

21 ways to spot a bad driver before he gets you

Popular Mechanics

TOOL CARE: A master craftsman's secrets

WINTER DRIVING: The best way to go in snow

AUDI 5000: Happy owners' 3,000,000-mile driving report

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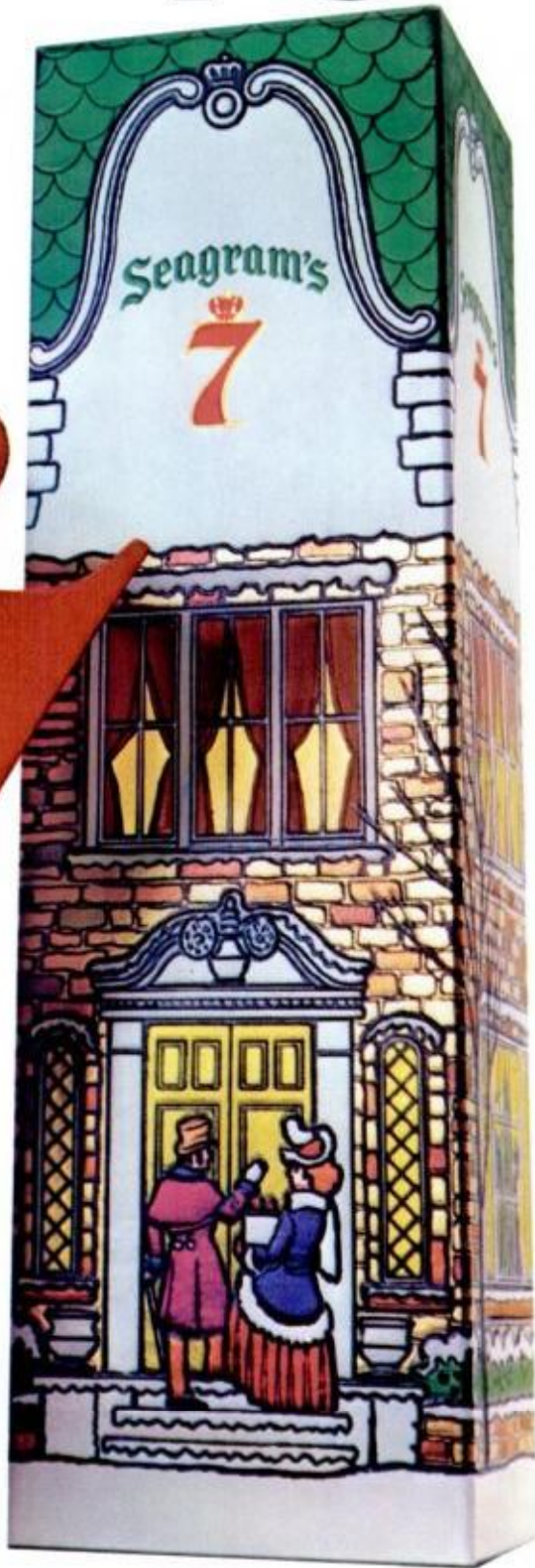
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On the cover

Duels between World War I vintage aircraft are routine on summer weekends at the old Rhinebeck Aerodrome, near Rhinebeck, N.Y., where photographer Howard Sochurek took PM's cover photo. This issue's special illustrated essay celebrating the 75th anniversary of the Wright Brothers' first flight at Kitty Hawk begins on page 63.



DECEMBER 1978

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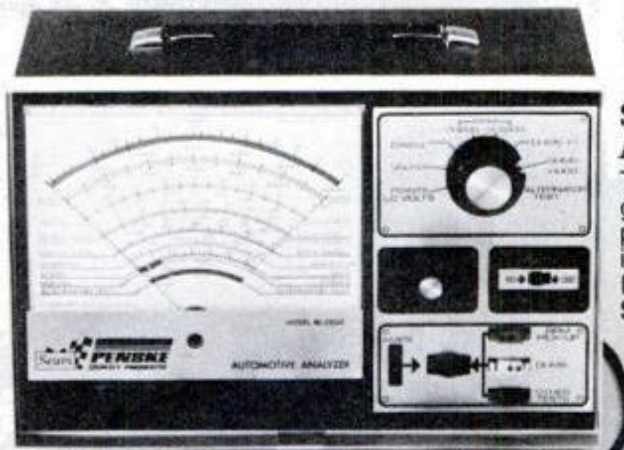
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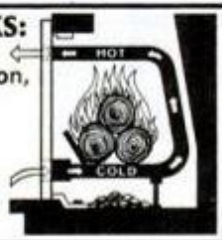
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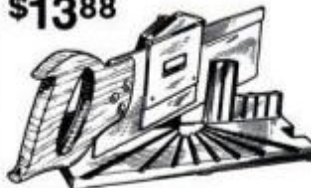


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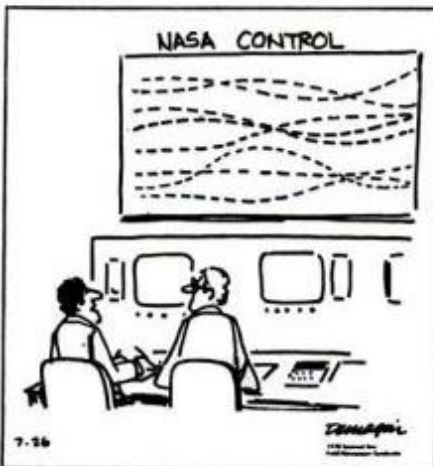
LETTERS TO THE EDITOR

Space doubt

Richard Dempewolff's interesting article *Our Growing Junkyard in Space* (August '78, page 57) might have triggered a Ralph Dunagin cartoon in many newspapers (7/26/78). It shows two NASA people watching their readouts while one says, "We could try to move Skylab to another orbit position, but there doesn't appear to be one open at this time."

W.F. SPANKE
SPRINGFIELD, VA.

Says cartoonist Dunagin: "I'm not sure that your story was the sole impetus for the cartoon, but it was definitely a contributing factor." PM was pleased to discover Dunagin has been a subscriber for several years. The cartoon below, Dunagin's *People by Ralph Dunagin*, is reproduced through the courtesy of *Field Newspaper Syndicate*.



"WE COULD TRY TO MOVE SKYLAB TO ANOTHER ORBIT POSITION, BUT THERE DOESN'T APPEAR TO BE ONE OPEN AT THIS TIME."

Splinter gripe

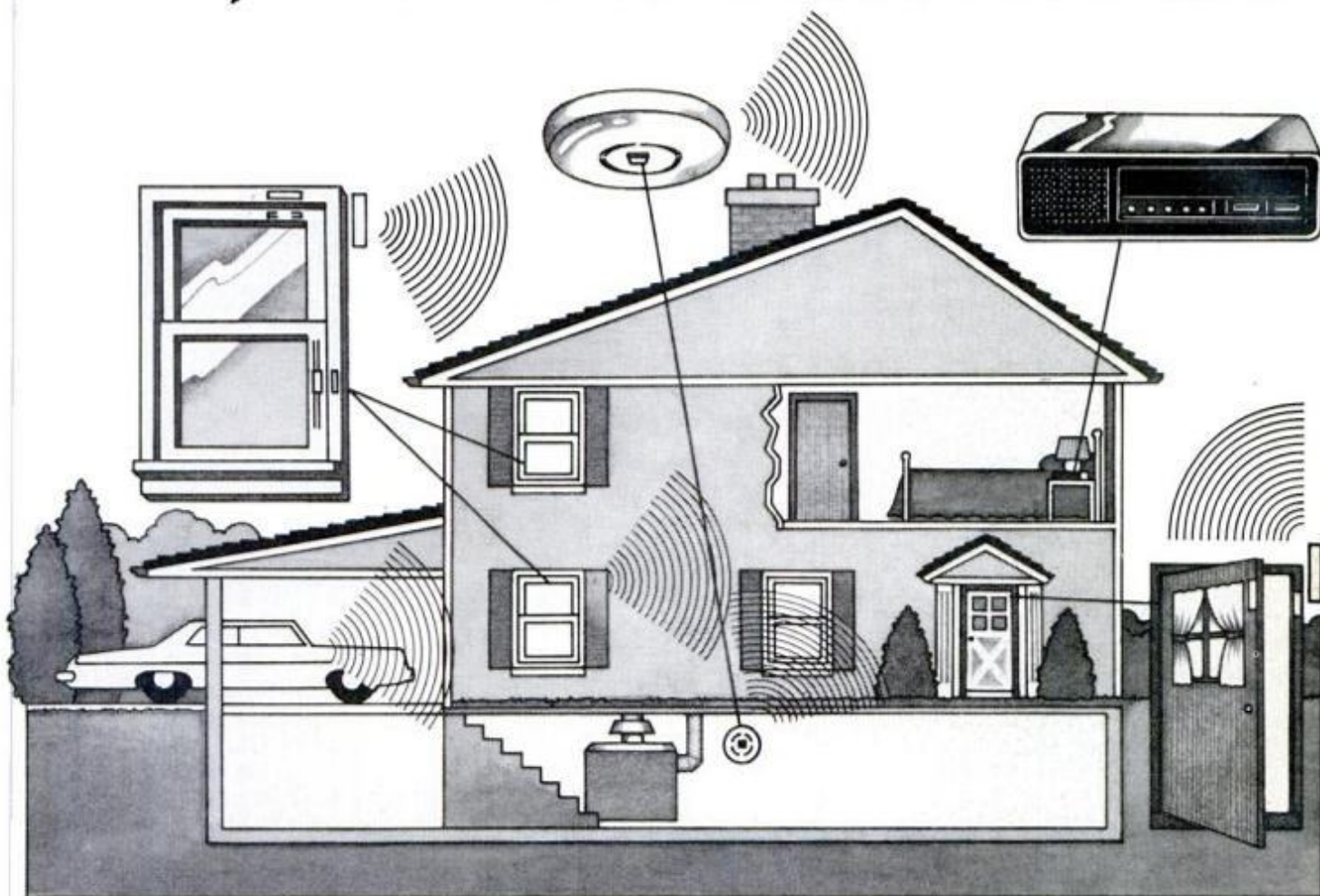
On the strength of your review I purchased a Craftsman 72-tooth carbide blade for my radial-arm saw. They do indeed make a very smooth end cut, but mine, at least, causes splintering on the underside of the board being cut. I've tried slow, medium and fast saw motion—all to no avail. Is there any recourse other than a return of the blade for a refund?

FRANKLYN A. GRAFF
LEBANON, CONN.

One of the characteristics of a radial-arm saw is a tendency to splin-

(Please turn to page 8)

Protect your home against burglary and fire with the new, low-cost Norelco wireless Home Patrol™.



In the time it takes you to read this ad, seven homes will be burglarized.* What's worse, tonight over twenty men, women and children will die in fires. That's why you need the new Norelco Home Patrol.

You get a receiver, one door and three window sensors, each with its own transmitter, and the Norelco smoke alarm.

What's more, you can customize a Home Patrol system for your specific protection needs with accessories like additional door and window sensors, receivers, smoke alarms, heat sensors, auto sensors and even an emergency alert. The Home Patrol system can also safeguard apartments, condominiums, house trailers and boats.

Simply attach each door and window sensor. The instant an intruder tries to get in, the intruder light flashes on the receiver and it sounds a shattering alarm.

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Chances are you've wanted more protection for your family but couldn't afford it. Now, thanks to advanced circuit technology, the Norelco Home Patrol can give you that protection at a fraction of the cost of expensive wired systems. It's so easy to own and install, it would be criminal not to! Look for the new Norelco Home Patrol in the home protection centers of your local stores.

*Based on FBI reports of one residential break-in every 13 seconds.



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And burglars before they break in.**

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LETTERS

(Continued from page 6)

ter along the cut bottom when crosscutting. This occurs because the blade protrudes only slightly through the workpiece. A very slow feed rate may cure the problem, or, at the least, minimize it. Another possible fix is to apply tape over the cut line on the bottom of the board being cut. One other point: don't use the 72-toothed to cut stock thicker than $\frac{3}{4}$ inch.

We brightened his world

I must congratulate you on the article by Lorraine Dusky (*Startling New Theories on Light and Color*, Sept. '78, page 80). I have dealt with color all my life, as an artist working for color printing firms and teaching art classes. I am forever looking for authoritative information on color to use in lectures I give to art groups.

It has always been my contention that the color we surround ourselves with influences our health and behavior. I am grateful to PM for showing that ideas of mine which have been considered outlandish are finally proven to have some substance.

GILBERT GUILLERY
AMITYVILLE, N.Y.

Rolling right along

When we saw the September issue we were amazed to see the plans for the scooter (*Scooter's Safer Than Skateboard*, page 181). My husband had designed and built a similar one for our son in June. Just as with yours, he used roller-skate wheels.

However, after purchasing a used skateboard at a garage sale, he replaced the roller-skate wheels with the urethane ones from the skateboard. What a difference! It's much easier to control and can even make corners. The wider wheelbase also makes it easier to balance. It's the favorite riding toy around.

MRS. EDWARD A. SUMMERS JR.
MENOMONEE FALLS, WIS.

Storm-window caulking

In *22 Ways You Can Save Energy Around Your House* (Sept. '78, page 142), item 7 says to caulk the joint where the storm window joins the wooden window frame. Is this correct?

Everyone I have talked to says the storm windows have to breathe to prevent condensation. If you seal the storm windows, would you have the condensation problem?

LARRY MCCOLLUM
DOTHAN, ALA.

Yes, the instructions are correct—

they refer to caulking under the aluminum flange that is screwed to the window frame. Just don't put any caulk in the weepholes which are located along the lower rail of the storm frame.

Boxed out

The article *How to Install a Stand-by Generator* (August '78, page 18B) was very timely. I have just bought a portable generator. What is the make of the fiberglass box in which the generator was installed?

LEONARD A. EDWARDS
ST. CROIX, VIRGIN ISLANDS

The box pictured in the article comes with the Homelite generator we featured. Your only alternative, we suspect, is to build a custom-fit box for the generator you purchased. If more of our readers write in asking about a protective box for a generator, we will probably design and build a PM version.

Cheers for Rabbit diesel

After reading *PM Owners Report: Dodge Omni and Plymouth Horizon* (Sept. '78, page 88), I must say that neither car is what I would consider ideal from my experience. The 31.9 mpg highway doesn't even begin to compare with our VW Rabbit Diesel's 63 mpg highway and 54 mpg in the city. Sure, the VW is a more expensive car, but you can't put a price on the higher quality workmanship.

We've owned numerous American cars, but our experience with VWs is that they never say die. Detroit has the potential to make the finest cars in the world, but they just don't care enough to exercise it. With the new VW plant in Pennsylvania, the best cars in the world may soon be American-made.

CLIFFORD M. MOLLOY
HOUSTON, TEX.

Swat did you say?

There is one small item every camper and tourist should have on hand: a fly swatter. Most people assume flies are ubiquitous and in such numbers that replacements for fallen comrades are unlimited.

With few exceptions, this is not the case at all. Most campsites and roadside rest areas have a definite, supportable quota. Kill those off when you arrive and, except for strays, you won't have to contend with the pests anymore while you are there.

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One of the secrets of the success of this school is the fact that its founder, J.E. Smith, was a teacher. So, when he originated his first course in radio over 60 years ago, it was carefully designed with training in mind. And that principle has guided us ever since. In every technical course we offer. Today, every aspect of our courses in TV and audio servicing are student-oriented to make learning as fast and as easy as possible.

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Right off, that means that you get far more than book learning. NRI gives you practical, hands-on experience as you progress. In our Master Course in TV and audio servicing, you actually construct a 25-inch diagonal solid state color TV. You start right with the basic parts and as you build it, you introduce and correct typical servicing problems, ending up with a complete unit, ready to use. That way, you get the actual bench time and intimate knowledge you need to handle real servicing problems. And before that, you even assemble some of your own electronic test instruments so you not only know how to use them, but how they work. That kind of training sticks with you... gives you extra confidence.

And Mr. Smith taught us something else, too. Not to go too fast. So, our courses have what we call "bite-size" lessons. That's another way of saying that they're easy to digest. Big enough to cover a specific subject thoroughly, but not so much that it'll overwhelm you. Written clearly, without a lot of gobbledegook. And we keep in mind that you're learning at home, so you take our lessons at your own pace. That way, you can learn in your spare time without interfering with your present job or eating up too much of your family life. Of course, if you want to move ahead faster, we're behind you all the way. The point is, it's your choice.

Professional Instructor/Engineers

One of the ways we back you up is with a fully-qualified staff of professional instructor/engineers. They're there to help you when you have a problem with any aspect of your studies... lessons, theory, bench training. And because most of them



John F. Thompson, NRI President

actually helped plan your lessons and designed your equipment, you'll get answers right from the horse's mouth, answers that are clear and to the point.

I might add that these are not a bunch of ivory-tower professor types. In between checking your lessons and giving you personal help, they're busy keeping up with the state of the art, designing new equipment and revising lessons to get you ready to handle even the latest equipment. As a case in point, take the audio equipment we added to our course recently. Not just stereo, but *four-channel*. Maybe a little exotic, but when a servicing problem like this hits your bench, you're ready for it. It's the kind of thinking and planning ahead our founder would have liked.

I Dare You To Do It

Now you might think I'm bragging a little too much on how good NRI is, and maybe I am. I'm mighty proud of our accomplishments. But the proof of the pudding is in the eating... how our training works in preparing people for actual jobs. So I'm inviting you to ask the only people who can give you a totally objective answer, professional TV and audio technicians. And here's my bet. Just look in your yellow pages for a couple of TV repair shops, ask to speak with anyone who actually does the repair work, and ask him what he thinks of NRI. I'll bet he says, "Do it!"

I'm not really sticking my neck out, because I know something you may not. Almost half the TV servicemen working out there have taken home-study courses. And among them, it's NRI more than three to one! Ask the pros on the firing line and three to one they'll recommend NRI to you as their first choice. I'll be happy to send you a copy of the national survey that proves it.

Why do the pros like us? Because NRI works. You take it at home so you don't have to go to classes. You take it in your spare time, so you can hold down your job while you get ready for your step forward. And you take it easy, because our

bite-size lessons make it easier, let you set your own pace.

Equipment Designed for Learning

And to top it off, NRI's equipment is exclusive. We design most of our own, so it's not somebody else's hobby kit or a stripped-down and mostly assembled commercial unit. It's designed so you really learn as you build, designed to give you lots of honest bench time, designed to give you the satisfaction of finishing up with a fully operable, top-quality unit that's comparable to any commercial set on the market. But you built it... you learned something on it! That's J.E. Smith's philosophy again.

It all boils down to the fact that we've aimed our training at a very practical goal... giving you the skills you need to move ahead in a rewarding career. Or even to have your own full- or part-time business.

Send for Free Catalog, No Salesman Will Call

There's lots more to tell about NRI training in TV and audio servicing and other courses, but not much space left to do it. So I'm inviting you to send for our free catalog of electronics courses. It contains a complete description of every course, including each lesson, training kits, and experiments. Full color photos show you exactly what your course will include in the way of test instruments, electronic components, and major kits like the 4-channel audio center and color TV.

No salesman will call on you, either. We don't work that way, never have. Our catalog shows you what we have to offer you, what we can do for you. Look it over, then think about it and make your own decision without outside pressure. J.E. Smith always felt that his best students were the self-motivated ones.

I can only add this. With over 60 successful years and more than a million students behind us, we must be doing something right. Just ask anybody we've helped along the way. So get started on your future. Send the postage-paid card and check the course that interests you. If it has already been removed, write me and I'll personally see that your catalog gets rushed to you. And thanks for listening to me.



John F. Thompson, President
NRI Schools
McGraw-Hill Center for
Continuing Education
3939 Wisconsin Avenue
Washington, D.C. 20016



71GY-55C-BL36

HOMEOWNERS' CLINIC

QUESTIONS ANSWERED

Double helping

The previous owner of my home re-sided over the original asbestos shingles and reroofed over the original asphalt roof. Is this good practice?—Kirk Williams, Newburgh, N.Y.

Yes. In fact, it's common to cover existing siding and roofing. Use solid crown molding to fill the gap between the casing face and the new line of shingles. A more expensive way is to extend the casings out to receive the added thickness. Some sidings have their own channel or J-type trim that is nailed to the face of existing trim to receive new siding.

When reroofing, make sure the added load doesn't overstress your roof. Check with your local building department before proceeding. Make sure nails are long enough to penetrate layers of original material. You may need 1 $\frac{3}{4}$ -in. nails.

Humidity and insulation

I have blown-in cellulose insulation in my attic with no vapor barrier. I want to put a humidifier in my home. How will the moisture affect the insulation? Should I remove the cellulose and replace it with foil-backed fiberglass?—Peter Messina, Reston, Va.

Without a vapor barrier you shouldn't humidify. Moisture will penetrate insulation and condense, possibly rotting your framing. If money is no object, remove insulation and install a vapor barrier.

As a less costly step, I recommend using paint as a barrier. You should install new plasterboard on the ceiling (buy foil-backed type or prime the back of regular panels with aluminum paint). Even without the plasterboard, to keep moisture from penetrating your attic, paint all ceilings with at least two coats of vapor-resistant oil paint (water-base paint is generally not an effective barrier).

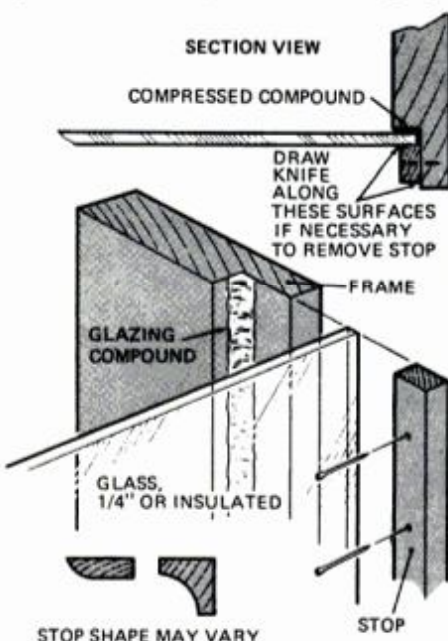
Window replacement

How do I replace broken glass in my picture window?—Michael Drechsler, West Hartford, Conn.

On most picture windows, the frame is rabbeted to receive the glass (see drawing). To replace the window, spread glazing compound in rear and side of rabbet and set glass in place. Press glass gently against compound and nail

stop in place to keep glass from falling out. Be sure there's a small amount of compound between stop and glass.

To remove glass, reverse the procedure. Coats of paint may have sealed the stop to the frame and glass. Draw a utility knife blade through both sides of the stop to loosen. Ease stop out with a putty knife, but be careful not to damage the frame. Take care also when removing the broken glass (I use heavy-duty rubber utility gloves). Scrape off all old compound so new glass will sit prop-



Guide for replacing picture windows.

erly in frame. When measuring for replacement glass, deduct 3/16 in. from width and height of opening to allow for easy installation.

Flaking flagstones

Due to rain and freezing weather, my 40-year-old flagstone patio flakes apart in slivers. Is there a sealer that stops water from penetrating flagstone? I'd prefer a glossy sealer that's not slippery to walk on.—Dr. J.E. Terence Kavanagh, Warren, Ohio.

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 order(s) to PM, Dept. HCG, Box 1014, New York, N.Y. 10019.

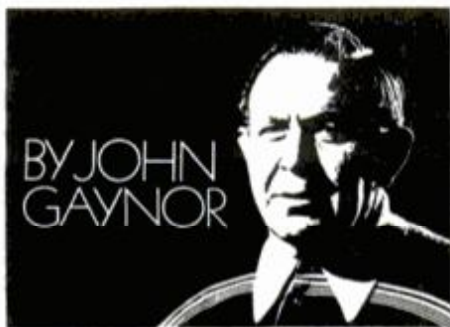
Flagstone is any hard rock that lends itself to cutting into layers. Some types are more impervious to water than others, but most have many-layered veins. You don't say whether your patio stones rest on earth or are embedded in mortar. Nor do you describe the type of joints.

Water generally penetrates flagstone layers and causes cracking when it freezes. Stone edges must be thoroughly cleaned before applying sealer. Since sealer won't "bridge" gaps between stone and mortar, if you have mortared joints, they should be pointed (refinished with fresh mortar) first. Toch Div., Carboline Co., 350 Hanley Ct., St. Louis, Mo. 63144, makes a good liquid sealer called Acri-Seal that lists for \$6.80 a gallon. It's nonflammable, nontoxic and covers 300 to 600 sq. ft. per gallon, depending on the porosity of the stone. Stones and bricks I tested with Acri-Seal darkened slightly and picked up a slight gloss. Toch claims it's a nonslip coating. I found that two thoroughly brushed-in coats were better looking than one thick coat.

Rusting once more

In response to our discussion of rust inhibitors (June '78 Homeowners' Clinic, page 10, *Wrought With Rust*), reader Michael Shuey of San Francisco also recommends a product called Trustan-7, which he says gives superior results as a rust preventer and primer. A 7-ounce can costs \$4.99 postpaid from Trustan Corp., Box 5204, Ironbound Station, Newark, N.J. 07105. Another product offering similar results is Noverox, \$6.20 postpaid for 8 ounces, from Novapox, Inc., 960 North San Antonio Rd., Suite 231, Los Altos, Calif. 94022.

Whichever product you use, be sure to follow directions. **PM**





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PM WORKBENCH

PM EXAMINES PRODUCTS AND SERVICES

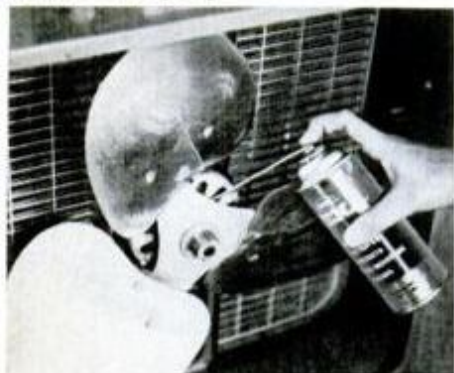
Plug a leak fast

Waterplug is a hydraulic cement claimed to block leaks—even gushing holes—in concrete or masonry in just three minutes. Powder mixes easily with water to form a quick-set putty with high structural strength. It will even set up under water. Sold at build-



ing supply and home centers, it's \$2.10 a pint. Write Standard Dry Wall Products, 7800 Northwest 38th St., Miami, Fla. 33166 for free brochure, Circular 14-C.—D.O.

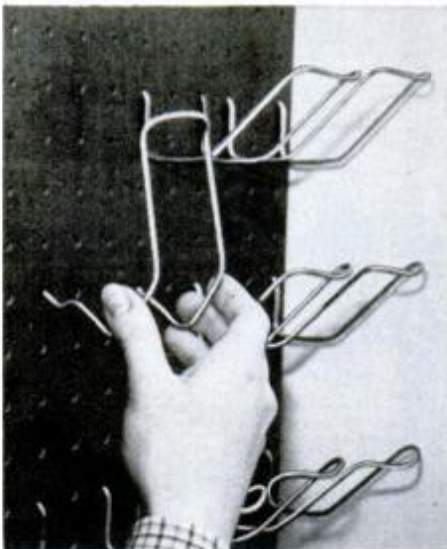
Lubricant spray



Lubricate fan's moving parts with Ten*4.

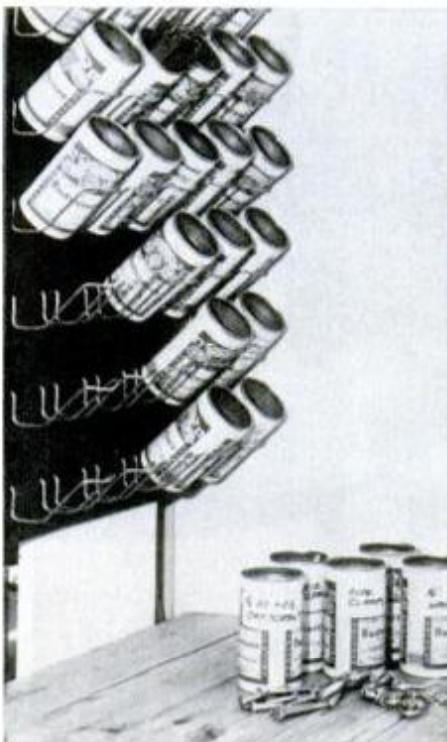
Industrial strength Krylon Ten*4 lubricates, penetrates rust, cleans and removes moisture in numerous household applications. Fluorocarbon-free aerosol comes with tube for spraying in tight spots. Protects doors, windows, car engines, electric parts. About \$3 for 11-oz. can at hardware, houseware stores. From Borden Chemical.—P.A.

Canny storage



Wire holders fit perforated board.

The Adacan storage system lets you put your hand on the right piece of hardware quickly. Containers are tilted forward by wire holders for easy access to contents. Labels can be read at a glance. Best of all, system uses an abundant national resource—used soup and beverage cans. Twenty holders cost \$4.95 postpaid; 40 holders with perforated board and mounting screws, \$12.95 postpaid. Pierce Products, Box 805, Marathon, Fla. 33050.—J.P.



Be sure to remove can tops safely.

Digital torque wrench

The light alloys used in much of today's machinery make torquing of nuts, bolts and screws a frequently critical operation. The latest torque wrench from Sears is accurate and easy to use. Digital calibrations are extremely easy to



Scale on wrench is easy to read, even in awkward work position (above).

Dial is claimed to be accurate to plus or minus 3 percent each way.

Torque wrench is protected by case.



read (see photo) and eliminate need for on-the-spot calculations. Sears claims tool is accurate to within plus or minus 3 percent in both directions. Scale calibrations are in both metric (Newton meters, Nm) and English (foot-pounds). The 1/2-in.-square drive sells for \$54.97; the 3/8-incher is priced at \$49.97.—H.W.

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.

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a sports/utility vehicle. The all-welded steel box frame resists distortion better than riveted frames. Heavy-duty axles permit Scout to carry heavier loads than any station wagon. And even with that big inside cargo space, Scout's outside dimensions permit easy maneuvering in tough spots.

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So don't send a car to do a Scout's job. Visit your International Harvester Scout Dealer and test drive a Scout soon. Because anything less is just a car.

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DETROIT LISTENING POST

'81 Plymouths and Dodges

Chrysler is planning an all-new, front-drive body shell, designated K-body, which will replace both the corporation's Volare/Aspen compacts and the front-drive Omni/Horizon in the 1981 model year. While the new Plymouth and Dodge compacts will be smaller and lighter than the current Volare/Aspen (comparable to GM's '80-model front-drive compacts, due next spring), the '81 Omni/Horizon will likely remain close to their current size and will be built on a shortened version of the same unibody platform. Chrysler is developing a new four-speed overdrive transaxle for these cars, plus a pair of new four-cylinder engines (2.2 and 2.8-liter) to replace the 1.7-liter Four and manual-shift transaxle presently purchased from VW.

Ford engine plans

Although Ford says it can come up with a diesel engine if necessary, it is still unconvinced about the diesel's future emissions problems. Instead, Ford engine people are working hard on a low-emissions, high-fuel-economy "Programmed Combustion" engine (PROCO), along with the so-called "dual displacement" concept.

PROCO, somewhat similar to Honda's very effective CVCC three-valve stratified-charge system, involves injecting a small, rich air/fuel charge into the cylinder, which is then ignited and touches off the much larger-volume lean charge that supplies most of the power. Ford says it can be nearly as fuel-efficient as a diesel engine at a much lower tooling cost. It also provides the same performance as a conventional engine, and does not have the noise, vibration, cold-starting or unique emissions problems characteristic of today's diesels. But it is not likely to be ready for production until the mid-1980s, according to Ford, when it may come in V8 form in larger cars and light trucks.

Dual displacement, a joint development with Eaton Corp., involves mechanically disabling (with electronic control) a certain number of an engine's valves so that it runs on fewer cylinders during idle and cruise conditions (see PM, page 68, Nov. '77).

Four new GM diesels

Meanwhile, General Motors is pressing ahead with as many as four new diesel engines for future products. An all-new 5.0-liter (302-cu.-in.) V8 diesel (not derived from any existing gasoline engine) is under development at Chevrolet and could be ready by 1981. Cadillac has a 4.1-liter (250-cu.-in.) diesel V8 in mind and (judging by its small displacement) may be thinking of turbocharging it as an answer to Mercedes' turbo five-cylinder diesel.

U.S. turbo-pioneer Buick Div. is reportedly planning a 3.8-liter V6 diesel (based on the current V6 gas engine) which would also be a good candidate for turbocharging. And Chevrolet, having shelved the idea of a compact V4 engine design for future small cars, is now working on a new 1.8-liter inline gasoline Four for '81 and looking for corporate approval to develop a diesel version, as well. Dieselization plans for Pontiac's 2.5-liter Four apparently have been scrapped, but watch for turbocharged versions of both this engine and the division's 5.0-liter V8, perhaps as early as next fall.

Eliminate congestion, save fuel

The national 55-mph speed limit is credited with saving some fuel, but a recent GM Research Lab study shows that a lot more—as much as 15 percent—could be saved if only traffic flowed smoothly. Staggered work hours to reduce congestion could help, but optimum economy would result if average urban trip speeds were increased to posted limits, say the researchers. Coordinating successive traffic lights would be the most feasible way of accomplishing this, but major city streets with timed lights are still rare.

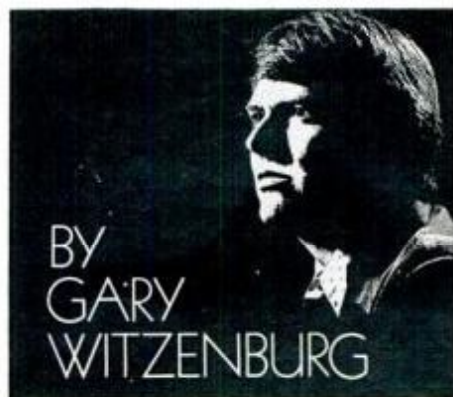
More light metals, plastics

Continuing efforts to trim weight from cars has resulted in a number of interesting materials innovations in the '79 models. Industry firsts include chrome-plated aluminum bumpers on '79 full-size Chrysler products, AMC Jeeps and Ford's LTD and Marquis station wagons; wheels entirely of high-strength, light-alloy (HSLA) steel on GM's new Eldorado, Toronado

and Riviera; chrome-plated flexible plastic on Chevy Camaro's lower grille; plastic load floors under the hatchbacks of Ford's new Mustang/Capri and VW's U.S.-built Rabbit; ultrasonically welded plastic instrument panels on Chrysler's Newport, New Yorker and Dodge St. Regis; optional fabricated aluminum wheels on the same new full-size Chrysler products; and a die-cast aluminum intake manifold, whose two halves are joined by electron-beam welding for Chrysler Sixes.

No less than 37 parts on Chrysler's Omni and Horizon, including the grilles, taillamp housings, instrument clusters and consoles, are of ABS plastic; seats in the '79 Corvette are made entirely of plastic; and soft plastic front and rear-end caps grace both the '79 Mustang/Capri and the new Omni/Horizon two-door coupes. Ford's LTD and Marquis make extensive use of HSLA steel for frame and other components, as do the Mustang/Capri and Omni/Horizon, and aluminum intake manifolds are used on some Chrysler V8s, Ford's 351 V8 and certain General Motors engines. Aluminum is also making its mark industry-wide, in such components as brake master cylinders, bumper reinforcement beams, transmission cases and pump housings.

However, a recent GM study showed that plastic parts are more energy-efficient to produce than aluminum. An inner fender liner, for example, might weigh five pounds in aluminum, six pounds in plastic and 13 pounds in steel. But the aluminum would require the energy equivalent of six gallons of gasoline to produce, as opposed to three gallons for steel and only one for plastic. **PM**



BY
GARY
WITZENBURG

THE PM GARAGE

CAPSULE REPORTS ON NEW AUTO PRODUCTS BY THE EDITORS

Recharges your air conditioner

If your car air conditioner seems a little sluggish, it might need a recharge. Check your sight glass under the hood. With the engine running, there should be only an occasional bubble. A stream of bubbles, or none at all, means a low Freon charge.

Mechanics usually recharge an air conditioning system for about \$25, but you can get a kit for



Air recharging with kit is easy.

around \$8 and do it yourself. When our Dodge started to poop out, I bought a kit from Interdynamics Inc. and had the cold air flowing in about 20 minutes. Accompanying instructions were easy to follow. It's best to wear goggles. Remember, too, to be patient. It takes longer than you'd suspect for the Freon to enter the system. For more information, write Interdynamics Inc., 78 18th St., Brooklyn, N.Y. 11232.—M.L.

Self-storing air compressor

We've reported on 12-volt air compressors before. They're handy but tend to tangle when you carry them in the trunk of your car. I've discovered one, though, whose plastic case forms a container for its wire, hose, chuck and the plug you stick in the cigaret lighter.

The unit is made by Interdynamics. It retails for \$17.98, comes with 10 feet of wire, 2.5 feet of hose, has a clamp-on chuck and works like a bear. It draws only 2.5 amps., so you can pump up a lot



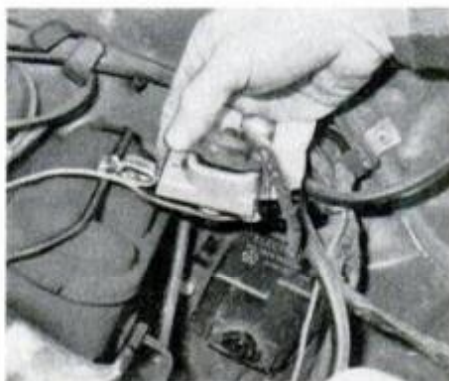
Air compressor comes in neat package.

of tires or inflatables before it runs down your car battery. Check your local chain stores or write to the manufacturer: Interdynamics Inc., 78 18th St., Brooklyn, N.Y. 11232.—M.L.

Electronic regulator eliminator

Almost all cars today have electronic voltage regulators, and GM cars have them integral with the alternator (though usually replaceable as a separate part). Great—we're all in favor of electronics—but how do you determine if a charging failure is in the alternator or regulator?

A supercheap answer (under \$2.50) is a device that easily permits you to eliminate the voltage regulator from the picture. If the system now charges with the regulator out, you know it's the problem, not the alternator. The tool is designed to ground out the alternator field (which the regulator should control), and it works on GM, Ford and Chrysler systems. For Ford and Chrysler products, you disconnect the wiring from the external regulator, plug it into the appropriate terminal on



New test device grounds alternator field.

the tool and ground the tool with the attached alligator clip. On GM Delco alternators, you insert a springlike prong into the back of the alternator where it comes in contact with the field terminal and grounds it against the alternator body. You could do all this grounding with a screwdriver and jumper leads, but this tool takes out all the guesswork and costs no more than a jerry-rig setup. Available from Thexton Manufacturing Co., 7685 Parklawn Ave., Box 35008, Minneapolis, Minn. 55435.—B.H.

Etched in glass



Diamond pen etches ID number in glass.

A theft-insurance policy for \$3 is what you get with D-Tec's diamond-tipped pen. It works like a charm, scratching an identification number on car windows and other valuables with no effort at all. Consult your local police precinct's crime prevention unit for the ID number it prefers you to use. D-Tec, Inc., 108 Massachusetts Ave., Boston, Mass. 02115.—B.H.

Clever 'pocket' gas pumper

Where there's a will there's a way—a way to keep a self-service gas-pump nozzle working although the service station has removed the catch. The Pocket Pumper is plastic, has three notches (for slow, medium and fast gas-flow speeds) and is inserted into a gas-pump nozzle handle as shown. A hole lets you use it as a key ring. Check to see if it's prohibited where you live. It's \$1 from GRS Instruments, 8730 King George Dr., Suite 100, Dallas, Tex. 75235.—B.H.



Simple device fits gas-pump nozzle.

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Flash pictures? You bet. The Ektramax camera has a built-in electronic flash that's great for stopping action.

This Christmas, give the new Kodak Ektramax—the ultimate "Can-Do" camera.

©Eastman Kodak Company, 1978.



The new Kodak Ektramax camera.



Taken indoors without flash.

Taken with built-in flash.

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

PHOTO HINTS

Stopping the shakes



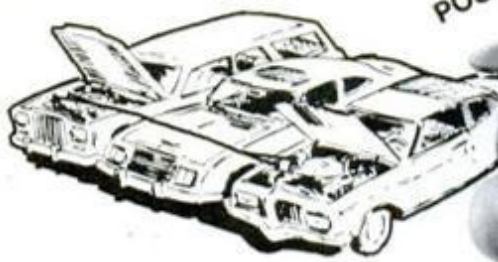
Even a fairly sturdy tripod can be shaky when used anywhere near its maximum extension. To stop the shakes, hang your loaded camera bag from the tripod—the extra weight will greatly increase stability. Make sure that the bag doesn't interfere with the tripod legs.—*Bob Berger*

Clean your plate



Your camera's oft-neglected pressure plate can pick up tiny particles of dust and grit that, although difficult to see, can scratch the base side of film. It's advisable to clean the plate periodically with a piece of lens tissue moistened with a drop of rubbing alcohol.—*Bob Berger*

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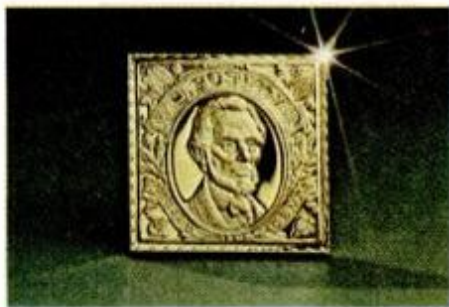
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Postmasters of America Announces

OFFICIAL GOLD ON SILVER PROOFS OF AMERICA'S GREATEST STAMPS



The 4¢ "Fleet of Columbus" Blue Error, issued in 1893, is known to exist in only one unused pane of 50 stamps, plus some individual used specimens.



The 90¢ Abraham Lincoln Stamp, released in 1869, is the rarest and most valuable stamp featuring the portrait of Abraham Lincoln.



The Pan-American Exposition 2¢ "Fast Express" Invert, illustrated actual size (above) and enlarged to show fine detail, is a celebrated rarity. Only a few sheets bore the invert error.



The 24¢ Signing of the Declaration of Independence Invert shows the Signers upside down due to a printing error. This 1869 issue is one of the most valuable U.S. stamps.



The 10¢ George Washington Stamp released on July 1, 1847—with the 5¢ Franklin—was the first general issue of the U.S. post office. It is a key acquisition for important collections.



