance to move. Or he can fire both the rifle and launcher simultaneously if he wishes—a seemingly small improvement that adds up to a whopping big difference in combat ability.

The hand grenade itself plays a sneaky new trick. The old type was detonated by a four-second fuse. This frequently gave the enemy enough time to dive for cover or even, in some cases, to pick up a grenade and hurl it back. And any soldier daring enough to attempt a delayed throw by mentally counting off seconds before releasing the grenade was taking terrible risks.

The new grenade prevents this by incorporating a double-detonation system. It explodes on impact, giving the enemy no time for escape. If no impact should occur within four seconds, it still goes off, triggered by a backup fuse. Really sneaky. The new

grenade also is capable of an average 35-yard throw, compared to 25 yards for the earlier type.

Flameless flame thrower

The guys who used to have to carry those treacherous flame-thrower tanks on their backs and walk right in on top of an enemy will be happy to know something's been done about that, too. The old-style backpack tank contained highly flammable liquefied petroleum that, when hit by gunfire, would instantly cremate the unfortunate user.

Now they've eliminated the tank. The new M202A1 FLASH flame thrower actually throws no flame. A bazooka-like launcher, it fires explosive projectiles that burst into flame on impact, saving the soldier from having to carry raw fuel on his back. The FLASH launcher has four barrels and an effective range of about 100 yards—much greater than that of the old hose-spray thrower.

The 81-mm mortar is still with us, but its weight has been reduced 25 pounds from 132 to 107, and its range increased almost 600 yards from 3300 to 3885. The latest version also sports a much more sophisticated sighting system.

Even the sniper's rifle has come in

for improvement. The new 7.62-mm M21 fires semiautomatically merely by pulling the trigger. The older .30-cal. M1903A4 had an awkward bolt-action manual feed that slowed its firing rate and made it more difficult for the marksman to keep his eye on the target. It was also limited to a 5-round clip, while the M21 takes a 20-round magazine.

Standardizing calibers

Note that the new 7.62-mm sniper rifle uses the same size of ammunition as the 7.62-mm M60 machine gun, partly as a result of NATO's move to standardize gun calibers for all allied nations to simplify munition stockpiling, eliminate costly and confusing duplication and permit easy interchangeability from one weapon to another. Also note that all new U.S. calibers are specified in metric (millimeter) sizes—again to make them compatible with long-used European metric designations.

About the only weapon that *hasn't* changed much is the classic .45-cal. automatic pistol, traditional sidearm used since World War I. But then nobody could hit very much with it anyway.

All in all, soldier, you've come a long way indeed. **PM**

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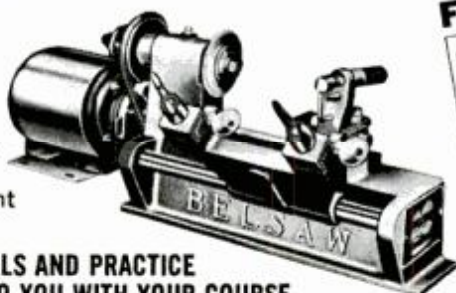
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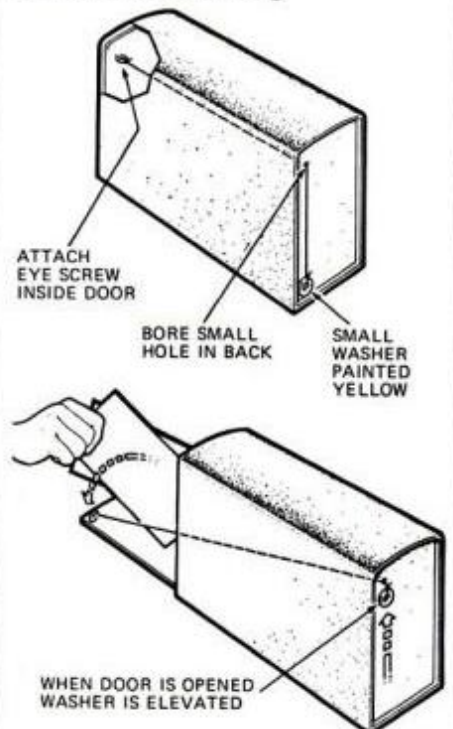


Restore the wooden handles of tools left outside or garden tools used in bad weather by lightly sanding and coating them with boiled linseed oil.—*Parry Yob*

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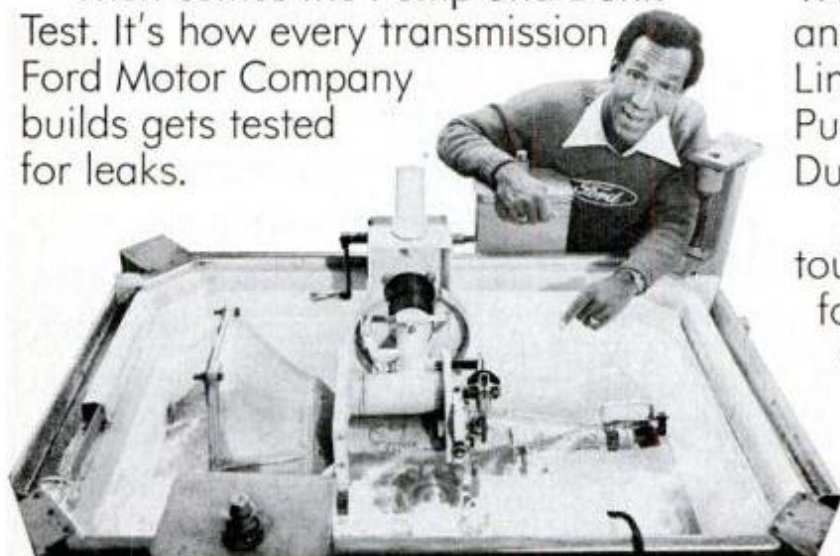
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11. 2-3 Upshift Test.
12. 3-2 Downshift Test.
13. 2-1 W.O.T. Downshift Test.
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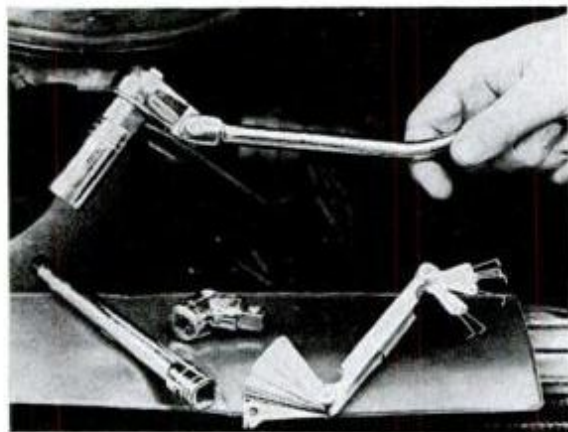
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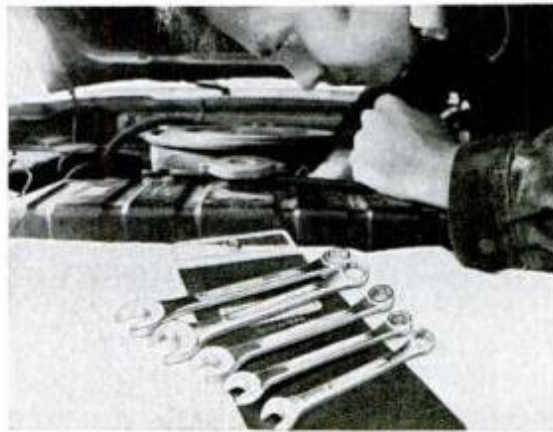
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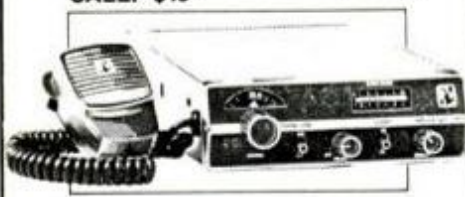
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RESCUE FROM A TYPHOON

(Continued from page 76)

all was smooth. An undercurrent of excitement permeated the ship. Chief Torpedoman Jon Hentz of Brunswick, Me., penned a quick letter to his wife: "We left Guam in a hurry, there are two tropical storms headed here and a B-52 crashed at sea 300 miles away . . ."

Nuclear submarines like *Barb* and *Gurnard* don't carry banks of batteries or great volumes of fuel, which occupy nearly half the hull space of conventional subs, and they're much larger—about as long as a football field and more than 31 feet in diameter. In the crew's mess of the *Barb*, 30 men can be fed at once, and in minutes the compartment converts to lounge or theater. It was here the crew gathered to discuss ways of rescuing the downed airmen.

Prospects not pleasant

The prospects were not pleasant. A submarine is designed to perform submerged, not on the surface. In any sea, her keelless cylindrical hull rolls and wallows like a sick whale. Further, when surfaced, a sub is "conned" from a three-by-four-foot cockpit bridge atop the "sail" which projects like a dorsal fin 15 feet above the center of the hull. It houses ladder and communications link between control room below and upper bridge, and also serves as a fairing for masts and antennas. The cockpit itself, separated from the ship by a watertight hatch, is open to the weather. There is no provision for getting down to the main deck from the cockpit, nor is access to the deck possible from deck hatches except in calm weather. Even small waves wash into open hatches.

In this operation there was a real risk that survivors pulled from the sea would be dashed to death against the hull. It was decided to bring them over the port sail plane, a winglike vane extending some 10 feet out from the sail. Though even at the tip they wouldn't quite clear the hull's bulge, it would be far less dangerous than working from the main deck. Finding the men in the storm-tossed sea would be less difficult. Military aircraft already were circling them. Sophisticated navigation and communications equipment would solve the rest.

That evening at 7:30 Lt. Cmdr. Rushing, refreshed by sleep, came on duty, stepping around a clutter of rescue equipment being readied. *Barb* was still submerged when the PA system clicked on: "This is the

(Please turn to page 160)

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RESCUE FROM A TYPHOON

(Continued from page 158)

captain. Commander Submarine Squadron 15 reports five B-52 crewmen have been sighted by aircraft, but heavy weather has forced surface ships to turn back. *Barb* and *Gurnard* will handle the operation."

Juergens then instructed Rushing to come to periscope depth. As the ship rose above the 400-foot level, the men began to feel surface motion. At 200 feet Rushing noted the ship was rolling 10° each way. It was about 11 p.m. when *Barb* came to periscope depth, rolling and pitching violently. Lt. Cmdr. Jim Okeson could hear radio communications between the orbiting aircraft and Guam Search and Rescue Control. *Barb* was about 12 miles from the rafts.

Sub surfaces violently

By midnight the sub had closed the distance enough to surface. Suddenly she was sucked upward. Instead of a normal keel depth reading of about 26 feet, the reading dropped to 11. Instantly the ship heeled over on her beam. Men swore. Some ended against bulkheads or dangling from handholds. The ship hung for a moment, then went the other way. Rushing shouted course changes to the helmsman, looking for minimum roll. One heading took her nearly head on into the seas, which broke over bow and sail, forcing her beneath the surface. This would never do with men on the bridge.

Trial and error found a "best course," but it was still rugged. Men hung on as best they could. Some were sick. Never had *Barb* taken such a beating. Her single screw drummed air when it lifted clear. The impact of the stern and sail planes slamming back into the waves sent shudders through the hull.