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The fifty most treasured and most significant United States postage stamps, as chosen by Postmasters of America. Authentically re-created in 24 karat gold on sterling silver, in limited edition.

Of the thousands of postage stamps issued by the United States Post Office, few have achieved the status of greatness. Most specimens of these great stamps are in major private collections, or are housed in leading museums. Each is a prized treasure and some are virtually priceless.

Now, as a lasting tribute and commemoration, Postmasters of America will honor the fifty greatest postage stamps ever issued by the United States in a collection of official gold on silver Proofs.

Each of these great stamps will be captured by skilled sculptors and engravers in the enduring magnificence of 24 karat gold electroplated on solid sterling silver. Postmasters of America has appointed The Franklin Mint, the world's largest and foremost private mint, to re-create each gold on silver stamp in all its fine detail. And each stamp will be minted in precious metals with The Franklin Mint's famed gem Proof finish, so that the frosted sculptured area—corresponding to the stamp's intricate design—stands out against a background of mirror-like brilliance.

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with more passenger room inside to help give you comfort on even the longest trips—with more head room, leg room and shoulder room—front seat and back—than last year's LTD. Yet the new LTD is actually easier handling and easier parking than before, even in tough city traffic.

In addition to its standard 5.0 litre V-8 engine, the full-size 1979 LTD offers you an impressive list of standard features, in 2-door, 4-door and Wagon models.

Ford LTD for 1979. A New American Road Car designed to take you across town or across the country in

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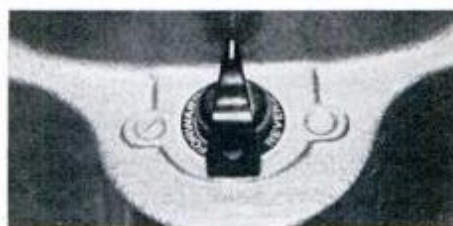
LTD Landau 2-Door Sedan

FORD LTD

FORD DIVISION



PM LOOKS AT SHARPENSET GRINDER



The grindstone is water-cooled, making this English unit a joy to use. Switch (above) sets direction of wheel's spin.



Finger touch test proves how cool and safe grinder performs. Well holds and recirculates 1 1/4 pints of water.



Center guide ring prevents centrifugal force from spraying water. Ring height adjusts so the stone can be used until it wears down to the last 1/16 in.



Sharpenset grinder proved to be the best ever used by PM's two shop experts.

As any craftsman knows, sharpening an edged tool on a dry grinding wheel isn't easy. If done improperly, high heat from the wheel can draw the temper from steel, softening the edge. Grinding on a wheel also gives a hollow bevel—which isn't always desired.

So we had high hopes when we got the opportunity to test this Sharpenset wet power grinder. Here's what we found:

The grindstone spins in a vertically-mounted, cylindrical cup. It presents a flat, horizontal grinding surface instead of the vertical spinning wheel found on conventional grinders. When grinding most tools up to 2 1/2 in. wide, you hold the tool edge tangent to the inner edge of the stone. The entire tool edge is then in continuous contact with the stone to assure even, effective grinding. The unit accommodates long-edge tools as well.

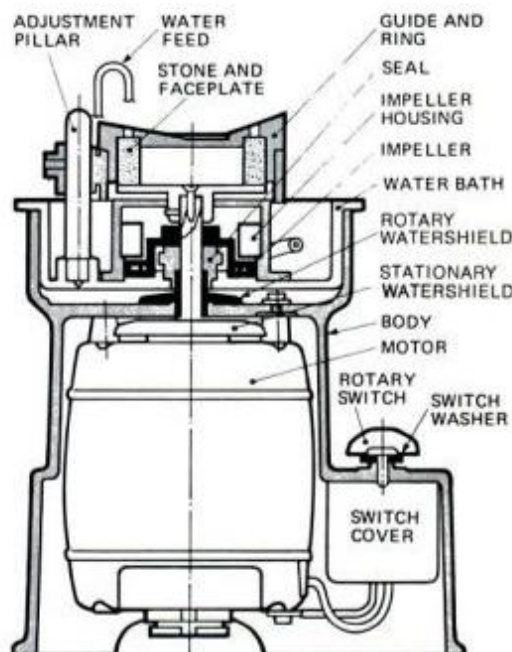
We put a plane blade, several chisels and a lathe gouge through the paces and the results were most gratifying. Quickly and with ease, the Sharpenset produced better-sharpened tools than any grinder either of us had used before. New bevels were ground and honed to a mirror-like finish in very short order. Since the tool doesn't heat up, you can grasp close to the

grinding edge for complete control and accurate manipulation. Another plus is that there's no dangerous sparking, except occasionally with a 50-grit coarse stone.

The grinder housing is well-constructed from heavy cast aluminum and powered by a 1/4-hp motor. A built-in pump circulates water from a reservoir through a copper pipe that directs a steady flow on to the stone. The unit is remarkably quiet and vibration-free. It has enough heft that it doesn't require anchoring to a workbench. Yet, it's light enough to be moved about easily.

The cost for such effortless, high-quality sharpening isn't cheap. The Sharpenset sells for \$335, plus \$4.25 shipping, which probably prices it out of the range of most do-it-yourselfers. But for serious woodworkers and professionals, the unit is a smart investment. You'll put edges on tools like you never have before.

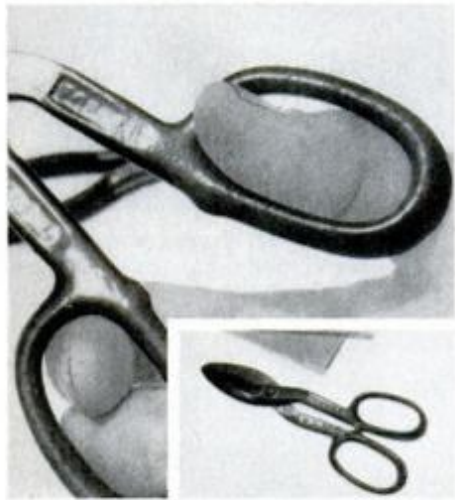
The grinder is available by mail (see specifications at right). It has a 180-grit stone and dressing stick. The 50- and 280-grit stones are \$24.50 each.—R.C. and H.W.



SPECIFICATIONS—Sharpenset Grinder

Main frame: Heavy cast aluminum
 Motor: 1/4-hp, 110-v., 60 cycles, 1600 rpm
 Switch: On/off/reversing
 Height: 14 in.
 Weight: 32 lbs.
 Diameter: 12 in.
 Drive: Direct
 Water flow: Impeller-pump driven
 Price: \$339.25 postpaid, additional stones, \$24.50 each.
 Maker: Sharpenset Engineering, England; available from the Garrett Wade Co., Inc., 302 5th Ave., New York, N.Y. 10001

PM LOOKS AT AIR DRY PLASTIC COATING



PDS is a liquid plastic that air dries to form a thick, solid coating on practically anything—metal, plastic, glass, rubber, foam, etc. It's not hard or brittle, but has a smooth, durable texture like rubber that's ideal for gripping. It even insulates against electric current. Apply by dipping surface in

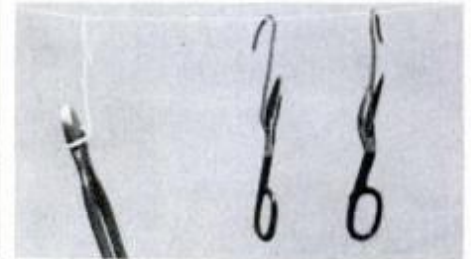


PDS gives new life to ugly, rusted tools or other surfaces. Just dip in liquid.

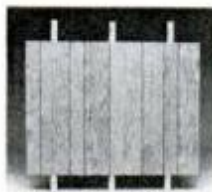
can, or brush on PDS after diluting with unleaded gas or special thinner. Dries in four hours; peels off if you desire. Apply several coats. A 16-oz. can costs \$5.49 postpaid. In eight colors from Plasti-Dip International, 1458 West County Rd. C, St. Paul, Minn. 55113.—*R. Capotosto*



Withdraw slowly to prevent dripping, hang to dry. Forms an easy-grip coating.



What Max BondTM joins together, let nothing put asunder.



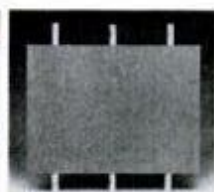
Paneling/Furring Strips



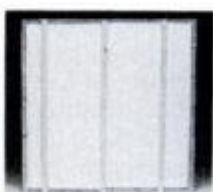
Cork/Plywood



Metal/Foam



Hardboard/Furring Strips



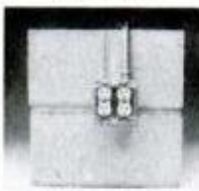
Foam/Concrete



Molding/Paneling



Foam/Foam



Outlet Boxes/Concrete



Furring Strips/Concrete



Decorative Beams/Ceilings



Paneling/Drywall



Subflooring/Joists

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'Tis a great place to hide one for "the C.C. Season," we thought as we flew north. So we left our case of holiday cheer on the polar ice cap at 84°50'5"N, 63°55'2"W on April 25, 1978. (Why April? Because we want to be home for the holidays, too.)

To find it, hire a ski-equipped plane and head north from Resolute Bay in the Canadian Arctic. Remember, though, polar ice moves. So don't be disappointed if the C.C. has disappeared by the time you reach our coordinates.

There's an easier way to get your holiday supply of C.C. Just make a list of everyone you want to remember with gifts of Canadian Club. Then head for the nearest store displaying our handsome gift-wrapped package and say, "C.C., please."



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PM LOOKS AT A TEXTURED WALL FINISH

Ruff-It is an acrylic-based substance that adds bold, permanent texture to walls and ceilings. According to the manufacturer, it resists cracks and yellowing much better than plaster-based materials. With two hours' drying time, application is almost foolproof. You can scrape off wet material and start over if you like, or put it back in can. A thin coat covers 60 sq. ft.; thick coat 20 sq. ft. Available in six colors.

—Rosario Capotosto



Ruff-It comes premixed, ready to use. A 2-gal. can lists for \$14.99 at home centers and building supply stores.



Texture wet surface with trowel, twine, paintbrush comb, glove, cement spreader, wood scrap, paintbrush or foil.

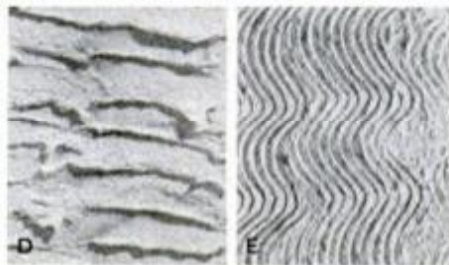


Apply a thin coat of Ruff-It with a plasterer's trowel. Add texture by smearing coat in a rhythmic pattern with any tool.



Ruff-It has consistency of plaster but excellent adhesion. It grips practically anything—wood, glass, metal, etc.

Some textures we created



Pattern A was made with a stiff brush flicked in rhythmic arcs; B, by pressing an aluminum-foil sheet into the wall and then peeling it off; C, by running gloved fingers across the surface; D, with small, repeated swipes of a pointed trowel; and E, with long, wavy strokes of a paintbrush comb. Ruff-It is made by Z-Brick, Box 628, Woodinville, Wash. 98072.

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EY 4

How to repair portable room heaters

by Mort Schultz

On frosty mornings or whenever you want some quick heat in a small area, a portable room heater can provide it. And, happily, the units are simple mechanisms that you can fix yourself.

There are basically three types of portable heaters: *bowl-type heater*, in which the heating element is composed of nichrome wire coiled around a ceramic core; *rod-type heater*, with one or more heating elements consisting of nichrome wire wrapped around a porcelain insulator in rod-fashion; and the *ribbon-type heater*, in which the heating element is a ribbon of nichrome wire that is strung between insulators on each side of the reflector pan. Once you've determined what ails your heater (the troubleshooting chart will guide you), strip

it down for repair work as outlined.

Before proceeding to repair your heater, there are several variations in heaters that you should know:

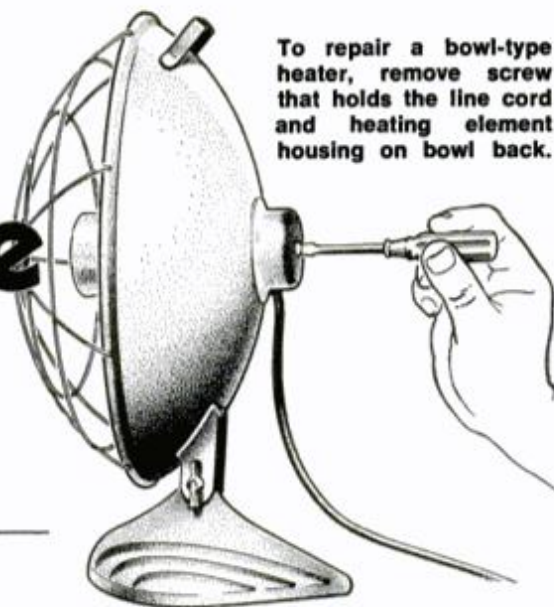
- Most heaters possess a reflecting panel and motor-fan assembly which produce both radiant and forced air heating. However, some heaters have no motor-fan assembly and provide only radiant heat.

- Some heaters have a cooling feature. When set for cooling, the fan alone operates. The heating element is shut off.

- Most heaters have an adjustable thermostat or temperature control. You can set the temperature control knob at one of a variety of settings to provide more or less heat.

When you turn the heater on, contact points close, energizing the unit. The heater provides heat until

To repair a bowl-type heater, remove screw that holds the line cord and heating element housing on bowl back.



the temperature increases sufficiently to cause the bimetal thermostat contact points to bend apart. When contacts break, electricity ceases to flow.

Manipulation of the temperature control knob allows greater or lesser tension on contacts. Thus, it takes more or less heat to cause contact points to break.

The terms "thermostat" and "temperature control" are interchangeable.

- Practically all room heaters manufactured in recent years are equipped with a safety tip-over switch, normally combined with the

(Please turn to page 32)

TROUBLESHOOTING GUIDE

No heat

1. Tighten loose connections or replace broken wire.
2. Replace defective power cord.
3. Replace defective temperature control, tip-over switch assembly.
4. Replace open heating element.

Heater heats, but there's no fan action

1. Replace broken wire.
2. Replace wave washer if motor works, but blade doesn't turn.
3. Replace blade if hub is worn.
4. Service or replace defective motor.

Temperature control out of calibration (Too much or not enough heat for setting)

1. Replace the temperature control and tip-over switch assembly.

Heater is noisy when operating

1. Foreign object is hitting fan.
2. Fan binds or sticks against case.

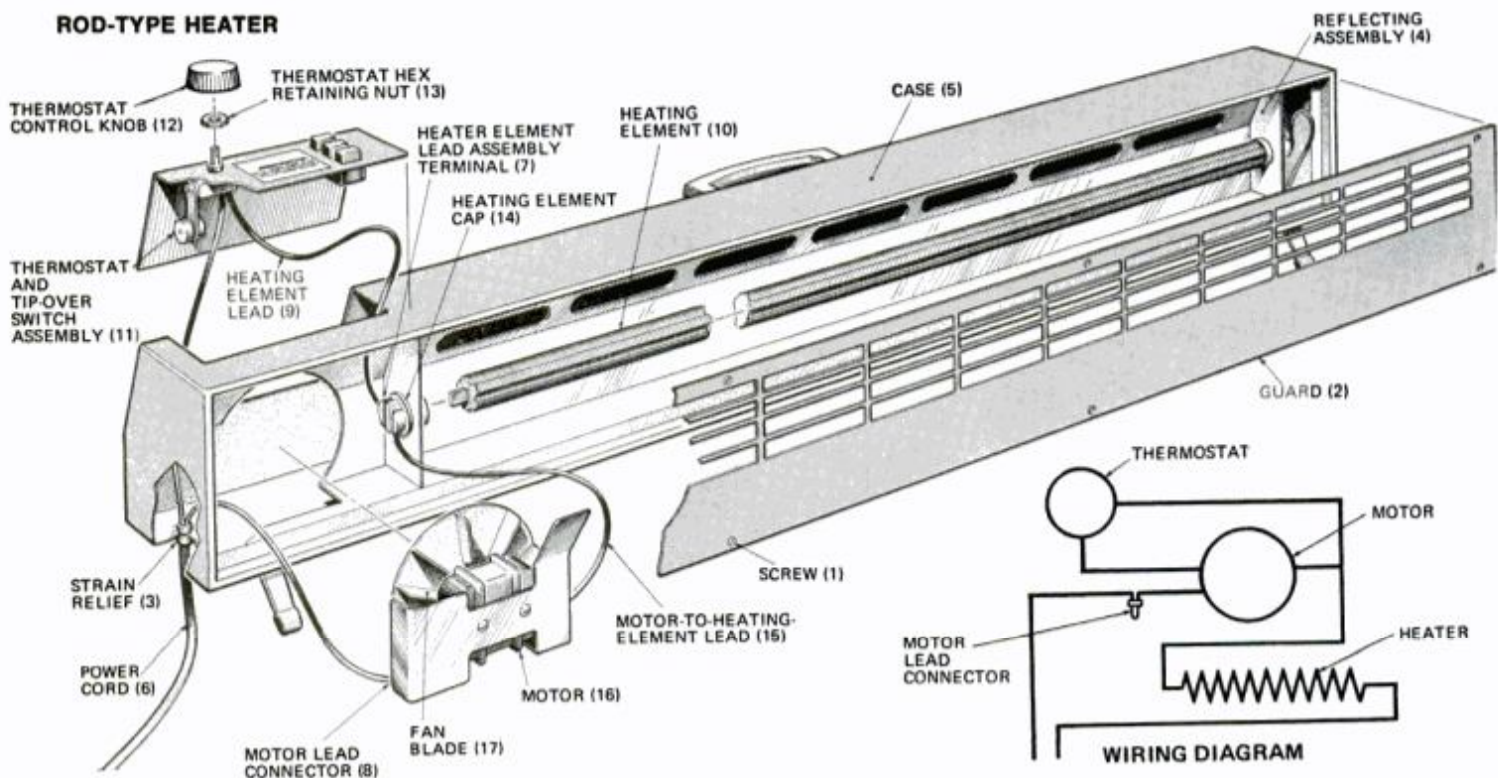
Intermittent operation

1. Tighten loose connections.
2. Replace faulty temperature control.

Unit won't shut off if tipped over

1. Replace faulty temperature control and tip-over switch assembly.

ROD-TYPE HEATER



THE COLOR OF THINGS TO COME.

A large, three-dimensional green box is shown from a perspective that highlights its top and side panels. The top-left panel features the word 'FUJICOLOR' in a large, white, bold, sans-serif font with a black outline. Below it, on the same panel, is a red oval containing the words 'FUJI FILM' in white, bold, sans-serif font. The top-right panel also features a red oval with 'FUJI FILM' in white, bold, sans-serif font. The box is set against a dark background, and the lighting creates a sense of depth and shadow.

FUJICOLOR

FUJI FILM

FUJI FILM

In Japan, taking pictures is more than a hobby. It's a way of life.

And the film used most is Fuji film.

In fact, in 120 countries around the world, over 10 million pictures a day are taken on the film in the green box.

Pictures with sharp, bright, beautiful color.

And now you can get this same beautiful color in America, in sizes that will fit any camera you own.

And just because our film comes from Japan, doesn't mean you can't have it processed at the

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Next time you need film for your daughter's birthday or Uncle Norman's 50th wedding anniversary, try a roll of Fuji film.

You may not be used to the color of our box, but wait till you see the color of your pictures.

OVER 10 MILLION PICTURES A DAY ARE TAKEN ON FUJI FILM.

REPAIRING PORTABLE HEATERS

(Continued from page 30)

thermostat in a single assembly. This switch takes the form of a weighted arm that swings on a pivot. When the heater tips over, the weighted arm swings and causes contacts to break, shutting off the heater.

■ Most room heaters operate on 110-volt 50-cycle a.c. or 120-volt 60-cycle a.c. Some possess one heating element that is usually rated at 1000, 1320 or 1620 watts. You select the desired heat range by setting a low-high heat switch.

Important: Never try to repair breaks in heating wire by twisting ends together. Replace the element. Replacement parts are available from dealers or the manufacturer.

Bowl-type heater disassembly

Caution: disconnect heater during the entire operation.

In bowl-type heaters, where the heating element is nichrome wire coiled around a ceramic core, the bowl acts as a reflector. A line cord attaches to the core and when plugged into an electric outlet, allows the coil to glow. Heat is radiated from the polished bowl.

This is the simplest room heater. Failure occurs if the line cord or

heating coil malfunctions. To make repairs, remove the screw holding the line cord and heating element housing to the back of the bowl. Disconnect the line cord from the screw terminals in the base of the heating element. Replacement heating elements are available.

Rod-type heater

Caution: This heater must be disconnected during the operation.

1. Remove screws (1) holding the guard; also clamps if your heater has them. Take off the guard (2).

2. Remove the power-cord strain relief (3) which is around the power cord where it enters the unit. A special tool called Heyco pliers permits you to remove this part without breaking it. Ask an appliance or hardware dealer to order one for you. If you break the strain relief, get a replacement or wrap the power cord heavily with electrician's tape.

3. Remove fasteners, if any, and carefully slide the complete heating element and reflecting assembly (4) from the case (5) so you can reach leads to disconnect them.

4. Disconnect the power cord (6) by detaching it from the thermostat and tip-over switch assembly (11) and the motor lead connector (8).

Consult the wiring diagram below.

5. Disconnect the heating element lead (9) that goes from the heating element lead assembly terminal (7) to the thermostat and tip-over switch assembly (11).

6. The thermostat and tip-over switch assembly can now be removed by pulling off the control knob (12) and removing the thermostat hex retaining nut (13).

7. The heating element (10) can be removed by pulling off the heating element cap (14) and detaching the motor-to-heating element lead (15) at the element.

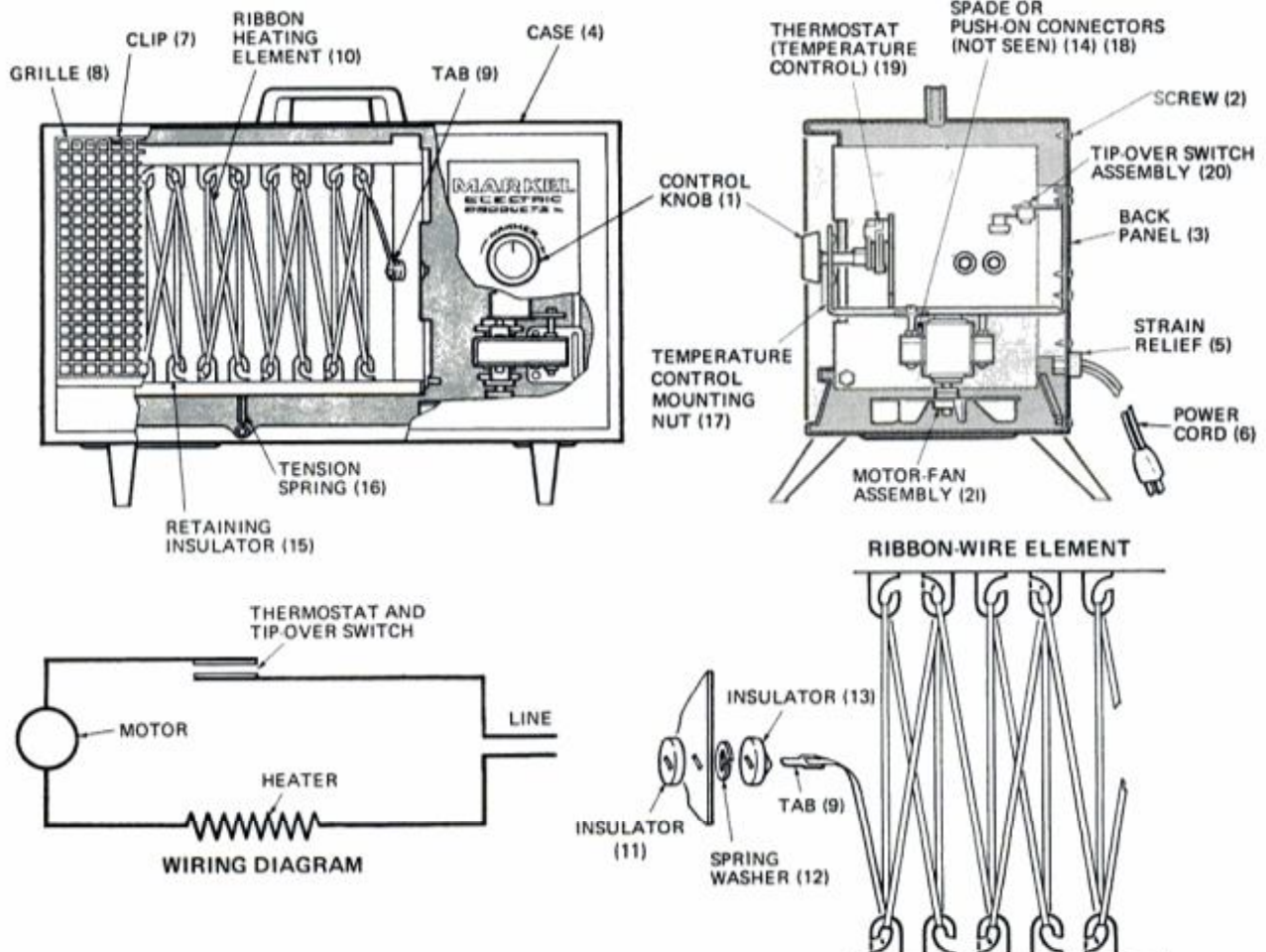
8. Two screw assemblies normally hold the motor (16) in place. Unscrew them to remove the motor.

9. The fan assembly is positioned on the rotor shaft of the motor. Disassemble it by removing the snap ring in groove at the tip of the rotor shaft. Working toward the motor, remove the washer, blade (17), wave washer, washer and clip, which is flush with the motor.

10. Reassembling this heater is done in reverse of disassembly. Before putting things back together again, spread a light coat of SAE 30 motor oil on the motor's rotor shaft. This reduces wear on the fan and motor assembly. Make sure all ter-

(Please turn to page 34)

RIBBON-TYPE HEATER



Golden Lights



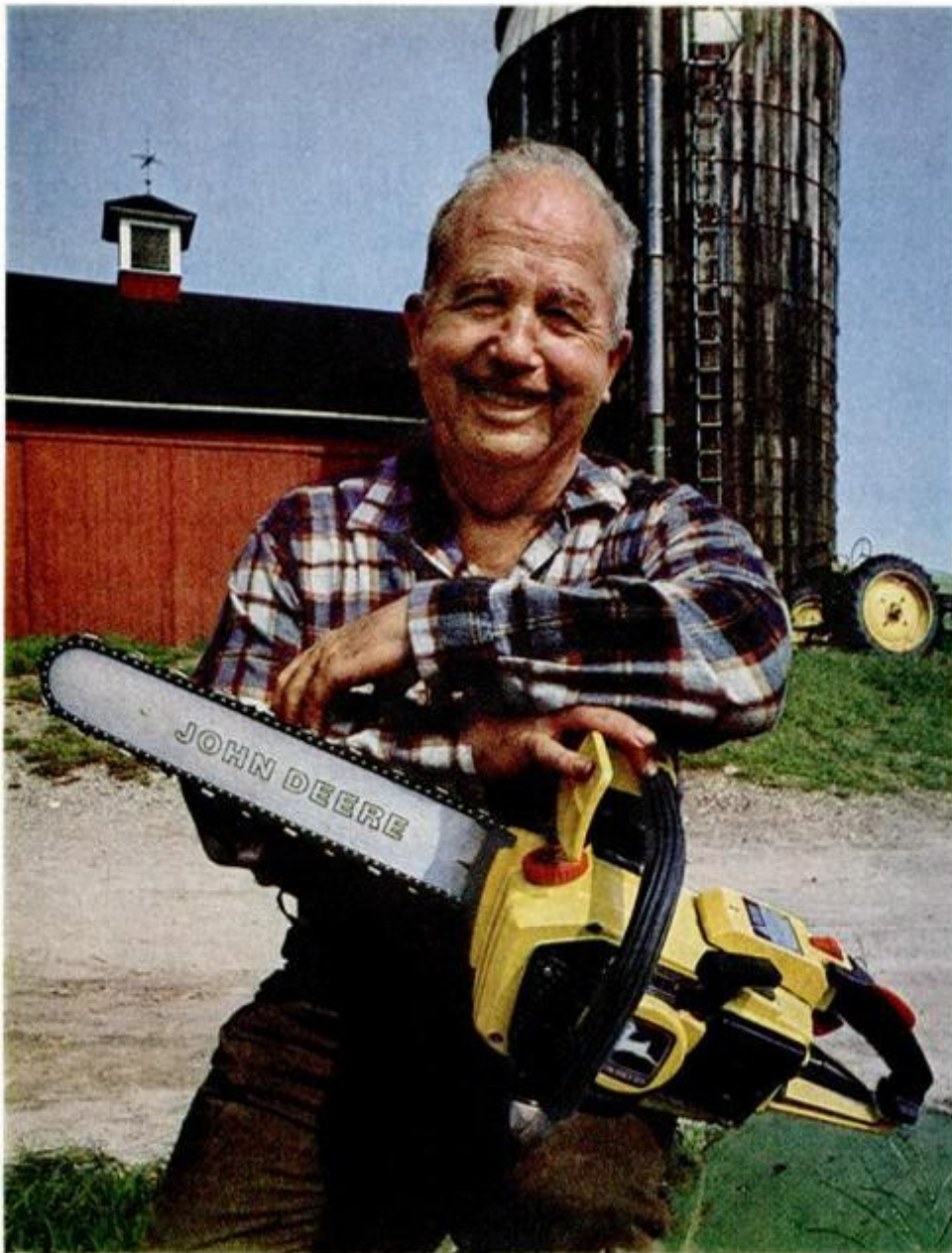
Only 8 mg. tar.

Taste so good you won't believe they're lower in tar than all these brands:



Source of all 'tar' and nicotine disclosures in this ad is either FTC Report May 1978 or FTC Method. Of All Brands Sold: Lowest tar: 0.5 mg. 'tar,' 0.05 mg. nicotine av. per cigarette, FTC Report May 1978. Golden Lights: Kings Regular and Menthol— 8 mg. 'tar,' 0.7 mg. nicotine av. per cigarette by FTC Method.

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It's not easy replacing the ax your granddaddy gave you.

They don't make axes like they did back in Granddaddy's day. So I looked into chain saws. Good ones. And some bad ones, too. I held them. Ran them. And bought a John Deere.

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Now I'm trying to decide which of their log splitters to get. Floyd up the road has the one with wheels. Swears by it.

Anyway, I hate to say it, but I'm almost glad that old ax fell down Hudson's well. This way of making sawdust is pretty close to fun.



**Nothing Runs
Like a Deere®**

For a free folder, write John Deere,
Dept. 52, Moline, IL 61265.

REPAIRING PORTABLE HEATERS

(Continued from page 32)

minal connections are re-engaged tightly.

Ribbon-wire type heater

Caution: This heater must be disconnected during this entire procedure.

1. Remove the control knob (1). The knob may be held by a setscrew, so look for one, or it may be pressed on. Knobs are often glued on the temperature control shaft. Heavy pressure may be needed to get one off.

2. Withdraw the screws (2) in the back panel (3). The heating unit and back panel can now be removed from the case (4) as a unit.

3. Remove the power cord strain relief (5) and power cord (6) as described for rod-type heaters.

4. Pull the push-type clips (7) off the tip end of the grill (8) and remove the grill.

5. With pliers, twist the tabs (9) on the ends of the ribbon heating element (10) to a straight flat position. Remove the end insulator assemblies. These normally consist of an insulator (11), spring washer (12) and another insulator (13).

6. Unhook the spade connector (14) coming from the motor and remove the ribbon-wire heating element. (10).

Note: Consult the wiring diagram.

7. You can now remove any retaining insulator (15) that is cracked or broken and has to be replaced. Insulators are generally held by tension springs (16).

8. Remove the temperature control mounting nut (17). Pull the other spade connector coming from the motor (18). Disconnect the temperature control thermostat (19) and tip-over switch assembly (20).

Note: Check the wiring diagram.

9. Withdraw the fastener assembly holding the motor and fan assembly (21) and remove the motor-fan assembly.

10. **Reassembly.** The following procedure will help you replace the ribbon-wire heating element:

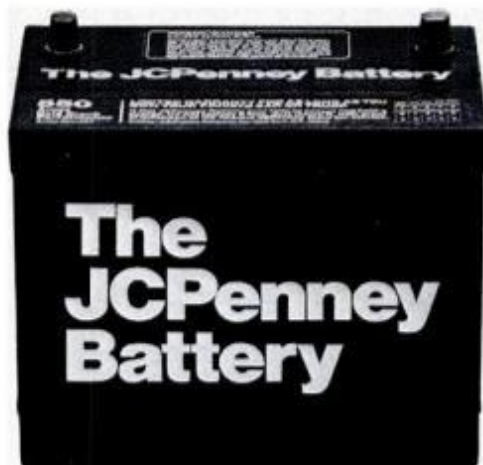
A. Wear rubber gloves to keep moisture on your hands from getting on the element.

B. Insert one tab of the ribbon-wire element through one end insulator. Twist the tab so the element is held in place at this end.

C. String the ribbon-wire element over the retaining insulators and insert the second tab through the other end insulator assembly. Twist the tab to lock element in place.

Caution: After assembly, no part of the ribbon-wire element should sag. If the element touches the case it presents a shock hazard. **PM**

It never needs water. Ever.

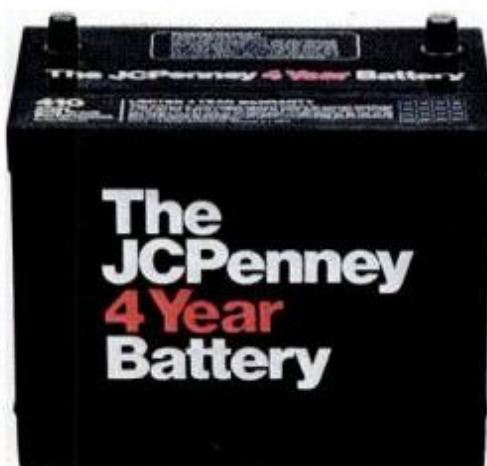
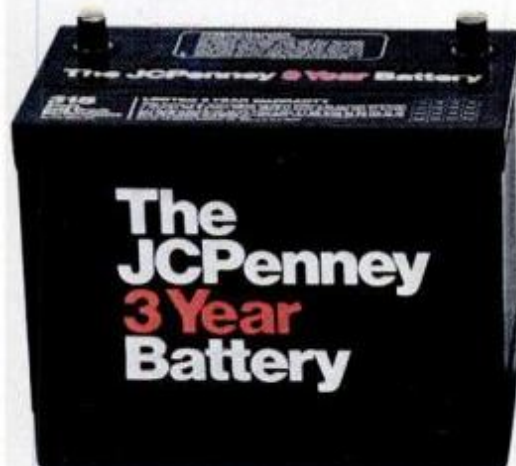


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Wishy-washy washer

Our automatic clothes washer works well except in the spin/dry cycle. It doesn't revolve as rapidly as it used to. The clothes remain very wet. Can you tell me what's wrong and what must be done to fix it?—Albie Bruzek, Fridley, Minn.

Certainly. First, make sure you aren't overloading the machine.

Second, check the drive belt between the motor and spin pulleys. If the belt is glazed or damaged, replace it. Press the belt about midway between the pulleys. Deflection should range between $\frac{1}{4}$ and $\frac{1}{2}$ in. If necessary, tighten the belt.

Third, try shaking the pulleys from side to side. There should not be any play. Tighten the pulley setscrews if necessary.

One of these repairs will usually pep up a sluggish machine. If not, the trouble is probably due to a defective drive clutch, binding spin brake or malfunctioning transmission. For these problems, unless you have repair experience and own a detailed service manual, you'd better call a serviceman.

Sound of beating drums

The Bradford dryer we bought three years ago still dries clothes well, but now it makes a loud, rumbling noise. A few months before the noise started, my husband replaced a broken drum belt. Since it began, he's tightened everything in sight. What's wrong?—Mrs. H. Kitay, Lakewood, N.J.

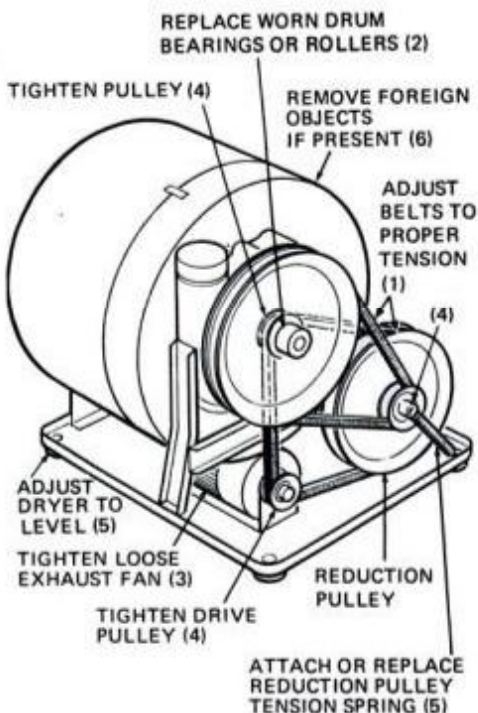
Several manufacturers made clothes dryers under the Bradford name for the now-defunct W.T. Grant Co. It's difficult, therefore, to identify specific model differences that could cause the noise. However, there are enough common problems to investigate. Use the drawing to familiarize yourself with a typical dryer's belt-pulley system. The drawing shows a two-belt system; other units have a single belt that wraps around the drum and an idler pulley. The pulley is driven by the dryer motor and, as it revolves, the belt turns the drum. Hence, six possible causes of your unit's noise are:

■ A loose belt. Belts on a two-belt system should have a deflection of $\frac{1}{4}$ to $\frac{1}{2}$ in. when pressed midway between two pulleys. In a single-belt unit, deflection should range from $\frac{1}{8}$ to $\frac{1}{4}$ in. Tighten any belt that

is looser than these specifications.

■ A tight belt. This strains the drum bearings, causing them to wear and make noise. You can get a replacement set of bearings from a parts dealer. You must remove the drum to replace bearings. The drums on some dryers ride on plastic cams or rollers that can also wear out and cause noise.

■ A loose exhaust fan or impeller. Your dryer's fan is either part of the motor or driven by the motor by



Six ways to eliminate dryer noises.

means of a belt. You may be able to tighten the fan by tightening the fan-blade setscrew.

■ A loose pulley. Tighten all pulley setscrews.

■ A dryer that isn't standing level. An unbalanced machine throws pulleys and fan out of line. Check level in both directions with a carpenter's spirit level. Adjust, if necessary, by adjusting the dryer's leveling feet. Make sure the reduction pulley tension spring hasn't popped loose from the reduction pulley.

■ An object that has wedged between the housing and drum. Turn the drum by hand to see if the drum binds in any spot.

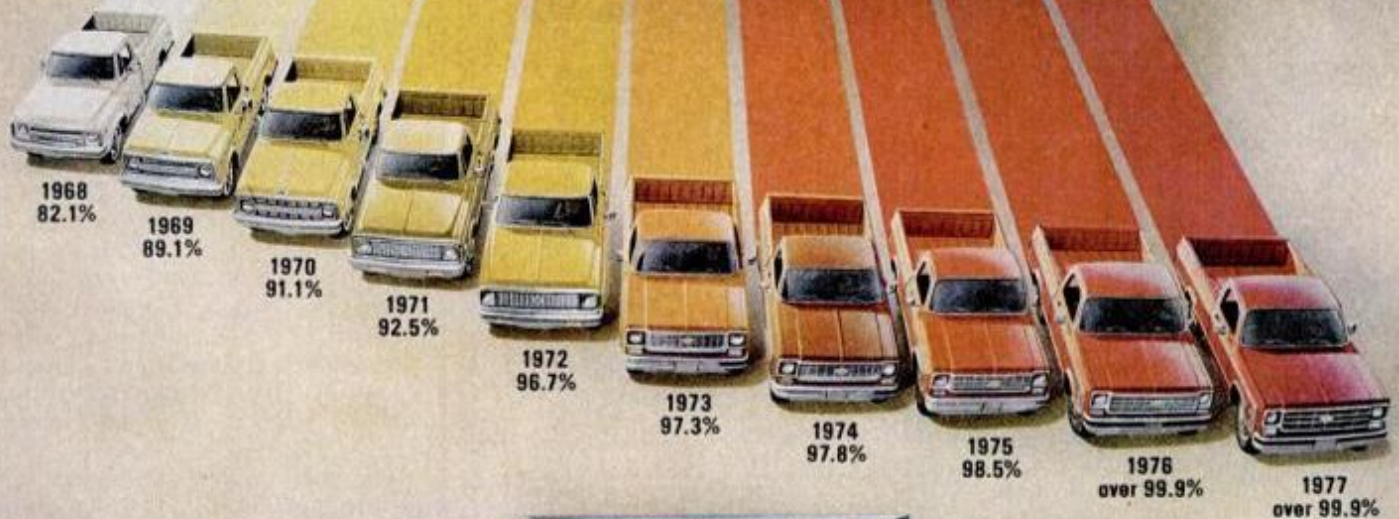
Hot under the collar

The self-cleaning oven of our General Electric range (model J796-

(Please turn to page 38)

Tough record to beat. 95.3% of all Chevy trucks, in the ten most recent years recorded, were still on the job. This is based on the latest R. L. Polk & Co. model year registration statistics through July 1, 1977. (1978 statistics are not available.) 95.3%. That's a pretty impressive record when you consider some of the tough jobs Chevy trucks are asked to do—jobs they do so well. So if you want to buy a tough truck, see your Chevy dealer. Or if you want to lease a tough truck, many Chevy dealers can handle that, too.

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APPLIANCE CLINIC

(Continued from page 36)

Y2DC) has an erratic temper. It normally heats to the desired setting, but once every six or seven times, it gets "angry" and breaks into the self-cleaning cycle. Whatever's cooking burns to a crisp. We've replaced the thermostat without success. Can you help?—D.W. Vandeyen, North Syracuse, N.Y.

There is no thermostat as such in this model. It uses a responder and sensor to control heat. The sensor is a thermistor that is affected by heat. Located behind the oven, it performs a thermostatic function. The responder is the control that reacts to "messages" from the sensor. It's located in the control panel.

You probably replaced only one of the units in this two-part system (most likely the responder). Both should be replaced because a malfunctioning sensor or responder can cause the problem you describe. To do the job, turn off power to the range. Open the control panel, where you should find an envelope containing the oven's wiring diagram. Follow the diagram to replace the responder. Move the unit away from the wall, remove the lower panel, and find and replace the sensor.

Frozen ice-cube maker

Water always freezes solid in the supply tube of the ice-cube maker of our General Electric (model TCF-16C) refrigerator. I've taken the unit apart several times to thaw it out, but ice always builds up again in a few weeks. Nothing appears to obstruct the flow of water, and there are no leaks in the tube. The unit worked fine for many years. Why doesn't it work well now?—James E. Oetken, Waterloo, N.Y.

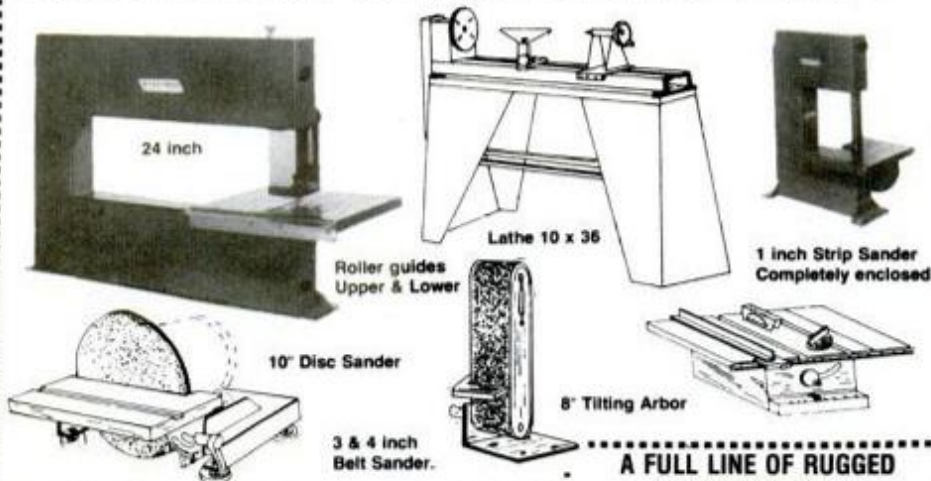
Most GE models use an electric wraparound coil heater to keep water in this supply tube from freezing. Your heater is probably burned out.

In most models, the heater coil is wrapped around the valve that's mounted in back of the vegetable compartment. In other models, the heater is wrapped around the water-supply tube.

Make a continuity test to determine whether your heater is working properly. If the test fails to show any current in the coil, you should replace it. **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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ALL OUTDOORS

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

During 1978, a variety of new products joined old favorites that make roughing-it outdoors easier. Product tests showed that some were great, a number were fun to use only once, and others couldn't hold up under field-trial conditions. Several items will need additional durability checks, but appear to be ideal additions to an outdoorsman's gear—or worth considering as a Christmas gift.

For fishermen

Years of action on rocky streams, shell-covered beaches and coral reefs will be the final test for DuPont's upgraded Stren monofilament line. The original had become a standard for anglers, but new Stren is claimed to have the same strength and invisibility to fish, but more than double the abrasion resistance. Now a trophy lunger should have only half the chance to break off by chomping the line or pulling on a well-used length. If new Stren lives up to laboratory sandpaper tests we'll have a new tackle-box favorite.

Stream and surf fishermen particularly, but also anyone who has to walk into the water, will get big benefits from the latest from Royal Red Ball. In the past, the choice was flimsy plastic waders that could snag during first usage or before you got them on. Or you could pay big money for heavy, bulky rubber jobs that were brutes to travel with, punctured too easily when worn, and cracked anyway when folded and stored.

Then late this year the Flyweights arrived. Chest-high with stocking feet, they're made of waterproof polyurethane-coated nylon that we've found has remarkable resistance to punctures and snags. Best of all, perhaps, you can roll them up and fit all 11 ounces of them in one shoe inside your luggage or tackle box. For a full system, I've tried Royal Red Ball's Bama Sokket insulated socks inside the Flyweights plus Lunger wading shoes, but hightopper Stream King shoes are also available with flat felt soles for slick, mossy bottoms or molded rubber for rocks. Test report for Fly-

weight waders: ideal traveling companions. Royal is also leading the way with waders in women's sizes.

Finest of custom-made rods I've found comes from Ned Segar of Rodmakers Supply, 10346 Southwest 187th St., Miami, Fla. 33157. And if you want to craft your own, he can supply everything needed. For bait casting, I've also been experimenting with Garcia's fast-cast ThumbBar on its narrow-spool Ambassador 4600C reel. By clicking it into free-spool position with the thumb of the casting hand, it makes one-hand operation possible—and proves one can even improve on a classic. For travel, the Daiwa Mini System rod-reel in its pistol-sized case stows in a glove compartment or airline bag. Though fragile, it is a neat unit.

And for a Christmas gift? If you don't know just what an angler wants, Zebco's new sets com-



Stocking-foot waders (\$60, Royal Red Ball) weigh only 11 ounces, are almost tearproof, roll into pocket-size pack, inflate around top for fit, flotation.

bine matched rod, line and reel carefully so that size and action are complementary. Every fisherman can use a spare for himself or when a young friend comes along.

For campers

Our favorite gadget for this year is a clever \$7 L.L. Bean backpack item called a Maxi-Mini Thermometer. This little three-way device from the noted Freeport, Me., outfitters, reads present temperature in Fahrenheit and Celsius, plus how cold and hot it's been since yesterday or the last time you reset it. Left in a glove compartment or car trunk during

summer, it can give scary readings for why you shouldn't store a camera there. In a winter tent overnight, you can easily confirm (or refute) the comfort rating of your sleeping bag. Handled with care, it's very useful.

Around a woodlands cabin, or anywhere tall trees are found, we keep on hand a High Branch Tree Saw from Green Mountain Products, Norwalk, Conn. You toss a weight up over the branch and then, pulling on long lanyards supplied, you position a flexible cable saw over the out-of-reach limb and neatly cut it off.

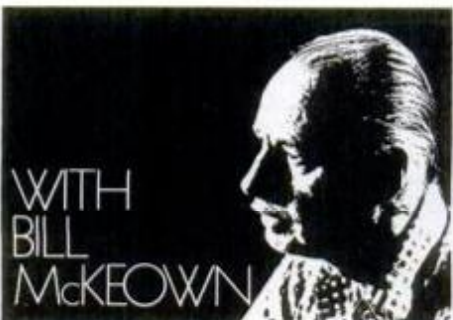
Rugged and warm camp clothing is getting so expensive that it's good to find costs can be cut with sew-it-yourself kits. The largest selection—over 100 items—is offered by Frostline Kits, Frostline Circle, Denver, Colo. 80241. Their free catalog is worth writing for.

For boatmen

For keeping fragile gear like a camera intact and dry on a boat or even in the water while skin diving, there's the Sports Pouch from Sima Products, Skokie, Ill. It's waterproof when folded and zipped, has a shoulder strap, and even provides padded flotation if inflated. We've found it an excellent shipmate.

Best boats we've tested this year include Wellcraft's slick Nova 250XL—a style leader—and Hydra-Sport's center-console fisherman, an open-cockpit offshore model made of Kevlar 49 for extra strength and lightness. We liked Cruisers' Barnegat 22 for overnighting and Glastron's versatile little SSV-188 18-footer for run-about action.

Offshore, our pick again is Don Aronow's remarkable Cigarette line. And for the fastest of all, watch for Bernie Little's brand-new *Miss Budweiser* unlimited. It may top 200 mph! **PM**





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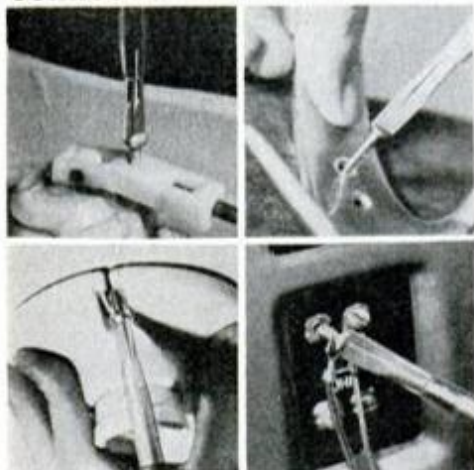
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SCIENCE WORLDWIDE



Patient is readied for hyperthermia treatment. Hot water flows through tubes in pads.

A case of smallpox

We reported in September that smallpox has been virtually wiped out. But scientists still keep virus samples in laboratories. In one lab, someone contracted the disease last August and died.

The victim, a medical photographer at the University Medical School in Birmingham, England, had been working in a room above a lab that was experimenting with the virus. She transmitted the disease to her mother and subsequently died. Her mother survived.

Luckily, the smallpox outbreak doesn't set back the global eradication program, reports Donald A. Henderson, dean of the School of Hygiene and Public Health of Johns Hopkins University. But it points up a potential for disaster.

Should other accidents like this occur, an unvaccinated population would be prey to a devastating epidemic. "This incident illustrates very clearly that we have to reduce the number of laboratories working with this virus to the absolute minimum," Henderson says.

Twelve labs currently possess the virus, but the World Health Organization would like to reduce the number to four, including the Center for Disease Control in Atlanta. Two U.S. labs have not given up their virus stocks: the American Type Culture Collection in Rockville, Md., and the Army Medical Research Institute of Infectious Disease at Fort Detrick, Md. "I see no reason for either lab to retain the virus," Henderson says.

Vitamin C protects metal

Vitamin C has long been touted as a protection against colds. Now scientists at PPG Industries in Springdale, Pa., say that it can protect metal from corrosion.

While not quite as good a protector as chromate, Vitamin C (ascorbic acid) is environmentally safe, requires less energy, is cheaper to apply and does not cause cancer as chromate does. The acid is thought to etch the metal surface and combat oxidation, especially on iron-based metals. After treatment with the vitamin mixed with a little molybdenum, the metal is rinsed with deionized water, drip-dried and then primed or topcoated.

Hot enough for you?

The patient shown above is wrapped up in what may be a useful new kind of cancer therapy—whole-body hyperthermia. Early results indicate it brings measurable results for certain carefully-monitored patients.

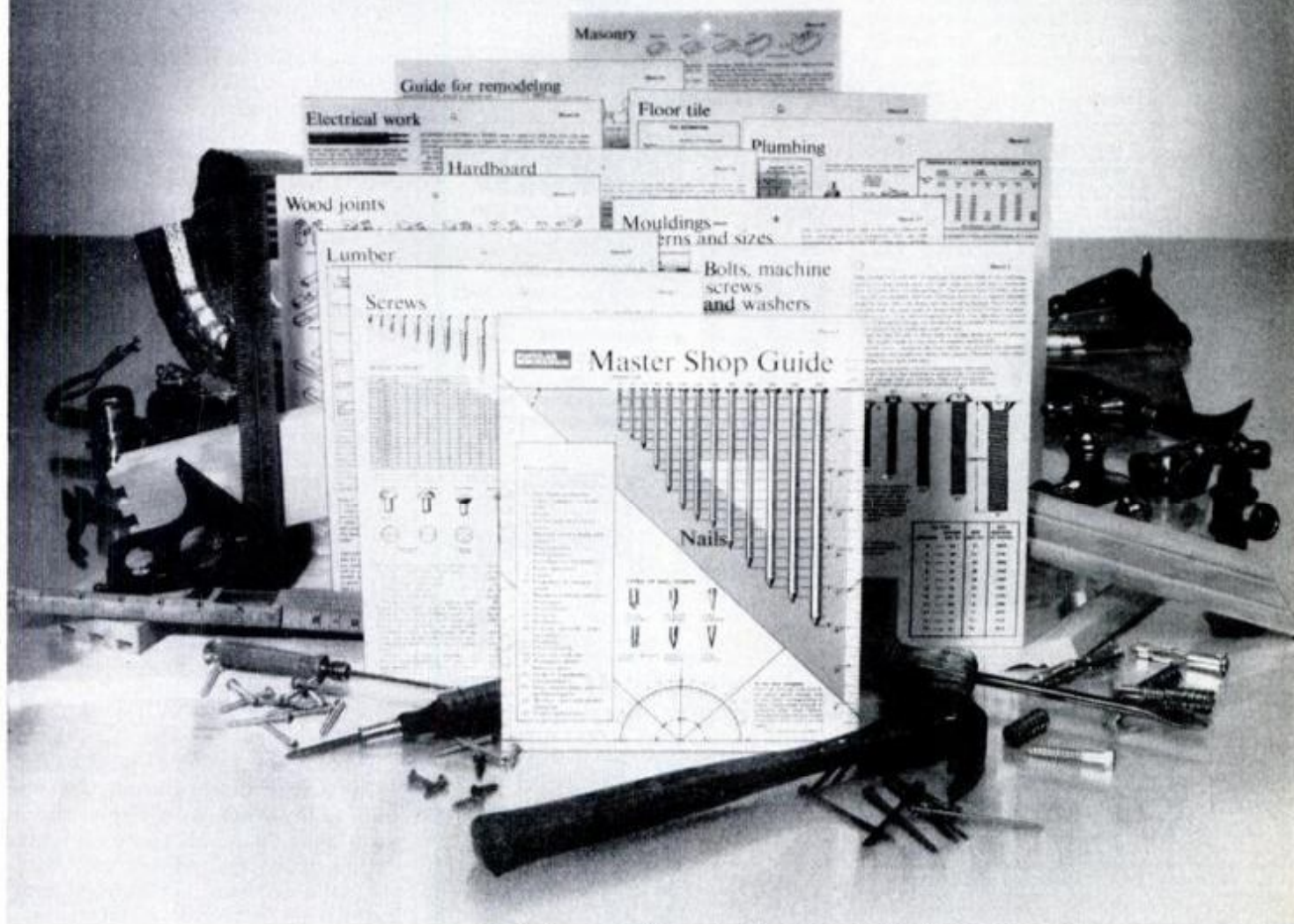
Recent studies suggest that tumor cells are more likely to be injured by heat than normal cells. National Cancer Institute researchers devised a computer-controlled system to circulate hot water through special blankets strapped to the patient to slowly raise body temperature to 41.8° C. (107.2° F.).

After two hours at this temperature, the patient is cooled off in about half an hour.

Of 14 patients tested, four showed measurable tumor shrink-

(Please turn to page 44)

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SCIENCE WORLDWIDE

(Continued from page 42)

age, one for as long as a year. No patients were cured by the procedure, and none was harmed. All patients were severely fatigued after treatment. The patients, all under 65, had different cancer types and healthy cardiovascular systems, but had not responded to other treatments.

Dr. Joan M. Bull, a project leader, and others are testing whole-body hyperthermia along with conventional chemotherapy. Results are not in, but even if the tests fail, new knowledge about chemotherapy action at higher metabolic rates should prove valuable.

World's oldest fish?

Discovery in Wyoming of bony fossil fragments of a primitive fish 510 million years old has pushed back the age of the earliest known vertebrate animals about 40 million years, reports the Department of the Interior.

The fish, identified by Interior paleontologist John Repetski and named *Anatolepis*, was about 1 to 3 inches long and lacked movable jaws. It probably swam clumsily along the muddy sea floor grubbing for food. X-ray analysis of the fossil fragments revealed strong evidence *Anatolepis* was a vertebrate. Similar Arctic specimens found two years ago were 40 million years younger.

Repetski notes that *Anatolepis*, surviving as a species for 40 million years, was very successful. Man has survived only 2 or 3 million years.

Since the discovery of the Wyoming fish, other *Anatolepis* samples have been found in rocks of marine origin. Thus the widely-held theory that the earliest vertebrates originated in freshwater habitats is on shakier ground.

Dining on oil and phosphates

A recently-found microorganism that eats phosphates and oil may be a boon to sewage treatment and oil-spill cleanup, say scientists at the University of Arizona at Tucson.

Acinetobacter phosphatovorans, called harmless to life forms indigenous to tidal zones, has a more voracious appetite than similar microorganisms. In sewage tests, levels of oil and phosphates fell below detection limits after two days of treatment with an activated sludge containing the organism.

Researchers Irving Yall and Charles Russ found the organism in a San Antonio plant known for efficient handling of phosphate wastes.—Tom Sahagian

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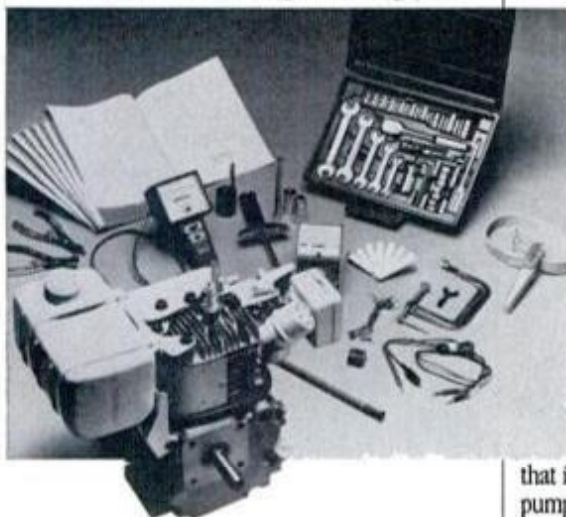
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IMPORTS & MOTORSPORTS



Strada will feature 1.5-liter transverse Four, fwd, 24/24 powertrain warranty and under-\$5,000 price tag.

Fiat Strada

When owners of other small cars see the studio-fresh Fiat Strada, they may feel like they have a garage full of cold pizza. It's not easy to give a four-passenger box on wheels a touch of class, but the Italians do it naturally, with the same pizzazz as when they pronounce Gucci, Pininfarina, Bertone, Coggiola and Giugiaro. (It was Giugiaro, remember, who helped VW with a shape for the Rabbit).

There are more coachbuilders in Turin than any other place in the world, and it's there, too, that Fiat designs and builds its cars. The Strada ("street" in Italian), already on sale in Europe where it's called the Ritmo ("rhythm" in Italian), will be here in February, replacing the boxy, 8-year-old Fiat 128. The 128 featured a transverse engine and front-wheel drive long before everyone else got on the bandwagon and went to that efficient layout.

This is only a sneak look at the Strada in its U.S. version; we'll have more when it hits this shore.

Sox, Martin and Mirage

Now that the Plymouth Champ and Dodge Colt hatchback ("Mirage" in Japan) are on the road here, the car shown below should be easy to identify—even with the addition of the back doors. A four-door (five if you count the hatch-

Mirage is a golfers' special: one-third of back bench folds down for clubs.



back) Mitsubishi Mirage recently went on sale in Japan and may find its way here next year. The split bench in the back of this one is unique: a one-third/two-thirds setup. Two passengers can be squeezed in along with golf clubs (the Japanese are crazy about the game).

I wonder what Mitsubishi



Sox & Martin are back with a Challenger.

thinks about the Challenger it makes for Dodge as it's been set up by drag racers Sox & Martin. The team is campaigning the Challenger in the NHRA AFX (factory experimental) class. The car, as shown above, bears only exterior resemblance to the sporty coupe seen on the street. Under the hood, 406 cubic inches are athrob and everywhere else there's hop-up hardware from the likes of Hays, Hooker and Hurst. The parachute is a Simpson (in case you're new to the game, that's to help the car stop before it runs out of race-track).

Toyota's new fwds

Now it's Toyota's turn to try its hand at a couple of cars with front-wheel drive. Its first venture into the fwd market is with two twins, the Tercel and Corsa (as identical as Buicks and Oldsmobiles), differing only in trim details. Both models come in two-door hatchback, and two and four-door notchback sedan versions.

Straightforward styling is evident in these photos from Japan where the cars are now on sale. When they do come here (not for about a year), they will, I'm sure,



Four-door configuration is a Tercel.

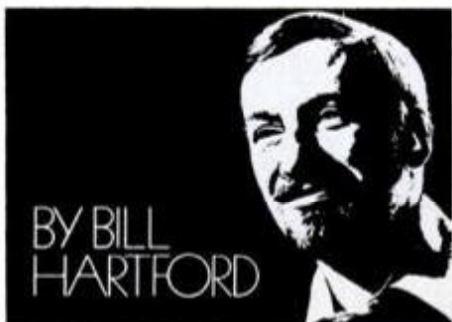
tighten Toyota's grasp as No. 1 import. (Why Toyota sedans sell so well with their boring and plain lines is a mystery to me.)

Dimensions of the Tercel and Corsa are identical at 98.4-in. wheelbase; 157-in. length; 61.2-in. width; 54-in. height. Weight is 1760 pounds. The 1452-cc, ohc Four is transverse and works into



Three-door hatchback model is a Corsa.

a four-speed transmission in the two-door sedan, and into a five-speed in four-door and hatchback models. Other specifications (not features, but standard practice these days) are front disc brakes, radial tires, MacPherson struts and so on. **FM**



BY BILL
HARTFORD



Tough Ford pickups: America's No.1 sellers.*

Ford pickups are built tough. With tough Twin-I-Beam front suspension, an all-welded cab, extensive rust protection, and a double-wall box on every Styleside. And they're tested tough at Ford's Arizona Proving Ground over miles of truck-jarring bumps, chuckholes, salt sprays.

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Ford's Arizona Proving Ground

*Based on R.L. Polk & Co. registrations.




















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Mac 110 now just \$74⁹⁵*



| FEATURES | McCULLOCH MAC 110 | POULAN MICRO 25 | HOMELITE XL 10 | SEARS 35202 | REMINGTON YARDMASTER |
|---------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| PRICE (Manufacturer's suggested list) | \$89.95 | \$79.95 | \$84.95 | \$78.95 | \$89.95 |
| DISPLACEMENT | 32 cc | 33 cc | 26 cc | 33 cc | 31 cc |
| BAR LENGTH | 10" | 10" | 10" | 10" | 12" |
| CHAIN BRAKE |  | | | | |
| HAND GUARD |  | | |  | |
| AUTOMATIC OILING |  |  |  |  |  |
| MANUAL OILING |  | | | | |
| MUFFLER SHIELD |  | | | | |
| SAFETY TRIGGER | | | | |  |
| THROTTLE LATCH |  | | | |  |
| RIGHT HAND GUARD |  |  |  |  | |
| CHAIN CATCHER |  | | | | |
| SAFETY TIP | | |  | | |

The above prices are the suggested list prices published by individual manufacturers, their distributors or their agents. Actual prices may vary by area and at the discretion of individual dealers. Data for the above models are on file at McCulloch Corporation and are available upon request. \$74.95 is the manufacturer's suggested special price for the Mac 110. †Low-Kick Guide Bar

***Save \$15 on Mac 110 Now through December 31, 1978**
The lowest priced chain saw with Chain Brake.



McCulloch Corporation, Los Angeles, California 90009



Menace in the aisles?

Among public officials, zeal is not exactly in a state of excess, so we don't make a habit of condemning it. You sometimes wonder, though, if "data churning" merely to get attention isn't becoming too common a bureaucratic fault, particularly in Washington.

We're referring to an exercise the Commission for Product Safety went through recently to decide if it should develop a set of safety standards for grocery carts. That's right, grocery carts.

Did you know an empty grocery cart can be "caused to overturn" by as little as 5 pounds of force applied to the handle when the front wheel is turned about 75° to the axes of the cart? Also by raising one of the rear wheels 5.5 inches? And that a grocery cart can easily turn over at a speed of 3.67 feet per second when turning in a 4-foot radius?

Underwhelmed by this exhaustive research, the Commission saw no reason to call for a grocery cart safety standard at this time. We tend to agree. Our deal with the CPS is that we'll be careful in the supermarket if they'll start running down things that really do endanger people who use them.



Last of a great breed

The P-47 Thunderbolt shown was the last one of that model to be built, and rolled off the Republic Aviation line in 1945 as aircraft No. 489444—one of 15,300 Thunderbolts built, of which only 25 are known to remain intact. It's now at the new Nassau County, N.Y., Museum Air & Space Collection, which opens this month. Vital numbers on the "Jug," as WWII fighter jocks knew her, are as follows: 36 feet long with a 42-ft. wingspan; weight of 16,300 lbs. without ordnance; powered by 2800-hp Pratt & Whitney "Double Wasp" to speeds up to 450 mph. In the won-lost column, she was 4.6 to 1 over Axis aircraft.

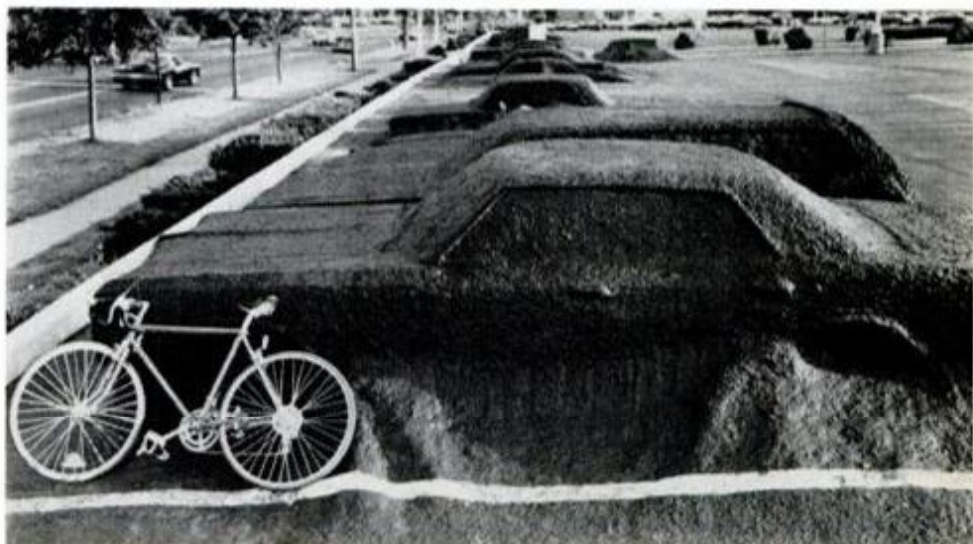


Eyes have it

If you've been wondering what they do during those long, cold winter nights in Sweden, our answer might run something like this: Based on the evidence at hand, that being the drawings you see herewith, they uncork the aquavit and sit around until somebody comes up with a new design for something or other that has remained unchanged for centuries. Anyway, that's our theory. They tell us, does Stockholm's Vesto company, that the four-eyed scissors can be safely played with and used by youngsters, and that the three-eyed version can be conveniently hung on a hook or passed from hand to hand without danger. *Skoal!*

PM's Whatsit

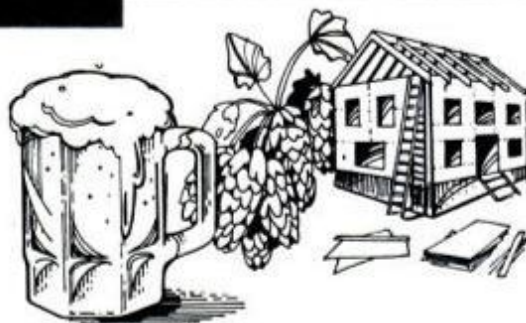
No, this is not a special blackout decor option for sport coupes in the 1980 model line. Nor is it the official response to those drivers who have been clamoring for the elimination of tow-away zones. We can only tell you what they tell us: It's a "public sculpture" consisting of 20 partially buried junked cars covered with asphalt. The owners of a shopping center in Hamden, Conn., paid good money to have this done by a New York City firm known as Sculpture in the Environment. Art lovers should note that it does have a title: *Ghost Parking Lot*. Car lovers should take solace in the fact that all the bodies were completely stripped and usable parts recycled.



IPM BRIEFS



Dialogue above is PM's best guess as to what was said during a demonstration put on by Britain's Royal Signal Corps Motorcycle Exhibition Team.

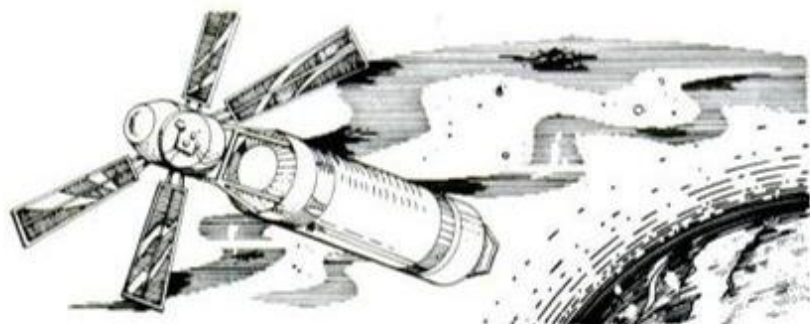


Perfect for coasters

One of the brewing industry's major waste problems has to do with hops—the aromatic flowers of the hops vine that give beer its "bite." After hops lend their essence to the brew, they immediately become a soggy, gloppy mass of useless refuse that can't even be sold as a fertilizer. It costs brewers as much as \$40 per ton to dispose of it.

But now two researchers in Middlesex, England, have come up with a process that apparently turns marinated hops into a legitimate building material. Treated with formaldehyde, the soggy hops harden into a woodlike substance its inventors describe as "an attractive, strong particleboard, midway between chipboard and hardboard." It's been successfully tested in home and shop.

The obvious name for it is "beerboard"... and did you hear the one about the carpenter who was always three sheets to the wind?



PM FOLLOW-UP . . . Skylab

Our story on the menace of space junk by Richard F. Dempewolf (page 57, Aug. '78) told in detail how space agency officials hoped to stabilize the decaying orbit of the tumbling Skylab satellite by reactivating its power systems and gyros. Subsequently, they did—and they didn't. The result deserves a little more attention than it's getting.

The 84-ton satellite's tumbling motions were eased in mid-June and its gyros turned on. But weeks later, Johnson Space Center head Chris Kraft, a NASA veteran, allowed that he didn't share the optimism which had been reported following the initial maneuver.

Other officials then agreed that the Skylab's orbit will probably continue to decay at a rate that will bring it to a spontaneous, fiery re-entry well before it can be reached (late '79, early '80) by the Space Shuttle under the current plan to attach an auxiliary booster (also detailed in PM's story).

Will 84 tons of Skylab be incinerated before impacting the ground? No one really knows—in fact, the only encouraging word NASA could pass along was that 80 percent of Skylab's orbital track is over water. Stay tuned.



The inevitably futile last-minute gift suggestion

We know that Christmas is just another day for the person-who-has-everything, and that your gift, whatever it is, will only wind up in the drawer marked W.I. (for Woefully Inadequate). But let's face it—you have to try and we have to suggest, so here goes:

How about a stereoscope? This one's an obvious replica (of the original 3-D viewer without which no proper Victorian sitting room was complete), but it's got brass fittings and comes with 62 "views" from original photos taken from 1859 through 1920. Scenes include the San Francisco Earthquake, Paris World's Fair, etc. It can be ordered by mail from Stereo Classics Studios, 145 Algonquin Pkwy., Whippany, N.J. 07981. Cost is \$19.95 for stereoscope and photos, plus \$1.50 handling charge. Pedestal base is \$6.95 extra.

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This is GE Performance Television.

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GENERAL  ELECTRIC

1979 DODGE MAGNUM

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A good family car should make the family that owns it feel proud to be seen in it. Magnum's bold profile and distinctive Cord-type grille take care of that.

A good family car should give a smooth, comfortable ride to the whole family. Hefty wheels and radial tires combine with a 5.2 litre (318 cu. in.) engine and automatic transmission to provide a substantial, yet manageable, feel. A combination that has a surprisingly high mileage rating. 23 MPG HWY./16 MPG CITY.*

A good family car should handle well in all kinds of driving situations. Magnum is as at home on the highway as it is on city streets.

A good family car should do all of this... but a *great* family car should also make you just feel good about driving it... even when the family's



not around. See your Dodge Dealer about buying or leasing this unusual family car.

Who wants to be average, anyhow?

*EPA estimates. Your mileage may vary depending upon your car's condition, optional equipment, and your driving habits. California estimates lower.

**"HEY, THAT'S
MY DODGE!"**



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CAR CLINIC

SOLUTIONS FOR MECHANICAL HEADACHES

BY MORT SCHULTZ



Reverse psychology

My 1978 Plymouth Volare stalls when the automatic transmission is shifted into Reverse. The dealer has rebuilt the carburetor, tested the ignition system and tuned the engine. The car performs magnificently, except in reverse gear. Can you tell me why?—Garry Walchuk, Manitoba, Canada.

Look to the new lockup torque converter. Starting in 1978, it has been installed in Chrysler cars with automatic transmissions, except those with 440-cu.-in. engines and California models with six-cylinder engines.

The lockup torque converter locks the turbine to the front of the converter housing with a friction clutch operated by hydraulic pressure. This eliminates normal slippage during high-gear cruising to improve gas mileage by about 4 percent.

When your car is operating in any gear except High, the converter should not be locked. Application of the lockup feature in any gear except High causes stalling. In your case, a bleed-by condition is probably allowing application of pressure to the lockup valve, which is causing lockup in Reverse. There are two ways your dealer can tackle the repair. He can replace the front pump in the valve body where a bleed-by condition takes place or, if that doesn't solve the problem, he can replace the transmission.

Oil's well that ends well

My car is a 1977 Buick Regal with a 350-cu.-in. engine. From the beginning the carburetor air cleaner has been filling with motor oil. Thus far, I have replaced four air-cleaner filter elements and three exhaust gas recirculation filters. The dealer says the engine is pumping oil up through the EGR hose into the air cleaner. He replaced the PCV valve, but this hasn't helped. Now he wants me to add an additive to the oil. Can you

tell me what good this will do? If this doesn't work, he says the heads should be removed, which will cost me a minimum of \$175. Your advice is needed.—Van Brathwaite, Scottsville, N.Y.

I'll say it is. Advice: Try another dealer.

What good will an additive do? No good as far as I can tell. But I'll tell you what will help—finding and fixing that air leak in the intake manifold or valve cover seal. It is breaking vacuum, which is allowing air, carrying oil, to be drawn into the carburetor air cleaner.

First, steam-clean the engine. Then, apply sealer around the manifold and valve covers. Torque them down. This is the quick and inexpensive way to seal an air leak and is usually successful. But if the procedure fails, remove the manifold and valve covers, make sure surfaces are not warped, then install new seals and tighten. Following this procedure should cap your gusher.

Tip-in bows out

Since the day I bought my 1977 Ford Thunderbird (351-cu.-in. engine), the engine has been hesitat-

ing and stalling on acceleration following a complete stop. Two dealers and an independent mechanic have checked timing, carburetion and automatic choking. The condition has not improved. Please help me.—John C. Wilson, Jackson, S.C.

The condition is called tip-in hesitation, John, and it affects the 1977 Ford, Ranchero, LTD II and Cougar with 351-cu.-in. engines, as well as the T-Bird. The cause is insufficient accelerator pump discharge on acceleration. The fix is as follows:

- Remove and drain the carburetor.
- Take off the carburetor air horn and remove the float assembly, accelerator pump diaphragm, and accelerator pump spring.
- Locate the accelerator pump bleed restrictor, which is a small brass restrictor at the top center of the pump cavity.
- Use a 1/16-inch-diameter pin punch and hammer to drive the restrictor into the fuel bowl. Remove and discard the restrictor which has been causing the problem.
- Drive a new restrictor (part No. 373119-S) into place in the vacated restrictor bore.
- Reassemble the carburetor and enjoy driving a stall-free 'Bird.

Rx for RX

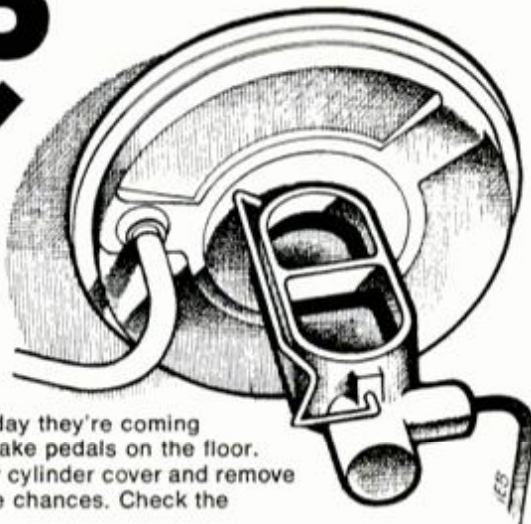
I believe that a recent experience I had with my 1973 Mazda RX-2 is worth sharing with other Mazda owners. When I tried starting the engine, it turned over with the ignition key at the Start position. However, when the key was returned to the On position, the engine died. A Mazda salesman showed me that the fuse which protects the fuel pump, regulator and ignition coil had burned out—



Averting brakedown

Be honest, now. When did you last uncap that master cylinder to check brake fluid level? The wise car owner does this once a month. He or she realizes that a loss of fluid signifies a leak in the system. Other drivers don't come to this realization until one day they're coming down a mountain and find their brake pedals on the floor.

Monthly, clean dirt off the master cylinder cover and remove the cover. If fluid is low, don't take chances. Check the brake system for leaks.



CAR CLINIC

(Continued from page 55)

replacing the fuse solved the problem.

The salesman also told me that the problem is common to Mazdas, and that owners who aren't aware of this fact frequently have their cars towed to shop for needless repairs. Perhaps this information will help them avert an unnecessary expense.—A. Tanner, Covina, Calif.

Thank you, Mr. Tanner—a good tip, indeed!

Royale headache

I have a 1977 Oldsmobile Delta 88 Royale which has 13,000 miles and a recurring stalling problem for which I have a temporary solution: Replace the fuel filter.

Each old filter has been covered with a grayish substance. So far, I've replaced four of them at a cost of \$6 to \$7 per filter. Can you tell me what the grayish substance is?—Charles H. Smith, Elmhurst, Ill.

It's junk, Charles. No offense, but we disagree with your "solution." The fuel tank of your Olds has apparently been the recipient of a load of contaminated gasoline. Apply the proper remedy—not a Band-Aid solution. Drop the fuel tank. Then flush the tank and the fuel system until they are clean once again.

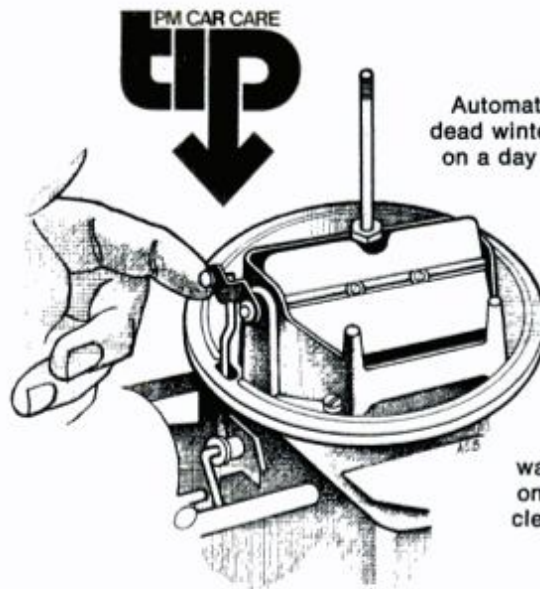
Blasting theories

At 30,000 miles, the 400-cu.-in. engine of my 1973 Pontiac is making an unbelievable racket after the car is started and driven a short distance. The oil-pressure warning light comes on. The noise has been diagnosed as noisy valve lifters. One independent mechanic said the trouble is caused by my having added an oil additive which he says, "thinned the oil and turned everything loose." I drained the oil and changed the filter, with no success. Now, the service manager at a dealership informs me that I need a new oil pump.

Would you please give me your opinion?—John Blast, Garden City, Mich.

The only way an oil additive could turn "everything loose" is if you followed it into the crankcase with a stick of dynamite, fuse lit. The additive theory is pure poppycock.

The dealer may be right, but before going through the expense of a new oil pump, investigate another possibility, which is more



Averting choke-up

Automatic-choke failure seems to happen in dead winter, often keeping you in your tracks on a day unfit for polar bears. The best time to check a choke, then, is at the first taste of cold weather. With the engine cold, remove the carburetor air cleaner. Have an assistant depress the accelerator to the floor. The choke plate should close. Start the engine. The choke plate should start opening, eventually coming to full-open position. If it doesn't work this way, the choke plate and linkage may only need a spritz of automatic choke cleaner. At worst, the choke may need a new part.

likely: a loose or cracked suction screen pipe in the bottom of the oil pan which is sucking in air, resulting in loss of oil pressure. An easy way to tell if this is happening is to overfill the crankcase by two or three quarts of oil. Excess oil will tend to fill the crack, preventing air from affecting oil pressure. If adequate oil pressure is maintained, it verifies that the suction pipe is damaged. Drop the pan and replace it.

SERVICE AND SAFETY TIPS

■ AMC informs us that Champion N12Y sparkplugs, or equivalent, must be used in 1978 Gremlins, Pacers and Concords with 258-2V engines, automatic transmissions and 2.53 axle ratios to prevent an exhaust emission problem. Originally, N13L plugs, or equivalent, were called for.

■ Don't get confused when replacing shock absorbers on Type 1 Volkswagen Beetles. It may seem that the lower shock mount of your replacement shock won't fit over the mounting pin. Your new shock absorber has a steel sleeve in the lower mount, whereas the old shock does not. But if you will look on the mounting pin, you will see that the sleeve from the old shock has rusted on the pin. Cut the sleeve off the mounting pin, and you'll be able to mount the new shock.

■ The stalling problem being experienced by owners of 1977 Buicks, Oldsmobiles and Pontiacs with V6 engines should be corrected by having the dealer apply service bulletins bearing the titles *Stalling* and *Cold Driveability*. However, if you don't have success getting the problem solved, the GM division that manufactured your car and the National Highway Traffic Safety Administration would like to know. You can reach the latter by calling, toll-free, 800-424-9393, or writing NHTSA, Office

of Defect Investigations, 400 Seventh St., Washington, D.C. 20590.

■ Barring an overturn by the courts (eight tire companies have filed an appeal), a new on-tire uniform rating system for bias-ply tires will take effect March 1, 1979. A rating system for bias-belted tires will be required by September 1. A system "will be applied to radial tires at a later date," says the National Highway Traffic Safety Administration. The purpose of the system is to allow consumers to compare the relative quality of one tire against that of others. The new standard establishes grading systems for tread wear, traction and heat resistance as follows:

1. Relative tread life. A numerical designation of 80, 90, 100, 110, 120, 130, 140, 150 and 160 will indicate comparative tread wear. A tire graded 150, for example, can be expected to wear 1½ times as well as one graded 100. This comparative system was selected rather than actual mileage estimates because tread life depends on variables like climate, road conditions, driving habits and maintenance practices.