"Let's go." Rushing and Torpedoman Steve Glasgow climbed the pitching bridge trunk. As Rushing opened the hatch to the cockpit, wind whistled and water slopped in. The men clambered through.

It was dark. Wind-driven rain and salt spray stung their faces. They careened to the four compass points as mountainous waves tossed the ship like a canoe riding rapids. They had to yell to be heard above the storm's roar. Their course toward the survivors was now with the seas. Though they were drenched by rain and spray, water boiled into the cockpit only occasionally. They tied themselves to the structure to keep from being swept overboard.

At 1:15 a.m. the rain stopped briefly and they saw a brilliant flare

about three miles ahead. Aircraft orbiting in the light radioed that eight rafts (some dropped from the planes) were visible. Even the empties were marked by lights. Lt. Lee Price, manning the periscope in control, was first to spot lights, and notified the bridge. Minutes later, in the flailing cockpit, Rushing could see three sets of lights bobbing up from behind giant waves. "Port 5°," he ordered, steering for the closest. Suddenly a red flare blossomed off port bow.

Survivor sighted

"Steer two-nine-zero," Rushing ordered. "Notify the captain we have a survivor in sight." He tried to put the *Barb* to the right of the raft, so they'd approach upwind. An orbiting aircraft dropped a flare revealing the full extent of the mountainous seas for the first time. Rushing wished he hadn't see it.

Capt. Juergens, Lt. Ron Ricci the *Barb*'s weapons officer, and Chief Hentz came crowding up into the cockpit. They could hardly move. Glasgow unstrapped and went below. Juergens tied himself in beside Rushing. Ricci and Hentz, equipped with life jackets and lines to keep from washing overboard, rigged a Jacob's ladder down the side of the sail to the safety track on the deck. Then they clambered down to the port sail plane.

Typhoon winds ripped the wave crests to shreds, blasting rain and spume in disorder. White water roiled over sail plane and bridge.

Rushing's approach to the raft put the wind-driven rain and spray at their backs, and the tossing raft came in sight some 10 yards off the port bow. As it passed amidships, Hentz aimed the throwing gun and fired. The line snaked out of sight in the darkness. He tried a weighted line, but the wind carried it off.

As the raft passed, Ricci yelled, "Hey! You okay?" and heard an affirmative yell. "We'll pick you up in a couple of minutes."

"Okay." The response whisked away on the wind and the distance widened. Rushing ordered engines to back down. As she slowed, *Barb* rolled 40°. A wave buried the bow and she began to go under. Ricci felt himself float off the sail plane, tethered to a submerging ship.

Hastily, Rushing ordered the helmsman back to his original course on forward speed. The ship sloughed off its load of water and rose again. Several attempts to turn brought seas over the sail and water cascad-

ing down the hatch. Finally, by scrambling below, securing the hatch, changing course, then returning to the bridge, they were able to find a better approach.

Wind blows raft away

The raft was now a mile distant. It was 2:20 a.m.

On the second run the wind blew the raft out of reach before they could fire a line. They tried the downwind side. The wind blew the weighted line back at them. On one try they fired a line right over another raft that hove in sight. There was no response. It appeared empty.

At 4:26 a.m. Juergens decided that further attempts in darkness would endanger both survivors and rescuers. Wet and exhausted, they clambered back down the trunk banging the hatch behind them. *Barb* submerged to wait for the dawn.

At 7:40, after a hot shower and soup, Rushing returned to the bridge. It was light, with heavy overcast and intermittent rain. The eye of Typhoon Rita had passed abeam. Though still rough, conditions had improved.

Aircraft still orbited the survivors. Using their radioed vectors, Rushing conned *Barb* toward a group of three rafts. As the distance closed, he made out two or three men sitting motionless in the nearest.

"Rescue team to the bridge!" he ordered. Ricci, Hentz and Gary Spaulding, an electronics technician, hauled themselves up through the hatch with their gear.

The plan was to shoot a line with a harness to each survivor. One by one, they'd be pulled through the water to the sail plane where Spaulding, a giant of a man, would lift them aboard and help to keep them from being battered as they were hoisted up the side of the sail. The harness line was fed down the bridge trunk to the control room where six men would provide the muscle to pull the survivors into the cockpit.

Rushing maneuvered the *Barb* to put the raft on her lee. The shifting wind blew the raft first one way then another. One minute the thing would ride a crest high above the submarine, then disappear in a trough under her bow the next.

Lines keep missing

At 20 yards, Hentz shot a line. It blew off on the gusting winds. A second attempt was better, but it whipped just before the men could grab it and drifted away. The raft

(Please turn to page 162)

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RESCUE FROM A TYPHOON

(Continued from page 160)

drifted out of range. Hentz, a top scuba diver, offered to swim a line out.

"You don't have to," Juergens said.

"I want to," Hentz replied. He clipped the line to his belt, timed his jump to coincide with the crest of a wave, then swam like hell to clear the ship. Wave after wave swamped him. He was thrown violently about on the crest of larger waves as they exploded in the wind.

Finally, he reached the raft. There were three men in it—Lt. Neely, Maj. Dvorak and Lt. Dodson, who was exhausted. He had been lying down out of sight with his head pillowed on the lap of one of the others. Dvorak had broken his elbow during ejection and couldn't use that arm.

The next step was to get a heavier mooring line to the raft. Gary Spaulding hurled a weighted messenger line, but it fell short. Hentz swam out to recover it. The heavy mooring line was hauled out and secured to the raft. It was about 8:15.

Almost doesn't make it

Hentz was wrung out, but knew he'd be needed on the sub to help haul the survivors aboard. With

safety line secured around him, he started the long swim back. As he neared *Barb*, he saw the screw come completely out of the water. The next moment all he could see was the top of the sail. Several times he saw the forward flood ports—sea intakes close to the hull bottom. Some of the swells had to be 40 feet high.

By now Hentz was so exhausted he had doubts about making it, but with Spaulding pulling the line, he soon neared safety. Waiting for a big wave, he kicked upward as Spaulding tugged. The wave dropped him on the hull safety track three feet from the dangling Jacob's ladder. The next wave threw him against the side of the sail. He grabbed the ladder and willing hands helped him up. Trundled off to his quarters, he lay on the floor recovering his breath.

Topside, the crew moored the raft 25 yards off *Barb's* port quarter. Rushing's problem was to keep the raft downwind and the men clear of the screw, while preventing the sub from sliding into a trough where she would roll so violently the survivors might be endangered. It called for a remarkable feat of ship handling.

Lt. Dodson was the first brought aboard. A life jacket was sent out by messenger line, and the crew started

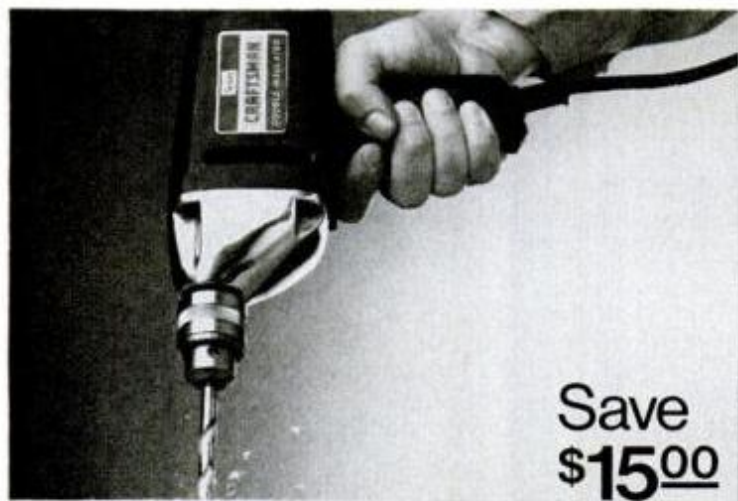
pulling him in. Dodson later recalled: "They pulled me to the conning tower and I hung there like a dead man, I was so tired. Then this big guy, the strongest man I had ever seen, pulled me over the edge of the conning tower." Dodson was lowered down the trunk into Control.

Two more brought in

Dvorak and Neely, being less tired, were brought in more easily.

By 10:00 a.m., the orbiting aircraft had vectored *Barb* to the next raft. With a single shot, Spaulding sent a messenger line over a lone survivor's head. The man grabbed it, pulled out the heavy line and the harness, buckled up and started swimming. The sub heeled over as the swimmer approached. Everybody heaved on the line and as the sub righted itself the survivor popped from the ocean like a penguin and landed on the sail plane. It was Airman Johansen. He had been in the water about 28 hours. The pickup had taken 13 minutes. *Barb* was getting good.

Meanwhile, the *Gurnard* was having problems. She had reached the scene after *Barb*. Any thoughts that Cmdr. Clyde Bell, the skipper, had of making a quick rescue were quick-



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ly dispelled by the 70-mph wind. At one time the force of the seas tilted and shoved her to a depth of 150 feet before the crew could fight her back up.

Finally, Cmdr. Bell elected to withdraw so as not to interfere with *Barb* or endanger the survivors. But he stayed on the surface to maintain radio contact with the aircraft. He had been assigned the job of coordinating the rescue efforts.

At daybreak, spotter aircraft directed *Gurnard* to the aircraft commander's raft. Capt. Johnson, having ejected last, had become separated from the others. As the ship maneuvered to try for a pickup, wind and waves conspired to prevent more than one chance per approach to get a line out. When they pulled alongside, the raft blew one way and the submarine another. When they both drifted in the same direction, the raft moved faster and soon outranged the line gun.

Superb seamanship needed

Each attempt required superb seamanship, maneuvering to stay alongside as visibility closed periodically to 500 yards in drenching squalls, and the ship rolled 60° across the sky.

What made matters worse, *Gurnard's* sail was nearly twice as high as *Barb's*, rising some 35 feet above the waterline. A pulley-mounted hoist had to be rigged between bridge and trunk base, with a harness line feeding through to men in the control room.

At long last, using a heavier line, Chief Torpedoman W.A. Nielsen got a successful delivery right across the raft. Then Capt. Johnson grabbed it, hauled in the rescue line and donned the harness.

In the cockpit, Lt. Cmdr. Ed Morgan, officer of the deck, waited until the mast completed a dip toward the raft. Then he yelled the crucial command: "Heave!" In the control room, the crewmen slipped and scrambled on the tilting deck to keep the line coming in. Johnson was snatched from his raft and flew through the air. As the ship rolled upright, the line hoisted him over the top of the sail. Someone tackled his boots and dropped him to the cockpit.

Mission accomplished

Johnson's feet hit the deck. He looked at the makeshift rig and shook his head. Later he told how he had been thrown from his raft three times during the night. "I must

have bailed 15,000 gallons of water," he said.

The mission was accomplished. En route to Guam, Commissaryman Curt Avery of the *Barb* baked a cake in honor of Lt. Dodson's 26th birthday. The celebration was dampened by the absence of the B-52's radar navigator, Lt. Col. J.L. Vaughn. Aircraft had sighted his body floating face down, still tied to his life raft.