2. Traction. An A, B, C grading system will be used. "A," the top rating, offers the best traction. NHTSA warns that tires with a "C" grading should be avoided although they may receive good marks for both tread life and heat resistance.

3. Heat resistance. An A, B, C grading system will be used. The "C" rating indicates the tire meets the government's existing standard for heat resistance at high speeds. However, tires with an "A" or "B" rating exceed this standard.

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.

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—*James V. Matthews*



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in pictures.



Kings: 17 mg "tar," 1.0 mg nicotine—
100's: 18 mg "tar," 1.1 mg nicotine av. per cigarette, FTC Report May '78

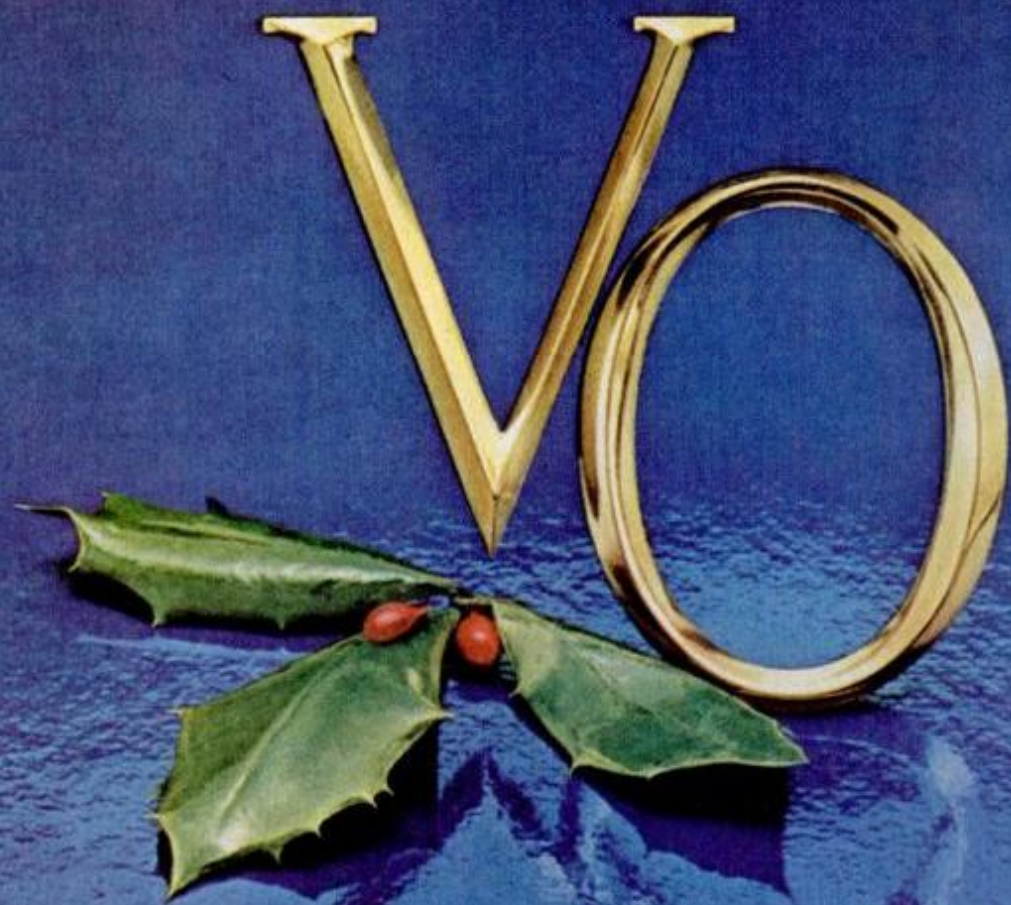
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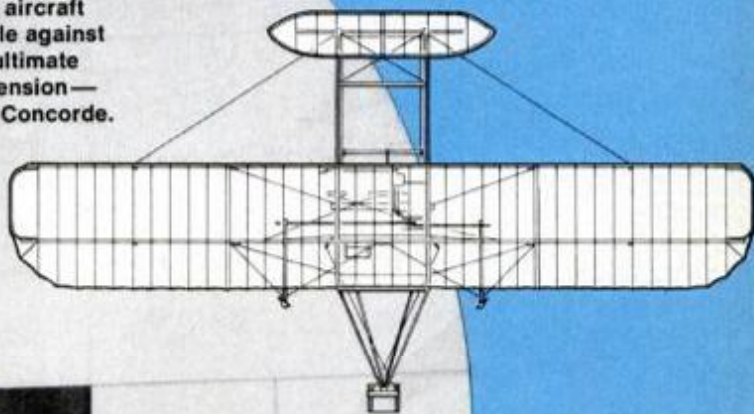
WINGS

75 years of powered flight

Just as at Kitty Hawk, the struggle for lift over drag still challenges aviation's best minds.

On the 17th of December at exactly 10:30 in the morning it will have been 75 years since the Wright Brothers first flew on that chilled, blustery beach at Kitty Hawk. To cover about 120 feet, the aircraft was aloft for 12 seconds. In the same interval, any modern Olympic sprinter could cover twice the distance and still have time to pull his warm-ups on. Obviously a lot has happened to aircraft in three-quarters of a century. Yet, the full comprehension of the fundamental flux—the fluid we call air moving across a shape we call a wing to

In a contrast that seems to span centuries rather than decades, the Wrights' first successful aircraft is shown in scale against the wing of its ultimate nonmilitary extension—the supersonic Concorde.





The "by wing alone" movement, always on the fringe, got a big push in 1942 with the development of Chance-Vought's V-173 "flying pancake" (above) as a Navy research aircraft. But nobody hung in with flying wings like Northrop Co. A scale flying model (right, above) led to its B-35 (opposite, top) and jet-powered YB-49 (opposite, below), all post-war curiosities. Northrop's prone-pilot XP-79 (right) was even farther out.



generate forces we call lift and drag—still eludes those who build aircraft today. We know, for instance, that if the net effect of its passage through the air is a downward deflection of the air, an equal and opposite force (Newton) will lift the wing upwards. We also know that if air rushes more quickly across the top surface of a wing than the bottom, a lower pressure (Bernoulli) on top will produce lift. But the integration of these and all ancillary aerodynamic phenomena is something upon which practically no two experts agree. It is in celebration of this ongoing mystery as well as the Wrights' magnificent achievement that the editors present this article.

by David A. Anderton

The Wright brothers flew on Dec. 17, 1903, for one primary reason: They alone had developed a light and efficient wing structure satisfying three basic needs: lift, control, and a place to put things.

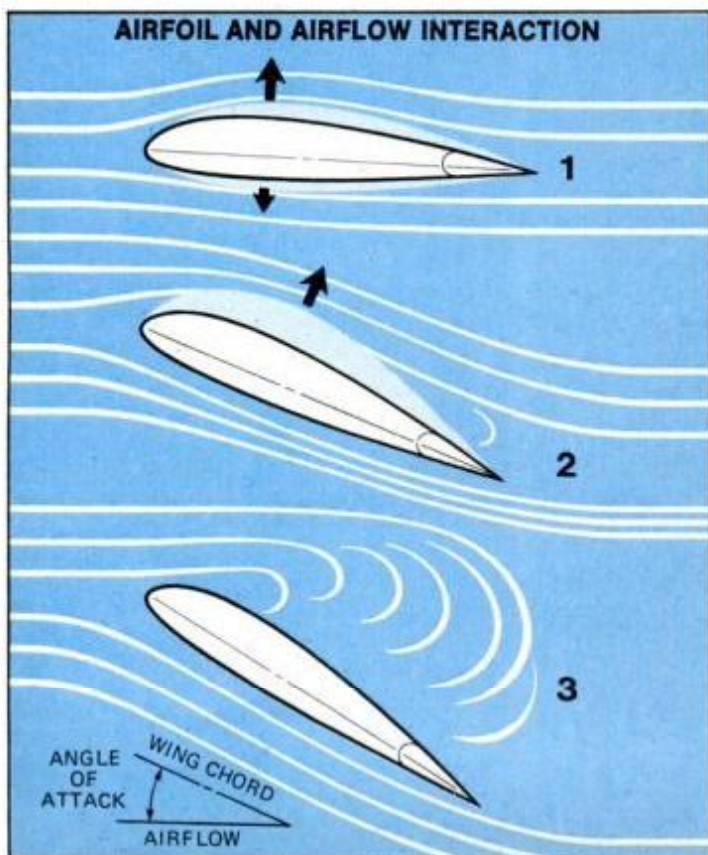
On the road from Kitty Hawk, designers have since learned how to develop special wing shapes to fly high or low, slow or fast. They have learned how to make thin, low-drag wings that generate high lift; how to build a thick wing so that the air "thinks" it's thin, and how to work with the air, instead of fighting it.

Along the way, they devised some weird and wonderful shapes: Wings that resembled those of birds or bats; wings that were circular, an-

nular, square or triangular; wings with strange contours that partially shrouded propellers; wings thick enough to hold passengers, engine mechanics, cargo or bombs. They experimented with quantities of wings—designing planes resembling powered Venetian blinds. They built wings that flapped, oscillated, nutated and rotated.

Today, wing design is—barring the unpredictable breakthrough—largely a matter of refinement. Batteries of mathematical formulas, hundreds of computer programs and thousands of expensive hours of wind-tunnel tests and flight research are pursuing the last elusive facts of lift and drag. Since the energy crisis, there has been design effort aiming at more efficient aircraft, and much of that work has been dedicated to improving the wing.

The Wrights' approach was a carefully reasoned one, based on contemporary knowledge, experiments of many others, and their own painstaking studies with wind-tunnel and tethered flight apparatus. They chose the biplane form developed by Octave Chanute, pioneering American designer engineer. It had two rectangular wings, separated by struts and braced by wires. The Wrights wanted a structure both strong and somewhat flexible, because they had devised a system of lateral control that depended on *twisting* the entire wing box structure around its longest dimension. They used struts to carry compression forces, and wires to take tension, as well as to apply control loads to twist the wing.



"Angle of attack" refers to relationship of wing chord to direction of oncoming airflow. At low angle of attack, airflow is smooth and moderate lift is the result.

As angle of attack is increased, lift forces build to a peak, then the airflow begins to move away from the wing, starting near the trailing edge and going forward until...

... Stall occurs! At too high an angle of attack, flow breaks away from entire surface. Depending on wing design, it can destroy lift instantly without warning.



It was such an elegant solution, so very basic, that wing design remained essentially frozen for years. That is, of course, something of an oversimplification. Monoplanes, braced and unbraced, were around from the early days of aviation. Louis Bleriot crossed the English Channel in one in 1909, and there were operational monoplane fighters in World War I. But single-wing dominance of aviation had to wait, because the strut-and wire-braced biplane wing was long the lightest and strongest construction.

Let's look more closely at a typical biplane: Both wings are almost rectangular in plan view. Both have a constant *chord*—the dimension from leading edge to trailing edge—and rounded tips. The lower wing may be somewhat smaller. But notice, as you look from either side, that the lower wing is set so its leading edge is behind the leading edge of the upper wing. Stagger, that's called, and it took a while to figure out this was needed to give optimum performance with two wings operating in close proximity.

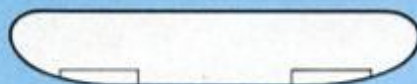
Now look at the end of a wing and study the shape of the wing cross section. That's the *airfoil* shape; in the old biplanes it was quite thick, compared to the chord. It was also much more highly curved on the upper surface than on the lower. Development of and changes in this basic shape is the key to improved airplane performance over the past 75 years.

Looking at its wings as if you were the air, you'll see why the biplane is obsolete. Those two thick wings and all those struts and wires

TYPICAL WING PLAN FORM SHAPES



WRIGHT: 1903



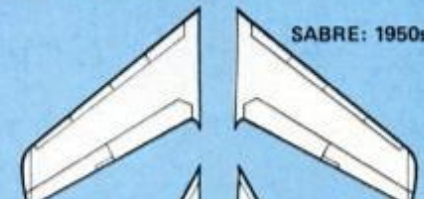
BIPLANE: 1920



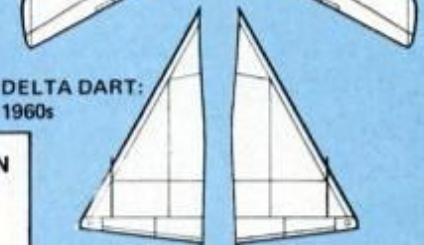
SPITFIRE: 1930s



MUSTANG: 1940s



SABRE: 1950s



DELTA DART: 1960s

AIRFOIL DEVELOPMENT PROGRESSION



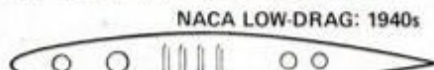
WRIGHT: 1903



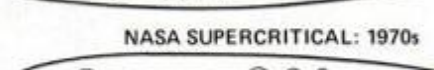
RAF 15: 1918



CLARK "Y": 1920s



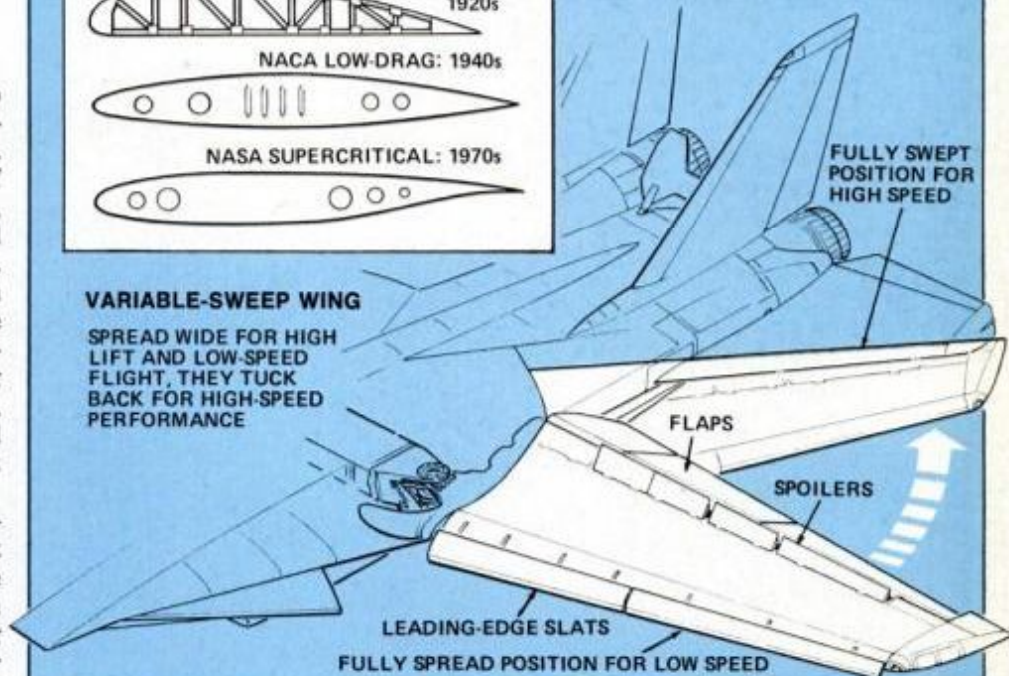
NACA LOW-DRAG: 1940s



NASA SUPERCRITICAL: 1970s

VARIABLE-SWEEP WING

SPREAD WIDE FOR HIGH LIFT AND LOW-SPEED FLIGHT, THEY TUCK BACK FOR HIGH-SPEED PERFORMANCE



FULLY SWEEP POSITION FOR HIGH SPEED

LEADING-EDGE SLATS
FULLY SPREAD POSITION FOR LOW SPEED

HIGH, LOW AND IN BETWEEN: A VARIETY OF WING POSITIONS



ORNITHOPTER



LOW WING



BIPLANE



SHOULDER WING



PARASOL WING



GULL WING



HIGH WING



INVERSE GULL WING



MID WING



REVERSE DIHEDRAL



WINGS: A 75th anniversary aviary

Fokker DR.I triplane (4 o'clock) was the nemesis of Allied flyers during WW I—but only in the hands of extremely skilled pilots. Top wing was known to defabricate and occasionally leave the aircraft entirely in violent maneuvers. ■ Beech Staggerwing (9 o'clock) led with lower airfoil, reversing usual biplane design. A Bendix Trophy winner in 1936, it was the true precursor of today's corporate jets. ■ With its "crescent" wing that approached the ideal theoretical shape of an ellipse, the Spitfire, became the most legendary fighter of

WW II. Some 1400 of them changed the course of the war in the skies over Britain in 1940.

■ The Navy's F4U Corsair (6 o'clock) was, in prototype, first U.S. aircraft to exceed 400 mph in level flight. Its "inverted gull" wing design was for prop clearance, also happened to make for a kindly ditching characteristic.

■ The F-104 Starfighter (2 o'clock), an early Mach 2 aircraft, has a wing no thicker than four percent of its chord. Its low-drag advantages at high speeds are a compromise, as Luftwaffe pilots over the years have found out.



JD-101

OD

Gehring

WINGS THAT FAILED— PROGRESS AT THE PRICE OF TRAGEDY

On Mar. 31, 1931, something happened that marked the beginning of the end for the wooden aircraft wing: A plywood-covered wooden structure of the type used by the Dutch designer, Anthony Fokker, in so many of his great aircraft failed, and a Fokker trimotor F. 10A of Western Air Express crashed near Bazaar, Kans. Among the fatalities was Knute Rockne, the legendary Notre Dame football coach. All Fokker transports were grounded until the cause of the accident, and a fix, could be determined. The best guess was that interior rot in the wooden structure and subsequent loss of strength had led to failure in air turbulence.

The Bureau of Air Commerce at once demanded that air transport operators begin inspecting the interiors of wooden wings periodically for rot. But these wings, in common with most aircraft structures of their day, had been designed without much provision for inspection; to make such access in existing wings would have meant stripping and recovering major portions of the surface at a prohibitive cost.

The wooden-winged Fokkers never flew again in airline service but, in leaving the scene, they spurred the development of the all-metal, low cantilever-



Crashes of Fokker Trimotor (below) and Lockheed Electra due to apparent wing failure occurred almost three decades apart. Both calamities ultimately led to advances in the design of safer and stronger aircraft wings.

wing aircraft that advanced air transportation in the 1930s.

If the failure of the F.10A wing that killed Rockne seemed catastrophic, even more shocking three decades later were the wing failures on two Lockheed Electras—one operated by Braniff, which crashed Sept. 29, 1959, and one flown by Northwest, which crashed March 17, 1960. Both broke up in flight, their wings shuddering violently carrying all aboard to their deaths.

The investigation that followed was a landmark in aeronautical engineering. Lockheed, whose design talents have long been respected by its airplane contemporaries, immediately sent Electra drawings to rival companies here and abroad for a check of the original calculations. A highly instrumented Electra was test-flown again and again in heavy mountain turbulence in search of the answer. And it was found: The sequence started with failure of an



engine nacelle assembly which weakened, and softened, its metal structure. The nacelle began to twist like a flexible twig spun between your fingers. Its whirl frequency resonated with that of wing-bending motion, and triggered a period of violent oscillations that rapidly ripped the wing from the fuselage.

In an extensive modification program, Lockheed rebuilt all Electras in service and production, stiffening the nacelles and adding strengthening skins and doublers to the wings. It cured the problem, but at great cost to the company and airlines—not to mention the crash victims.—D.A.

create resistance to the air—or *drag*, as aerodynamicists say. Overcoming drag requires power. Airplane designers have always tried to get more performance per unit of power.

Drag, like lift, varies with the *square* of speed through the air: Double speed, and both drag and lift quadruple. Therefore, the faster you go the less wing surface area

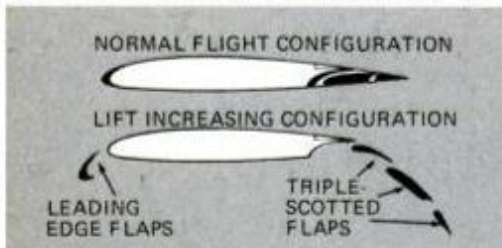
you need to support the plane in flight. This means less drag, and as the wing gets smaller, it is easier to internalize its structural strength. External bracing vanishes; the wing is internally braced.

Changing a single design element often is not enough. Wing shape advances have to be matched by power increases, by structural improvements, by understanding of

the *form drag* of basic shapes as well as the *skin friction drag* of all the little bumps and fittings jutting out into the slipstream.

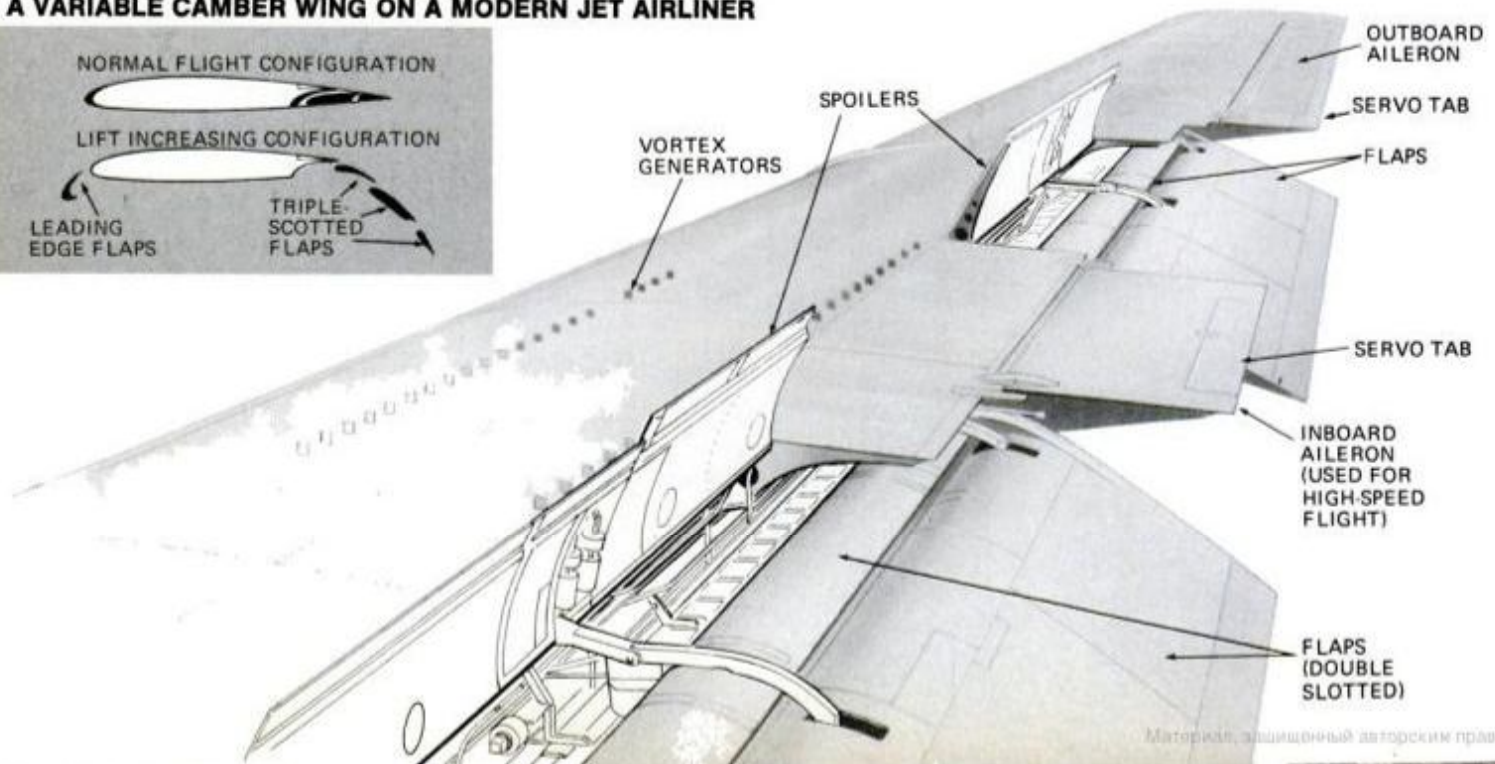
So well into the 1930s, first-line fighter aircraft in the United States and abroad were biplanes. The world entered a second global conflict with most of its air forces just half a generation removed from the Wrights' wood and canvas crea-

A VARIABLE CAMBER WING ON A MODERN JET AIRLINER



LEADING
EDGE FLAPS

TRIPLE-
SCOTTED
FLAPS



VORTEX
GENERATORS

SPOILERS

OUTBOARD
AILERON

SERVO TAB

FLAPS

SERVO TAB

INBOARD
AILERON
(USED FOR
HIGH-SPEED
FLIGHT)

FLAPS
(DOUBLE
SLOTTED)

tion. A new generation of fighters and bombers sprang forth, shucking off drag by housing engines inside clean cowlings, and by retracting landing gear inside cantilevered, internally braced monoplane wings.

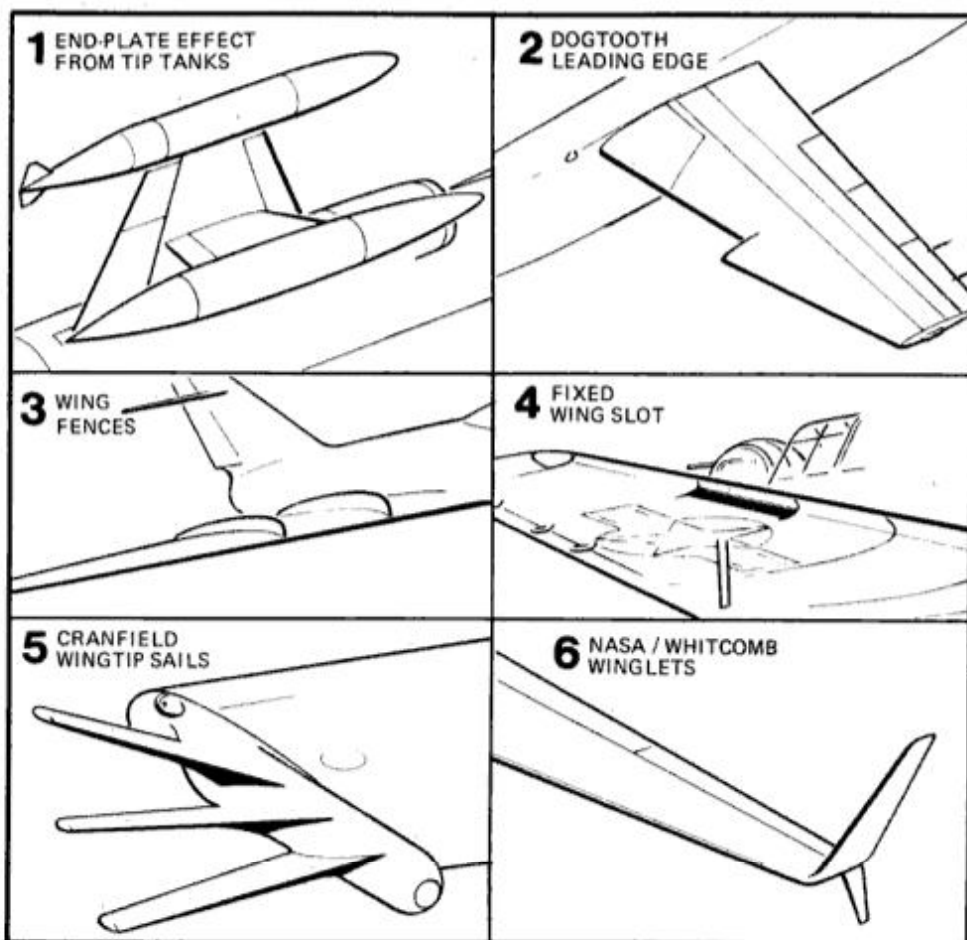
Walk around one immortal fighter plane from World War II, the North American P-51 Mustang: Its all-metal wing can carry machine guns and fuel and retracted landing gear within its streamlined contour. Its plan form is tapered, approaching an elliptical shape that aerodynamicists calculate is the theoretical ideal. Its airfoil shape was derived from long hours of wind-tunnel testing in the laboratories of the National Advisory Committee for Aeronautics (now NASA, the National Aeronautics and Space Administration). NACA scientists developed a huge "family" of airfoil designs over the years, for many specialized applications. The one family that may be remembered longest is the low-drag series of airfoils, sometimes called *laminar-flow* sections to describe the airflow pattern over the wing. (Laminar flow is smooth and low-drag; its opposite, *turbulent flow*, has higher drag.)

That Mustang airfoil differed from earlier shapes primarily in two ways: First, its maximum thickness occurred farther back than usual; second, its trailing edge was reflexed slightly. Arguments still arise today as to whether or not its low-drag sections actually "produced" low drag. Proponents say yes; opponents argue that the unavoidable presence of dirt, smashed bugs and irregular contours of skin caused by rough handling and battle damage destroyed the fine aerodynamic contours supposed to cut drag. Arguments aside, the Mustang remains an outstanding example of monoplane design.

But near the end of the war came the most dramatic change of all, the sudden emergence of a new shape with wings angled back to ease into the onrushing air. Born in theory in 1935, the sweptback wing had to wait for the arrival of the jet engine to reach its potential.

There are a number of swept-

ADDED ATTRACTIONS: AERODYNAMIC DEVICES TO INCREASE LIFT, REDUCE DRAG, IMPROVE CONTROL



wing concepts. One that didn't make it was the swept-forward wing, pioneered in wartime Germany. It was actually effective, so far as drag reduction was concerned, but had structural problems.

The triangular or delta wings of some contemporary military aircraft, like the Dassault Mirage III series, the MiG 21 or the General Dynamics F-106, are merely special cases of sweptback wing design. The S-curved ogival plan form of the Anglo-French Concorde supersonic transport is another variation.

Swept wings reduce the drag, but increase some other problems, like adequate lift generation at low speeds and at high angles of attack. All sorts of mechanical and aerodynamic fixes have been devised to make those wings behave. The most

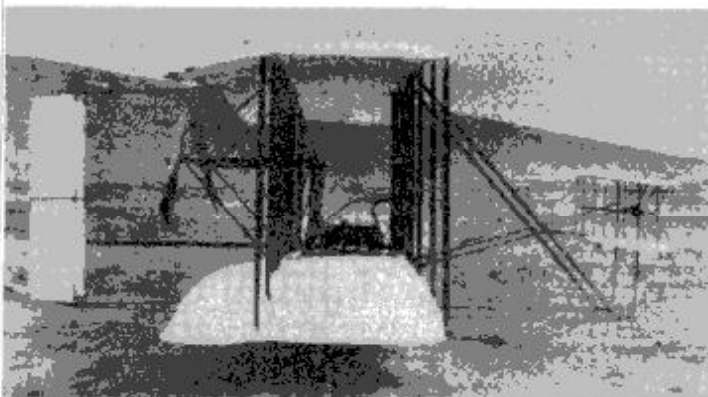
drastic solution, used widely in contemporary fighter design, is the *variable geometry wing* in which the angle of sweepback can be changed in flight.

For low-speed flight, the variable wings extend almost straight out from the fuselage, giving all the aerodynamic advantages of an unswept wing: high lift, excellent controllability at high angles of attack, gentle stall. As flight speed increases, so does the sweepback angle of the wings. At peak performance, they are tucked back alongside the fuselage and drag is at a minimum.

But the transition from biplane to sweepback has been paralleled by other changes much less obvious. To talk about them, we have to go to some basic aerodynamics (see *Airfoil and Airflow Interaction*, page 64). Aeronautical engineers spend the better part of a college year learning about this general subject, so don't expect a complete treatise here. You have to take some of this on faith—like the Wrights did.

If you slice through any modern wing you get a cross section shaped like an elongated teardrop—rounded at the front, pointed at the back, and curved more on the top than on the bottom. That airfoil section has evolved subtly over the

(Please turn to page 143)



Wrights' aircraft on beach at Kitty Hawk. Impact of their success coupled with the formidable array of patents they were to file actually served to "freeze" aircraft design for a number of years. The development of ailerons was at least in part a way of superceding the Wrights' patented wing-warping system.

Steel tire chains are manufactured for all popular passenger-car tire sizes; cost between \$20 to \$40 a pair.



When it hits again this year... KNOW HOW TO GO IN SNOW!

During the first days of any bad snowstorm, the only vehicles moving are those with tire chains.

by Bill Hartford
AUTO EDITOR

Snowbound in a toasty warm cabin, rubbing noses with your favorite movie star . . . it's a nice fantasy. But if you've got to be into your long johns and out on your appointed rounds—which is more likely the case—you must know a few things about going in snow.

Yes, it's cold and wet, and it can stop you dead in your tracks—especially if your tracks are not in the shape of snowshoes. Dog sleds, snowmobiles, maybe skis and snowshoes will take you to town, if you've got the stamina—and/or the dogs—but if you take the family car, and the family car is not a four-wheel-drive Jeep, then you'd better own a pair of tire chains and know how to use them.

Old gramps didn't worry his head

over radial snow tires; studs or no studs; all-weather, all-season sticky rubber or any other new-fangled gimmicks. He just put on his chains and went. You can't beat their bite for pulling and stopping. Steel-link tire chains are vicious as piranhas when they attack ice or snow. How much better are they than regular, snow or studded tires? See the charts on the opposite page.

Tire chains get their wicked grip from 12 or 13 cross chains that run across the treads (like radial plies) every several inches. The best of these cross chains have each link reinforced with a bar or lug, and it's this type that gives the best bite of all. The lugs, called V-bars on American Chain Co.'s Weed brand chains, are what really dig into the snow and ice. On dry pavement with your chains on, it's the lugs or bars that contact the surface, and they have to wear away completely before the links of cross chains even begin to wear. So they cost a little more than standard or twist-link types, but longer life and better bite make them worth it.

A pair of chains for the drive wheels of your car run between \$20

and \$40, depending on your tire size—the larger the tire, the greater the number of links required and hence the higher the price. Slightly cheaper than steel-link chains are plastic traction treads. They're not as effective as steel, but they're lightweight, easier to handle and quieter on dry pavement. Both types eventually need repair and all manufacturers offer replacement cross-links and treads. Auto accessory stores carry tire chains from one or more of the manufacturers listed on the opposite page.

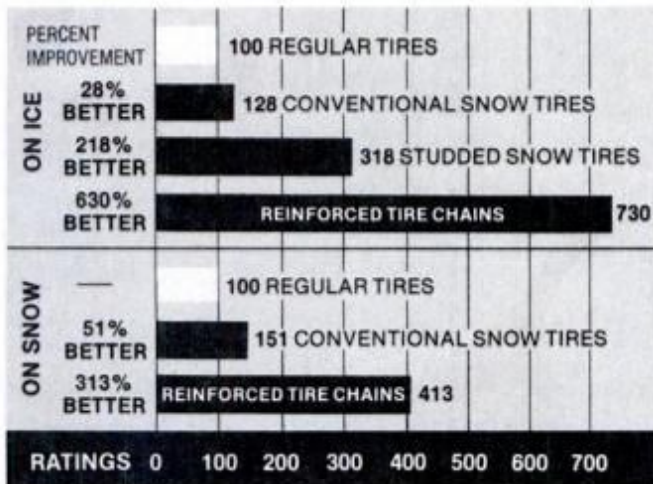
We still haven't mentioned the one thing about tire chains that didn't faze grandpa, but does faze us—putting them on. Like anything else, though, do it once, and you'll find it's no big deal. You'll quickly become able to install them at the drop of a flake. If you don't want to jack up your car, see the photos opposite.

There. Maybe this year when the first big snowstorm hits, you'll just settle in and enjoy it. But if there's an emergency you'll know that—with chains—you'll be able to get through. **PM**

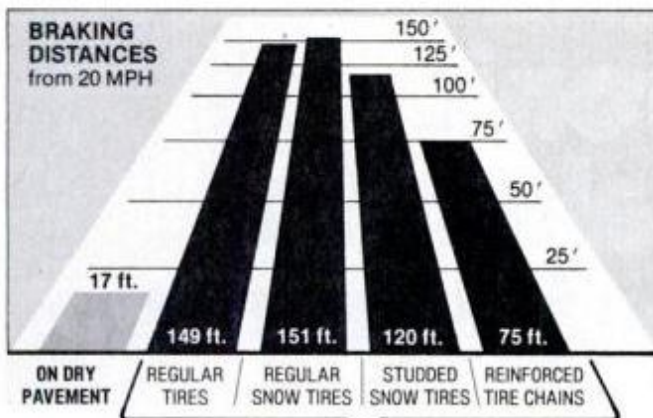
Starting and pulling ability



Checking pulling power with strain gauge in NSC tests.



Pulling ability of regular tires versus snow tires, studded snow tires and reinforced tire chains is compared above. The data, presented by the Safe Winter Driving League, were from tests conducted by the National Safety Council (NSC) at Stevens Point, Wisc.



On glare ice at 25° F., stopping distance of a car with reinforced tire chains is half what it would be if the car were shod with regular snow tires. Data dramatizes the fact that this winter the way to go—and the way to stop—is with tire chains.

TIRE CHAIN MANUFACTURERS

Steel-Link Tire Chains

American Chain & Cable Co., Inc., 935 Connecticut Ave., Bridgeport, Conn. 06602.

Campbell Chain Co., 3990 East Market St., York, Pa. 17402.

Nixdorff-Lloyd Chain Co., Dept. T, 1416 East 8th St., Winona, Minn. 55987.

Teledyne McKay, 850 Grantley Rd., York, Pa. 17405.

Western Chain Co., 1816 Belmont Ave., Chicago, Ill. 60657.

Cable Chains

Champion Cable & Chain Co., Box 162, Swanton, Vt. 05488.

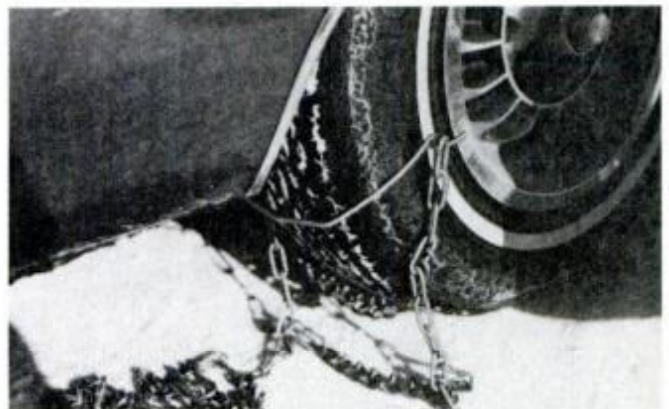
Elastomeric traction treads

Detwiler Corp., 36 New York Ave., Westbury, N.Y. 11590.

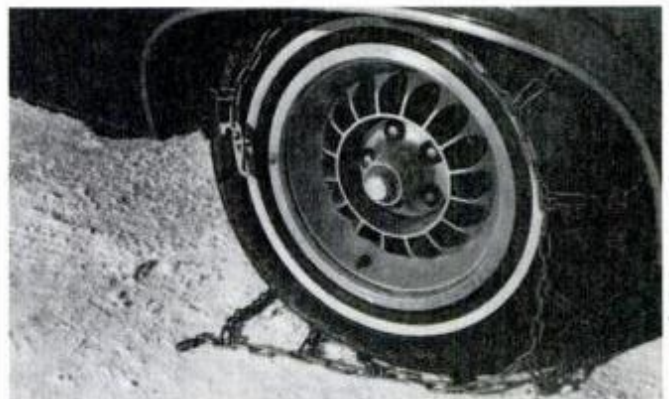
Putting on chains without a jack



1 Lay out chain flat and straight behind car. Cross-chain hooks should face up and, with reinforced chains, lugs should face up so they'll contact road.



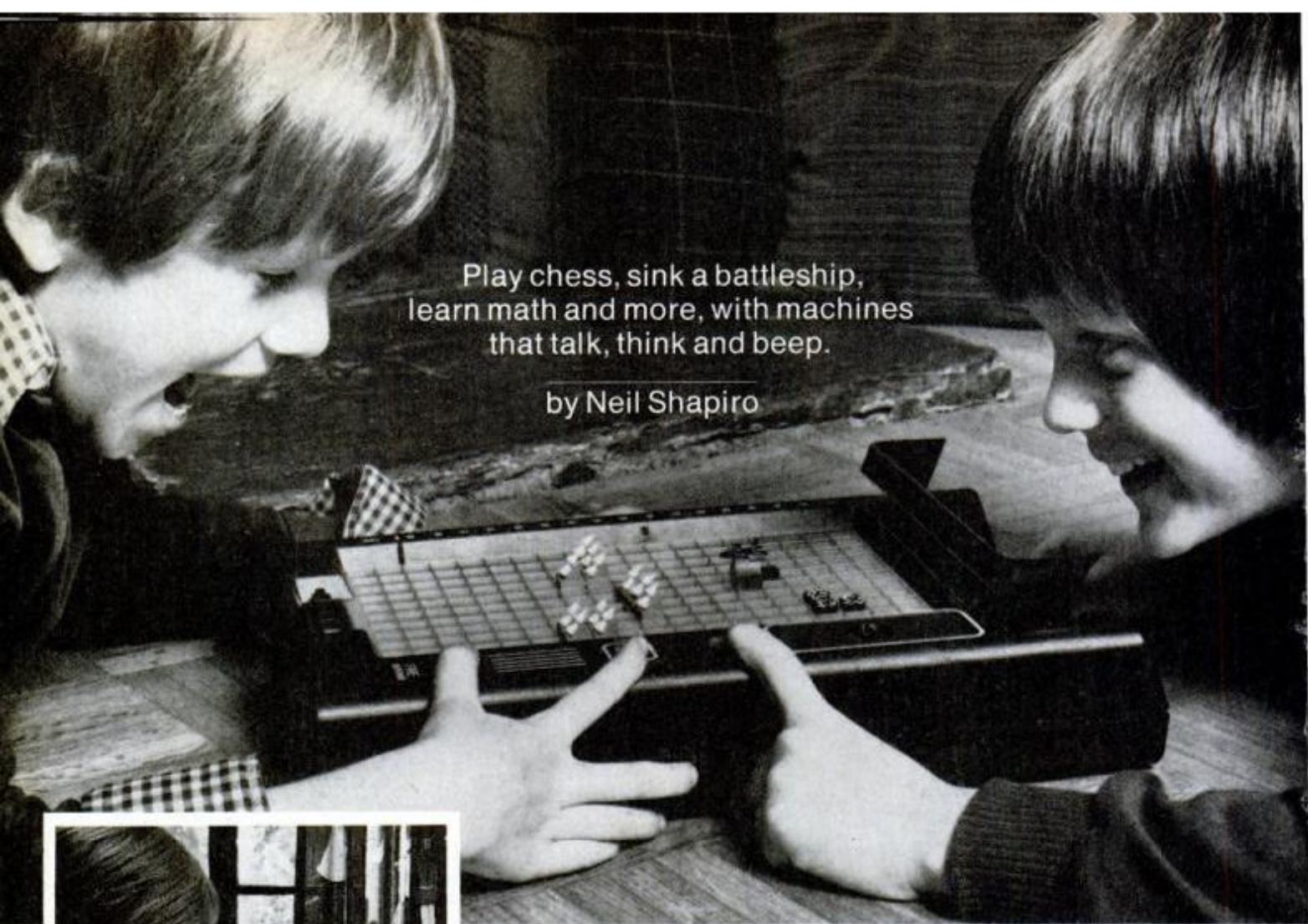
2 Gather chains behind wheel, attach end links on spring steel chain applier and slip applier onto the tire.



3 Drive car forward until applier is back to its starting point; the chain will now be wrapped around the tire.



4 Remove applier, fasten inner lock first and then the outer lock into the proper links for a nice, snug fit.



Play chess, sink a battleship,
learn math and more, with machines
that talk, think and beep.

by Neil Shapiro

The game of Intercept from Lakeside allows everyone the thrill of tracking and shooting down enemy aircraft, complete with realistic noises and lights. Retail at \$30.



2-XL is the name of this robot from Mego. While he is not a computer, 2-XL uses aspects of computer programming. His replies are dictated by sequence of an eight-track tape's tracks. 2-XL sells for \$60.

Electronic funmakers for up-to-the-minute gift giving

Computers can be a ball, as many owners of video games already know. But only recently has computer technology been applied to other areas in the traditionally nonelectronic field of toys and games. A few years back, it would have been ludicrous even to think of designing a toy based on a computer. It would have cost thousands of dollars and been bigger than the child.

A process referred to as Large Scale Integration has recently made it possible to fit as many as 20,000

transistors into a package (called an integrated circuit or "chip") no larger than a matchbook. The result: new miniature electronic gadgets of all sorts.

Programmable playmates

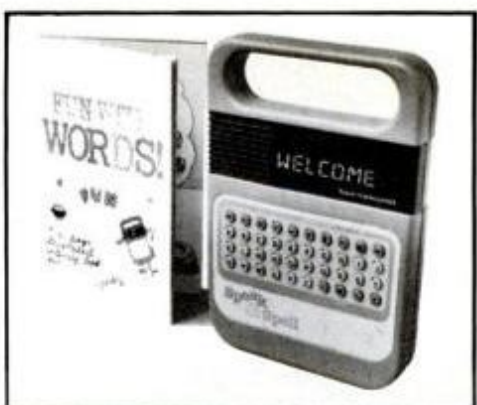
The tiny, programmable computer made its debut with video games, and the game of Pong paddled its way across America's TV sets. What was lacking, until now, was a low-priced, nonvideo way to use this technology.

The difference between an everyday, four-function calculator and a computer is programmability. The difference between a traditional game and one of the new computer-controlled ones is also programmability.

When you program a game, you are telling its on-board computer how to play. Whether the game or toy just adds sound effects to otherwise normal play, or is sophisticated enough to play a challenging game of chess against a human opponent,

Playskool's Alphie (upper photo below) is a computer playmate. He can sing songs, then—with the change of a card—play a game and even give matching tests. Alphie is a good example of programmed nature of these new computer toys. Sells for \$20.

Boris from Chaffitz (bottom photo) is a sophisticated computer capable of playing an excellent game of chess against an average player. He'll let you play black or white and at different degrees of complexity, acts as a teacher, sells for \$300.



Comp IV from Milton Bradley is a number guessing game with four levels of difficulty. Price is no secret—about \$30.

Speak and Spell from Texas Instruments is a new advance, will actually speak a word to be spelled by the child. About \$55.



Battleship from Milton Bradley computerizes the graph-paper game, keeps track of hits and misses, makes bomb noises and flashes lights. Price: \$35.



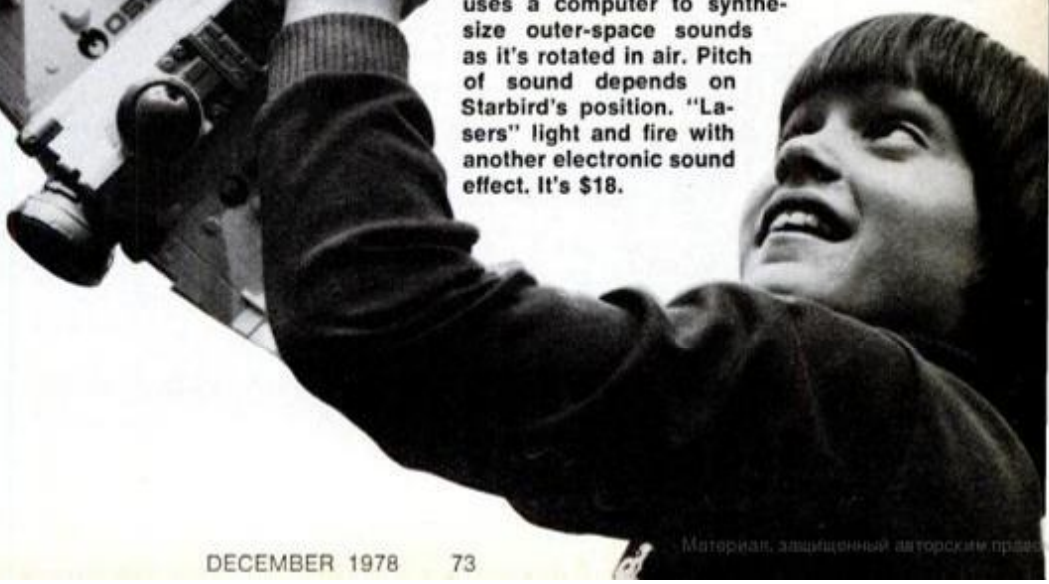
Starbird, a Milton Bradley toy, uses a computer to synthesize outer-space sounds as it's rotated in air. Pitch of sound depends on Starbird's position. "Lasers" light and fire with another electronic sound effect. It's \$18.

it is no longer a static device, but a playmate.

Milton Bradley's Comp IV was one of the first entries into this field by an established game company. Comp IV randomly decides on a number. The person playing guesses the number, the Comp IV gives clues as to how close each guess comes. This continues until the number is guessed or the human gives up.

Milton Bradley wondered if they

(Please turn to page 140)



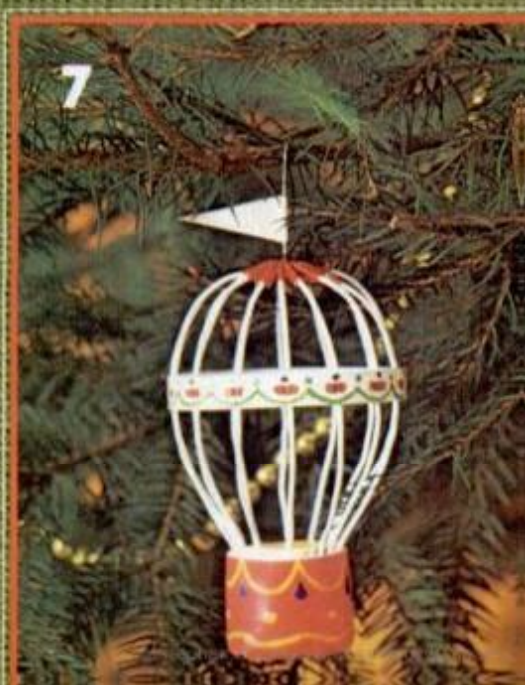


14 SPARKLING CHRISTMAS



Fill your home with the spirit of Christmas. Deck the house with PM's Christmas decorations—we've included a complete materials list and step-by-step directions for making all the decorations shown here.

Our design collection ranges from traditional, brightly colored and highly polished wood projects to contemporary designs made of clear plastic. You can try your hand at molding and



3



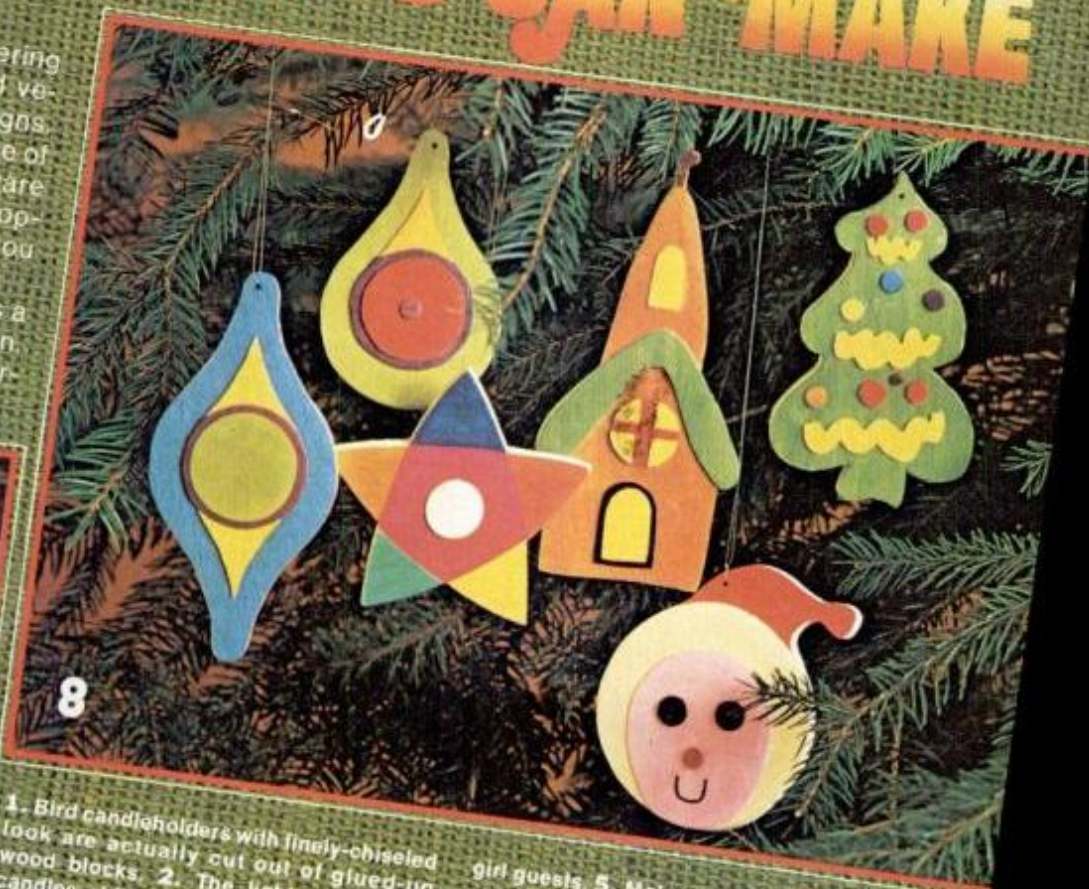
4



DECORATIONS YOU CAN MAKE

of plastic, shaping and soldering
and applying colored wood veneer
to make these holiday designs.
Many of the ornaments are made of
common household items, hardware
and balsa wood. Refer to the Shop-
ping Guide in this story for items you
may have trouble getting locally.
Crafting your decorations is a
great way to begin the holiday season.
These items can become heir-

8



1. Bird candleholders with finely-chiseled
look are actually cut out of glued-up
wood blocks. 2. The light of a dozen
candles shines from this contemporary
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crafted of colored veneer overlays on
plywood backing.



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9. Hang these colorful, old-time toys—ball and cup, tops, zizzer—on the tree. Give them to young guests as welcome gifts. 10. Although these ornaments have the look of antique glass, they're of casting resin poured into plastic tubing. 11. Make these cookie cutter shapes in an afternoon. They can be used for baking holiday

cookies before hanging. 12. Sparkling minitree is made of sheet acrylic and circles of prismatic film. 13. Santa moves in all directions at Christmas. PM's Santa window hanging is carved on a plexiglass disc. 14. Make this pine bough window hanging by pouring casting resin into a pie tin in layers sandwiching embedded objects.

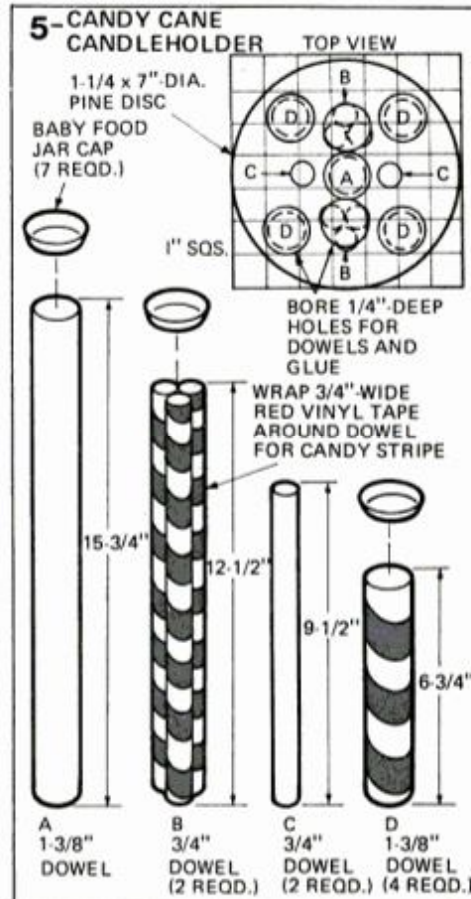
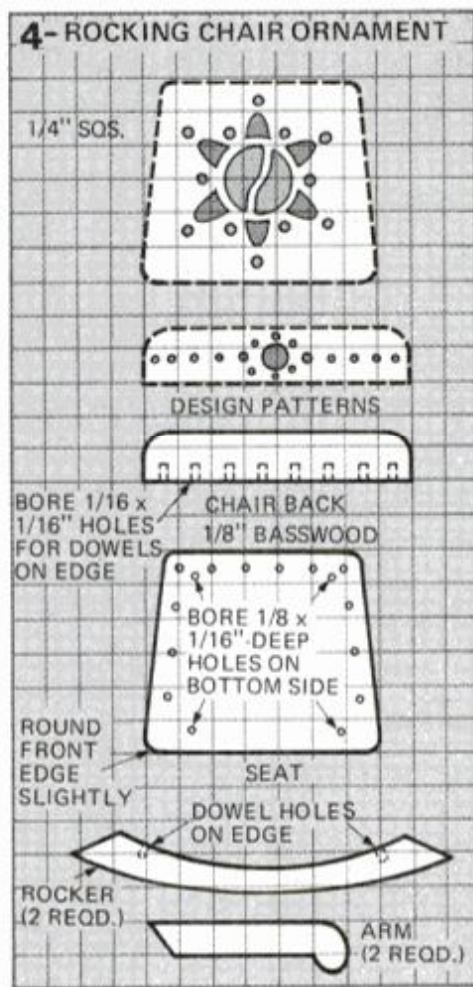
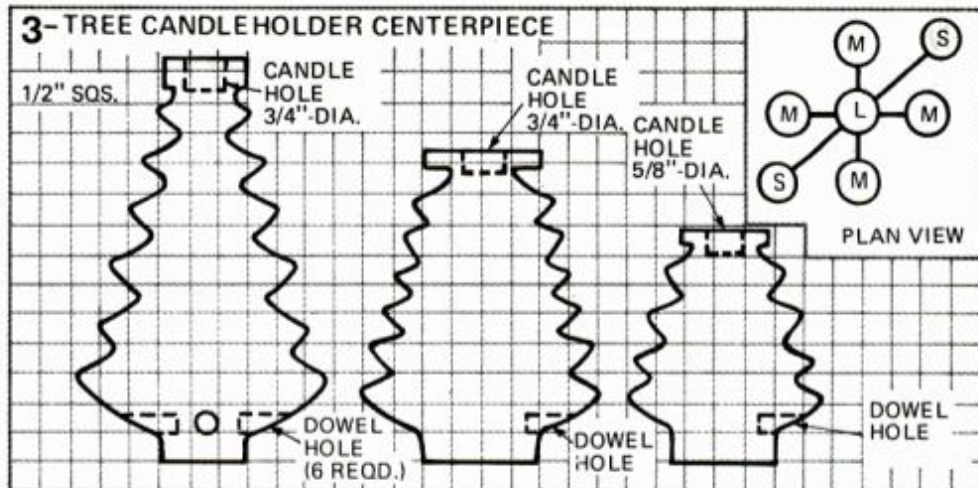
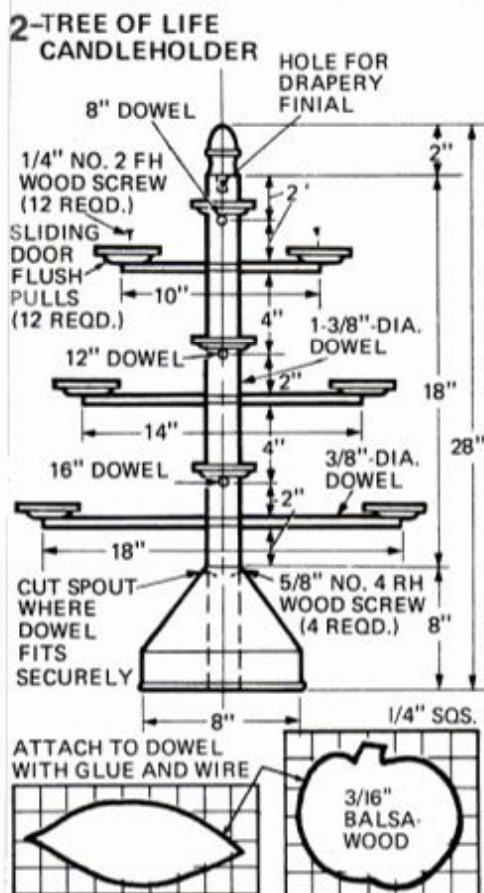
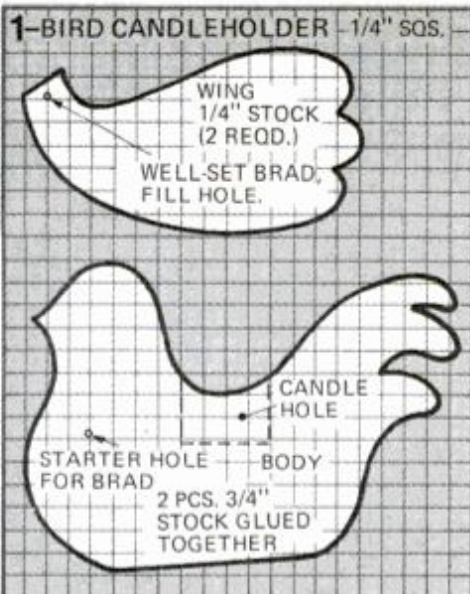


13



14

looms and be passed from you children, to their children and so on. **General painting directions** You can achieve a high-contrast, antique look on painted wood with this technique: Sand the finished project by starting with number 100 paper and working up to



a lathe-turned project, you can sand the item while it spins on the lathe at low to medium speed.)

Thoroughly dust, wipe with a tack rag and apply two light coats of Krylon Clear (No. 1301) spray. Or seal with one coat of 3-lb.-cut white shellac thinned 50 percent with denatured alcohol. Rub lightly with 220-grit paper between coats. Dust, wipe with tack rag.

Apply a prime coat of Krylon All-Purpose White (No. 1315) spray primer, or prime with a pigmented shellac such as BIN. (Note: If you use the latter, the sealing step mentioned above can be eliminated.) Lightly sand with 220-grit paper, dust, wipe with tack rag. Then spray on a coat of enamel, dry thoroughly, sand lightly, and spray on a final coat.

1. Bird candleholders

Materials for each bird: 1/4x2x3 3/4-in. piece of lattice for each wing; 2 pieces 3/4x4x5-in. stock glued together for body; 7/8-in. brads, white glue, plastic wood filler, sealer, primer, Krylon antique white spray enamel (No. 1503).

1. Cut 3/4-in. stock to length; glue up pieces for body. Apply glue sparingly to mating surfaces; expose to air for 30 seconds, press parts together. Clamp immediately, dry overnight.

2. Trace body from pattern above, cut out, sand all edges.

3. Trace and cut out wings. Locate entry point for brads. Nip off head of a brad one size smaller than the 7/8-in. brads used and use it to bore pilot holes for the attaching brads in the wings and body. Sand parts smooth, dust, wipe with tack cloth.

4. Bore candle hole.

5. Sand parts smooth, dust and wipe with tack cloth.

6. Seal, prime and spray paint according to general painting directions.

7. When paint is dry, affix wings to body with glue and brads. Support wings if necessary until glue dries (overnight).

8. Fill brad holes with plastic wood filler, let dry and sand smooth. Touch up with paint.

2. Tree of life candleholder

Materials: heavy duty funnel; 1 3/8-in. dia. dowel; 3/8-in. dia. dowel; 3/16-in. balsawood; light-gauge wire; drapery finial top; 4, 5/8-in. No. 4 rh wood screws; 12, 1/4-in. No. 2 fh wood screws; 12 sliding-door flush pulls; white glue; sealant; primer; white, red and green spray enamel.

1. Cut funnel as required. Bore four holes

Project designer/builders: Nos. 1 and 3, Stan Dunaj and Harry Wicks; 2 and 7, S. Dunaj; 4, Penelope Angell and S. Dunaj; 5, Doug Eisman; 6 and 12, Rosario Capotosto; 8, S. Dunaj and William Profet; 9, Dick Schnacke, H. Wicks, P. Angell, S. Dunaj; 10 and 14, Bettina Rybicki; 11, P. Angell; 13, D. Eisman and B. Rybicki.
PM color photos: Harry Hartman.

through funnel equally spaced near the top opening. Cut 1 3/8-in.-dia. dowel to size and position in funnel. Mark entry position for four screws to secure funnel to dowel. Bore holes in funnel and dowel and attach screws.

2. Mark and bore holes in large dowel for smaller dowel branches. Cut dowel branches and bore small holes in them at random to later attach wired leaves and apples. Leave room at ends for door pulls to hold candles.

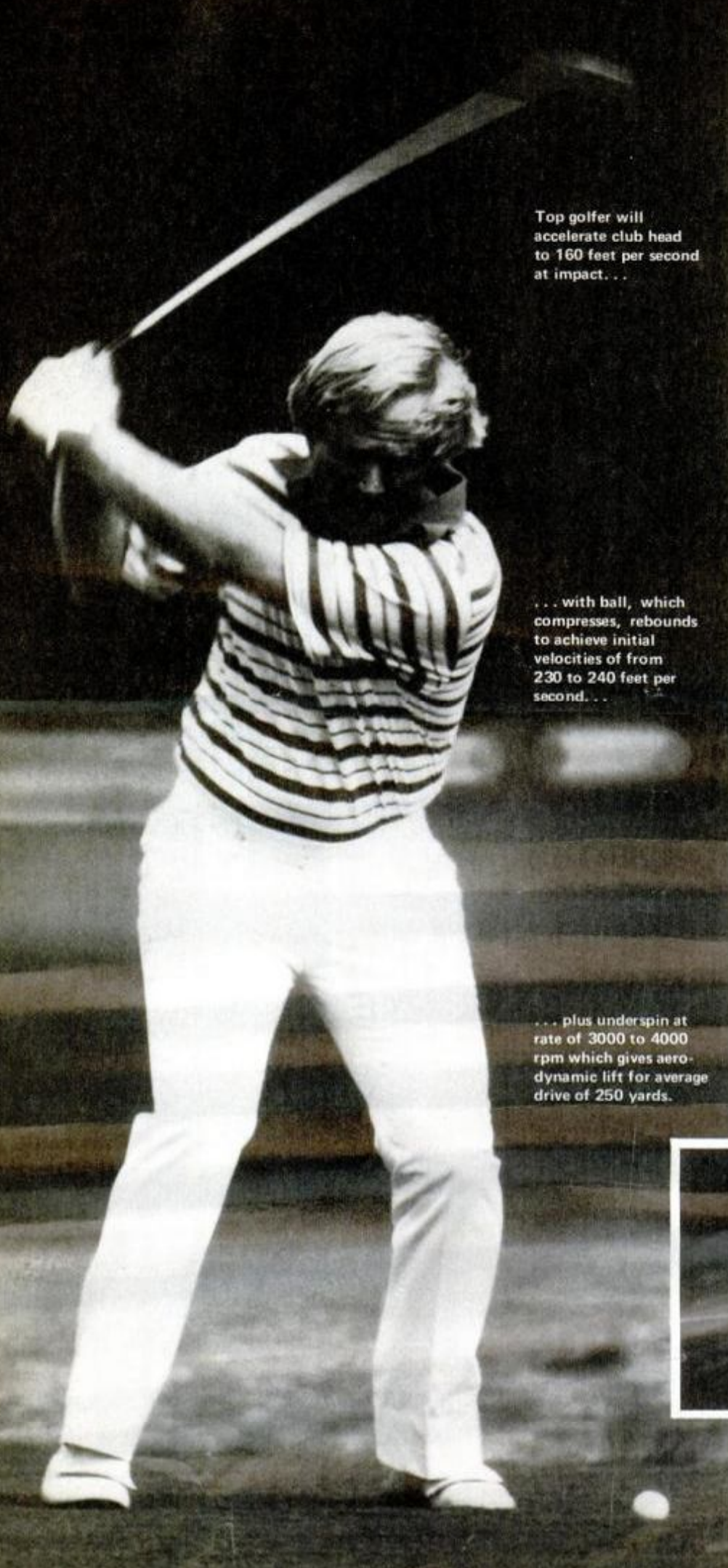
3. Bore holes for screws to attach door pull candleholders; slide branches in place and glue. Attach door pulls.

4. Bore hole and attach finial.

5. Seal, prime and paint tree white as explained in general painting directions.

6. Cut apples and leaves out of balsawood. Make a small hole for attachment wire with an

(Please turn to page 116)



Top golfer will accelerate club head to 160 feet per second at impact...

... with ball, which compresses, rebounds to achieve initial velocities of from 230 to 240 feet per second...

... plus underspin at rate of 3000 to 4000 rpm which gives aerodynamic lift for average drive of 250 yards.

Some golf balls 'fly' better than others. Some aren't even sporting. PM tells you how to spot 'em—and how not to get hustled by the ball.

During the better part of a millennium that men have been flailing away at round objects with long-shafted bludgeons and calling it a game, it has occurred to any number of players that the tools involved in this pursuit—this golf—could be improved. And over the centuries they have been: The modern golf club evolved from a simple crooked stick; today's ball from a handful of feathers sewn inside a leather covering.

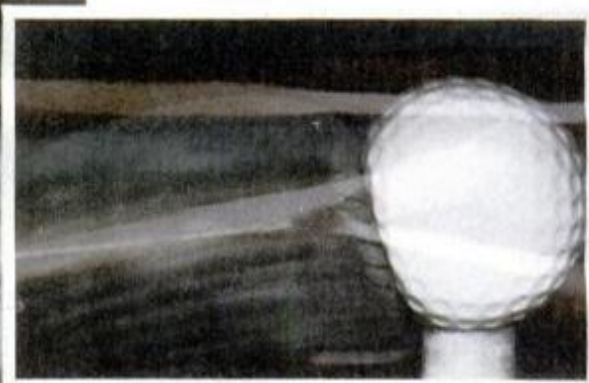
Along the way, however, these technological advances have been carefully monitored by organizations that have come to be recognized as golf's governing bodies. Situated respectively in the United States and Great Britain, they are the United States Golf Assn. and

GOLF'S

something called the "R and A"—meaning the Royal and Ancient Golf Club of St. Andrews, Scotland.

Acting more or less in concert since the turn of the century, the executive committees of these organizations have been primarily concerned with keeping the traditions—including equipment—of a gentleman's game intact.

Innovations that would radically change the physical possibilities of golf have been systematically disapproved by the USGA and St. Andrews. Among them were center-shafted clubs (1904), pitching clubs



Inertia power: Ball radically compressed by impact has still not left tee. Heavy hitters favor high-compression balls, but manufacturers' compression ratings do not accurately reflect a ball's coefficient of restitution—its reboundability.

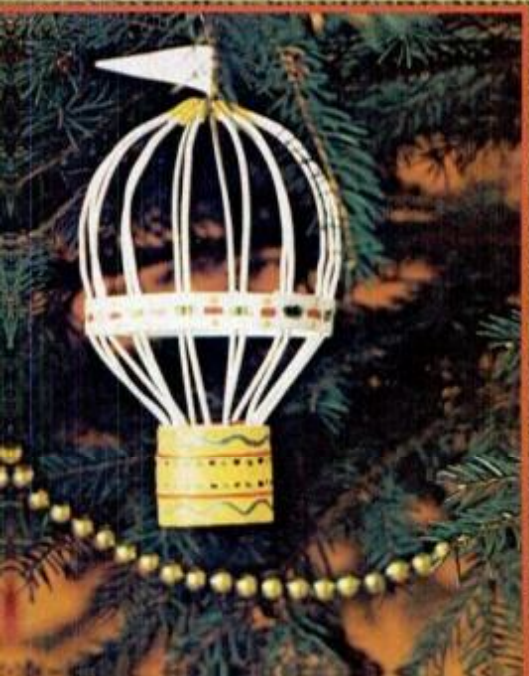
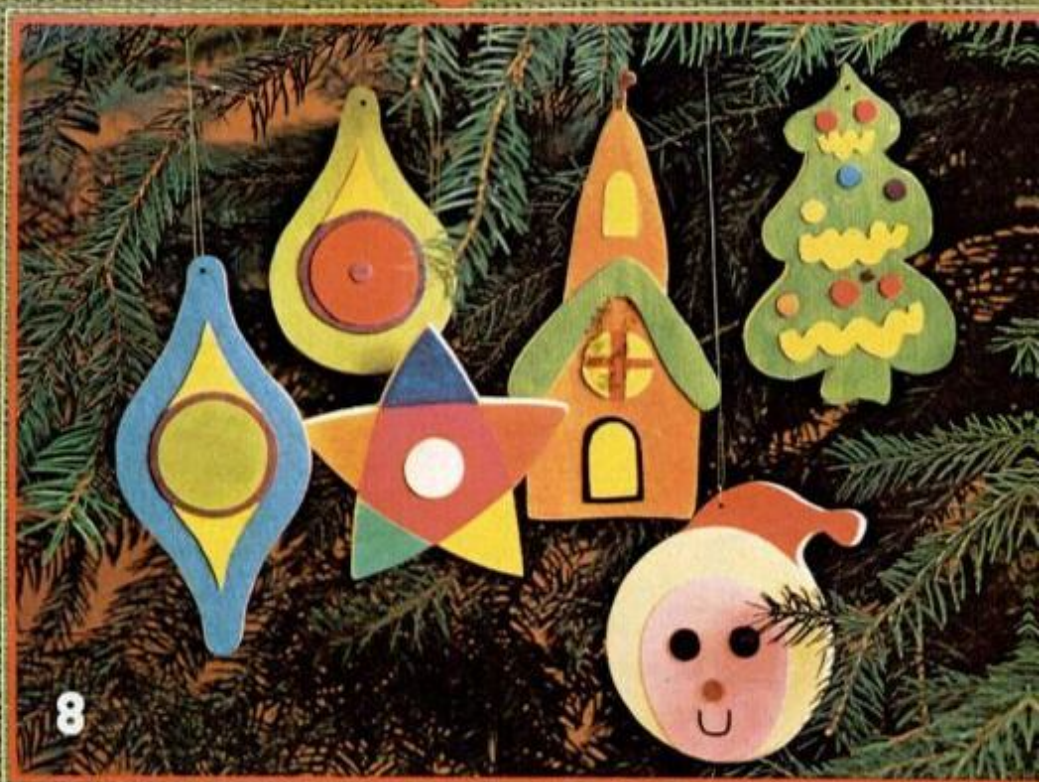


DECORATIONS YOU CAN MAKE

carving plastic, shaping and soldering tin and applying colored wood veneers to make these holiday designs.

Many of the ornaments are made of common household items, hardware and scrap wood. Refer to the Shopping Guide in this story for items you have a problem getting locally.

Handcrafting your decorations is a great way to begin the holiday season. Many of these items can become heir-



1. Bird candleholders with finely-chiseled look are actually cut out of glued-up wood blocks. 2. The light of a dozen candles shines from this contemporary tree of life made of dowels, balsawood and hardware. 3. Centerpiece consists of pine trees turned on a lathe. Link them together by dowels—or use them separately. 4. Brightly painted rocking chair ornaments are thoughtful gifts for little

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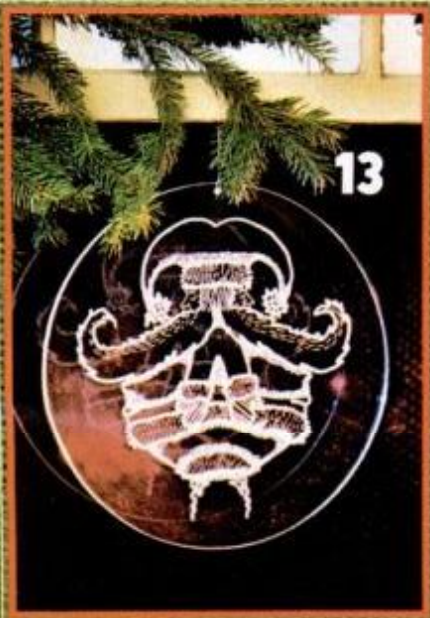
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9. Hang these colorful, old-time toys—ball and cup, tops, zizzer—on the tree. Give them to young guests as welcome gifts. 10. Although these ornaments have the look of antique glass, they're of casting resin poured into plastic tubing. 11. Make these cookie cutter shapes in an afternoon. They can be used for baking holiday

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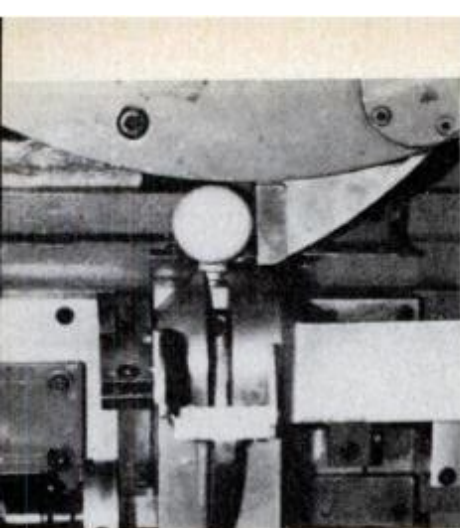
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looks and be passed from you to your children, to their children and so on.

General painting directions

You can achieve a high-gloss lacquer look on painted wood projects with this technique.

Sand the finished project smooth, by starting with numeral 120-grit paper and working up to 180-grit. (On



Wedge-like projection on flywheel of Illinois Tool Works machine imparts a standard impact force to balls that fly through photocell speed course in USGA test for maximum initial velocity of 255 feet per second (about 170 mph). USGA average distance maximum of 280 yards (flight plus ground roll) is tested by club-swinging machine known as "Iron Byron" (right) that hits a perfect shot every time. Some 5000 golf balls are tested annually.



SECRET WEAPONS

with deep-slotted faces (1924) and any club with a concave face (1931)—most of these, incidentally, after someone had introduced them in tournament play and won.

"Disapproved" means that the item is not sanctioned for tournament play under USGA rules, but it also implies that members of the USGA-affiliated golf clubs should not regard it as a properly sporting piece of equipment. It does *not* mean that you can't buy it on the market. You can, and, since gentlemen's games are occasionally played for money, some people do.

Rarely, however, would a golfer invest in a set of expensive clubs that is not USGA-approved. The deviation is usually fairly obvious, for one thing. Inventors submit literally thousands of golf club ideas for approval each year. Only about 50 of them on the average, guesses USGA technical director Frank Thomas, are original. Of these, few ever win approval.

"We're simply concerned with preserving the game," says Thomas. "The rules clearly state what is allowable and what isn't."

But when it comes to golf balls, the situation is somewhat different. A box of "special" balls is a minimal expense for a golfer who needs an edge, for whatever reason. The ball

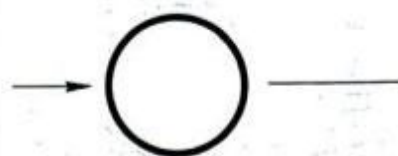
may be indistinguishable from among the 97 different balls which are currently approved for USGA tournament play—unless someone bothers to check.

The modern golf ball may have a liquid or solid core, over which rubber thread may be tightly wound or material may be built up in hemispheres (two-piece construction). The covering may be balata, a natural gum, or Surlyn, the inevitable cutproof du Pont synthetic. Its maker may rate its compressibility, on an arbitrary but commonly accepted index, at anywhere from about 60 (most compressible) to 100 (most firm). Because of the known aerodynamic advantages of a roughened surface (see box at right), golf balls are always "dimpled" with a regular pattern of anywhere from 252 to 336 surface depressions.

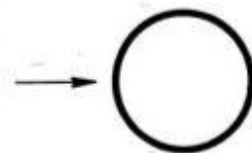
However it is made, to be eligible for USGA approval a golf ball can be no more than 1.68 inches in diameter and must weigh no more than 1.62 ounces. Additionally, when tested on an impacting device developed in 1941 by Illinois Tool Works (shown in photo above), its initial velocity must not exceed the USGA limit of 255 feet per second.

In 1976 the USGA came to feel that its initial velocity standard, after 25 years, was no longer suf-

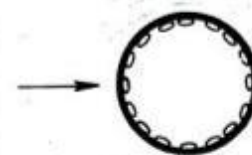
Golf ball aerodynamics



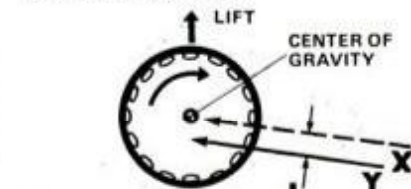
A. Smooth ball, idealized airflow



B. Smooth ball, actual airflow



C. Dimpled ball, no spin



D. Dimpled ball, spinning

Centuries ago, golfers had to reluctantly accept the fact that a scuffed-up leather ball went farther through the air than a smooth, new one.

The idealized laminar airflow (A) which was presumed, does not exist. Instead, flow around a smooth sphere breaks away violently (B) to form whorls and eddies that result in aerodynamic drag. Surface roughness prohibits laminar flow, replacing it with turbulent flow (C) that does not adhere to the ball and produces a smaller wake with much less drag.

Spin provides lift

When ball is impacted (D) by a club whose center of effort moves directly in line with the ball's center of gravity (X), no spin results. This is hardly ever the case, since most golf shots impart a spinning moment by acting through a line (Y) that is a certain distance (L) from the ball's center of gravity.

When the rough-surfaced ball spins, airflow is accelerated (low pressure) on one side and retarded (higher pressure) on the other. The ball will always move—rise, fall, hook or slice—toward the low-pressure side.

With average spins of 3000 to 4000 rpm resulting from tee shots, golf balls are aerodynamically "alive," and the dimple configuration—particularly depth-to-diameter ratio—is critical.

ficient. One reason is that a ball can be constructed with more of its mass farther from its center so as to store more impact energy, like a flywheel, in the form of spin. And spin, with a golf ball's dimpled surface, imparts lift. So two years ago the USGA published a total distance standard.

Thus, an approved ball must not have a carry-and-roll exceeding 280 yards, on the average, when hit by a mechanical club-swinging device (photo on page 79) onto the USGA's meticulously groomed, precision-leveled test fairway near Far Hills, N.J.

Obviously a "hot" ball, one deliberately made to come off the club-head at speeds greater than the 230 to 240 feet per second that pros achieve with their drivers, could give even an average golfer a big advantage over his equal playing an approved ball. When cannonball drives rocket out of a mediocre swing, something's awry. "Golf hustlers clam up when you mention this ball" reads the straightforward ad for one mail-order firm selling nonapproved balls.

Even after 1976, it was possible to come up with a golf ball that met all the USGA criteria then extant and still played better. Polara Enterprises, a California company, began producing a golf ball that offered a different sort of advantage: Hooks and slices—the side-spin that pulls a shot away from the fairway and out of the money—could be corrected in flight.

The idea was sophisticated; the execution simple. By arranging several rows of deeper dimples equatorially around a golf ball, it can be made to "seek an axis" as it flies through the air. Does the Polara ball work? "You can see it correct itself," one pro told PM. The USGA confirmed it last year by ruling the Polara ball not acceptable for tournament play.

Polara has since filed suit against the USGA. Meanwhile, USGA's requirements now include the following: An eligible ball must have "equal aerodynamic properties and equal moments of inertia" around every axis. So much for in-flight correction.

"There are any number of ways to make golf easier," comments USGA's Frank Thomas, "but then it wouldn't be golf, would it?"

Does it mean that all accepted golf balls are the same? "Not at all," Thomas says, "since knowledgeable golfers are playing different balls for different conditions—

(Please turn to page 124)

Dee-fense! An architect's view

The pro attacks, the architect defends," says Robert Trent Jones, dean of golf course architects and, in his 70s, still professionally active.

With longer hitters using better equipment on the pro tour, golf courses could soon become outmoded if Jones and fellow course designers didn't build in a certain amount of flexibility. One way is to situate the tee areas so they can be moved back, extending the initial driving range by as much as 40 yards. Trent Jones did this at his neighboring resort courses of Dorado Beach and Cerromar Beach in Puerto Rico, where PM recently went to talk to him about golf course architecture.

Trent Jones's 13th hole on the East Course at Dorado Beach (diagram below) is one of his personal favorites and is considered a classic by many who have played it. A dogleg that forces a golfer to choose a strategy before hitting the ball, it remains as much a challenge today as it was on completion 20 years ago.

For example: A player choosing pattern "A" can get to the green on this par 5 hole in two strokes—but he will have to have played two superb golf shots consecutively, both over water hazards. Patterns "B" and "C" offer a safer drive down the fairway off the tee (with no hope then of reaching the green in two), with the "B" player leaving himself an easy shot to the elevated green (if his second shot is good enough), and the "C" player leaving himself the option of still easier play in four shots, with good chance for a par.

"It's a demanding hole, but a fair one," its architect told PM, after which he teed off into the Caribbean wind, which blows constantly at 15 mph or

better, roughly from the pin to the tee, and subsequently made par.

A scratch golfer himself in his younger days, Trent Jones says "rewards and penalties should be innate in all great golf holes." In order to provide this quality, golf course architects must immerse themselves in disciplines ranging from agronomy to hydraulics. Jones's Cerromar Beach course, for instance, is drained after rains by an intricate network of interconnected lagoons and two massive pumps that can each transfer 30,000 gallons of water per hour. Its 18th hole has a bunker (sand trap) that extends *completely across the fairway*, a unique feature that some golfers find bizarre.