Air Force and Navy crews who maintained vigilant watch over the survivors day and night at dangerously low altitudes in the jaws of a typhoon had made the spectacular rescue possible. Admiral Bernard A. Cleary, Commander-in-Chief Pacific Fleet, put it well. "The coordination and teamwork were superb," he said. "I have never seen a more professionally executed operation in the face of so many difficulties." Adm. John S. McCain, Commander-in-Chief Pacific, radioed: "This rescue presented the ultimate test of professional skill and courage of the airmen and seamen involved."

Each ship was presented the Meritorious Unit Commendation, and 10 submariners who played perilous topside roles received individual commendations. It was, indeed, a job "well done." **PM**

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MAN-POWERED FLIGHT

(Continued from page 102)

human to set foot on the moon, and five centuries after Leonardo da Vinci himself had tried and failed . . . man, by his own motive power, had flown. Finally achieved was one of mankind's longest-held dreams. And, in an era of billion-dollar corporate team efforts, orbiting spacecraft and intercontinental ballistic missiles, this was likely the last truly "personal" achievement remaining in flight.

Yet, during those few minutes aloft, during which *Condor* flew the course's prescribed 1.1 mile, we had probably not exceeded an altitude of 12 feet or a speed much over 10 mph.

Such modest speed and altitude were sufficient, nonetheless, for *Condor* to claim for its designer, aerodynamicist Dr. Paul MacCready Jr., the 50,000 pounds sterling (\$87,000) Kremer prize, among the richest ever offered for aerial achievement. The prize had been first posted in 1959 by British industrialist Henry Kremer. Kremer, struck by the fact that human-powered flight had somehow eluded man's best efforts since the dawn of civilization, hoped to spur its achievement. Initially, Kremer offered £5000, limited competition to British designers and turned the prize's administration—and rule-making—over to Britain's prestigious, London-based Royal Aeronautical Society. In 1967, Kremer doubled the prize and made the competition international. In 1973—with still no takers after more than 14 years—Kremer, almost in despair, raised the ante to its final £50,000.

In all, more than 70 of the world's

best design teams—many from illustrious aeronautical colleges in England, Austria, Italy, France, Japan, Canada and America—took seriously to the drawing boards, and many to the air, hoping to win both a place in history and the lucrative reward.

What looked easy wasn't

The Royal Aeronautical Society's rules and the flight course they decreed—which became known worldwide as the "Kremer course"—seemed, at casual glance, childishly easy. A craft, solely human-powered, need only take off and fly a figure-8 pattern around two pylons set half a mile apart, maintaining an altitude of at least 10 feet at each end.

In the absence of any others, the Royal Society's rules came to define "man-powered flight." But the "sim-



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ple" requirement proved to be not so simple as it seemed. As I squeezed into *Gossamer Condor's* cramped pilot's compartment—a barely shoulder-wide plastic-skinned cocoon centered beneath *Condor's* big wings—I was keenly aware of those who had gone before me. Throughout all history, fewer than 30 or 40 had managed, man-powered, to fly at all—and none had met the Kremer challenge.

The human-pedaled *Mufl*—its stubby 44.3-foot wingspan hard put to sustain the 246-pound weight of plane and pilot—was first to gear its prop through a bicycle-type chain and sprocket drive, the "power train" most man-muscled crafts were later to adopt. Built in 1935 by two young German Junker aircraft engineers, *Mufl* made several flights, once for 790 yards. But it was catapulted.

First craft to fly truly "man-powered" was likely the *SUMPAC* (its name derived from Southampton University's Man Powered Aircraft Club which had built it). *SUMPAC*—a monoplane with an 80-foot wingspan—was the first heavier-than-air craft to take off pilot-powered. The date was Nov. 9, 1961. On that milestone "hop"—it was scarcely a "flight"—*SUMPAC* lifted muscle-powered into the air and flew about 50 yards at an altitude of a mere 5 feet. Before it crashed four years later, *SUMPAC* managed 650 yards, barely a third of Kremer's distance.

The real trick: turning

Another Britisher, the equally ill-fated *Puffin I*—its pilot pedaling a bicycle in its nose—reached 993 yards. Neither ever actually attempted the Kremer figure-8 course. And with good reason. Aerodynamically, neither had mastered the Kremer course's essential trick: turning.

The first "muscle plane" to do so—make 180° turns while airborne—was *Puffin II*, the British-designed veteran of some 90 man-flights before it was smothered in a 1969 crash.

Not, in fact, until mid-1976—seven years after *Puffin II* had first turned the trick—was another man-craft able to accomplish the essential Kremer course turns. This was the *Stork*, a product of 13 years of engineering effort by students at Tokyo's Nihon University, under Dr. Hide-masa Kimura, designer of Japan's famed World War II Zero fighter.

Incredibly, over the then 17 years since Henry Kremer had first ignited man-flight competition, only two

(Please turn to page 166)



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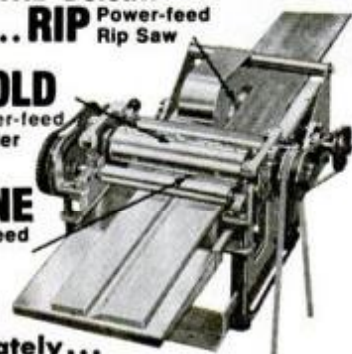
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"I've been a planer man 44 years and now retired. The Belsaw has earned me \$60,000 in eleven years with the only expense being \$7.50. For the initial cost, it's the best investment I ever made."

Robert Sawyer — Roseburg, Oregon

"This machine pays for itself making money out of scrap boards. It is a very well built machine and I confess it is more than I really expected for the price. It does everything you say it will."

Stephen Schultz — Orangeville, Penna.

"I bought a batch of walnut in the rough, and after planing it on the Belsaw I figured I saved enough money to pay for two-thirds the cost of the Planer. It really does a good job."

R. S. Clark — Springfield, Ohio

"I make furniture, grandfather clocks and many other things. My Belsaw does nice work and I couldn't do my job without it. I really like it."

W. W. Robinson — Flat Rock, Illinois

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"I recommend the Belsaw as the most useful shop tool any craftsman could own. We use one every day in the Workbench model shop... couldn't get along without it."

Jay Hedden, Editor
Workbench Magazine

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tool of its kind in the world
turns rough lumber into
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The BELSAW Planer/Molder/Saw is a versatile piece of machinery. It turns out profitable precision molding, trim, flooring, furniture... in all popular patterns. Rips, planes, molds separately... or all at once. Used by individual home craftsman, cabinet and picture framing shops, lumber yards, contractors and carpenters.

No previous experience necessary

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MAN-POWERED FLIGHT

(Continued from page 164)

man-craft had managed anything more than pedestrian straight-line flight. The third was *Gossamer Condor*. Turning ability was *Condor's* trump. And, until now, one of its best-kept secrets.

The more than 30 hours of computer time which had gone into the design of *Condor's* aerodynamically remarkable airfoils—in particular its out-front "canard" flight-control mini-wing—had a singular aim: to build into *Condor* both aerodynamic lift and turning unmatched in the long history of man-powered aircraft.

As my cyclist-shod feet powered *Condor's* prop-driving bicycle pedals, my two hands manipulated the twin secrets of its turning ability. My left hand worked the twist-grip canard-wing control stick. Shoving the stick one way tilted the out-front canard—really a tail hung from a boom ahead of the big main wing—up. And *Condor* nosed up, climbing.

Flaps provide control

Pushing the control stick the other way did just the opposite, tilting the entire flight control airfoil down and nosing *Condor* downward. But the control stick's ultimate secret lay in its twist grip, which controlled the ailerons—the two 29-inch-long, 8-inch-wide flaps hinged to the canard airfoil's trailing edge. Turning the twist grip left or right simultaneously lowered one of the aileron flaps while raising the other, forcing the *Condor* to turn left or right. The Wright brothers' plane used something similar, also fitted with turning ailerons.

But perhaps the ultimate turning secret is the "wing warp" stick concealed beneath the 45° slant-back pilot's seat. The stick, through an ingenious double-decked pulley, controls *Condor's* all but invisible "wing-warping" wires. Two of the .022-inch-diameter piano wires run from near the pilot compartment three-quarters of the way out to each wingtip, a distance of some 36 feet. Fixed to the extremities of each wing's leading and trailing edges, they twist or "warp" *Condor's* 96-foot-long wing into turns.

Mechanically, the "wing warp" wires pull the trailing edge of the "turning wing"—the right wing when making a right turn—down while relaxing tension on the wing's leading edge. At the same time, wing-warping wires on the opposite wing relax their tension, permitting that wing to rise. In a way, the wingtips themselves are forced by their warp-

(Please turn to page 168)

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. . . since 1947,
the only
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If you enjoy working with wood, or would like to . . . if you are considering setting up a woodworking shop, or expanding one—then you should consider the Shopsmith Mark V.

Compact Utility

In less space than required to store a bicycle are the five most important tools for a workshop. A 10" table saw, 12" disc sander, horizontal boring machine, 16½" vertical drill press, and 34" lathe.

Unique Design Concept

Shopsmith overcomes the standard reputation that anything multiuse tries to do too much and ends up doing nothing well. It is the only tool designed specifically for multi-use. In a single tool there is the complete compatibility and non-duplication of the four basic parts that make up every stationary power tool: 1) a motor 2) a spindle 3) a table (tool rest in the lathe) 4) and bench.

By attaching various tools (saw blades, drill bits, etc.) to the spindle and changing the relationship of the operating tool to the table, Shopsmith performs each tool operation in the conventional tool manner.

Simple to Use

Included with every machine is a well illustrated book that takes you step-by-step through the tool changeovers. After a few hours of practice you'll be making changeovers in less than 60 seconds.

Please don't be confused. Some critic's objection that you're "always changing over" simply isn't so! Woodworking isn't done by hopping from one tool to another, you plan your projects so you do your sawing, then drilling, etc.

Shopsmith owner Fred Wescott of North Scituate, Mass. sums it up best when he wrote us as follows: "I've heard objections about frequent lengthy changeovers from people who do not own Shopsmith, but I've never heard it from a Shopsmith owner."

The Right Power - The Right Speed

The Shopsmith Mark V is equipped with a 1-1/8 h.p. commercially rated motor. It's 13.5 amp and uses standard 110 volt household current.

Different tools and operations require different speeds. The Shopsmith exclusive speed dial allows for speed adjustment, while motor is running, from 700 to 5200 RPM. No belts or pulleys to change like individual tools.

Accuracy Built-In

No matter who flips the switch—experienced craftsman or beginner, the Mark V will do the same for both. Precision positive stops, ability for micro-adjustments, and convenient ready-to-use jigs make it possible.

It's Costly To Duplicate

Compare Shopsmith feature to feature and capacity to capacity to individual power tools. You're in for a real surprise! To duplicate the features and capacities of the Mark V in individual tools, would require buying commercial tools at three times the cost of a Mark V. Many features can't be duplicated at any price!

Of course you could purchase a table saw, sander, drill press, and lathe at less than commercial prices. But, even then, the table saw and drill press would cost as much or more than a Mark V.

Project Savings Justify

Over the years the Mark V will pay for itself many times over. No matter how small or big your project is, your Mark V and you can do it for less than hiring it done or buying it. From making a bird house to building a grandfather clock, you'll save by doing-it-yourself.

Commercial Uses

The versatility and accuracy plus the space saving feature of the Mark V make it the ideal tool for maintenance departments of hospitals, schools, industrial plants, apartment complexes, or anywhere a woodworking shop must be set up in limited space and on a limited budget.

Shopsmith Mark V's are used in schools to teach woodworking and in hobby shops of military bases or condominium complexes. Wherever there is a need for a woodworking tool, you'll find the Mark V.

The Best Tool For You

We know the Mark V is the best tool for you. But, only you can decide that. Over 300,000 other woodworkers have made the decision to own Shopsmith woodworking tools and have not regretted it.

Before you purchase a power tool or add another to your shop, you should determine for yourself whether Shopsmith is the best tool(s) for you. Send for informative brochure today.



...the mark of excellence
in woodworking.

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Vandalia, Ohio 45377



The Mark V as a 10" table saw, gives a 3¼" depth of cut with a 48" rip capacity. Exclusive Speed Dial permits power sawing of hardwoods. Use your Mark V for ripping, cross-cutting, mitering, beveling, molding, tenoning, grooving, rabbeting and dadoing.

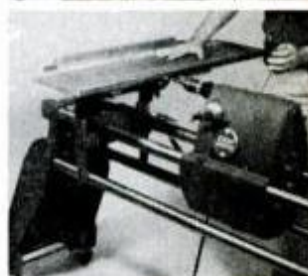
The Mark V as a 12" disc sander gives you operations not possible on other sanders. Like finishing edges to precise dimensions. It's actually a jointing operation and is done by setting the rip fence at a slight angle to the disc. Sanding duplicate pieces to exact lengths is another Mark V exclusive.



The Mark V as a lathe offers exceptional capacity with a 16½" swing for faceplate turning. Exclusive Speed Dial allows a speed range of 700 to 5200 rpm. Use your SHOPSMITH Mark V for spindle turning, faceplate turning, concentric drilling, taper turning, and metal spinning.



The Mark V as a horizontal boring machine permits perfect dowelling. Material is laid flat on large 14" x 18-3/8" table and backed up by rip fence. Exclusive feed stop assures all holes will be exactly the same depth. Lock the table at a specific height for perfect alignment of holes at same level. Unlimited capacity for mortising and concentric drilling.



The Mark V as a 16½" vertical drill press can be setup to drill perfect screw pockets. The rip fence and tilting table form a V-block for holding material. Time is saved on every drilling operation because the Mark V has depth control dial, ready made jigs, and the right speed for every operation without belt changes. Use your Mark V for drilling, mortising, routing, shaping, metal drilling, reaming.



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Yes, please send me more information on the Shopsmith Mark V. I understand there is no obligation and no salesman will knock on my door.

Name _____
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MAN-POWERED FLIGHT

(Continued from page 166)

ing wires to behave much like ailerons, further banking *Condor* into her turns.

Wing warping solves problems

Aside from aiding turning, wing warping has a number of other aerodynamically important purposes—all designed to overcome problems which had limited nearly all other man-craft to straight-line flight.

For one, the nearly 2° of wingtip "twist" achieved through warping compensates for the up to 2 mph higher wingtip speed on turns. On turns, wingtips "fly" faster than the rest of the craft—at *Condor's* 9 to 10-mph airspeed, a critical 10 to 20 percent faster. Unless this higher wingtip speed had been compensated for by warping, *Condor*, as did most of her man-powered predecessors, would have tended to yaw or slip and would have balked at turning.

Few of *Gossamer Condor's* ingenious design secrets were obvious when I first saw the craft at the Shafter, Calif., airport and met Dr. Paul MacCready Jr., *Condor's* designer and owner. MacCready, three times U.S. national sailplane soaring champion (1948, '49, '53), the first American to be named International Sailplane Champion (1956), holder of a physics degree from Yale and a doctorate degree in aeronautics from Cal-Tech, is a top meteorologist, aerodynamicist and inventor of the MacCready Speed Ring used by glider pilots around the world. At 51, he is chairman of Aerovironment, Inc., a high-science Pasadena, Calif., firm deeply involved in air-dynamics—from wind-power energy systems to those air-drag reduction devices seen today on so many large trucks. His *Gossamer Condor*, as I was soon to discover, is a textbook example of aerodynamic brilliance.

Needed: both cyclist and pilot

MacCready needed someone to power and pilot *Condor* over the Kremer course and, hopefully, into history. Required was an uncommon combination of ground and air talents: someone, preferably a bicycle racer, who was also a pilot. Luckily for me, I was both. I'd been a good, although not expert, amateur competition cyclist and, as a hang-glider enthusiast, had accumulated more than 40 hours aloft.

"It's going to take a lot of work and doing," Paul MacCready warned, as I signed on as *Condor's* pilot and engine. A share of the Kremer prize would be mine should we succeed. Our team consisted of Dr. Peter

Lissaman, an Aerovironment vice-president, aerodynamicist and specialist in airfoil design; Vern Oldershaw, a sailplane expert who became *Condor's* structural chief; and my two ground handlers, 22-year-old Philip Esdaile, two years younger than myself, and Sam Duran, my roommate. They'd be my outriders, pacing my flights on bicycles and calling out my altitude.

The work and weight-shedding—trimming both my own 150 pounds and *Condor's* then 84 pounds—began. To weigh *Condor*, we slipped two ordinary bathroom scales under her wheels. The question wasn't whether *Condor* could fly the Kremer-8, but whether I had sufficient stamina and pedal-power to go the distance at the required altitude. Every pound trimmed from *Condor's* and my flying weight would reduce by three-quarters of 1 percent the power I'd have to put out.

From manpower to horsepower

MacCready's calculations showed that over the run I'd need, on the average, to pedal-produce the equivalent of 0.35 to 0.36 hp. "Manpower," I preferred to call it. But whatever its name, I'd have to produce that much power almost continuously just to keep flying and more, in spurts, when climbing (a 30-percent power increase), turning or bucking a headwind. A headwind of 2 mph was about the maximum we normally permitted *Condor* to fly in.

Never in the long years of man-powered flights had any pilot been required to produce so much sustained muscle power over so long a distance and time. Scarcely four months before, Nihon University student Takashi Kato, man-pedaling Japan's *Stork*, had broken all existing records for human endurance when he stayed aloft 4 minutes, 27.8 seconds. In doing so, he eclipsed the previous man-power endurance record—set by RAF Flight Lt. John Potter in the *Jupiter* in 1972—by nearly three full minutes.

But MacCready's careful reckoning showed it might take *Condor* seven minutes or more to get over the Kremer-8—three minutes longer than even Kato's record 4½. That's when I "went on the machine," building both my endurance and power output on a special ergometer machine. The ergometer is a precision exercise cycle which shows its pedaler's output in fractions of a horsepower. I installed the machine in my apartment and spent an exhausting 30 minutes or more on it every day. At the end, I could churn out 0.35 hp continuously for 20 to 30 minutes. At peak, I reached

spurts up to 1.2 hp, the kind of power I might need when climbing or turning, especially near the course's end to gain enough altitude to clear the final 10-foot marker.

Paring off pounds

As I began a diet which would lean my six-foot frame 15 pounds to a "flying weight" of 135 pounds, Vern Oldershaw was putting *Condor* on a mechanical diet. Ironically, Vern was to trim nearly as much weight (14 pounds) from *Condor's* frame (to its final 70 pounds) as I was to take off mine.

To slim *Condor's* weight, Vern leaned an ounce here, a gram there. The several hundred feet of already thin-walled aluminum tubing that formed *Condor's* wings and fuselage were thinned even more—chemically etched to lighten their weight. Vern managed to reduce the canard airfoil's weight considerably by painstakingly machining ⅜-inch-square spruce stringers until their walls were a bare ⅛-inch thick. *Condor's* slimming was carefully calculated to preserve a margin of strength.

Meanwhile, every day and almost every weekend, we'd trial-fly *Condor*. For me, that meant getting up at 5 a.m. so as to be out at Shafter airport, with *Condor* wheeled out of its hangar and flight-readied, by 6:45 a.m. Local wind turbulences were such that we had little more than an hour and a half each day when *Condor* could be safely flown. Roughly, the safe-fly time slot was between 6:45 and 7:15 a.m.

Light breezes like hurricanes

If the wind gauge showed higher than 2 mph, we didn't fly. Breezes much higher were like hurricanes to the fragile *Condor*. They made pedaling difficult and maneuvering sometimes impossible. Besides, the Kremer rules decreed that "all attempts (for the record) shall be made in still air." This was to prevent any man-plane from getting a wind assist. Of course, by Kremer-rule definition, "still air" could be anything up to 10 knots—not very still.

Accidents, despite all our precautions, not only imperiled *Condor's* success but, at least once, threatened the now \$40,000 man-craft's very survival. Just a month before its historic flight, *Condor* was nearly done in by a crop-dusting biplane which shared the same area of Shafter's airport. The cropper's takeoff, although fully a quarter mile down the runway, caused a shotgun-loud turbulence that sheared off *Condor's* left wing.

But *Condor* had been designed to be quickly repairable. Some new wing-

support piano wires, a new foam-plastic leading wing edge, the Mylar skin re-ironed to flying tautness (to do it, Vern Oldershaw used his wife's electric kitchen iron), and *Condor* was ready to fly again—sometimes only minutes after some misfortune.

Then, scarcely two weeks before my record flight, it happened. *Condor* crashed. On that flight I had *Condor* wide open—doing 10-11 mph, at least—when a line suddenly let go, wiping out the pitch control. *Condor* pitched uncontrollably nose up, stalled, shuddered, then dived steeply for the ground. We hit hard. The impact threw me, my feet still strapped to the pedals, on my side. People came running, thinking I was hurt. I wasn't. But *Condor* was in a coma. The crash demolished much of the fuselage, including my pilot's compartment.

Flying nine days later

Nine frantic days later we had *Condor* put together again and flying. Luckily, or perhaps with premonition, we'd already started to build a spare fuselage, this one even lighter than the smashed one.

Then, on Aug. 22, I came within a wink of making it. With the Royal Society's official observers on hand

as witnesses and an NBC-TV crew's cameras filming it, I powered *Condor* completely around the Kremer circuit. But just short of the finish line I misjudged the final marker's height. I thought I had altitude enough to pass well over it. Perhaps it was overconfidence or plain exhaustion. Whatever the cause, I was two feet too low.

For a long while after I landed, I slumped in *Condor's* stifling cockpit, numbed by the knowledge I'd come so close. Still, I'd kept *Condor* aloft 7 minutes, 23 seconds—a record for man-powered stamina and flight.

The next day, Aug. 23, I told myself I was going to make it. Surprisingly, despite the previous day's grueling failure, I felt rested. I'd had nearly six hours' sleep. I'd gotten up at 5:15 a.m., drunk a glass of lemonade (the only food or drink I'd allow myself before flying), and headed out for Shafter airstrip. Fortunately, the weather was still holding right despite it being nearly 7:30 a.m. I signaled my outriders: "Ready!"

Legs churning, I revved *Condor* up to takeoff speed—110 rpm. Moments later, she lifted. We were airborne.

With one eye on the airspeed indicator in front of me and the other straining to see the course's starting 10-foot-high marker through the plastic windshield, I pushed the canard control stick to climb. At the same movement, I twisted its grip into a right turn, so as to circle north around the marker, then head southeast to finish the course's more than mile-long figure-8.