"It's simple," says Robert Trent Jones. "Every golf course should have at least one controversial hole, and this is it."

Robert Trent Jones discusses the 13th at Dorado Beach with PM's Robin Nelson.

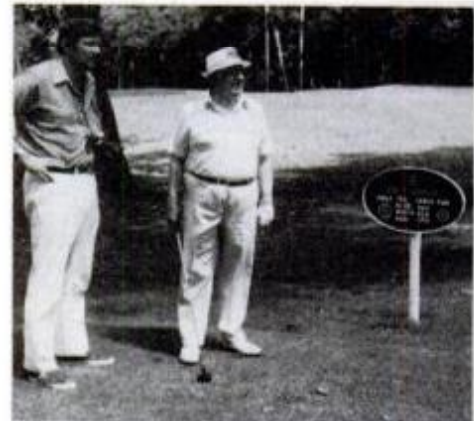
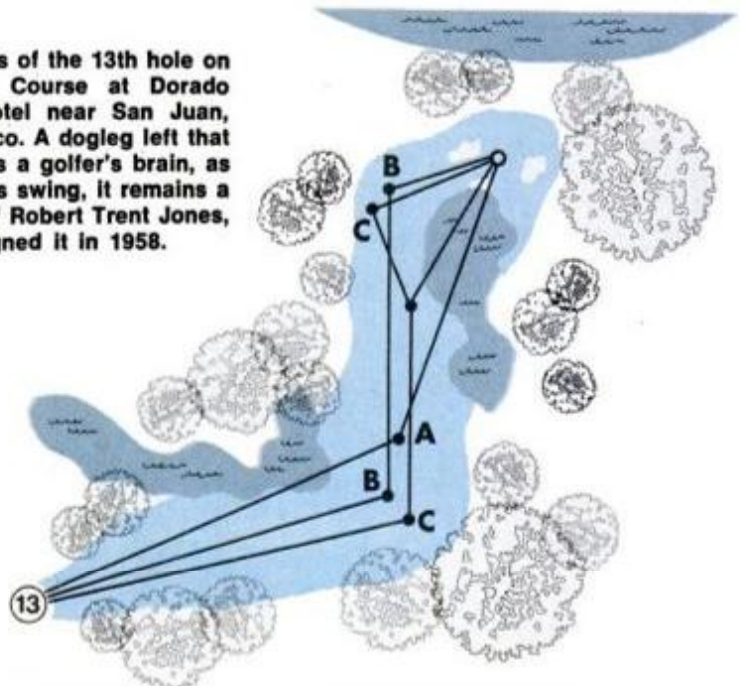
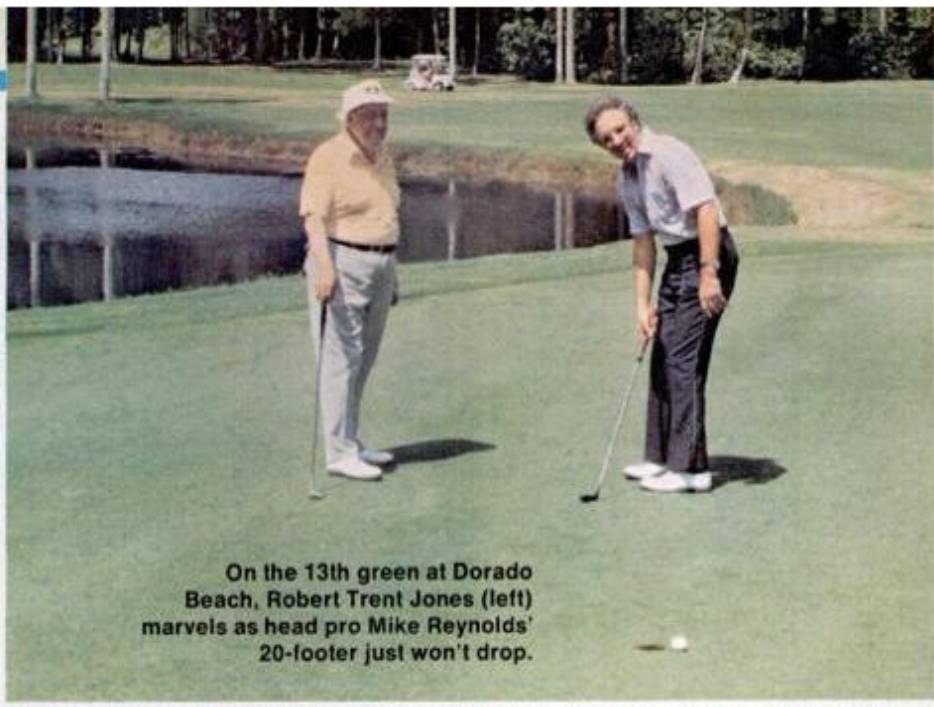
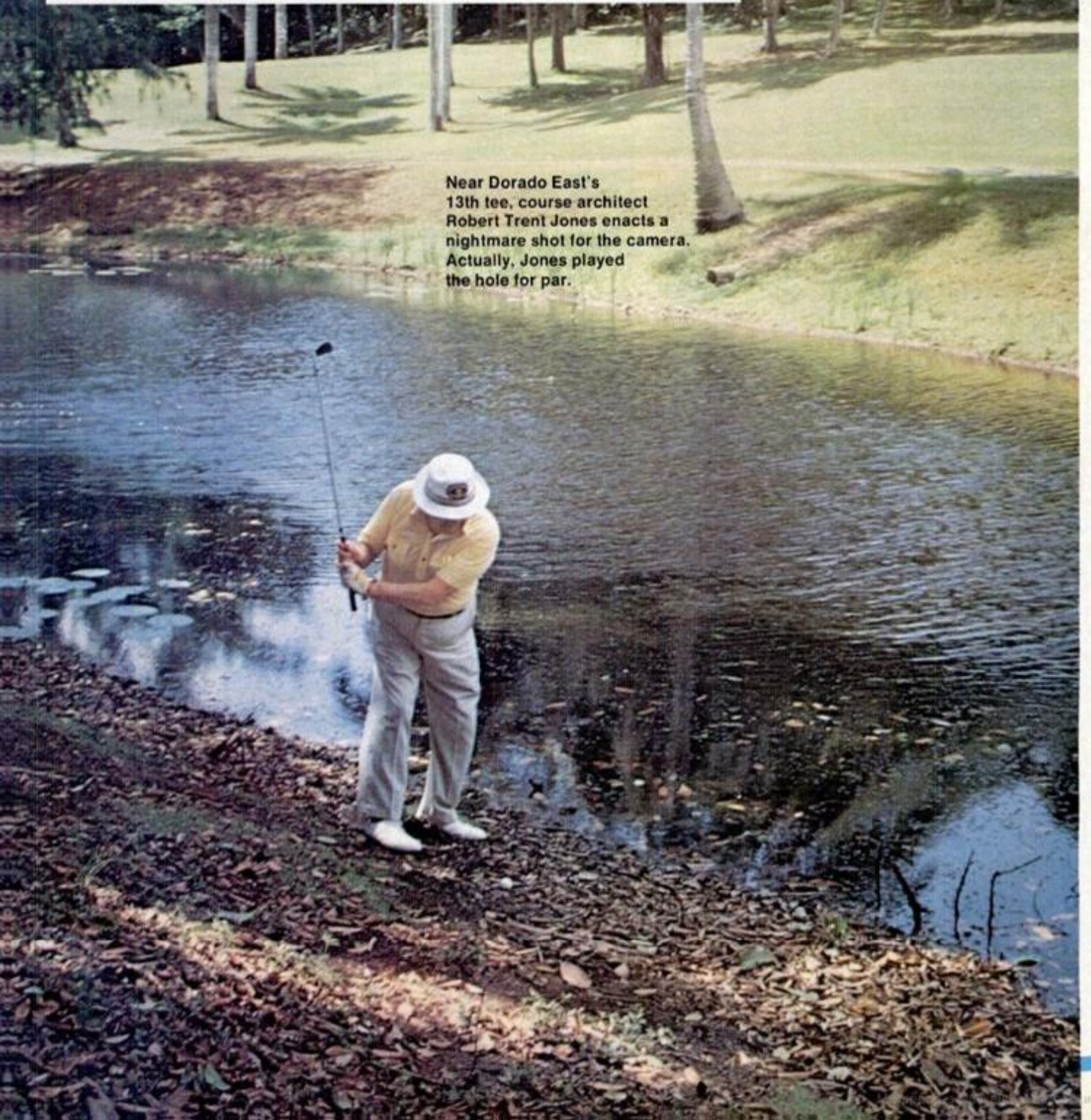


Diagram is of the 13th hole on the East Course at Dorado Beach Hotel near San Juan, Puerto Rico. A dogleg left that challenges a golfer's brain, as well as his swing, it remains a favorite of Robert Trent Jones, who designed it in 1958.





On the 13th green at Dorado Beach, Robert Trent Jones (left) marvels as head pro Mike Reynolds' 20-footer just won't drop.



Near Dorado East's 13th tee, course architect Robert Trent Jones enacts a nightmare shot for the camera. Actually, Jones played the hole for par.

New fiber that's better than the birds'

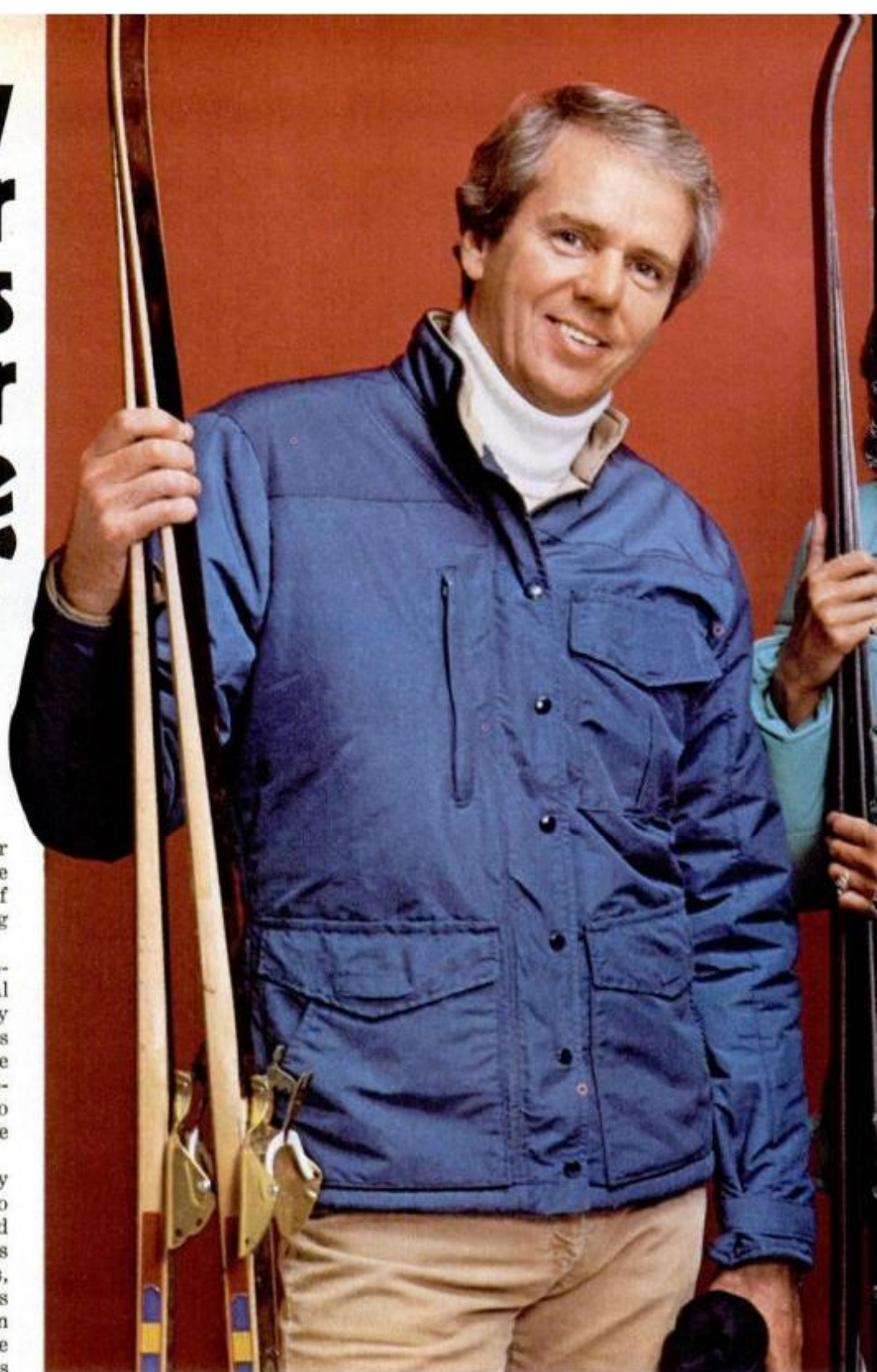
Lightweight insulation outperforms down.

by Bill McKeown
OUTDOORS EDITOR

First we learned how to fly higher and faster than a snow goose heading home. Now it looks as if we've found the secret of keeping warmer than a snow goose.

This winter the 3M Co. is introducing Thinsulate Brand Thermal Insulation which they claim is nearly twice as warm as down from ducks and geese or any present man-made imitation. 3M also seems to have upset some favorite theories of how to dress and look to keep comfortable when it's cold.

Today's fashionable fat-look may be the first to go. Kids sent out to play in the snow used to be layered with long underwear, heavy shirts and pants, sweaters, overcoats, scarves, mittens, caps and leggings until they looked like the snowmen they built. More recent trends have been towards bulking with less weight—puffy expedition vests and jackets, parkas and pants fluffed out with expensive down filling that lofts up to provide insulation and the look of membership in a Mount Everest assault team. But if a material had twice the heat retention properties of down, then clothing could be made with half the lofting thickness. And if a slim boundary layer of dead air might further increase insulating efficiency without bulk, stylish cold weather wear could be made for active outdoorsmen, particularly, that would not need all that extra thickness. Several companies that have tested 3M's new



In the lineup above, the jacket at left with 3M's new Thinsulate insulation has less loft bulk than the polyester-lined model in center or down-filled, quilted one at right. In the three lower photos, the jackets (in the same order as above) are recorded by an Aga Thermovision camera. The colors indicate the relative amount of heat loss, otherwise invisible to the eye. The greatest heat loss is in the white and red end of the spectrum; the least, in the blues and greens.

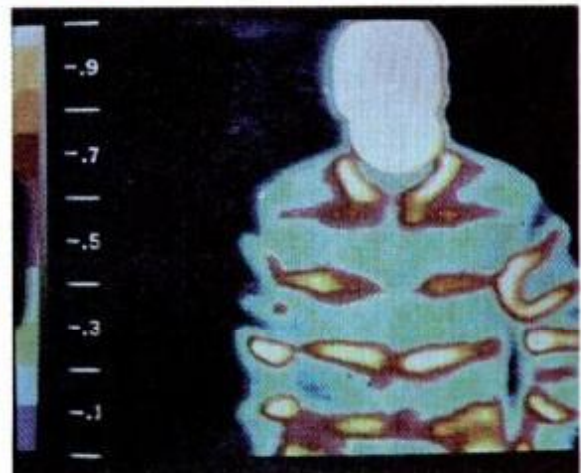
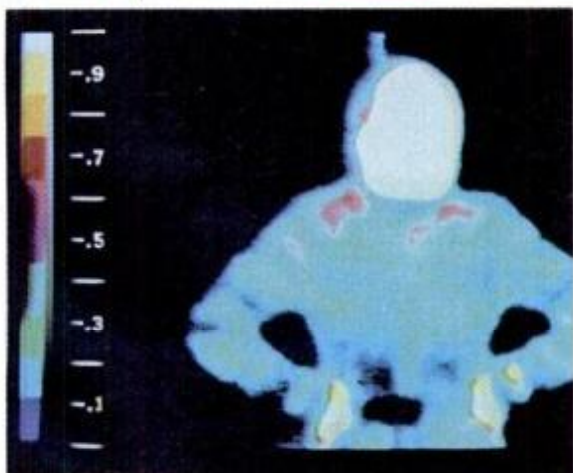


fiber are starting to market cold-weather gear using it. AMF-Head Sports Wear will introduce ski clothes with Thinsulate insulation this winter. Camp 7 and Sierra Designs have announced jackets. Grandoe has gloves and ski mittens lined with it.

Testing hasn't been easy. Airline baggage handlers in Minnesota were given unmarked gloves with and without the insulation to use all last winter as they loaded planes. Reports showed they often couldn't tell the difference between the new and old. Then the results were fed back through the computers based on days when the temperature really dropped. Suddenly the comfort reports came out in favor of the new gloves.

The product appeared to be good, but how good? How do you line up samples in a laboratory and run "comfort" tests that the competition will want to duplicate to check your claims? Not surprisingly, the experts at the U.S. Army Natick Research Insulation Evaluation Labs have developed measurement methods to provide numbers showing what uniform materials will keep troops warm and effective, if not cozy and happy. The measurement invented is the CLO (short for "clothing"), and is a unit of clothing insulation. A wool business suit worn at 68° F. has the rating of 1 CLO, a bikini may be .04 CLO, slacks about .44, shoes .03, a jacket .31 CLO. Since clothing does not produce heat but controls the normal escape of it, too many CLOs would cause heat stress on a hot

(Please turn to page 137)



Thinsulate jacket on facing page shows least heat loss in thermographs. Girl skier's polyester fiberfill jacket (second left) retains heat because of thicker loft of the synthetic. (Continuous filaments of the material need little quilting.) At left, the familiar, puffy down jacket shows layers of heat retention, also escape of heat along stitches.



Basic techniques and carefully chosen equipment give you great results.

by Bob Berger

This time of year, much of your photography is indoors, with flash—shots of family and friends, for example. And by following our suggestions, you'll end up with pictures you can be proud of.

The first step in improving your pictures is to take the flash off the camera. Hold the flash high, and to the side of your subject. This way, you keep the flash from reflecting in your subject's eyes, and making them appear red in a color photo—or white, in a black-and-white shot. You also minimize distracting background shadows while adding a feeling of depth.

If there is one major problem with flash photos, it's that they always look like *flash* photos. After all, aiming the flash squarely at the subject won't result in natural-looking lighting.

A better approach is bounce lighting. Instead of pointing the flash at the subject, bounce the light off a wall or ceiling. Allow two extra F/stops for light loss. Or measure from flash, to bounce surface, to subject, and divide the distance into the guide number, to determine the F/stop.

In most flash situations, using black-and-white film gives enough latitude to cover fairly large exposure errors.

But color slide shooting is more

critical. Exposure has to be correct. And bouncing flash off colored walls or ceiling may result in an unpleasantly tinted subject. Easiest way to shoot bounce flash color photos is to restrict yourself to white ceilings and walls. Or, improvise with a white bedsheet or white paper.

Bouncing your flash from a white photo umbrella eliminates the variables of colored walls and ceilings, and in effect, transforms any room into an instant studio. Larson Enterprises, 18170 Euclid St., Fountain Valley, Calif. 92708, manufactures a wide range of umbrellas and other lighting gear.

There are times when bounce flash just isn't workable. You may, for instance, want a dramatic effect, with deep shadows and bright highlights. In that case, try multiple flash. One setup that works nicely for portraits is to position one flash at a 45° angle to the subject, and high enough to throw a short nose shadow on the subject's face. On the opposite side of the camera, at subject height, place a second flash. Wire the flashes together, or connect the 45° flash to a slave trigger, an electric-eye device which is tripped instantaneously by light from the camera flash.

Some flash setups can make for exposure problems. The most accurate way to measure exposure is

How to take good flash pictures



Typical sunny-day photo, with deep shadow areas on the subjects' faces, is a likely candidate for fill-in flash technique.

Shot was improved by combining sunlight with flash-fill lighting to give less contrast, ample detail in shadow areas.





Flash on camera is harsh, unflattering. Shadows behind subjects are distracting. Foreground is overexposed, washed out.



Flash that's bounced from a photo umbrella gives soft, natural lighting and an even exposure throughout this photograph.

with a flash meter, such as the Minolta Flash Meter II. An alternative is to simply bracket exposures. Many photographers rely on the Kodak Master Photoguide—a pocket-sized book that's full of excellent exposure data.

One seemingly unlikely place to use flash is outdoors, for portraits on a sunny day. The technique is called fill-in flash, and the idea is to brighten shadows which can ruin an otherwise perfect shot. Set your camera as you normally would for a sunny-day exposure. Divide the guide number for your flash by the

short out. One notable exception: the Paramount heavy-duty sync cords, which have been found tough enough to be sold with a five-year warranty.

The PC tip at the camera end of the cord must be kept snug for good electrical contact. Pliers don't do the job; Paramount's Tip Conditioner does. You can buy it at your camera shop, along with the heavy-duty cord, or write the manufacturer, Paramount Cords and Brackets, 769 Burke Ave., Bronx, N.Y. 10467.

Having read this far, if you have only a simple camera with a built-in



A flash diffuser softened the light for these portraits, but retained its directional quality as well.

F/stop you're using. The result will be the distance in feet at which the flash should be set from the subject—if you want a strong fill. Usually a more subtle fill is preferable, and it's best to move the flash 50 percent farther back.

Finally, some miscellaneous thoughts about the sync cord that joins flash unit and camera. Avoid using coil cords; they invariably

flash, you can improve your photos by: 1. Positioning your subject away from background to eliminate distracting shadows. 2. Turning up room lights, and having your subject look at a bright light just before you snap the picture, to avoid red eye. 3. Remembering to watch out for mirrors, windows and eyeglasses that may reflect your flash. **FM**

Larson Soff Box Mini (right) has a translucent front panel to diffuse light. It accepts up to three shoe-mount-type flash units and spreads their light evenly over an angle of 150°.

Two easy-to-use brackets (below) are the Vivitar Pistol Grip (left), shown with a Vivitar 283 flash in place, and Paramount's flash bracket, with same flash unit in place. Both brackets permit quick adjustment of flash position if the situation should change.



Minolta Flash Meter II (right) measures flash illumination, continuous illumination or combinations of each. LED display reads to within 1/2-stop accuracy—you needn't calculate. Such instruments save time, make an incorrectly exposed picture unlikely. They're especially useful in color photography.



Three flashes set up for slave operation: Rollei/Honeywell Fotoeye II (left), a Vivitar slave (center) and the ingenious Leki Slave Trigger (right) made with a long cable to allow positioning of the slave away from the flash unit.

Speaking as a former Cadillac owner," says an Oregon helicopter pilot, "I find the Audi 5000's workmanship excellent. The exterior and interior detailing, including paint, far exceeds any American product I've ever owned."

This pilot—one of 1000 Audi 5000 owners we surveyed—goes on to report that he chose his car initially for its German engineering, general quality, styling, performance and investment potential.



Clean styling brought owners to the 5000. Four rings represent merger of four German companies (Audi, Horch, Wanderer and D.K.W.) into Auto Union.

"I feel it will keep its value in the future," he concludes.

Here's a Texas excavating con-



tractor: "I went looking for a good-handling car that was comfortable. In the past four years, I've owned a Datsun 260-Z, a BMW 2002 and a Porsche 924. The Audi approaches their handling and performance, but there's space and comfort for five adults.

"Except for one brake adjustment, I've had no cause to go back to the dealer other than for routine maintenance. The dealership's owner seems to realize that good service sells cars, and he takes pride in his work. And on the sales end he dealt very openly and honestly with me.

"Workmanship rates excellent,

with door and window seals perfect. It's a very comfortable car, with an airconditioner that cools quickly. Rear passengers feel a bit cramped, but they're used to big U.S. cars and never ride in the back of those, so it's hard for them to compare. My only complaint is a minor one—the paint under the door handles seems to scratch easily. And I'd make only one change: put the battery in airconditioned models somewhere else. It's under the back seat, where it's hard to check."

And now to a 67-year-old retiree from Colorado: "Our Audi was hit in the rear at a stoplight," he reports, "and we sustained \$350 worth of damage to the car, none to us, and it cost \$1800 to repair the other car. A fireman remarked that we should be glad we had a well-built car like the Audi.



Built as a four-door sedan only, the 5000 is highly praised for its comfort.

By MICHAEL LAMM WEST COAST EDITOR

**Handling superb,
engine lacks zip,
but value is most
impressive
to owners**

Fuel economy of the five-cylinder ranges between 18.6 and 24.7 mpg.

Front-wheel drive feature was singled out by 15.1 percent of owners as their reason for buying the 5000.





Five-cylinder, fuel-injected engine is smooth, but owners feel it lacks zip.

"My previous cars were Audis, too—a 1970 and a 1976 100-LS. This new one is the easiest-handling, quickest-starting car I've ever owned. It's also superbly comfortable. My wife and I are plagued with bad backs, but we can make a 400-to-500-mile trip in one day without bother.

"Complaints? Yes, I have three. First, the roof should extend forward about 6 inches so the sun doesn't shine in to heat up the front seats. Second, the tire-valve stems are too close to the wheel rims—makes checking tire pressure difficult. Three, the whole dashboard needs to be pulled to change a light bulb. That's a bit of

a chore for us do-it-yourselfers."

A California medical marketer has this to say: "The five-cylinder engine lacks power from 5 to 50 mph. I feel it should be turbocharged or replaced by a Six. However, I do find the quality excellent and have had only tiny mechanical problems (stoplights and backup lamps didn't work). The dealer's service department seems more interested in Porsche owners, so I'd rate service average.

"It would be nice to have four-wheel disc brakes instead of [\(Please turn to page 154\)](#)



Handling of front-wheel drive car is easy winner as best-liked feature.

Audi's five-cylinder sedan

First it was Mercedes with an in-line Five, now Audi. And it's rumored that GM is also exploring the possibilities.

But five-cylinder engines in cars aren't new. The Adams-Farwell had a radial Five in 1906. Henry Ford tried to tame the in-line Five around WW II, but finally gave up because of rough idle.

Audi has taken its four-cylinder Fox engine, added one more cylinder, lengthened the stroke by 6.4 mm and, through a combination of crankshaft counterweights and ignition/cam timing, has managed to domesticate the Five so it's acceptably smooth. Balance weights have been added to the front and rear of the crank, and softer engine mounts help.

The fuel-injected powerplant displaces 2144 cc (131 cu. in.) and produces 103 bhp at 5500 rpm.

The engine rests in the unitized body/chassis longitudinally—the long way—ahead of the front driving axle, giving a weight distribution of 62/38.

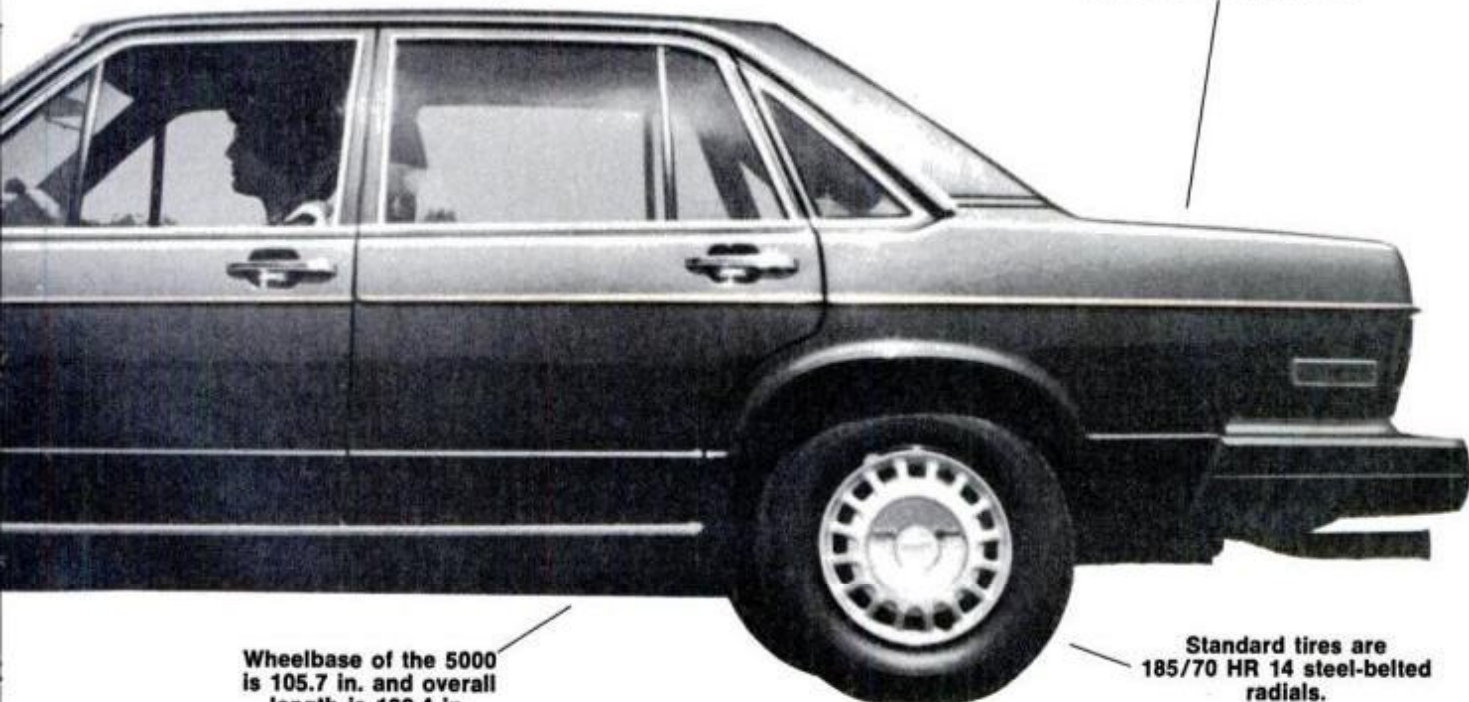
Suspension is by MacPherson struts up front, with a stabilizer bar and lower lateral links. Around back, a beam axle doubles as another stabilizer bar. The rear axle is suspended on coil springs and located by trailing arms.

Price of the 5000 hasn't changed since our Firsthand Report (page 106, Nov. '77). At less than \$9000, it's one of the best car values around.—M.L.

A NATIONWIDE SURVEY BASED ON 3,017,655 OWNER-DRIVEN MILES

Sunroof, airconditioner and other options cost extra, but cruise control is standard.

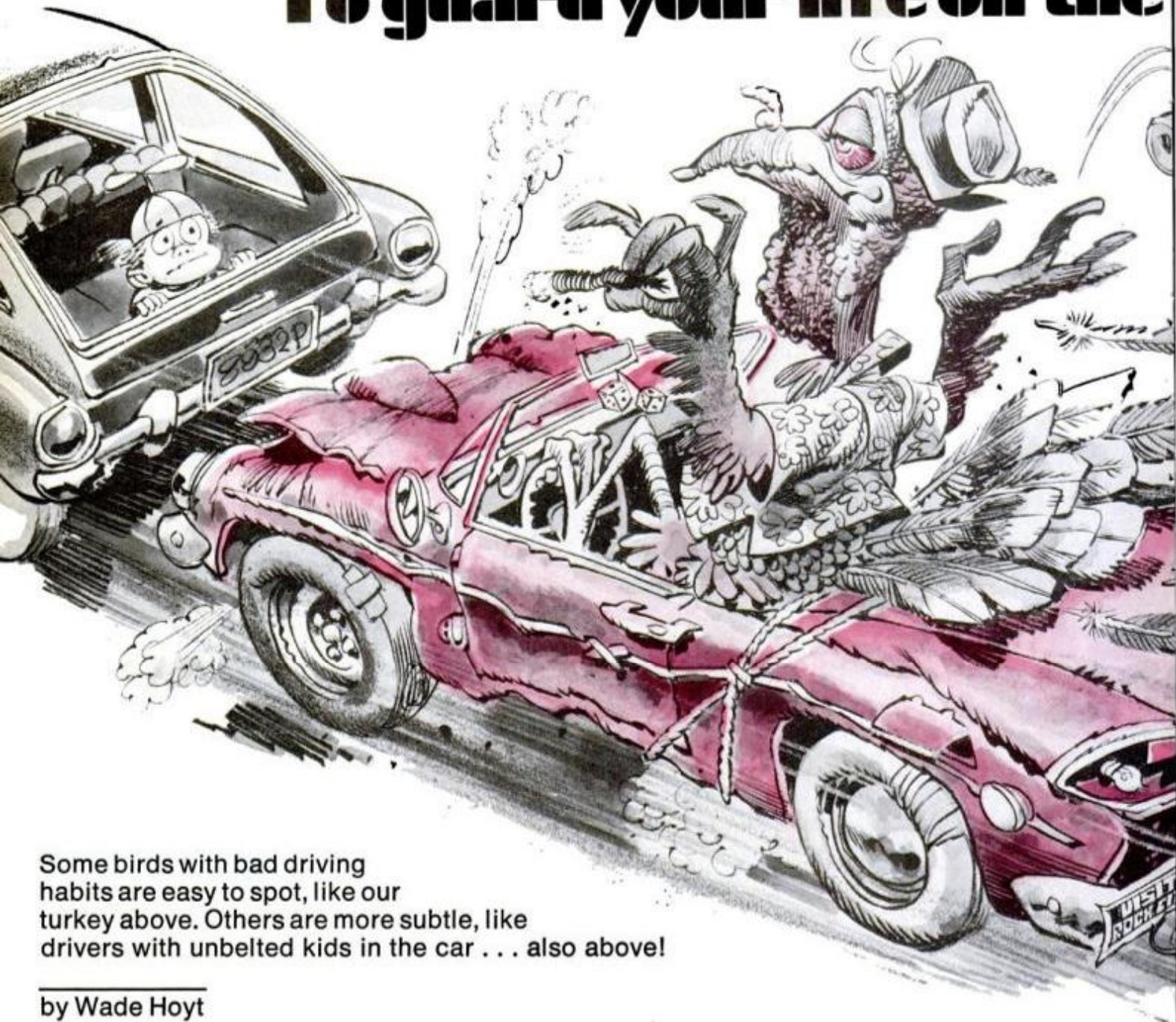
Trunk of the 5000 is specifically praised by owners for its roominess.



Wheelbase of the 5000 is 105.7 in. and overall length is 189.4 in.

Standard tires are 185/70 HR 14 steel-belted radials.

To guard your life on the



Some birds with bad driving habits are easy to spot, like our turkey above. Others are more subtle, like drivers with unbelted kids in the car . . . also above!

by Wade Hoyt

Why is it," my buddy Stormin' Norman asked a while back, "that whenever I drive down the highway I can spot a turkey before he does anything? Something goes off inside my head and says, 'Look out for that clown—he's going to cut you off.' And sure enough, as soon as I pull up to pass him, he cuts me off!"

I've had the same experience and been thankful for my premonition, but it got me to thinking. Suppose it isn't ESP, but just an ordinary defense mechanism operating on an unconscious level. Norman isn't really clairvoyant. As his eyes scan the road, they pick up certain images—the kinds of cars around him and their behavior—and send messages to some subliminal level of his brain. The guy who eventu-

ally cut Norman off had probably been wandering over the white line for miles. It's just that ol' Stormin' hadn't consciously noticed it. But a subconscious level of his brain got the message and sent off an alarm to the conscious level saying: "Watch out!"

Well, that's great, but why depend on such a tenuous chain of events? Why not make a conscious effort to cultivate and improve this early-warning system? Wouldn't that make safer drivers of us all? You bet it would!

With the help of some professional drivers and the National Safety Council, I've begun to form guidelines for spotting "turkeys"—dangerous drivers—on the road. To do this, you must pay careful attention to the cars around you and mentally

check them out in three categories:

1. The appearance of the other car;
2. The behavior of each car, and 3. The sort of person driving it.

Some are obvious cuckoos. Others are more subtle. They may not be dangerous at all, but statistics show that some kinds of cars and drivers are more likely to have accidents than others. You should give them a wide berth, just in case they do something flaky while you're nearby. Here's a list of birds to be especially wary of:

Category I: Car appearance

Rumpled grouse: We've all seen these rolling wrecks on the highway—the guy whose filthy car is battered on every corner, the sides raked by close scrapes, fresh new ones and rusty old ones equally

road, you'd better know...

HOW TO SPOT A 'TURKEY!



neglected. Keep far away from this bird, to stay out of his next scrape.

Cockeyed nuthatch: This bird only comes out at night. You can spot him by headlights so far out of whack that one casts a dinky puddle of light almost under the front bumper, while the other one seems to be on anti-aircraft duty. Spot him from behind by the way he lights up the trees along the road. Not only can't he see where he's going, but he blinds oncoming drivers, as well. Don't try to pass him until the road is completely clear of oncoming traffic.

Greater auk: A close relation to the rumped grouse, this bird races down the road with such obvious mechanical defects as a dragging muffler, wobbling wheel, nearly flat tire, or a badly cracked windshield.

You want to be nowhere near him when a defect finally lets go.

Lessor auk: This bird drives a rental truck. Any time you see one, chances are it's being chauffeured by an amateur trucker or, worse yet, a first-time trucker who is trying to learn how to handle an unfamiliar rig. Always steer clear of rent-a-trucks.

Striped road runner: We've all seen these self-styled Mario Andretti in their pin-striped hot rods and racing-striped sporty cars. Some have dangerously subverted their suspensions to conform to hot-rod fashion—jacked-up rear ends with fat tires of dubious parentage and lowered front ends with skinny motorcycle tires. Sporty cars tend toward safer road-racing suspensions, but if a car's decked out to

look like a racer, its driver may be more interested in getting through the next turn first than he is in getting through it unscathed. Sports and specialty cars have the highest accident involvement, and two-door coupes have more and worse accidents than four-doors.

Messenger pigeon: These birds belong to the bumper-sticker flock. Some are harmless, like "Vote for Smith," or "Camp Gitchee Gume." But stickers that are put-downs, or brag of alleged sexual superiority are often displayed by drivers with aggressive or antisocial tendencies, both on and off the road. Some recently spotted varieties: "Italian Stallion," "Psychiatrists Make Better Lovers," "Evil, Wicked, Mean & Nasty," "Truckers Carry Big Loads," "Bakers Have Hot Buns," and the wordless *Playboy* bunny sticker. This species also includes vans and hot rods, with names like "Mother's Worry," "The Tan Torpedo" and "Vengeance II," which makes you wonder whatever happened to "Vengeance I."

Blind-spotted tern: Every car has a blind spot, but some drivers go out of their way to create new ones. Look out for station wagons with rearward vision blocked by cargo, vans with tiny back and side windows, and sedans with right rear windows blocked by hanging clothing or "For Sale" signs. Remember, a blind-spotted tern can't see you coming, so use your horn—that's what it's there for.

Arrogant puffin: Easy to spot these birds in luxury cars, often shrouded in cigar smoke. Behavior based on territorial imperative: the more bucks I pay for the car, the bigger the chunk of road I get. Lane

change without signaling is frequent flight pattern. Plumage is easy to spot: Cadillacs, Continentals, Mark Vs in light and pastel colors. Seville birds are particularly predatory.

Category II: Car behavior

Red-eyed weaver: Drunks cause over half the fatal accidents in America. You can usually spot one by his flight pattern—slow, uncertain driving that may include weaving from lane to lane, driving much too slowly for the traffic conditions, pulling over so far to let another car pass that two wheels ride up on the curb, stopping 50 feet or more behind the car in front at a light—or not stopping at all!

Don't try to pass this booby unless you have at least two clear lanes. If he's weaving, pass as he starts to veer away from your lane, not when he's gone as far as he can and is about to veer back. If he's holding up a line of traffic, find an alternate route before the inevitable accident. If you have a CB radio, report him to the police immediately. If they want to do him a favor, they'll drive him home. If they want to do everyone else a favor, they'll take away his license.

Red-eyed nodder: Hard to distinguish from the red-eyed weaver because of identical flight pattern, this bird may just be sleepy, not drunk. If a good blast on the horn doesn't shape him up long enough to get by, assume he's drunk and treat him accordingly.

High-flying kite: This bird's problem is drugs, not alcohol. He may be weaving, nodding, or driving like an out-of-synch Andretti. My man at the National Safety Council says that pot smokers are less of a problem than heavy drinkers for two reasons: 1. There are fewer of them. 2. A pot high only lasts a half hour or so, while a drunk's reflexes may be impaired well into the morning after. Still, if you spot a driver smoking funny little homemade cigarets, treat him the same as a drunk.

Tailgating swift: A commonplace pest who rides right on your tail. Don't try to hold him up and "teach him a lesson." He'll just cut someone off to pass you on the right. Some will even pass on the shoulder or median strip. Use your turn signal, pull over and let him fly by. You want this dodo ahead of you, where you can watch him.

Flightless ostrich: This is an extremely quirky bird that wipes out thousands of lives on our highways each year. It has no idea that

it has to fly in formation when sharing public roads with other drivers. In town, he stops in lane to let out passengers; on interstates, he stops to back up if he misses an exit ramp. On multi-lane roads he doesn't keep right. In general, he wreaks havoc on traffic flow.

Category III: Driver appearance

To spot these species, you must look beyond the cars on the road and home in on their drivers. This is always a good idea anyway. If you can establish eye contact with the other guy, you can at least be pretty sure he sees you coming. Here are some birds to beware of:

One-winged nosher: Commuters are infamous for eating donuts or drinking coffee while they drive. Like smokers, they can only devote one hand and one eye to driving, and there's always the danger that they'll spill hot coffee or drop burning ashes into their laps just as you pull alongside. If you must pass them, do it quickly. Be especially wary of the **lost loon** subspecies—a bird who won't pull over to look at his road map, but tries to read it on top of the steering wheel.

Limp-wristed bustard: A close relation of the one-winged nosher, this bird will attempt to control 5000 pounds of flying metal with the wrist of his right hand. His left hand is either draped over the rear-view mirror—rendering that device completely useless—or else holding down the roof. Whatever you do, don't startle this bird! Pass him unobtrusively, if you must, and never on a curve. Use extreme caution when you spot a female—snuggled under this bird's right wing.

Strutting rooster: This aggressive, macho driver asserts his masculinity by passing everyone on the road. Often displays characteristics of the striped road runner, messenger pigeon and tailgating swift.

Great horny owl: A swivel-headed bird so busy watching the chicks that the highway seldom gets 10 percent of his attention. Use your horn or get between him and the hens, to get his attention.