Victory at last

Pedaling to hold altitude, the canard airfoil out front my only visible "horizon," I fought a strategic delaying action: to pace my pedaling, conserving my strength for the final turn and climb. Then it came. After passing the halfway mark, I began to sense it—the onset of fatigue. Vaguely, I was conscious of the ground moving below me, of the outriders trailing alongside, of the pedals' incessant clacking.

Numbed by exhaustion, I kept pumping furiously, my left hand sweaty on the stick. Then I saw it coming—the course's final marker. Suddenly we were up—and passing over it. I eased downward, toward a landing centuries in the achieving. Together, *Gossamer Condor* and I had flown into history. **PM**

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it gives momentum effects and smoother starts. The latter are obtained because the transistor circuit has better voltage regulating characteristics and because it generates pulses that overcome friction and magnetic motor cogging effects.

True-action throttles

Realistic starts and stops are simulated in transistorized controls called true-action throttles. Linn Westcott, editor of *Model Railroader* magazine, was one of the first to develop a true-action throttle circuit. Westcott's TAT IV transistor throttle circuit has become a classic model for many others to follow. Many hobbyists have built the throttle and several companies offer kits for building it. One is Tri-Delt Sophisticated Electronics. Tri-Delt offers a kit of printed circuit boards, heat-sink and other components. An enclosure is not supplied, however—you build the parts into your own control panel.

Recently, Heath has offered an updated version of the TAT IV throttle in kit form. It is functionally the same as the original circuit, but some of the transistors have been replaced by operational amplifiers. Other additions to the basic circuit include electronic overload protection as well as the versatile switching features mentioned earlier. The kit comes with circuit board, components and cabinet.

As the throttle is advanced, pulses appear at a rate of about 40 per second. The pulse width of each pulse is about 2.5 milliseconds. The wheels of the locomotive begin to turn—so slowly you can hardly see them move. As the throttle is moved farther, a slowly increasing d.c. voltage is applied to the track and the train slowly accelerates. The gradually increasing voltage is caused by charging a capacitor in a timing circuit.

The circuit has a starting voltage adjustment. As the voltage increases above the starting voltage setting, a squelch circuit causes the starting pulses to decay away. This is done because the pulses tend to cause noise and motor heating. When the train reaches running speed, it is operating on pure d.c., causing the least motor heating and noise.

Slow stops

When the throttle is pushed to off, the train will continue to run or drift at a very slowly decaying speed as the capacitor gradually discharges, simulating the inertia of a

massive train. The brake circuit discharges the capacitor through a resistor and simulates the stopping of a heavy train. Several braking rates are available on most controllers. As the train slows almost to a stop, the squelch circuit reapplies the pulses and aids in producing a smooth stop.

The throttle includes a voltage compensation circuit and a load compensation circuit. The voltage compensation circuit senses train current. When the train attacks a hill, its current increases. The voltage compensation circuit detects the increase and realistically slows the train as it climbs the hill. When the train descends a hill, the circuit causes the train to increase its speed. The voltage compensation circuit has a slow response time. The load compensation circuit has a fast response time; otherwise, its operation is similar to that of the voltage compensation circuit. It senses momentary loads on the motor caused by gears binding, tight bearings, or wheels being cramped in track switchwork. It responds instantly and momentarily increases the voltage to allow the motor to overcome the extra load. The result is a smoother-running locomotive.

Other types of throttles

Another type of true-action throttle is marketed by Fyffe Electronics. The Fyffe throttle applies d.c. pulses to the track. The amplitude of the pulses is 12 volts. As the throttle is advanced, the width of the pulses is increased, causing the motor to pick up speed. A d.c. bias is gradually added to the pulses until pure d.c. is applied to the track at full speed. The rate of acceleration is timed by a timing circuit as in the other throttle. The throttle also has an inertia-simulating brake and is supplied with an aluminum cabinet.

Power Systems, Inc., produces another type of true-action throttle with a smooth start. Its circuit starts the train with half-wave rectified d.c. pulses at 60 per second. As speed is increased, the voltage progressively converts to full-wave rectified pulses. A pulse-production circuit senses the speed setting and controls the conversion from half-wave pulses at starting speed to full-wave at full speed. A current limiter circuit senses overloads and limits current to a safe value. Load compensation is used to yield smooth operation and allow several locomotives coupled together to run at the same speed without jerking.

Controlling 10 trains at one time

Operating two or more trains on one track used to involve splitting

the layout into blocks or segments of electrically isolated track. Toggle or rotary switches let a chosen power pack be connected to each desired block. Each operator connected his pack to the block his train was going to enter and disconnected it from the block he had just left. This system has long been used on most layouts, but now electronics allows multiple train operation without breaking the system into blocks.

The system, originally known as Astrac, was developed by General Electric and is now offered by Alphonics. Constant a.c. voltage of 16 to 24 volts at 60 hertz is applied to the track. The a.c. acts as a carrier for signals used to control the train. The control is by short, high-frequency pulses superimposed on the carrier. Position of the pulses with respect to the carrier waveform and the length of a burst of pulses determine the direction and speed of a locomotive. Frequency of the pulses determines which locomotive will respond.

The Alphonics system can control 10 trains simultaneously. A 10-channel transmitter and a matching receiver for each channel are used. One receiver is tuned so it responds only to its signal, controlling the motor speed in its particular locomotive. Constant a.c. voltage applied to the track can also be used to light lights in trains at constant intensity and to serve as a carrier for speed and direction control signals.

Six-channel operation

Janssen Enterprises sells a German-made system similar to the Alphonics system except that two frequencies are used for each channel—one forward and one reverse. The transmitter has six channels, allowing six trains to be controlled simultaneously. Miniature receivers in the locomotives trigger solid-state switches that control train speed and direction. A steam sound generator can be added to each locomotive to simulate the chuff of a steam engine. A whistle can also be added. As with other command systems, this features constant-intensity lighting by the a.c. carrier.

Constant-intensity lighting

Lights in model locomotives become bright when the engines run fast. Since this is hardly like prototype operation, we go to electronics for an answer. Two methods are used to obtain constant-intensity lighting: diode drop and supersonic frequency.

The diode drop method is based on the fact that the voltage drop across

(Please turn to page 172)

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ELECTRONIC MODEL RAILROADING (Continued from page 170)

a silicon diode is about 0.7 volt. Two diodes connected in series have a constant drop of about 1.4 volts. If the diodes are connected in series with the locomotive's motor, the motor acts as a voltage-dropping ballast. As the voltage is increased, the motor increases in speed while the voltage across the diodes stays at about 1.4 volts.

If a 1.5-volt light bulb is connected across the diodes, it will light brightly for all motor speeds. When the train is stopped, enough voltage is applied to keep the lights lit, but not enough to run the train. A second pair of diodes is needed to light the lights when the train is reversed. Modeltronics offers a ready-made headlight regulator module to connect to the motor.

Pacific Fast Mail makes a constant-intensity unit using a transistor to drop the excess voltage. A regulator circuit, it uses the diode drop method to apply a constant 1.4 volts d.c. to the lights. Since it does not require a motor connected in series, it can be used to control passenger-car lights, too.

The second method uses a super-sonic frequency generator to supply power to the lights. This generator is a power oscillator-amplifier delivering a sine wave signal of from 25 kilohertz up to several hundred kilohertz to the track. At these frequencies, the reactance of the motor causes little of the signal to go through the motor. Lights, on the other hand, light at full brilliancy independent of train speed.

Realistic sound effects, too

In their never-ending quest to make their railroads realistic, model railroaders have added sound effects, too. Three methods are now used. One sends audio signals through the track to a speaker in the train. Another sends a modulated carrier signal to a receiver in the train. A third has the sound-generating electronics mounted in the train.

Pacific Fast Mail (PFM) markets a system that sends audio signals through the track to a locomotive. It makes the sounds of leaking steam, safety valves popping, chuffing (synchronized with the wheels), whistle and bell. It also includes a transistor throttle with momentum effects and a constant-intensity lighting circuit. All sounds are generated in the unit and sent through the track to a speaker mounted in the train, usually in the locomotive tender.

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circuit generates a 300-kilohertz signal that lights the train's lights and tells the electronics when to generate a chuff of steam. In a steam locomotive, the chuffs occur four times for each wheel revolution. In a model locomotive, a cam-operated switch closes four times for each revolution of the wheels. Each time it closes, it connects a capacitor across the track that puts a heavier load on the oscillator in the lighting circuit. A detector senses the additional load and turns on the chuff generator.

The chuff generator has a volume control and a control to vary hiss pitch. A cutoff control determines the duration of chuff. The chuffs stay at nearly constant lengths for any cutoff setting. As the speed increases, the chuff sounds start to blend into the roar of a speeding locomotive. By adjusting controls, the sounds can simulate the effects of climbing or descending hills, starting heavy loads, or drifting at a constant speed.

Electrons produce chuff and hiss

The chuff and hiss circuits create sound with a white noise generator. One method used is to break down a semiconductor junction in a transistor or diode. The breakdown is controlled so the semiconductor is not destroyed in the process. During the breakdown, electrons tend to avalanche, some hitting others, causing electrical noises. When the resulting noise is amplified, it sounds like rushing steam.

The PFM system also has whistle and bell circuits. The whistle can be varied in pitch and intensity by controls on the panel. It can be made to wail like the steam locomotives of old or, by setting another switch, to give the sound of steam blowing off or of popping safety valves. Bell sounds are generated by a distorted square wave with a decay effect. Controls turn the bell on or off and regulate its rate.

A system that generates sound and modulates a 150-kilohertz carrier is manufactured by Fyffe Electronics. It includes the Fyffe throttle described earlier, a whistle circuit and a chuff circuit. The carrier signal is used for constant-intensity lighting and for synchronizing the chuff as in the PFM system.

Instead of sending the audio signal through the track, the carrier is modulated and sent to a receiver in the train. This makes the circuit immune to audio frequency electrical noise generated by the motor, by pulse circuits in power packs, or by other sources. A cam-operated switch

(Please turn to page 174)

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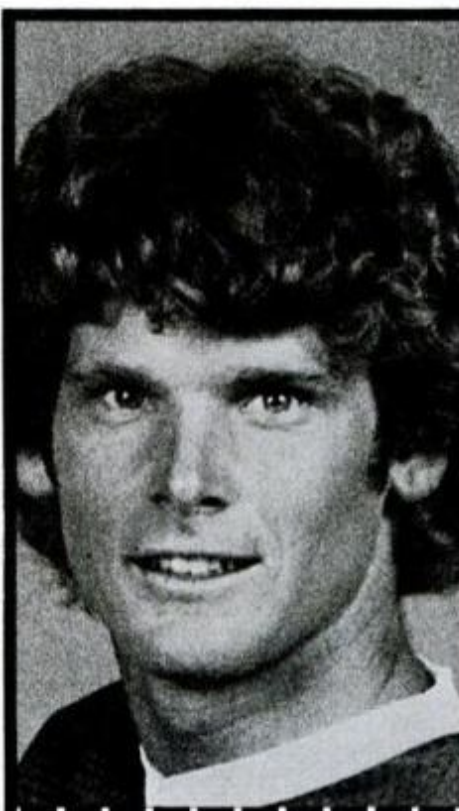
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ELECTRONIC MODEL RAILROADING

(Continued from page 173)

can be used to synchronize the chuff with the wheels.

The system also provides a circuit that can automatically vary the chuff rate without a synchronizing switch. It monitors the voltage applied to the train and increases the chuff rate as voltage increases. The receiver and speaker can be mounted in the locomotive or in a boxcar.

The whistle oscillator has controls that vary sound and pitch to allow realistic blasts and wails. The sound is transmitted to the same receiver in the locomotive that is receiving the chuff sounds. The unit also has a brake squeal circuit. The brake squeal automatically turns on whenever the brakes in the throttle circuit are applied.

The chuff or exhaust circuit controls can vary the chuff volume to simulate climbing or descending hills. A switch puts the circuit into an automatic mode that senses the delay in the throttle circuit and varies the sound accordingly.

Self-contained sound

The third type of system generates sound in the locomotive. Modeltronics sells self-contained, battery-powered systems for steam and diesel locomotives. Again, the steam exhaust sounds are synchronized by a cam-operated switch. An automatic self-adjusting exhaust control, regulated by engine power, causes the exhaust to get louder as the locomotive works harder. When the train starts or climbs a hill, the exhaust barks loudly. As the load levels off, so does the chuff. The sound system is normally mounted in the locomotive tender. If the tender is too small, it can be mounted in a car.

Since the unit is self-contained, it can be used with any type of throttle, because pulses generated by the throttle will not interfere with it. The unit is powered by a mini-sized battery. As voltage to the track is increased to run the train, circuitry allows power to be taken from the track, thus increasing battery life.

Modeltronics also sells diesel and turbine sound systems. The diesel sound unit can simulate the sounds of various types of diesels with or without turbochargers. When the turbocharger type is used, the turbo whine can be adjusted. When the locomotive is idling, machinery clatter can be heard. When track voltage is increased, circuitry detects it and causes the whine to increase and the clatter to become less audible. The whine also varies as the locomotive accelerates. The unit uses no bat-

teries, but gets its power from the track.

The turbine sound system is similar except that it gives the sound of pressurized escaping exhaust from a steam or gas turbine locomotive it is simulating. Again the sound is controlled as the engine accelerates or decelerates. The unit requires a miniature battery for power. Also available are diesel horns.

Computers tell real speed

A recent addition to model railroad electronic circuits is Barney and Associates' model railroad speed computer. In old-time speed indicators, arbitrary speeds were simply labeled at fixed settings around the speed-control throttle knob. But different locomotives and trains require differing amounts of power, so the speed readings were rarely accurate.

The Barney control, however, operates on a completely different principle. A train going 60 scale miles per hour moves 88 scale feet in one second. In one quarter of a second, it will move 22 scale feet. The speed computer uses two pairs of photocells and lights spaced 22 scale feet apart.

When a train passes the first photocell, it starts a timing circuit. When the light to the second photocell is interrupted by the train, the elapsed time from the timing circuit is obtained and the speed computer circuit is actuated. Results are displayed on a digital readout mounted in a model building. Digital integrated circuits convert the time measured to scale miles per hour using the conversion factor mentioned above. One model can be used with HO-scale trains where 3.5 millimeters on the model represent one scale foot. Another model is designed for O and S-scale trains where 1/4 inch and 3/16 inch represent one scale foot respectively.

A look at the future

Model railroaders have started to use digital integrated logic circuits to control signals on their layouts. Some have even added circuitry to the signal systems to allow trains to be automatically controlled. The logic circuits keep track of a train's location and automatically apply power to the blocks of track the train will operate on. Another recent trend is the use of radio-controlled trains—like R/C model planes and boats. Some model railroaders are even contemplating using microprocessors to control trains. If your bag is electronics and you like trains, model railroading electronics may be just what you're looking for. **PM**

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HOW TO PICK TRACK GAUGE

(Continued from page 107)

delight and, in fact, is a product of former watchmakers, a factor also reflected in its comparatively high price. While intriguing, it's more attractive to miniaturists than true model railroaders—and it certainly isn't for children. Elaborate multitrack layouts with sprawling storage yards and complex switching would be impractical to operate in a gauge of such diminutive size. But a few short lengths of track laid out on a mantelpiece or other display area, incorporating those old-time nostalgic European locomotives and coaches, could create a handsome scene indeed.

How much space do you need?

The accompanying diagram shows the minimum space requirements for a basic oval layout in all five gauges. This is important to study when selecting a gauge to suit your needs. Note that neither G nor O will fit on a standard 4 by 8-foot sheet of plywood, a commonly used base for many beginning layouts. An HO-gauge layout will just barely make it but not by much and will have to be kept simple. One "out" is to buy a table-tennis top, which measures 5 by 9 feet. This will give you just enough extra space to accommodate an O-gauge loop and a good deal more HO trackage, but it still won't handle a G-gauge layout.

The big space-wasters in any gauge are, of course, the curved end sections that permit a train to go whizzing con-

tinuously around an endless loop—a very satisfying sight, especially for youngsters. Model railroaders faced with limited space resort to several tricks to minimize this problem. One is the so-called "dog-bone" layout which, as its name implies, is simply an oval—or series of concentric ovals—squeezed together in the middle. Besides saving space, the arrangement offers other benefits: Bunching the tracks together at the center gives easier access to derailed trains and actually tends to make a simple layout look more complicated than it really is.

A variation on this is the L-shaped layout, which is essentially a dogbone bent around a corner of a room. Another space-saving arrangement is "point-to-point" operation in which tracks run parallel in a straight line along a wall, often on a board not much wider than a bookshelf. Trains shuttle back and forth from one end to the other but can't turn around. While this isn't likely to excite the younger set, it is favored by many railroad buffs who feel it more closely approximates true prototype operation—real trains, after all, don't go whizzing around in circles.

Don't throw your train a curve

A final point to bear in mind when selecting a gauge is that some scales—most notably HO and N—offer a choice of several different degrees of track curvature. HO, for instance, has fixed-curve track sections from 15-inch to 22-inch radius. Using short-radius bends can compress a layout into less space, but can also pose

problems. Express trains cannot move through sharp bends at high speed without danger of derailing. Also, some longer locomotives and passenger cars can't negotiate such tight turns at all.

A general rule of thumb is to use the gentlest possible degree of curvature on high-speed main-line tracks and to run your passenger trains on these. Shorter-radius curves can be used on branch lines, sidings and yard tracks where trains will be moving more slowly and will more likely consist of short switch engines and freight cars. The same applies to turn-outs, which also come in several degrees of curvature.

Space tight? Use 'shorty' cars

If space limitations dictate that you must use short-radius track, buy the so-called "shorty" type of passenger cars. These are made slightly shorter than true scale length especially to negotiate tight curves. While not quite "prototype" in appearance, they look reasonably realistic and will save you a lot of derailment headaches.

Some gauges—O, HO and N—offer flexible track sections that can be curved to suit your particular needs. These are handy for creating "easements"—variable-radius curves—and for making connections where fixed-length track sections just won't fit. But avoid the temptation to force them into excessive bends or you'll wind up with the same old bugaboo—derailment. Keep your trains—and your hobby—on the track.—Ken Brooks

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blood pressure. Beyond that point, no sounds will be heard because the pulse is no longer impeded.

Blood pressure is recorded as the systolic number followed by the diastolic number—for example, 120/80. (Verbally, this is referred to as 120 over 80.) The numbers represent millimeters of pressure. A reading of 120 systolic pressure would indicate that the force of the blood pulsing through the artery would raise a column of mercury 120 millimeters.

Normal readings

Systolic blood pressure also represents the maximum pressure in the artery when the heart muscle is contracting. Between contractions, there is a minimum level of pressure in the artery and this pressure is diastolic. Pressure measurements of from 110/60 to 140/90 usually are considered normal, according to the A.M.A., although other factors must be considered in making judgments about the state of a person's health. And because individual blood pressures can vary from day to day or from morning to evening, a single reading on a sphygmomanometer dial should be considered only a clue to true blood pressure. Physicians who encourage people to take their own blood pressure believe that home readings, properly taken over a period of time, will reflect more accurately the person's actual average blood pressure than a single reading in a doctor's office. (Also, readings taken in a doctor's office can appear higher than normal if a patient is nervous.)

Blood pressure gauges with a dial usually are guaranteed for five to 10 years but tend to lose accuracy over a period of time and should be checked at least once a year against a mercury-column device. These also can give false readings, but are the most reliable.

Some electronic sphygmomanometers measure blood pressure without the aid of a stethoscope. One features a microphone built into the arm cuff. It detects the blood movement—"Korotkoff sounds"—and translates them into systolic and diastolic readings. In some models, a red light flashes when the critical levels are reached. Batteries operate these devices and must be up to par to insure accuracy.

Stethoscope can be handy

An ordinary stethoscope, also handy for checking vibrations and other sounds in automobile engines and other mechanical devices, can

be purchased for about \$5 to \$10. Professional stethoscopes, with higher sensitivity for body sounds, cost upward of \$30. While most are simple, rugged instruments, defects can develop. Most common problems are cracked diaphragms and deterioration of the tubing.

For anyone interested in an electronic stethoscope, at prices starting above \$100, such instruments are available with transistorized circuitry and volume controls that boost ordinarily inaudible sounds to hi-fi levels. At least one model, in fact, is equipped with receptacles that allow connections to tape recorders, amplifiers or speakers.

Electronics and liquid crystals have even moved in on the old-fashioned fever thermometer. Battery-powered electronic thermometers sense body temperature through a thermistor that can be inserted into the mouth, the rectum or an armpit. The thermistor measures temperature variations through electrical resistance changes; electronic circuitry converts the resistance measurements into a Fahrenheit or Celsius meter reading. Such thermometers can be purchased from mail-order sources or in certain department stores for about \$15 to \$20.

Liquid-crystal thermometers

Encapsulated liquid crystals that can indicate differences between normal body temperature (98.6° F. or 37° C.) and a fever can be obtained from mail-order houses supplying scientific equipment. Plastic sheets containing the crystals also are sold through regular consumer sources. They display the letter "N" (for normal) when applied to the skin or "F" for fever). Liquid crystals in Mylar sheets are sensitive to temperature changes of approximately 1° Celsius and the changes are displayed in colors that shift from red through orange, yellow and green to blue as the temperature rises. A one-foot-square sheet of the temperature-sensitive liquid crystals costs about \$5.

The small strips that indicate normal body temperature or a fever have been advertised for approximately \$2 for one or \$4 for four. The old mercury thermometer, still used in some hospitals and doctor's offices, costs around \$2 and is calibrated to read a range of from 94° to 110° F. or from 33° to 44° C. Each change of $\frac{1}{10}$ ths of a degree is indicated by a short line along the temperature scale. When using a mercury thermometer, it's helpful to remember the basic design of the

device. The numbers indicating temperature are marked along a ridge which also serves as part of a magnifier through its convex shaping. The rounded opposite side of the glass tube is coated with a reflective surface that is intended to make it easier to find the mercury column.

Body temperatures between 97.6° F. and 99° F. are not important; normal temperatures may vary that much between morning and evening. Fevers usually begin above 100° F. Skin temperature can vary from 85° to 95° F. because of such factors as local blood circulation patterns or layers of fat beneath the skin. Rectal or oral temperatures are regarded as most accurate. Rectal temperature readings are recommended for small children who may bite the thermometer and swallow mercury.