Quailing hen: Statistics show that women are much better drivers, on the average, than men. The secret is in the way many women drive—low, slow and cautious. Remember this next time you drive behind a woman—she may slow down or stop where you'd barge through. If you don't stop when she does . . . another black mark for male drivers!

Ever notice that some women refuse to yield the right-of-way in

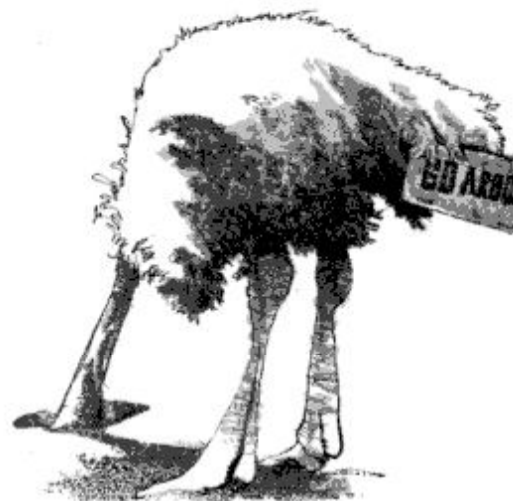
alternate-feed situations? Maybe this behavior comes from years of men opening doors for them. Maybe I'm a chauvinist pig, but when I meet a lady driver in an alternate-feed merge, I never expect her to let me go first, even if it's my turn.

Immature gander: Male teen-age drivers have dreadful accident records. They have everything going against them—immaturity, lack of experience and a grossly unjustified confidence level. They also tend to go joy riding, 12 to a car, and drive beat-up old wrecks. The surprising thing is that 20-to-24-year-olds have an even worse record, and they tend to be married, have more experience and drive newer cars.

Silver-tipped coot: Drivers over 75 years of age also have a very bad driving record, due no doubt to failing physical and mental capacities. Please remember that these observations are based on statistical averages. They don't mean that everyone under 24 or over 75 is a menace. Only that they call for an added note of caution.

Ethnic snipe: Here comes the most touchy subject of all—the National Safety Council's statistics show that minority groups, in general, have worse accident records than the majority. This has to do with economic and sociological factors—not with ethnic background. Poor people drive older and/or smaller cars, both of which have higher fatality records. Oppressed minorities have higher alcoholism and suicide rates than the general population. Like sex and age, race alone does not brand a driver as dangerous. If he is, chances are your wariness of his action or appearance will have already brought him to your attention as a possible turkey. **PM**

Flightless ostrich stops in lane whenever it so desires. It frequently maims and kills by stopping and backing up on interstates to get on an exit ramp it was too blind or stupid to prepare for in advance.



NEW NOW for home and shop

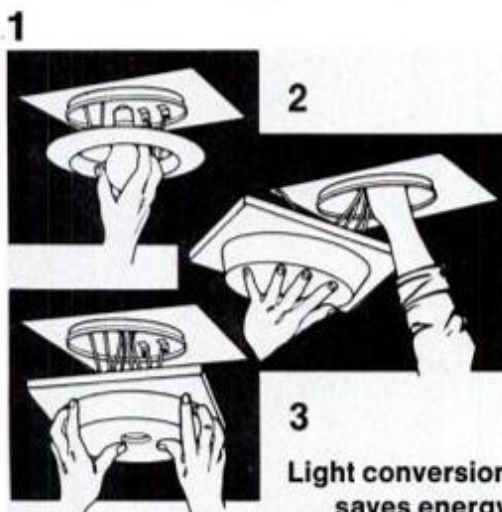
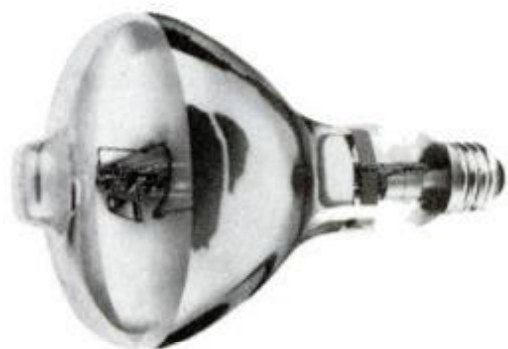


Queen Anne writing-desk kit

You can build a Queen Anne writing desk from a kit, even if you have no woodworking experience, say the kit's makers. The desk features a large center drawer and four side drawers with dovetail construction, cabriole legs and brass-finished hardware. Made of solid 3/4-inch cherry, the kit comes precut and smooth sanded. About \$300. Emperor Clock Co., Fairhope, Ala. 36532.

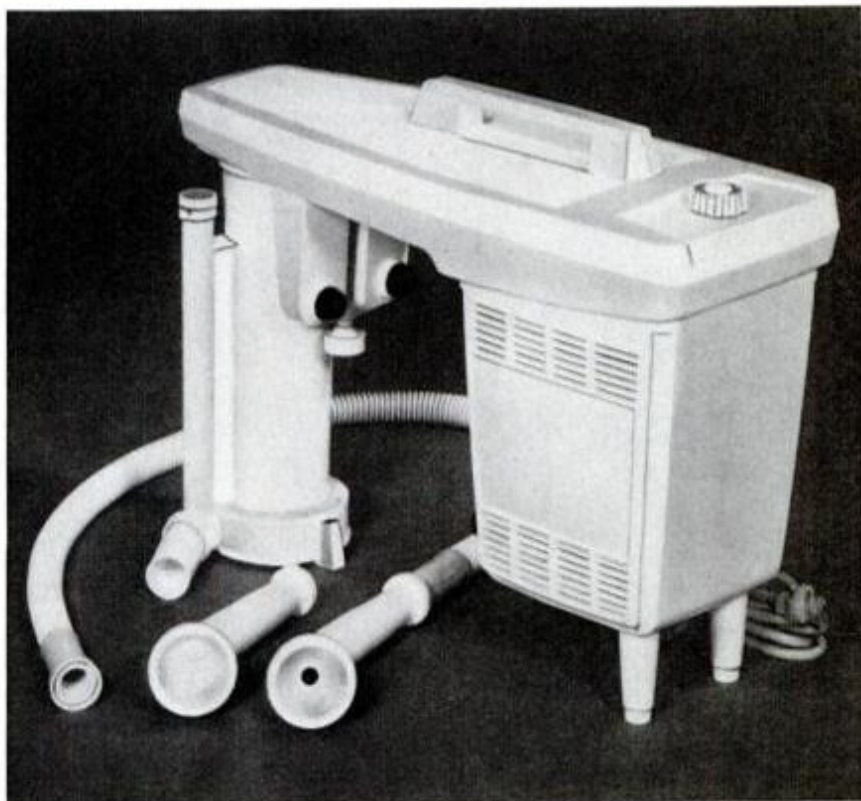
Light up your plant's life

The Super Plant Lite is a combination incandescent, fluorescent and mercury vapor bulb that screws into an ordinary bulb socket. It's said to provide a better spectral balance for growing plants indoors and use 20 percent less energy. Lamps last from 5 to 15 times longer than incandescents, according to the manufacturer. A 160-watt bulb costs \$65, while the 250-watt is \$75. Available from Duro-Lite Lamps, 17-10 Willow St., Fair Lawn, N.J. 07047.



Light conversion saves energy

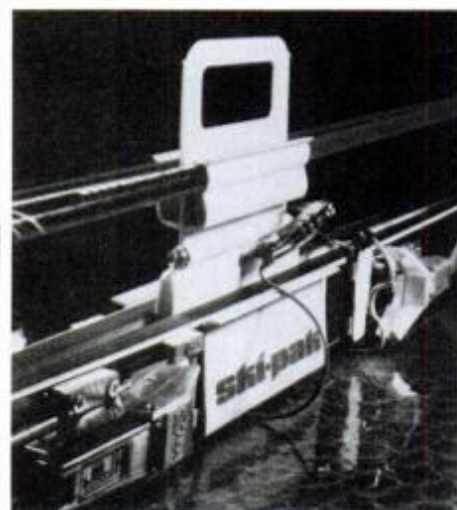
Convert an incandescent fixture to a fluorescent one with the Watt Watcher Recess Conversion Trim. Installation is in three steps (see diagram): 1. Remove existing trim and lamp. 2. Twist fluorescent adapter into socket. 3. Engage fixture springs and push trim into locked position. Model R216B makes use of a 22-watt circular lamp, and costs about \$25 (lamp not included). Conversion unit is available from Thomas Industries, 207 East Broadway, Louisville, Ky. 40202.



Mini maelstrom-making machine

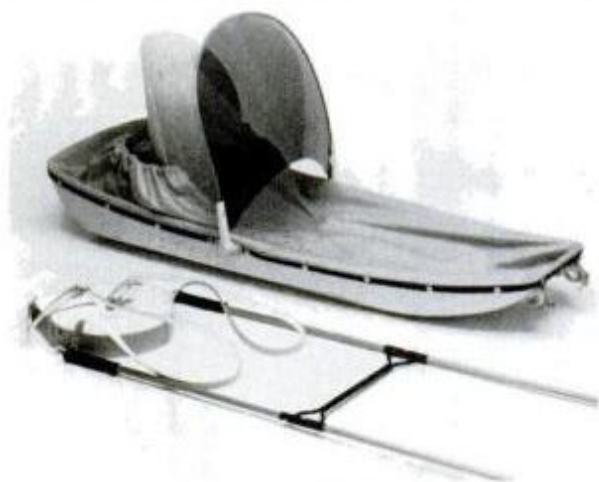
Turn your tub into a whirlpool bath with the Pollenex All-American whirlpool unit. Water action can be varied from heavy to gentle massage in seven steps. A movable housing and nozzle adjust direction of water flow. Hydro-massage dome and pulsator attachments provide different types of massage. An adjustable clamp mounts the 14-lb. unit to any tub. About \$160 from Associated Mills Inc., 209 South Jefferson, Chicago, Ill. 60606.

IT'S NEW NOW



Hold on to your skis

Ski-Pak is a hinged ski and pole carrier that comes with a combination lock and a 4-foot security cable. The plastic carrier weighs about a pound, opens flat to fit roof or trunk racks and folds for hand carrying. Both cross-country and downhill skis snap into place in the carrier. About \$20, including lock and cable, from Ski-Tree, Inc., Box 349/1 Pine St., Nashua, N.H. 03061.



Along for the slide

In Scandinavian countries, where cross-country skiing has been popular for a long time, sleds like these are common. The Pulk is a 12-pound fiberglass sled for hauling a child or gear while skiing cross-country. Such a unit has a hardwood seat, canvas top and plastic windscreen. A harness and two fiberglass poles can be attached for towing. The sled measures 50x19 inches. Model H50-700 costs \$160 from REI Co-op, Box C-88125, Seattle, Wash. 98188.



Matchless cooking with gas

The Alphin Matic Auto Ignition mini-stove has electronic ignition so no matches are needed. A butane cartridge, which attaches to the bottom of the stove and acts as a base, provides about five hours of cooking, the maker says. Three arms pivot and lock to form a 6-inch-diameter cooking support. Stove is about \$20; butane refills, \$1.59. ALH Inc., Box 7235, Nashville, Tenn. 37210.

Downhill racer

Big Ski is an alternative to the conventional sled. It's said to be able to perform almost any maneuver in most snow conditions. The 12-pound plastic toy requires minimal assembly and can carry up to 150 pounds, the maker says. All edges and corners are rounded for safety and there are no sharp metal runners. The plastic is said to be able to remain flexible at subfreezing temperatures. Under \$30 from Sweco, Inc., Box 18141, Pittsburgh, Pa. 15236.



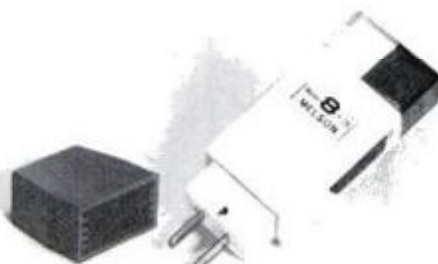
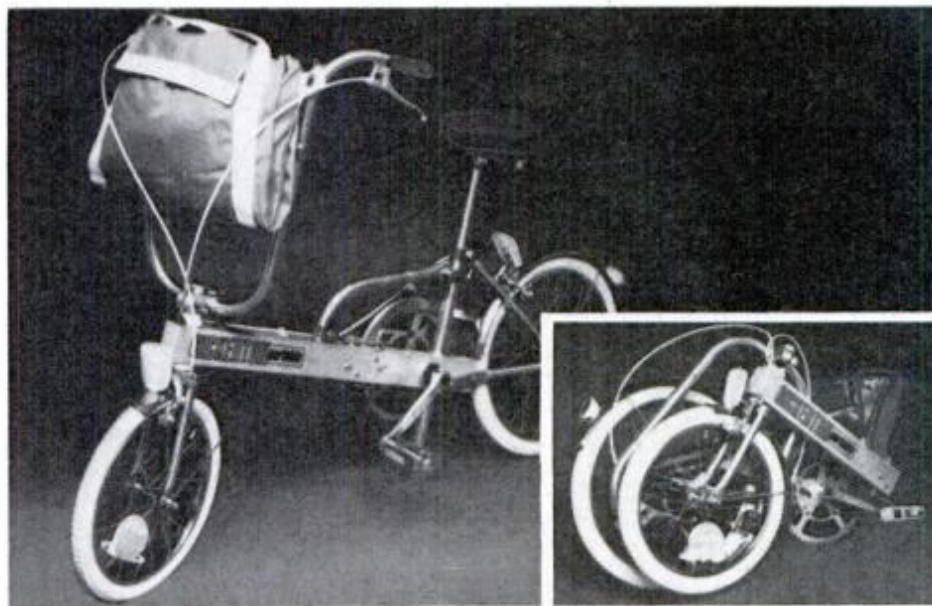


Not quite a Nolan Ryan

A turn of the crank of the Cytron 100 pitches a plastic safety baseball to the plate at up to 70 mph, the maker says. It's powered by steel springs and has adjustable speed for hitters of varying abilities. Accuracy is said to be over 90 percent in the strike zone at the recommended batting distance. The 14-pound unit is about \$80 from Cytron, 245 Spokane Falls Blvd., Spokane, Wash. 99201.

Join the fold

The Bickerton Portable Bicycle weighs only 25 pounds because of its extensive use of aluminum. It is said to fold and unfold in about a minute, and can be carried in its optional handlebar bag. The British-made bike is available in single and three-speed models and can be adjusted to riders of almost any size, child to adult. The three-speed, with bags, costs approximately \$400; the single-speed model is about \$30 less. Handleman's, 16 Reservoir Rd., White Plains, N.Y. 10603.

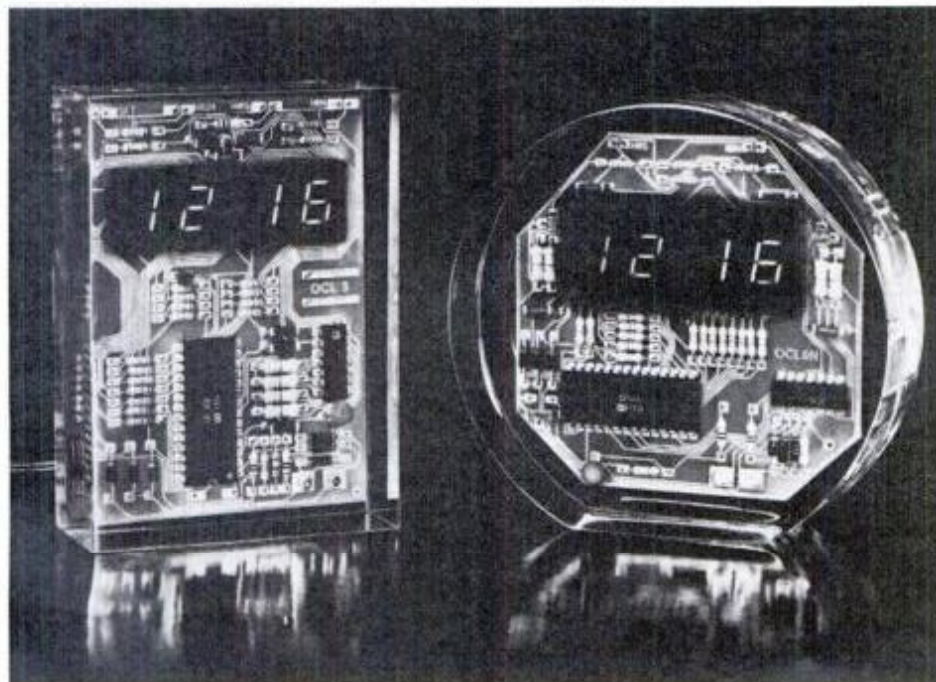


Rechargeable flashlight

This light shines up to one hour on a full charge, plugs into a wall socket to recharge. A built-in magnet grips metal surfaces; light shines white or blinking red. About \$11 from R.F. Morelli and Co., Box 236, Ringwood, N.J. 07456.

See-through clocks

Clearly, these British digital clocks are unusual. Their circuitry is embedded in blocks of acrylic polymer for all to see. Also buried in the plastic are the time controls, electronic sensors actuated by the mere touch of a fingertip. The unit works by counting the pulses of 60-Hz house current and is said to have a self-correcting feature. The Bomartan Acrylic Touch Clock is about \$180, \$200 for the round model. Randolph Scott Co., 14B Rye Colony, Rye, N.Y. 10580.



Reflects well on you

Joggers, bicyclists, pedestrians and motorcyclists often require extra visibility, especially after dark. The SV-260 Deluxe Vest is said to have four times the reflective brilliance of highway signs and 200 times that of ordinary clothing. The nylon vest slips over outer clothing, adjusts for fit with straps. About \$13 from Jog-A-Lite, Box 125, Silver Lake, N.H. 03875.



LITTLE IS BIG IN SNOW REMOVAL THIS YEAR

After the rough winter of '78, homeowners are buying snow-removal equipment at a record-breaking pace.

by Glenn S. Hensley

If you're eyeing one of those new, lightweight (about 40 lbs.) compact snowthrowers this winter, you're certainly not alone. In fact, there are so many of you with the same idea that manufacturers have literally doubled their output of such machines. They're anticipating the biggest season for sales of snow-removal equipment in history.

Back in August, scientists began telling us that increased sunspot activity gave every indication that this winter will be colder than normal. Even the woolly bear caterpillar watchers were forecasting a

foul winter as their little, wormlike creatures donned darker fuzz and added more plumpness to their wiggly bodies.

All this, plus the memory of last winter's severity, has created an unprecedented sales demand while thermometers hovered near the 100° mark—and snowthrowers became hot sellers, literally.

Demand may surpass production

If you haven't already purchased your own snowblower, there's a good chance you may have to depend on the generosity of your neighbor to keep your driveway and sidewalk clear of snow this winter. It is highly possible that last winter's "sell out" of machines may well be repeated this season. This is in spite of the fact that manufacturers say production of smaller, single-stage units will be up some 150 percent and the larger, two-stage

machines will be up by 30 percent.

Once considered a marginal machine by most homeowners, even in the snowbelt, snow-removal machines have now become a necessity in the minds of many. This is reflected in statistics, which show that only 12,000 units were shipped by manufacturers in 1957. By August of this year, they shipped 424,715 machines. That was already a hefty increase above the 267,950 shipped in 1977.

Demand for the smaller units is soaring faster than a NASA rocket. They fit right into a segment of the market that is building up as winters become more like those that old-timers talk about.

Types of snow-removal equipment

Just to refresh your memory, snowblowers (push-type and self-propelled) are the larger machines with an auger to chew into deep



Jacobsen's Sno-Burst has reserve power to remove deep snow without stalling.



Ariens has a line of models ranging from this 2.7-hp Compact to a 10-hp Deluxe.

snow, plus a rotary blower to eject that snow through a directable discharge chute.

Although the term is used to include all snow-removal equipment, snowthrowers are single-stage, usually push-type units. They consist of a rapidly rotating drum, fitted with rubber paddles of various designs. Those paddles can clean right down to a hard surface and contribute to a self-propelling effect for the unit. Gasoline-powered models range from a minimum of 2 hp to a maximum of 10. The 2-hp engines are two-cycle units requiring a gas-oil mixture as fuel.

Electrics, definitely in the minority, have about 2 hp available. They can, however, do a big job. Toro, a pioneer in the small snowthrower business, has an electric that will toss 200 pounds of snow off your walk in a minute. It clears a 12-in. swath.

Single-stage throwers work well

While the two-stage snowblowers are designed for more rugged use in deeper snow, you'll find that your new single-stage thrower can do almost any job the two-stages can do. It might take you a little longer, but you won't mind. It's pure winter pleasure to watch that plume of white snow arc up and away as you slice a clean path down to the mailbox.

You'll also find that your easily stored (hang it in the garage) single-stage model is probably better in the wet snow, so prevalent if you live in that band from Kansas City through St. Louis, Cincinnati, Columbus and on eastward. Wet snow has a tendency to clog and pack in the two-stage's discharge chute.

I know. Living in St. Louis and using a two-stage machine in last winter's snow, I found that slinging water-soaked slush took all the power my 5-hp blower could pop out. Even then, enough wet material remained in the discharge chute to cause restriction when it froze in layers.

Tips on selecting equipment

If you're in the market for snow-removal equipment and have your choice of machines available, follow these guidelines:

Select a unit that provides high power to clearing-width ratio. Choose a unit with controls that are easy to reach and resistant to freezing. Those controls should be operable when you're gloved.

Ask your dealer to explain the advantages and features of the models and makes he has. Find out whether he has parts and service for machines he sells. There's nothing as useless as a snow-removal machine that won't run for lack of a part.

Manufacturers are offering machines that can be pull-rope-started or have 110-volt plug-in electric-start options. From my experience, I've found that I didn't need the electric-start feature. A properly winterized and maintained engine fires easily, even on the coldest day. However, if you have a physical problem that makes pulling on a starter rope out of the question, you'll be glad the electric-start models are available. The feature costs about \$50 extra.

High-impact plastic is finding increasing use in the popular, smaller snow-removal machines. Used primarily as a weight- and cost-saving feature by manufacturers, it has other advantages. Should ice form on it, just wham the plastic with a



PM tries a Toro

If ever there was a winter to try out a snowthrower for the first time, it was the miserable miniature Ice Age that arrived one year ago. Record snowfalls kept our home state of Connecticut inundated, and our 100-foot-long driveway received a seemingly endless supply of drifts.

Luckily, waiting gassed up and ready to go in the garage was a Toro S-200, a lightweight machine with a capacity for a 20-inch-wide swath through the snow. Had I known in November the kind of snows we were about to receive, I'd have guessed the machine too small to handle the job. But, no, it cut through drifts that were taller than the motor housing and spiritedly threw its plume of snow high and well away from the blacktop.

Directing the stream of snow to the right, left or ahead is simply a matter of rotating a metal handle that turns the vanes on the front of the machine. The control is within easy reach of the operator. The test machine had an electric starter (its power cord goes to a household electrical outlet); we used it a couple of times, but the recoil starter worked so easily we didn't bother plugging in too often.

Equipped with upper and lower handles and light enough to lift (under 40 pounds with fuel), the S-200 can be used in a sweeping motion to clean porch steps. It's also easy to heft to a storage hanger on the garage wall.

The machine has a 2.25-hp Tecumseh two-cycle engine and a one-quart-capacity fuel tank. Its rotor is a two-section drum type made of aluminum and equipped with two rubber blades. All bearings are lubricated for the life of the machine, so no additional lubrication is needed.

The recoil-start S-200 sells for \$279.95; the electric-start model is priced at \$329.95.—John Linkletter

fist and it will flex enough to break loose any frozen coating. In addition, you can bang and bump the machine around without fear of scratching the paint or denting metal. Best of all, it won't rust.

There aren't many accessories for snow-removal machines. But if you own, or are purchasing, a self-propelled, two-stage machine, chains for the drive wheels are a necessity. Had I not had chains on my own machine last winter, it would have been a "push-type" most of the time.

Retail prices for these small units range from \$250 to slightly more than \$300. Two-stage machines go as high as \$1500; 5-hp blowers run about \$500; 8-hp machines are about \$750 and the 10-hp ones, \$850.

Safety tips for snow throwers

You'll find your new snow-removal machine to be a powerful weapon against winter's arsenal, but as with any "weapon" you should learn to use it properly. Otherwise, it can be hazardous to your health.

Remember, that machine can sling more than snow. It can propel rocks and chunks of ice with the

force of a major-league pitcher. So be careful. A few simple safety suggestions are on this page.

You'll find that the smaller, push-type throwers are not difficult to handle. They're light enough so you can pick them up and swish off steps, porches or patios. Remember, you don't have to push them "through" deep snow. They roll easily on the cleared surfaces after their paddles have powered the white stuff up and away. In shallow snow, push them as fast as you like. When it's deeper, push them as fast as they can accept and eject the snow.

How to maneuver your machine

Don't attempt to discharge snow into strong wind unless of course, you enjoy getting a faceful of frozen slush. It can plaster your glasses, pack your collar and pound your gloves before you're aware it's happened.

Plan your movement strategy in wind so each swath you clear will allow you to use the wind's force to help disperse snow over a wider area.

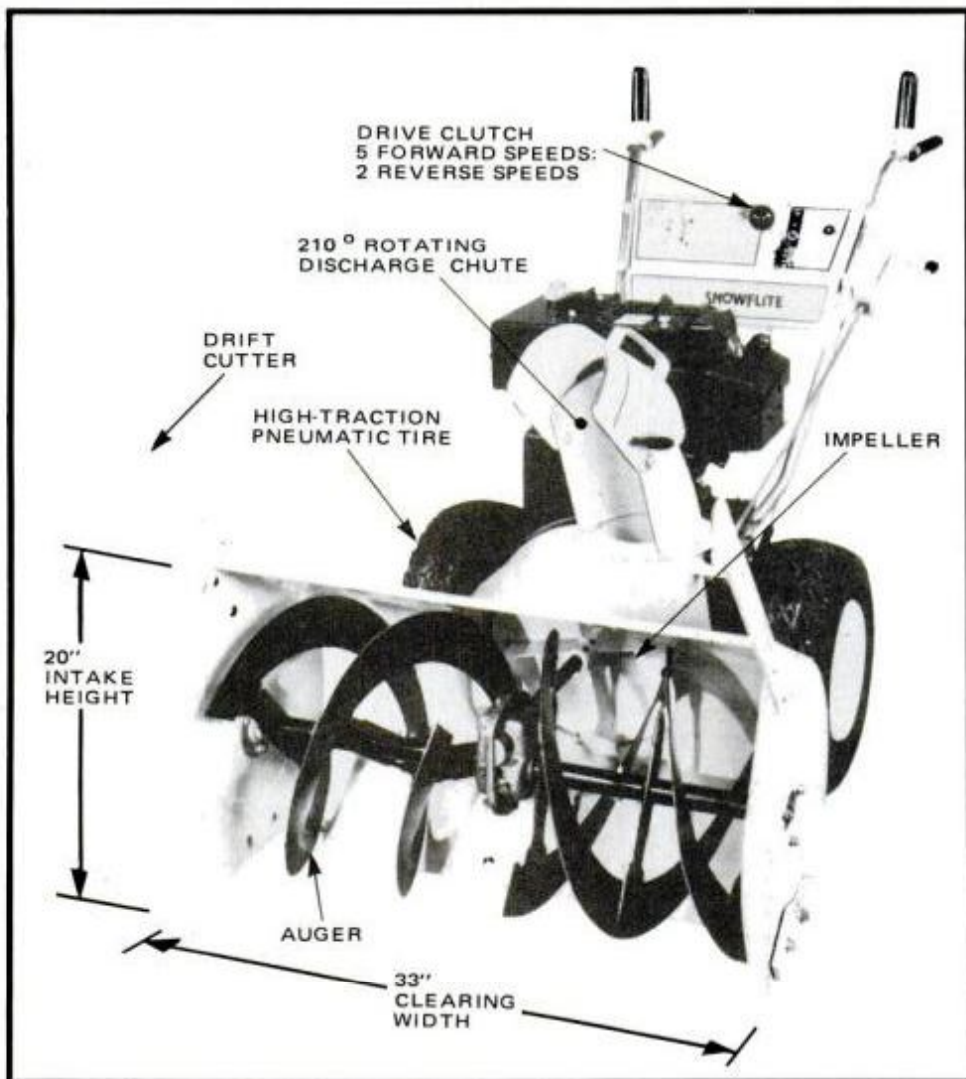
It's not like mowing your yard,

which can just be a matter of circling around and around until you're finished. Start snow removal on your windward side. Go backward and forward at right angles across the wind, each time directing the discharge leeward. That way, blown snow won't keep settling right back on cleared areas. You'll be moving it farther and farther to one side, away from the wind.

Storing a snow-removal machine

If you didn't prepare your snow thrower properly for hibernation last year, the seasonal start-up and maintenance suggestions on page 97 can get your thrower purring once again when the snow flies.

If you must store your thrower in an unheated garage or carport as I do, be certain to scrape and sweep away all slush and packed snow from inner parts of the machine upon completion of a cleaning session. That slush can freeze all working components into a solid chunk if left to do its dirty work. I've found a time or two that I needed to start the machine on a day following previous use, only to find it ice-locked.



SnoFlite 960, MTD's most powerful snowthrower, is two-stage model with 10-hp engine.

Snow-removal safety tips

You can clear a path in the snow safely and easily by following these tested tips from the experts at the Outdoor Power Equipment Institute:

1. Read your owner's manual. Test your machine and become familiar with it before attempting to remove any snow. Know its controls and be aware of how to bring it to an emergency stop.

2. Never direct that discharge chute toward any bystanders. Just as you should never point a gun at anything you don't wish to kill, never point a snowblower discharge chute at any person—or at your living-room window, either.

3. Adjust your travel height to clear gravel or crushed rock driveway surfaces. Gravel makes good "identified" flying objects.

4. Don't allow children to play with the machine—or in the blower's discharge—and don't allow adults to use it without proper instruction.

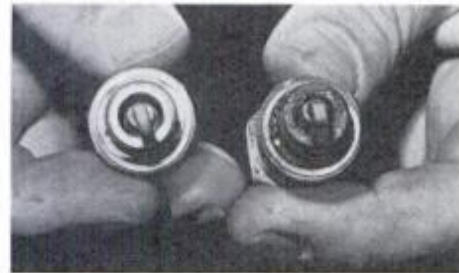
5. Disengage all clutches and shift into neutral—or kill the engine—before getting your hands, feet or clothing near moving parts.

Above all, use common sense. Snow-removal equipment can be fun to use, but the machinery isn't a toy and can prove dangerous if used by thoughtless individuals.

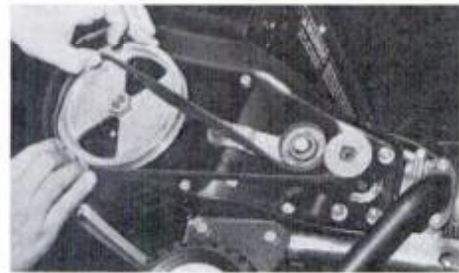
Seasonal start-up and maintenance suggestions

The worst of winter is yet to whistle across the snowbelt, so you have waited long enough to prepare your snow-removal equipment for emergency duty. Whether yours is a two- or four-cycle, single- or two-stage machine, getting it out of mothballs and into fighting trim should move to the top of your job priority list.

If you followed the recommendations in your owner's manual when



New plug (left) contrasts sharply with one that's seen several seasons' use. If yours has deposits like one at right, replace with new one of proper size.



Drive belts need replacing if they are stretched to the limit or badly worn. Chain drives rarely give trouble, but check them for tension and lubrication.



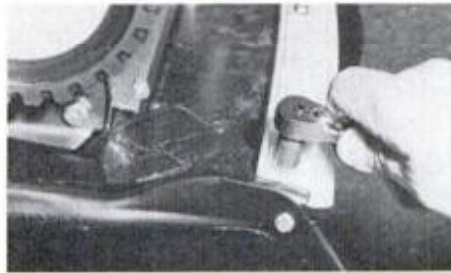
Inside surface of the discharge chute should be as slippery as possible. Wax it or spray with silicone to keep snow from sticking where you don't want it.

you stored the machine last spring, you'll be several jumps ahead of your less ambitious neighbors. But if you didn't, here are some care tips to simplify your task:

1. Leaving gas in the tank over summer is a primary cause of start-up problems. Gas goes stale quickly, especially gas-oil mixtures. Varnish-like gum can foul a carburetor on the first pull of a starter rope. Solution: Get old gas out of



Fasteners have a tendency to loosen in service, so give them all a pre-season snugging. Make certain fuel lines are tight-fitting while you're at it.



You may need to replace scraper blade, for it takes a beating as scoop end of the thrower bites into ice and debris. The job takes only several minutes.



Firmly clamp cable controls so sheath remains fixed while inner wire operates freely. A squirt of oil on the cable can help prevent freeze-up in sub-zero cold.

the tank. A simple siphon arrangement will work. Wipe the tank interior dry with a swab made of a cloth wad on the end of a dowel. Remember, you're working with hazardous material. Keep fire away and dispose of it safely.

2. Pull and check the sparkplug. Gap it to not more than .035 in. If you have doubts about its condition, replace it with a new one.

3. If yours is a four-cycle engine, check the crankcase for proper oil level. Didn't change it last spring? Do it now with the recommended grade of oil.

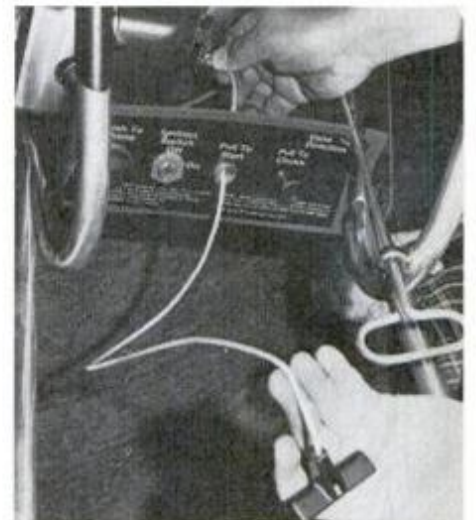
4. Next, "preflight" your machine by checking for parts loosened by vibration or damaged in service.

5. Clean away all rust and give the areas a fresh coat of paint.

6. Check pneumatic tires for proper air pressure. Adjust tire chains for proper fit.

7. Correct controls that feel "mushy" or bind in operation.

8. Check the fuel-tank cap for an open vent free from rust.— R. Graf and G. Whalen



Pull out the starter cord and check its entire length for fraying and wear. Reel it back in and pull out again to test for smooth engine turnover. If it binds, the rewind mechanism may be faulty and need replacement. This is one task that is more easily done now than later.

The only recourse then is to warm the unit until frozen parts let go. I've used an electric heat bulb to do this. It works on my metal machine, but be careful using such a technique on plastic models.

At season's end you should take steps to prepare your snowthrower for storage. This will assure a snowthrower that's ready to go next winter.

Store it under a protective tarp.

Empty its fuel tank and fill the crankcase (if it's a four-cycle type) with fresh oil. Clean the machine's snow-contacting surfaces and apply wax or silicone.

Final advice on your machine

The best guidance anyone can give you on use of your snow-removal equipment is to read and understand the operator's manual. Then go out and use the machine.

Experiment with it. You'll find yourself actually looking forward to the next snowfall—to the opportunity of watching a brilliant sun highlight a plume of white snow against shrubs and sky. You'll learn quickly what you can and cannot do with your machine. It'll send a strong signal when it's overloaded, so back off, slow down and enjoy the experience. It's certainly more interesting

(Please turn to page 124)

Install a humidifier and get rid of winter dryness

A rundown on humidifiers—what's available, features to look for and how to install a built-in unit.

No need to wake up on winter mornings with itchy skin or dried-out throat because your house air is too dry. A humidifier can add moisture that will help you feel—and your plants look—better during the dry heating season.

Adding a humidifier will also return much needed moisture to parched wood furniture and wall-coverings. One also helps cut down or eliminate static electric shocks when you touch a doorknob or light switch after walking on carpeting.

Saving on heating bills may be another advantage of running a humidifier, though there's some debate on this point. Some experts say

that humidifying a house will let you live comfortably at lower temperatures, while keeping down those fuel costs. However, others argue that any cost saved is spent on energy for humidifying.

How a humidifier functions

Simply stated, a humidifier puts moisture into the air. It can do this in one of three ways: *evaporation*, *atomization* and *vaporization*. Evaporator units pass air over a moistened medium, such as a rotating pad or disc. Atomizer units spray water droplets into the air. Vaporizing units use a heat source to vaporize water into steam.

There are also three styles of humidifiers: tabletop units, console units that look like cabinets and built-in units that are installed out of view. In forced-air heating systems, built-in units are placed on a furnace plenum or duct. In hot-water heating systems, built-ins fit behind a baseboard. Generally, built-in humidifiers deliver the greatest moisture evenly through a house, while tabletop and console units humidify one or two rooms.

Why heated air becomes dry

Indoor air becomes dryer in winter when cold air is brought into the home and heated. When warmed, this air is capable of holding more water vapor than it can when cold. But the amount of water vapor actually stays the same, so the relative humidity drops. Since this heated air can hold more moisture, but the moisture amount remains constant, the relative humidity (amount of moisture in the air compared with the amount of moisture the air is capable of holding at a given temperature) goes down. Household air can become desert-dry, throats parch and furniture dries out.

Experiments have shown that a

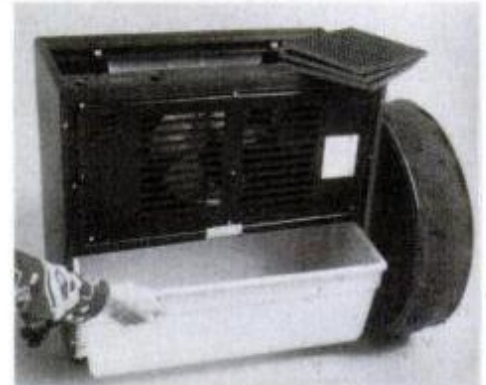
TABLETOP AND CONSOLE HUMIDIFIERS



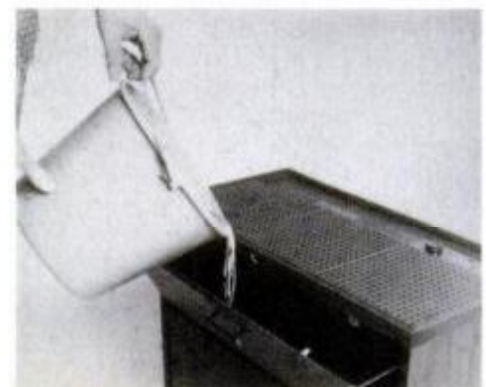
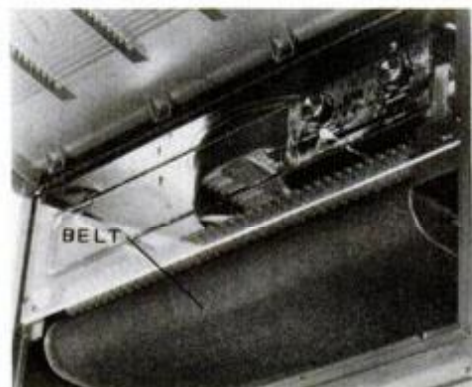
Lightweight tabletop humidifiers like the Squire (above) are easy to move. The 16-in.-diameter model has a 5-gal. per day output. Walton Labs, Moonachie, N.J. 07074. Output of the console model (below) is 16 gal. per day. It has an independent electronic air cleaner system. McGraw-Edison, Albion, Mich. 49224.



On console models, a fan forces air through a moistened pad, distributing moist air in the room. The pad can work in two different ways: Either it rides the rim of a large drum, as on the West Bend Waterwheeler (above), or the pad is on a belt that passes through a water reservoir, as in the Arvin humidifier (below).



Features to consider when buying a console are ease of both cleaning and filling. West Bend units, for example, have water reservoirs that are removed from the back for cleaning (above), yet they're filled through a hidden channel in the front (below). Other good features: a refill indicator and a water level gauge.



person is most comfortable at temperatures of 70° to 72° F. when the relative humidity is between 30 and 40 percent. Without a humidifier, the relative humidity of heated air can drop to as low as 13 percent.

Not all homes can be humidified

Before you buy a humidifier, inspect to make certain your house is both insulated and has a protective vapor barrier. Humidifying an uninsulated house is a waste of time and money, because the water vapor will go directly outdoors before the house air is adequately moistened.

Moisture added to the atmosphere of an insulated house that doesn't have a vapor barrier enters the insulation and condenses on it and the cold outer wall. This water makes insulation less effective and may cause rot in the wall.

If your water has a high mineral content, consider an evaporative humidifier. This type doesn't spray water directly into your home, and the moist air it puts there will be free of mineral residue.

Selecting a humidifier

Whether you select a built-in, console or tabletop humidifier, choose one with a capacity to fit your needs. To make a wise decision, you must know the square footage of your house and its basic construction—whether tightly built with heavy insulation, storm windows and weatherstripping around doors and windows, or loosely built without storm windows and doors and perhaps with an undampened fireplace. The more loosely a house is constructed, the greater the amount of parched, cold air it lets in and the more moisture is needed.

The Air-Conditioning and Refrigeration Institute chart below gives humidity requirements in gallons per day based on an 8-ft. ceiling height:

| House Construction | Building Size (Sq. ft.) | | |
|--------------------|-------------------------|------|------|
| | 1000 | 1500 | 2500 |
| Tight | 4.2 | 6.4 | 10.6 |
| Average | 6.5 | 9.8 | 16.3 |
| Loose | 9.2 | 13.8 | 23.0 |

A humidifier you select should have its capacity rating clearly noted. To assure accurate and dependable ratings, look for a unit that carries certification by a recognized professional organization. Built-in units are certified by The Humidifier Institute and the Air-Conditioning and Refrigeration Institute. Console units are certified by the Association of Home Appliance Manufacturers. After you've determined the needed capacity, other factors differ depending on

whether you select a portable or built-in unit.

Portable humidifiers

If your heating system won't accept a built-in humidifier, or if you want to humidify only part of your house, you can use a tabletop or console model.

Tabletops have the advantage of being light and easy to carry to a water source for filling. However, their capacity usually is limited to eight to 10 hours per fill.

Console humidifiers basically are a reservoir with a pad that passes through it. A fan forces air through the moistened pad, evaporating water and sending moist air into the room. The pad is on a revolving drum or is a belt on rollers. These units plug into standard outlets.