Using an otoscope

Families with small children may want to invest in an otoscope, available at prices from about \$15 to \$30. Oscopes are used for checking the health of ears. Youngsters occasionally develop ear infections, painful wax accumulations and problems from stuffing small objects into the canal.

An otoscope is somewhat like a pen-sized flashlight with a lens on one end. The lens is in a funnel-like speculum which is inserted into the ear canal. A battery-powered light illuminates the canal leading to the eardrum and the lens magnifies the image. Any irritation, wax accumulation, or foreign object in the ear will be clearly visible.

In using the instrument, it is helpful to pull the external ear as gently as possible in order to straighten the canal. The speculum should be moved forward slowly and carefully, making sure that the observer can see what is ahead of the tip. In a normal ear canal there may be a small accumulation of cerumen, or earwax, ranging in color from yellowish-orange to dark brown. In some cases, the canal may be blocked by it and the speculum will show nothing. If there is no plug, a viewer will see smooth pink walls of the ear canal with the pinkish or pearly-white ear drum at the end.

It may be difficult to examine the ear canals of a small child who struggles. If the youngster lunges, the otoscope can damage the ear canal or the eardrum, so it is best to have a second older person hold the child's head steady while the speculum is inside the ear canal.

In removing wax from the ear

canal, water used to irrigate the canal should be close to body temperature. Water that is too cold or warm can trigger a dizzy or fainting spell when directed into the ear canal. If there is concern about the condition of the cerumen or a foreign body in the ear, washings can be caught in a basin for examination by a doctor.

Attachments for Water Pik

Traditionally, a syringe is used to irrigate an ear canal in order to flush out waxy plugs or foreign bodies. However, a recently invented device can be attached to a Water Pik teeth-cleaning appliance. The attachment directs three jets of water into the ear canal in an alternating, gently pulsating pattern that rocks out a wax plug. Because of the design of the tip of the ear irrigator, the water jets do not produce pressure directly on the eardrum but rather along the sides of the ear canal. Exit channels for the water guard against buildup of undue pressure against the eardrum.

Other devices have been developed for Water Pik equipment for nose and throat irrigation. Warm water with salt added, or plain warm water, is directed into the irritated or infected area at a steady pulsating rate and at a regulated pressure that does not damage the sensitive tissues lining the nose or throat. Some doctors favor training patients to use the new devices at home for relief of symptoms of nose or throat infections, rather than such alternatives as nose drops, gargling or using salt water irrigating contraptions.

The Water Pik devices for self-treatment of other than dental problems were demonstrated at the 1977 convention of the A.M.A. by Dr. Murray Grossan of Los Angeles, a physician-inventor who also has developed biofeedback equipment and a Hydro Pulse machine that works somewhat like a whirlpool bath for muscle treatments, except that the water is pulsed through a cuff attached to the arm or leg. Since the water is in a closed system, it does not contact the skin directly. The frequency of the pulsations can be adjusted from one per minute to six per second to give leg muscles a range of stimulation equivalent to walking gently for a distance of 20 feet or walking vigorously for 10 miles.

Biofeedback equipment

Biofeedback equipment is available from the same stores and mail-

(Please turn to page 180)

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order houses that offer other medical devices to the general public. Prices range from around \$50 for basic biofeedback monitors to \$500 or more for sophisticated professional types of equipment.

One advantage of biofeedback equipment is that it enables a person to become aware of physiological functions he did not sense or did not recognize previously. For example, your stomach could be producing an abnormally high level of gastric acid without your immediate awareness

of the condition. By using electronic biofeedback equipment that produces an audible tone or a flashing light when the gastric acid activity increases, you can learn to control that bodily function through relaxation or some other technique so the signal diminishes when stomach acid diminishes.

Biofeedback equipment functions through sensitive electronic detection and amplification devices that pick up brain waves, changes in body temperature and so forth as

transmitted through the skin. They serve as a sort of electronic crutch that helps people with certain physical complaints to learn to control body functions by consciously guiding the flow of electrical impulses associated with that function. Some patients afflicted with irregular heartbeats, for example, have learned to control their heart rates, speeding up slow hearts, slowing down rapid hearts, or reducing the frequency of premature heart muscle contractions. However, it should be noted, the same or similar effects can be produced without electronic equipment as the Yogic masters of the Orient have been aware of for centuries.

Mind control

Regulation of the body by pure mind control, sometimes called operant conditioning, seems to work simply by rewarding a person with improved health. In other words, an individual who can learn through operant conditioning to lower his average blood pressure does not need to be reassured by a beeping tone or flashing colored light. And the objective is the same through either approach.

Biofeedback equipment generally involves monitoring of the alpha or theta brain waves of an individual and in the treatment of medical problems alpha waves are the most important since they indicate a state of relaxation. In one study of biofeedback efforts to control heart rates, stop asthma attacks, and lower blood pressure, scientists found that the alpha wave patterns of the patients were approximately the same as those recorded from the brains of Zen monks during periods of meditation.

However, most Western minds are gadget-oriented and Americans find it easier to learn control of bodily functions with biofeedback equipment. Yogic and Zen masters attain their ability to reach this state of operant conditioning through rigorous practice sessions. Westerners usually do not have the time to devote to serious operant conditioning. Also, through years of association with EKG, EEG, and other electronic equipment seen in hospitals and doctors' offices, Westerners seem better able to relate to the more tangible evidence of body functioning that comes from a black box attached by wires to electrodes on the skin. Biofeedback equipment may not be necessary, but for many Americans, the results are more believable.

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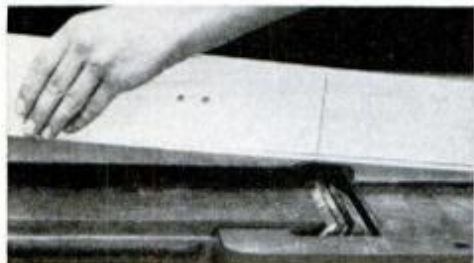
HOW TO USE A JOINTER

(Continued from page 119)

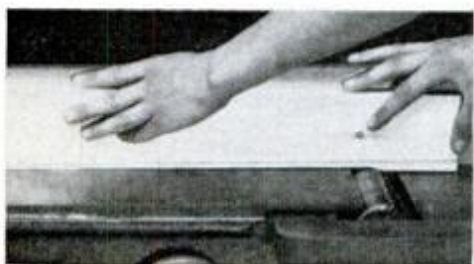
burn and render the blade useless.

Since grinding is only necessary when the cutters are in rough shape (nicked or chipped), honing at regular intervals will generally maintain the sharpness required for home shop activities. To do it, partially cover a fine carborundum stone with

Taper jointing



Long boards are tapered using two passes. First pass is made starting at the mark.



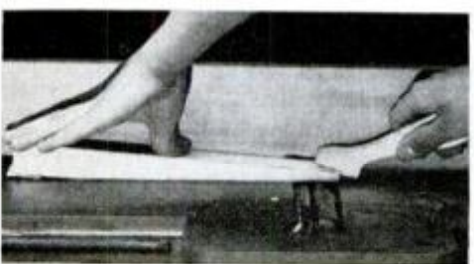
First pass is continued out to the board's end. Pencil line indicates desired taper.



Second cut is started at the far end of board and proceeds for full board length.



For short tapers, place taper start over knives; use a block to support front end.

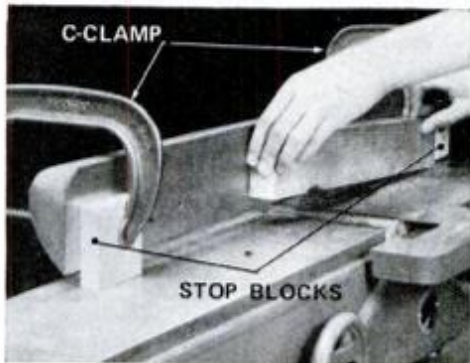


Never push short taper into cutters; instead, pull board from other side.

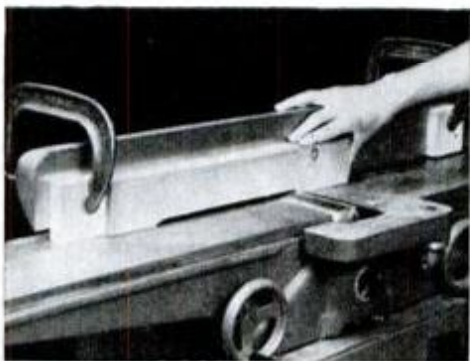
paper (to save the table surface) and position it on the front table as shown in the photograph on page 117.

After disconnecting power, rotate the cutterhead until the stone rests flat on a knife's bevel. Clamp the belt to the stand so the head cannot turn and hone cutter by stroking the

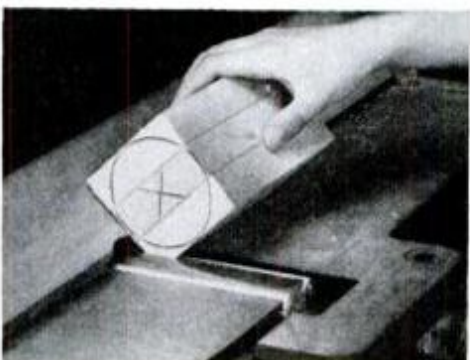
Chamfer jointing



For stopped chamfer, lower both tables, butt work against carefully located block.



Push work through to the stop block, back up slightly, raise end, remove workpiece.



Jointer is great for chamfering corners off hefty blocks to be turned on lathe.

stone lengthwise along the cutter. Do the same number of strokes on each knife.

To sharpen and joint knives to a true cutting circle, the edges must be jointed while the head is revolving. To do this, the stone is placed on the rear table and the jointer is turned on. A stop block securely clamped to the front table is a must or the stone will be drawn forward by the

spinning cutterhead (see photo on page 117).

Jointer basics

Remember to cut boards oversize to equal the amount to be removed on the jointer. For example, if you want a board exactly 4 in. wide and plan to joint both edges, rip the board 4 1/4 in. wide and set the jointer to cut to a depth of 1/8 in. One pass on each edge knocks off 1/8 in. and you will finish with a perfect 4-in-wide board.

About taper jointing

Tapering is one of the most important functions of the jointer. The easiest tapers are the short ones—that is, lengths shorter than the front table. To do it, the front table is lowered the desired depth and the stock placed on the front table, against the fence, in such a manner that the board is on the rear table at the start of the cut. From this attitude the work is simply pushed forward through the cutters.

To cut long tapers, it is necessary to do some arithmetic. The basic rule to remember is that the stock must be divided into a number of equal divisions—with each division slightly less than front-table length. In the photos we divided a 28-in. board into two divisions of 14 in. each (because the jointer's front table is 14 1/2 in.). Since a 3/8-in. taper was desired, the front table was set to a depth of 3/16 in. and two cuts were made. The first one starts at midpoint as in the photo on page 178; the second cut runs the full length of the board. Any length of board can be handled in this fashion—a 48 in. board, for example could be marked off in four 12-in. divisions.

Short tapers are best handled by pulling the work over the knives as in the photo on page 178. When the cut is set up, the front table is lowered the desired depth and the stock is placed on the table so the point at which the taper is to start comes over the knives. The board is pushed down until the end contacts the front table.

The other end is hanging free over the outfeed table. Here a block is slipped in place to support the workpiece. (At this stage, the jointer power is turned off.) Mark the position of the block and brad it to the workpiece so it can't move, or clamp the block to the table.

Before cutting any tapers on a finish project or piece of expensive wood, try a couple on some scrap wood to perfect your skills. **FM**

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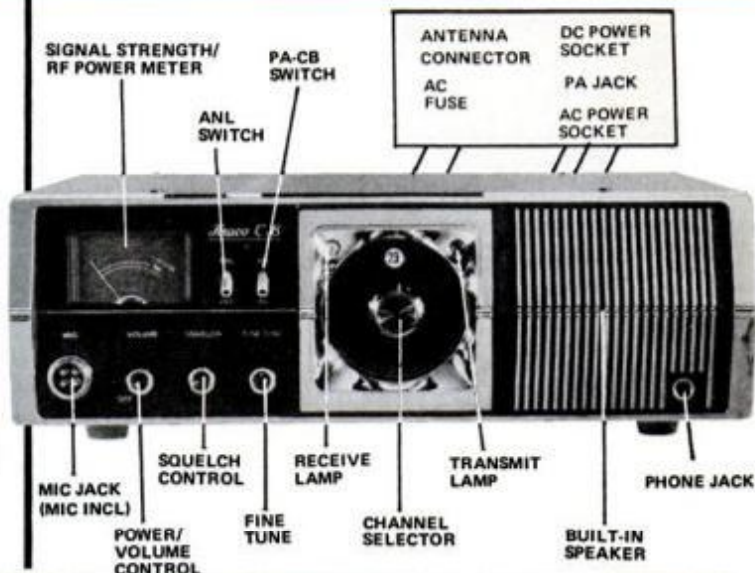
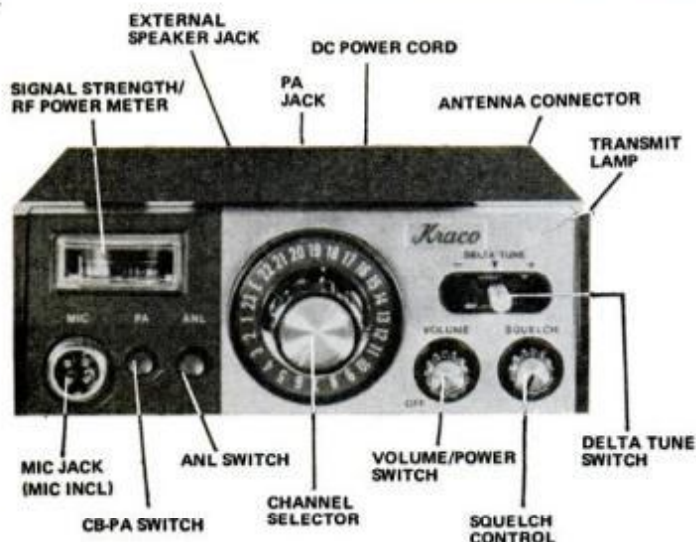
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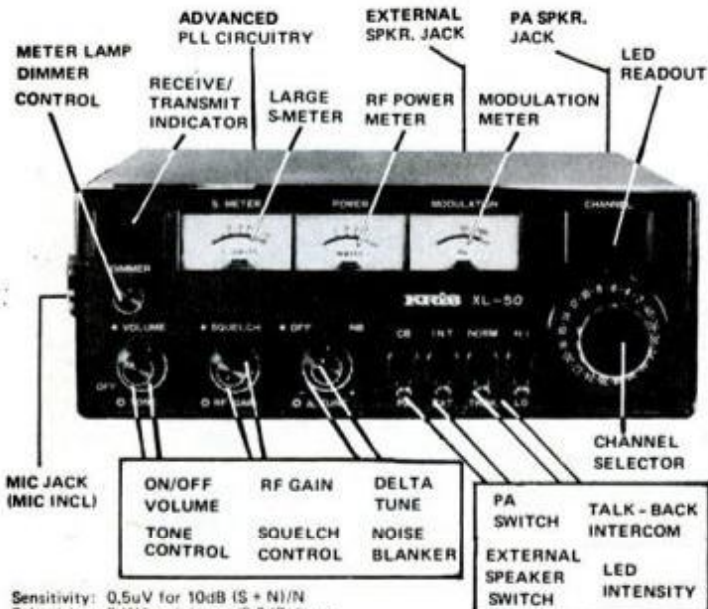
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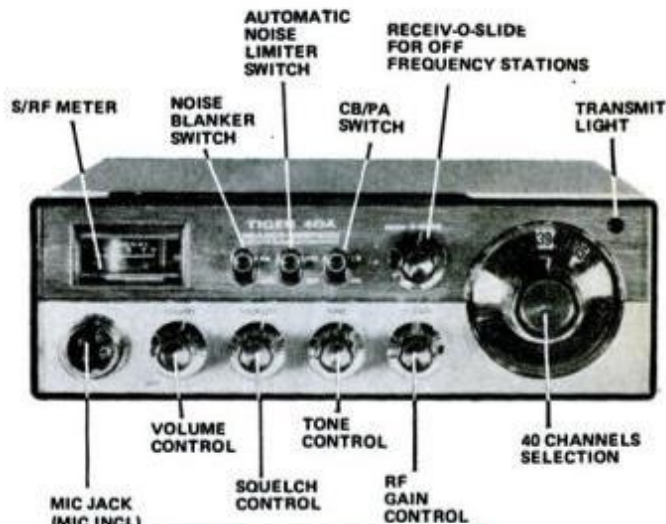
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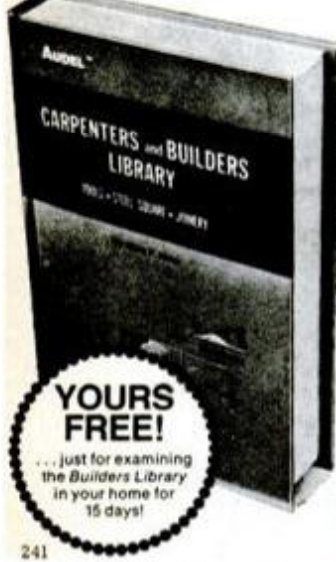
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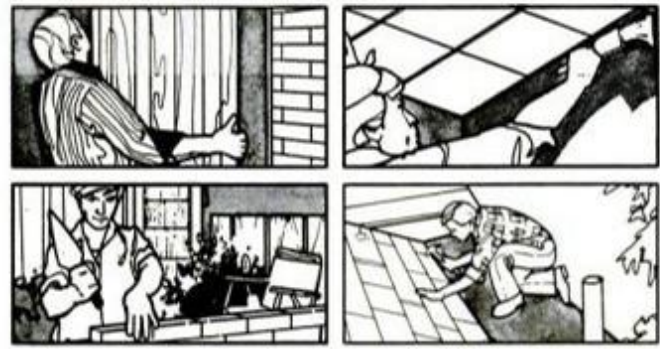


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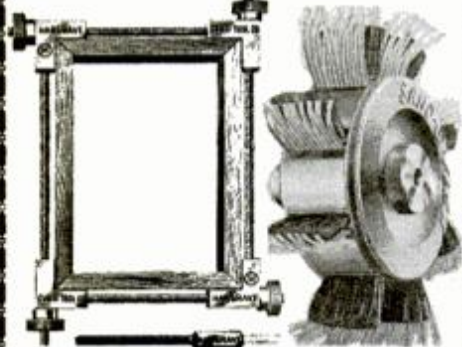
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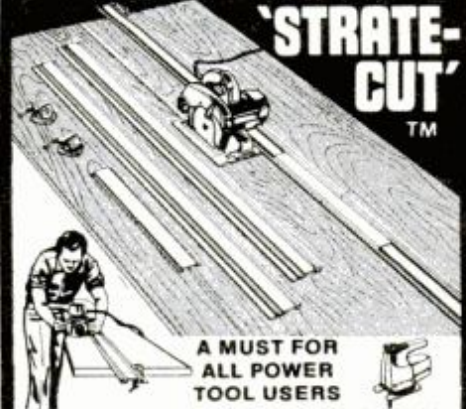
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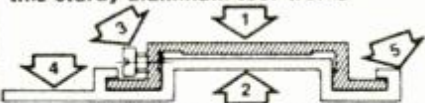
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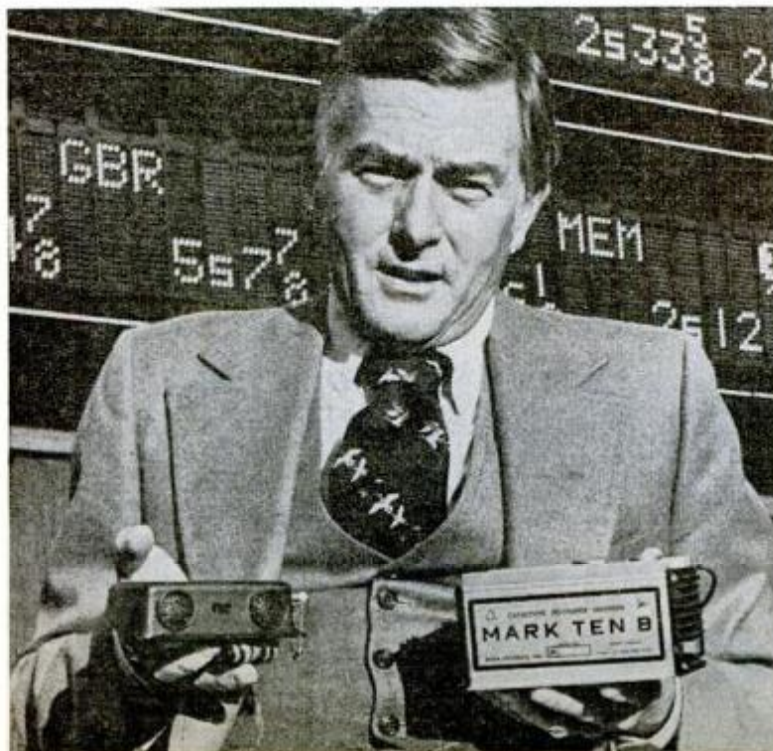
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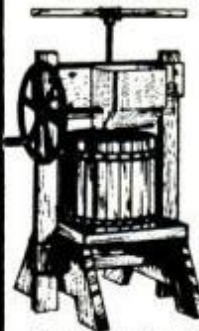
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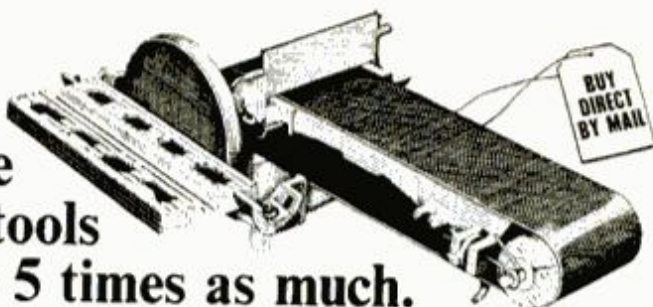


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