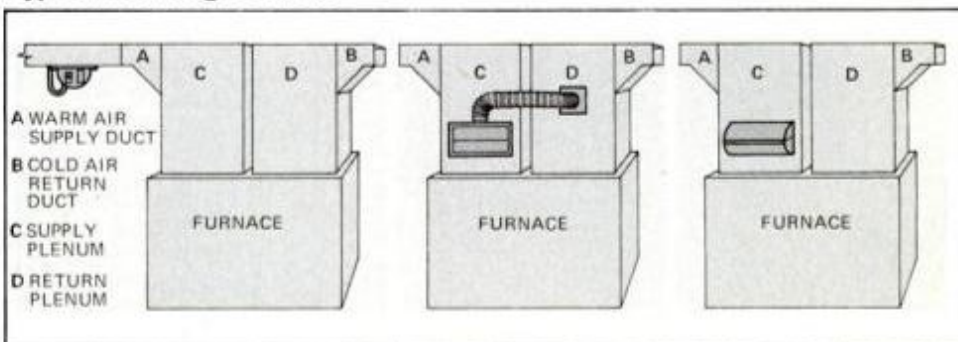
It's somewhat difficult to compare output capacities of consoles because makers specify output in a variety of ways. Some manufacturers talk about gallon capacity of their water reservoirs. Others give the square footage that the unit can humidify, or the gallons of water it releases a day.

But you can compare other features, such as ease of filling, moving, emptying, cleaning and servicing. Some units have a hose for filling at the sink. Since a filled unit can weigh over 70 lbs., in many cases you'll probably carry water to it. Look for a model that has a chute or funnel to guide the water during filling.

You'll need to clean the humidifier one or more times a season, depending on how fast mineral de-

BUILT-IN HUMIDIFIERS

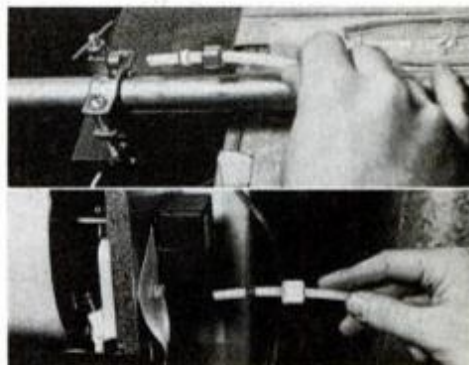
Typical mounting locations



Installing a humidifier between plenums



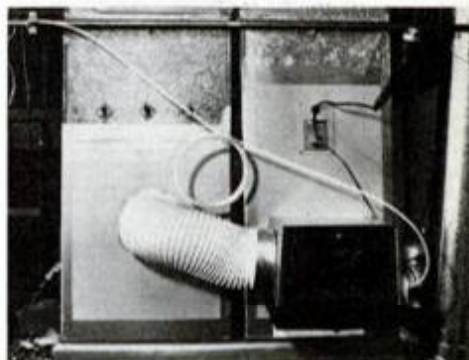
1 Mount templates that come with this Skuttle kit and cut plenum openings. Note humidifier cabinet, in place at right.



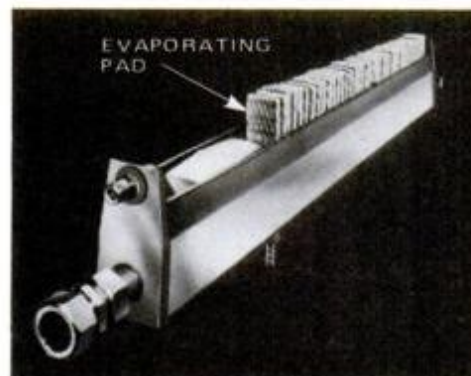
2 Connect water supply. Use saddle connector valve on water line. Attach plastic tubing to it (top) and humidifier.



3 Mount humidistat; plug into 115-volt electric outlet (not to light switch). Motor over 3 watts may need grounding.



4 When installation is done, run water to check for leaks, energize electrical system and set humidistat as desired.

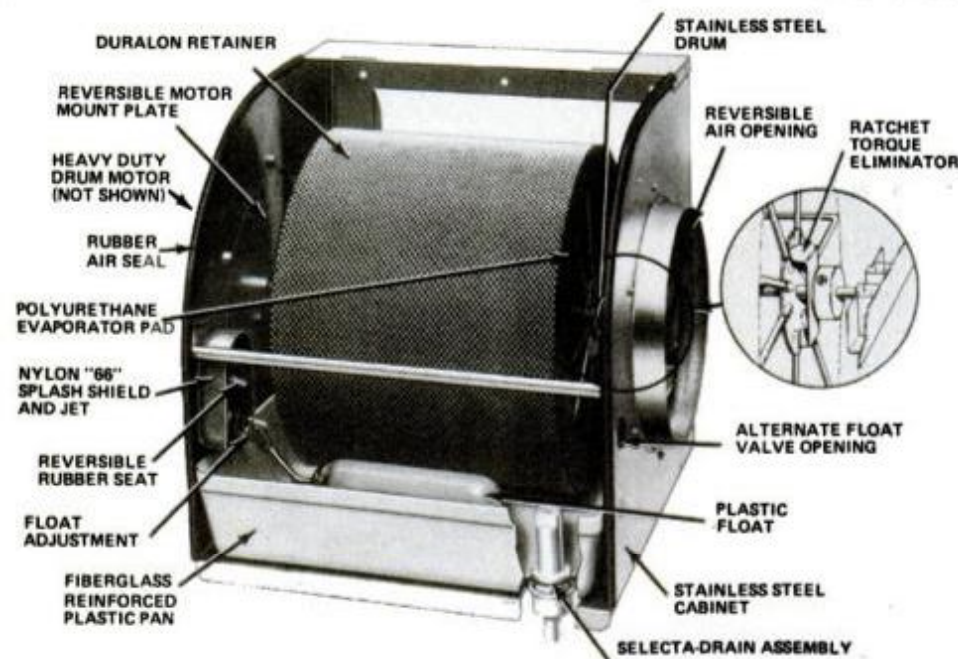


The Hydronic humidifier (\$132), designed for hot-water systems, fits behind a standard baseboard. Water feeds into it, is absorbed by pads, transferred to the air. Pennco, Box 223, Clarendon, Pa. 16313.

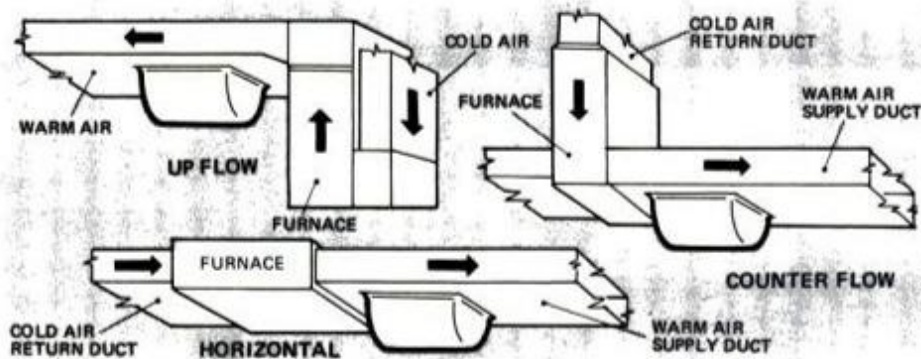
This humidifier kit from Skuttle (top, left) has all needed parts for installation on a warm or cold furnace plenum of a forced-air heating system. The air is forced through a revolving pad.

The AD 1 duct unit by Lobb (top, center) is installed as shown below it. Air in warm-air duct enters the unit via an adjustable manual baffle, passes the evaporating pad, is moistened and then flows out.

Inner workings of a humidifier are shown (left). Motor-driven rotating drum passes through a water-filled plastic pan and picks up water to moisten air entering the unit.



Installing an under-the-duct humidifier



1 The Good-Bye-Dry humidifier unit comes complete in a lightweight carton.

2 The unit is designed for mounting under the warm-air supply duct of a furnace. Determine which type of furnace system in the drawings most resembles

yours to see how you would install such a unit. If there is more than one supply duct from the plenum, use the duct that services the largest area of the house.



3 After selecting a location to install the unit, use adhesive strips to center mounting template on underside of duct.



4 Drill baffle mounting holes marked on template. Using tin snips, cut through the template and metal duct in spiral pattern until you reach the dotted line.



5 A baffle directs a maximum flow of warm air to the unit to increase its efficiency. Attach baffle to its supports. Position it in the duct with the baffle underside facing the airflow.

posits collect. This is when a removable water reservoir is a great help—a reservoir with a drain is also handy, since there is usually leftover water. Also, check to see that the belt or drum is easy to remove for cleaning. Make sure parts are accessible for servicing. Some units have a removable front grille and panel for getting at interior parts. Other units have a back panel that swings open to reveal working parts.

Cost for console units is in the \$65 to \$165 range. Tablets that dissolve in the water reservoirs are designed to cut down on mineral buildup. These are available from most makers.

Built-in humidifiers

Built-in humidifiers can be powered or nonpowered units. Powered ones deliver the greatest amount of moisture to your house. These are typically installed on a plenum or under a warm-air duct of a furnace in forced-air heating systems. They work by spraying a fine mist or exposing wetted pads to the air flowing through your heating system. The furnace fan then circulates the humidified air through the house. A humidistat can control the level of humidity.

The advantage of a built-in humidifier, besides its ability to hu-

midify the entire house, is that it stops and starts automatically as directed by the humidistat. Some units can be installed so they run only when the furnace is working.

Powered built-in humidifiers range in evaporative capacity from $\frac{3}{4}$ to $8\frac{1}{4}$ lbs. of water per hour. (A gallon of water weighs approximately 8.45 lbs. Thus, to convert pounds into gallons, divide by 8.45.) Units cost from \$65 to over \$200, not including installation charge.

Before you shop for a unit, check the dimensions of possible humidifier mounting locations on your heating system. As you shop, look for these features: ease of installation, inspection and cleaning. Any unit you plan to install yourself should come with complete directions. Pre-wired units are often the surest route. Units that have a window showing the machine's interior are the simplest to inspect. Models with removable components are the least trouble to clean.

Installing a built-in humidifier

The only tools you need to install a powered built-in humidifier are a hand drill, screwdriver, tin snips and pliers. It takes little more than an hour to complete most installations. Here's how you proceed:

1. Turn off the heat and electricity before installing the unit.

2. **Humidifier case.** With tin snips, cut an opening in the plenum or duct where you plan to make the installation. Attach the stiffener plate for the humidifier case with screws, then hang the box.

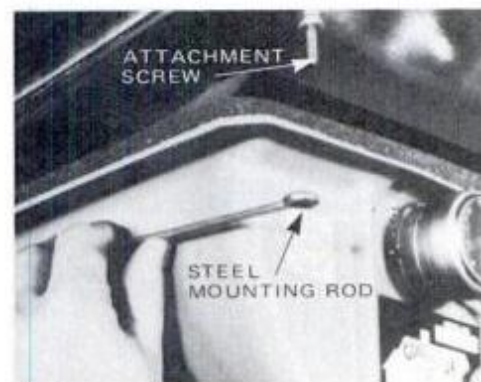
3. **Water supply.** Hook up the water supply to the humidifier by drilling a hole in the nearest cold-water line (if the saddle valve that comes with your humidifier isn't self-piercing). Attach the saddle valve. Run copper tubing between the valve and the float valve on the humidifier.

4. **Humidistat.** Cut an opening in the return duct or wherever you will place the humidistat according to the maker's directions. Mount the humidistat and connect it to the humidifier and power supply.

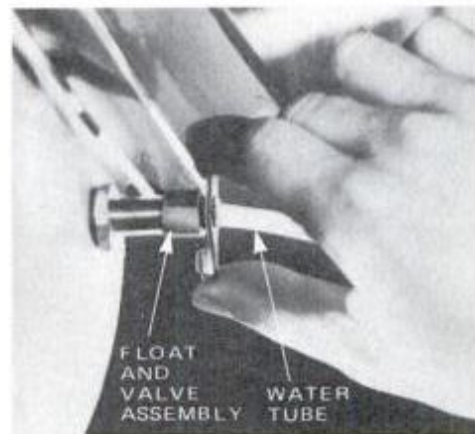
5. **Energize it.** Open the saddle valve to let the humidifier reservoir fill. Turn on the switch and set the humidistat at the level you wish.

As with many built-in humidifiers, the Good-Bye-Dry unit shown in the photos from Comfort Enterprises, Box 323, Leola, Pa. 17540, doesn't need a humidistat since it only produces moisture when the furnace is operating. However an optional control is available.

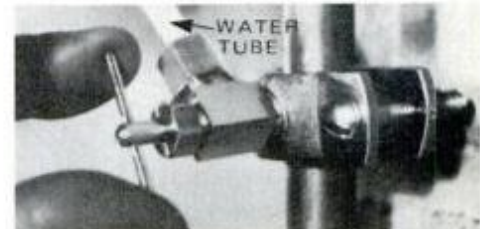
Whether you choose a built-in or portable humidifier, you'll have made a good investment in comfort and protection of furnishings. **PM**



6 Steel mounting rods fit under edges of both sides of the unit for support. Attach rods with mounting screws, slide the unit in place and tighten screw knobs.



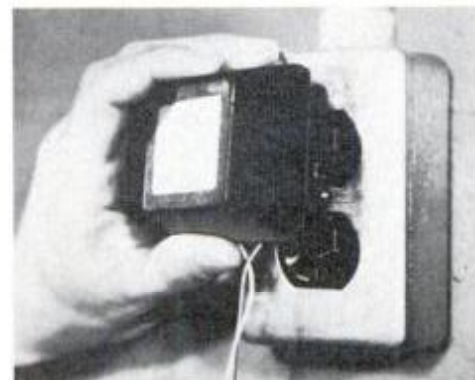
7 Secure the water tubing in the thread of unit's float and valve assembly.



8 Extend tube to nearest copper cold-water pipe. (Steel or brass pipes need drilling.) Attach self-tapping valve and saddle bracket assembly at end of the tube onto water pipe. Turn needle valve handle clockwise to pierce water pipe. To open the valve, turn handle counterclockwise (as with an ordinary faucet). Water will enter the unit and be maintained at the proper level by a float valve.



9 To make the electrical connection, fasten prespliced wires to each terminal on unit by tightening thumb nuts.



10 Kit comes with 20 ft. of wire. Plug in transformer to 110/115-volt outlet.



11 Once installed, the unit will operate automatically with the heating system to provide humidity throughout the house.



For most people, it is just about impossible to have too many mirrors in the house. At least one mirror per room offers obvious functional advantages such as saving steps for last-minute grooming operations. But wise home decorators are also well aware that mirrors can be used effectively to upgrade the quality of decoration—no matter what period your home is decorated in.

For that reason, we have included four distinct designs that are sure to please just about all tastes. Mirror number one is of contemporary styling, and was created with stock half-round molding as it comes from the lumberyard. Number two gives a comfortable, almost whimsical, feeling of contemporary mood because it is fashioned with super-cheap wood lath—straight from the bundle. Our Colonial, shop-made “antique” mirror, number three, is a close replica of the type of mirror you are likely to find in restored villages and the like. Ours duplicates an original right down to its exposed nailheads.

The one that will appeal to the under-25 set is the infinity mirror,



4 handsome mirrors you can build

PM presents four original mirror projects to keep your winter workshop humming.

by Ed Franzese and Harry Wicks



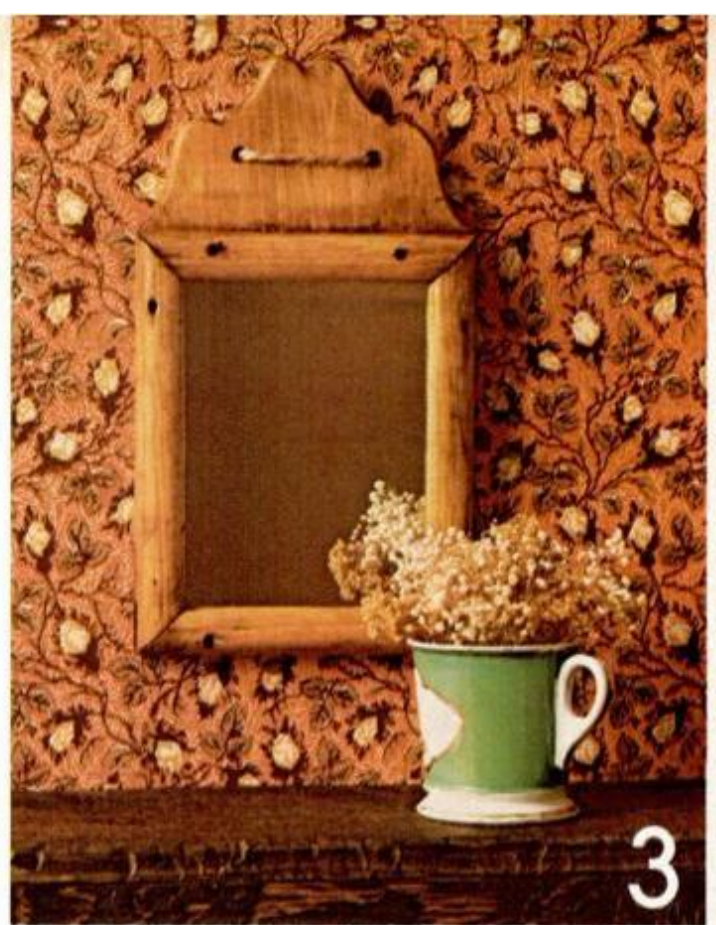
2

1. Elegant contemporary is fashioned of strips of half-round molding glued to plywood. Mirror is 16 in. square.

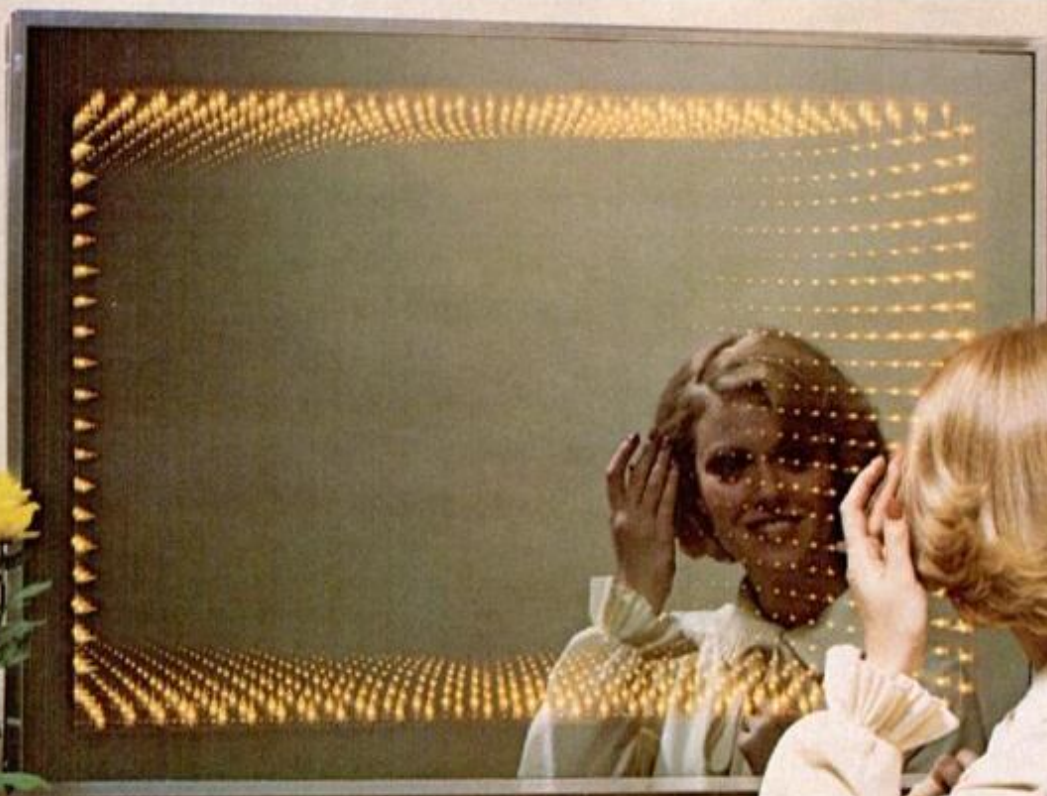
2. The handsome texture in this frame is nothing more than inexpensive wood lath left unsanded. Driftwood (gray) stain is then applied.

3. Replica of an early American frame even includes nailheads left exposed with simulated rust stains.

4. Infinity mirror design duplicates the \$500 commercial versions. Using PM plans, you can build it for about \$75—more easily than you'd think.



3



4

MATERIALS LISTS

1. CONTEMPORARY MIRROR

| Key | Pcs. | Size and description (use) |
|-----|------|---------------------------------------------|
| A | 1 | 1/2 x 36 x 36" plywood (back) |
| B | 12 | 3/4" half-round molding x 8' long (face) |
| C | 2 | 3/4 x 1 1/2" pine (outer frame) |
| D | 1 | 7/16 x 3 1/2 x 72" clear pine (inner frame) |
| E | 1 | 1/2" quarter-round (inner frame) |
| F | 1 | 1/4 x 15 1/2 x 15 1/2" mirror |
| G | 1 | cardboard backer board |
| H | 4 | No. 8 screw eyes |
| I | 6 | 1" No. 8 fh screws |
| J | 1 | 7/16 x 3 1/2 x 24 1/2" pine (hanger cleat) |

Misc.: Glue, sandpaper, finishing nails, satin-finish polyurethane varnish.

| | | |
|---|-------|-----------------------------------------|
| B | 2 | 3/8 x 3/4 x 36" wood lath (outer frame) |
| C | 2 | 3/8 x 7/8 x 36" wood lath (face frame) |
| D | total | 3/8 x 1 1/2 x 144" wood lath (face) |
| E | 1 | 1/4 x 9 7/8 x 9 7/8" mirror |
| F | 1 | 9 7/8 x 9 7/8" cardboard backer board |
| G | 1 | sawtooth picture hanger |

| | | |
|---|---|-----------------------------------------------|
| C | 2 | 1/2 x 2 3/4 x 21" pine (inside frame) |
| D | 2 | 1/2 x 2 3/4 x 32" pine (inside frame) |
| E | 1 | 1/8 x 25 x 35" hardboard, cut as shown |
| F | 1 | 1/8 x 25 x 35" hardboard |
| G | 1 | 1/8 x 21 x 31" mirror |
| H | 1 | 1/8 x 25 x 35" one-way mirror |
| I | 2 | 1/2 x 1/2" x 6' polished aluminum corner trim |

Misc.: 1 pkg. 1 1/4" x 16-ga. wire nails; 1 pkg. 5/8" x 16-ga. brads; 14 No. 6 x 1/2" rh wood screws; 11 No. 6 x 5/8" fh wood screws; 2 3/16" steel washers; 2 50-light Christmas-tree strings, parallel-wired; 3' heavy-duty braided picture wire; 9' extension cord; snap-on, in-line on/off switch; white glue; clear silicone, GE or Dow-Corning; 9 yds. Con-Tact-brand self-adhesive, A-21 black velvet Cushion All 2003.

3. COLONIAL MIRROR

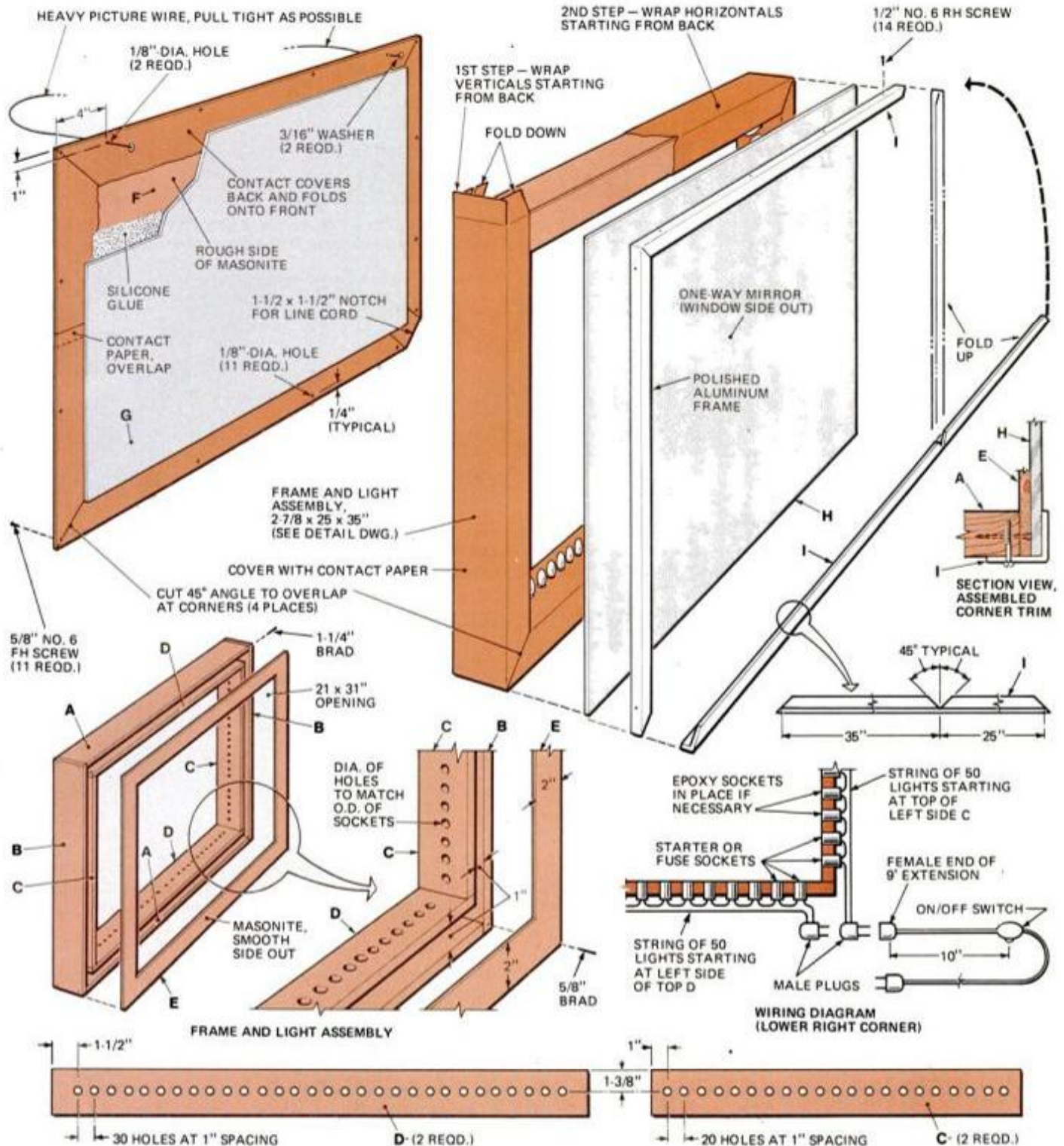
| | | |
|---|---|------------------------------------------|
| A | 1 | 3/4 x 7 1/2 x 13 1/8" pine (back) |
| B | 1 | 1" half-round molding x 40" long (frame) |
| C | 1 | 1/8 x 6 x 7 7/8" mirror |

Misc.: Cord or leather thong, sandpaper, white glue, stain, satin-finish polyurethane varnish.

4. INFINITY MIRROR

| | | |
|---|---|----------------------------------------|
| A | 2 | 1/2 x 2 3/4 x 34" pine (outside frame) |
| B | 2 | 1/2 x 2 3/4 x 25" pine (outside frame) |

INFINITY MIRROR



Workshop tune-up gets more

Periodic maintenance will assure a well-functioning tool when it's needed.

by George Daniels

Photos by the author

The best guide to maintaining any power tool is the owner's manual. Keep yours filed in a safe place and, if you lose it, send to the manufacturer for another. Specify the age, model number and any other descriptive information you can find on the tool.

For discontinued tools, use the following know-how to help diagnose and cure tool troubles that may have developed and avoid troubles that haven't.

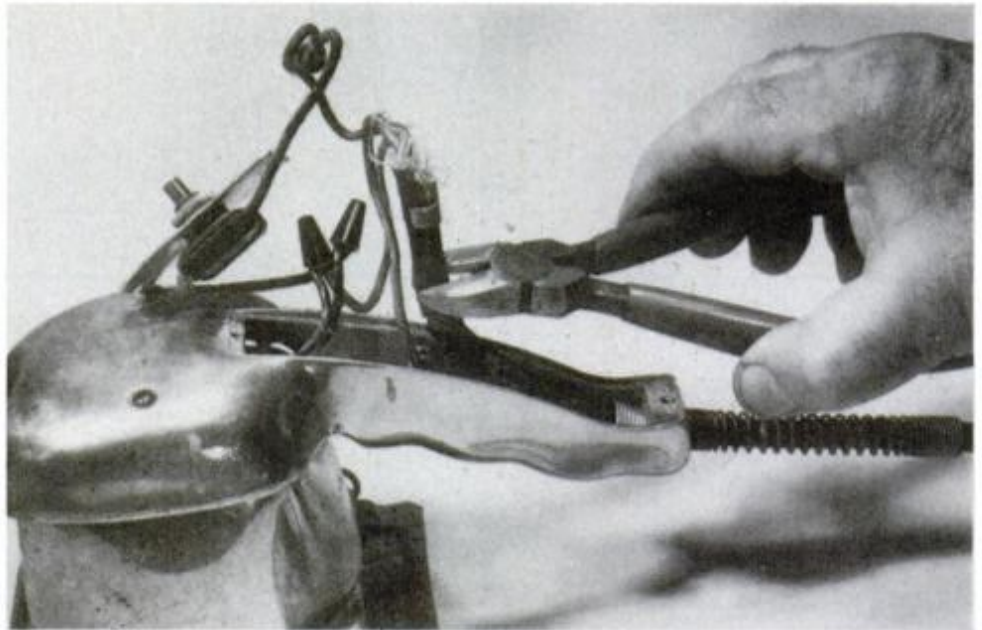
If your tool is an orphan for which needed replacement parts aren't available from the original source, look in a classified telephone directory for suppliers of the same type of item. You can often match bearings, motor brushes, toothed drive belts and other essentials this way.

Lubrication rules of thumb

Locate all oil holes and occasionally feed them a few drops of light oil like 3-In-One or No. 20 engine oil. Self-lubricating graphited sleeve bearings need oil too, and many have oil holes. If not, put a few drops on the shaft at the end of the sleeve so it can work in; wipe off excess. Do not oil sealed-for-life, grease-packed ball bearings. The oil may leach out of the grease and wreck the bearing. Finally, don't overlubricate; oil may seep out and form a sticky mass of oil and dirt that gums up the works.

Stationary power tools

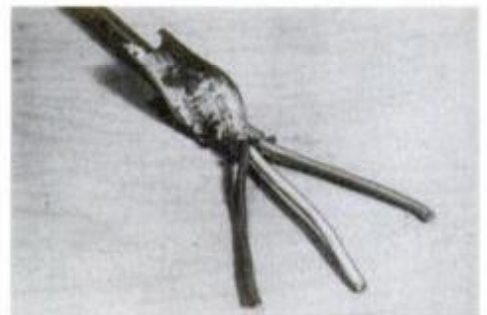
■ **Table saws:** If you've neglected a table saw or any other tool with a cast-iron table, its ground surface may have rusted—especially in a garage workshop. Remove rust from the surface and grooves with a rust remover. Wear gloves and goggles and follow the directions on the label. For added luster, rub the surface with 220-grit aluminum oxide paper. (In woodworking, rust removal is essential to keep rust from transferring to the work, which may cause finishing problems.) Protect the restored table with an oil film or rust-preventive lubricant.



1 To replace a frayed power-supply cord that enters a tool through the handle, clip it off near the end, but leave the connections intact for future reference.



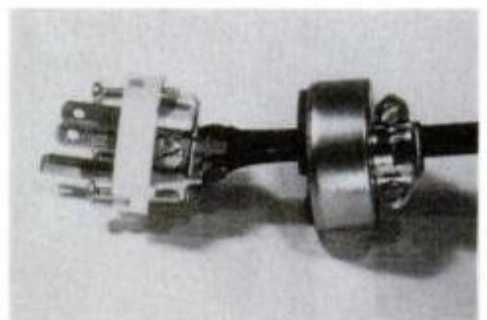
2 Make a slit in new cord's cover and bare enough wire to make connection. Trim off excess cover with scissors.



3 Note wire colors in new cord. Strip and connect wires to motor leads and ground; use original connections as guide.



4 Use screw-on connectors or pigtails and tape insulation when rewiring. Fold wires into handle to avoid pinching.



5 Use three-prong plug with new three-wire cord to help assure grounding. Screw clamp, on plug shown, grips cord.

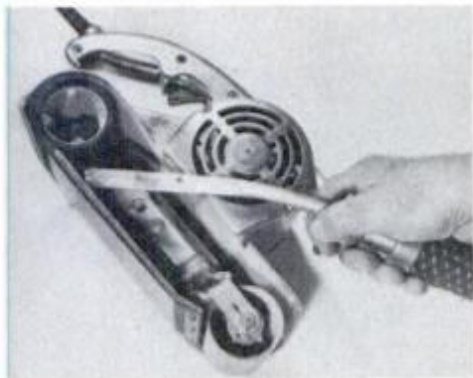
To check your table saw's tilt control, first thoroughly vacuum-clean the unit. Set the control at zero, raise the blade to maximum height and place a try square on the table against the blade. If the blade isn't square with the table, adjust the stop under the table.

Keep your saw's motor clean since sawdust can foul the centrifugal

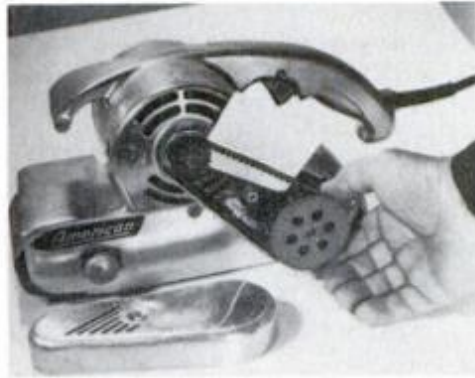
switch that changes over from starter winding to running winding. If it sticks in the starter position, it can burn out the winding. If it sticks in the running position, the motor won't start.

Check belt drive tension. You should be able to push the belt inward $\frac{1}{2}$ in. on short spans and about 1 in. on longer ones. Minor

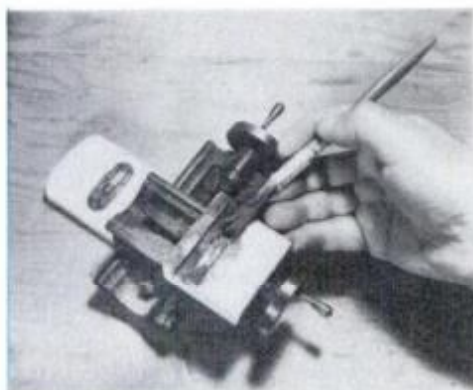
mileage from your tools



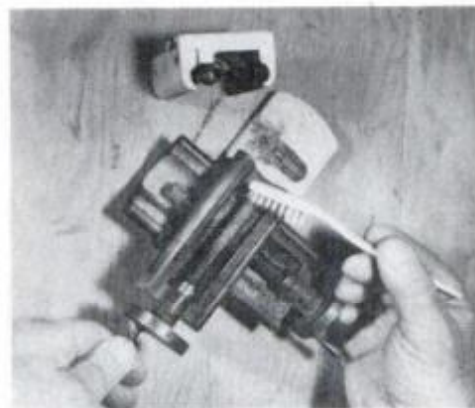
Vacuum-cleaner snorkel made from ½-in.-dia. soft copper tube partly flattened at end can clear dust from tight spots.



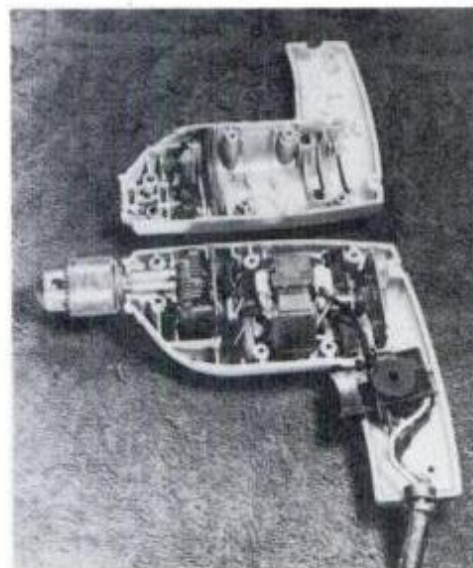
To inspect toothed belt, put white card behind it and turn drive sprocket. Look for frayed belt edges, ripped teeth.



Clean slide ways and toolpost mount of lathe's compound rest with stiff brush. Lubricate ways whenever lathe is used.

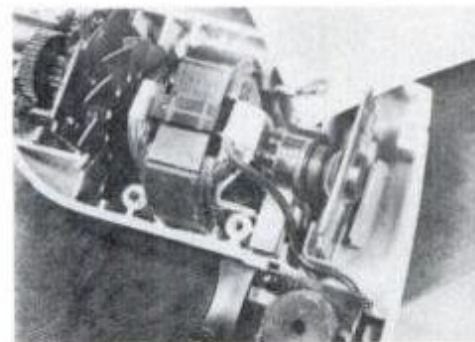


Brushing with toothbrush cleans metal chips from feed-screw threads. Then turn screw holding brush to threads.



slippage can be cured with a belt dressing like Woodhill Chemical's Belt Grip. An overtight belt doesn't last long and increases bearing wear.

Be sure the blade is sharp. A dull one increases bearing and belt wear because of the heavier load and longer running time. It also increases the chance of the work being kicked back at you.



Old towel spread on bench when you open power tools keeps small parts from rolling away (left). Observe how parts go together and watch for springs that may pop out. Clean commutator (shown at card corner above) with fine aluminum-oxide abrasive. Hold abrasive to commutator; turn fan; blow to clean off dirt particles.



Ring connector (see preceding photo) is fitted into top of holder (above photo, right) to supply current to brush through spring. Brushes supply commutator.

■ **Radial-arm saw:** To cure out-of-square end cuts, use a try square to check squareness with the table. The means of adjustment varies, but is likely to be two bolts at the side of the bevel latch. Loosened, they permit tilting the motor until the blade is exactly flush with the square. Tightened, they hold it that way.

Saw travel should also be squared with the guide fence. Make a trial cut through a wide board with a dressed edge against the fence and check it with a carpenter's square. If it's out of square, the saw track isn't perpendicular to the fence. To realign, first loosen the track arm clamp handle and lay a steel square on the table with one edge against the fence. Then pull the saw carriage slowly across the table to see how much and which way the travel is untrue.

The adjustment is usually on the miter latch, often a hex nut and setscrew or cap nut. Try adjustments carefully. The hex nut may automatically swing the track arm left or right, depending on the way it's turned. When you're satisfied, tighten the setscrew or cap nut to hold the new setting. There are also other adjusting arrangements; read your manual carefully.

Saw "heeling" may occur even when the track arm is square with the fence. This means that the teeth at the back of the blade are not following the kerf made by the teeth at the front. You feel a drag when you make a cut. Check it by making a cut into a board, but without pulling it past the board. If the saw is heeling, you'll see tooth (heel) marks at one end. Viewed from the front, heel marks on the right mean the back of the blade should be shifted to the left. Marks on the left call for shifting the rear of the blade to the right.

To adjust for heeling, loosen yoke clamp handle and swivel adjustment bolts. The lock bolts are often under a cover plate near the swivel latch. Turn the yoke as required, tightening and testing, until the heel marks vanish. Then tighten the yoke clamp handle, followed by the bolts. On some saw models, heel-correcting adjustments are at the yoke's motor-pivot point.

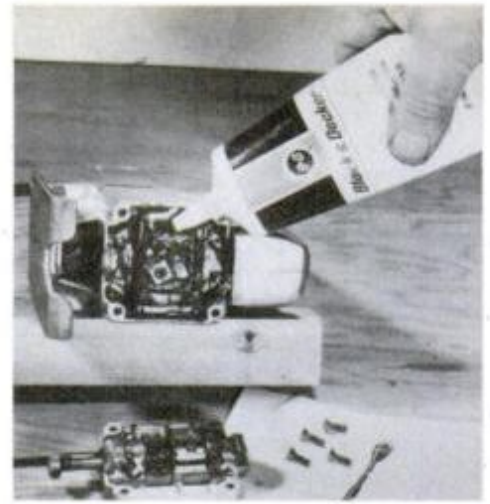
■ **Drill press:** Since most drill-press motors in recent years have sealed bearings, only quill and feed lever mechanisms are likely to need oiling. If there's play in the quill



Brushes can be checked and changed in some tools like this Sears circular saw without opening the motor housing. Caps unscrew to allow brush removal.



Mark brush and spring clip with penciled X on one side so both can be replaced in original positions when reassembled. (Penciled mark will shine on brush.)



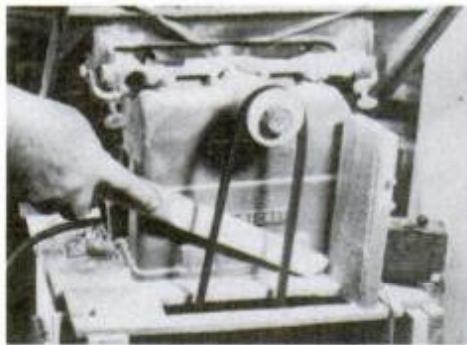
Intervals between regreasing gears of circular saws and reciprocating unit of sabre saws vary with make and model, but range from 100 to 200 hours of operation.

from wear (not likely with average use), look for a wear adjustment bolt. Some drill presses have it. Check the drive belt for correct tension as described for table saws. The tension can be adjusted by moving the motor and retightening the mounting bolts.

■ **Bandsaw:** Check your saw adjustments starting with the blade by opening the upper wheel guard. If the blade is not centered on the wheel tire, use the tilting adjustment to tilt the wheel in or out until it is. Test by turning the wheel by hand with the drive pulley removed. Next adjust the blade tension. If your saw has no tension scale, adjust the tension handle at the top until the blade allows a side flex of $\frac{1}{4}$ in. on a 6-in. span between upper and lower guides. Set the upper guide far enough above the table to provide the span.

Prior to tensioning, be sure you have proper clearance between the blade and the guide pins in the upper and lower guide assemblies. For most blades, the distance between the guide pins and the blade is .002 to .003 in. Refer to your manual. You can get this clearance by placing pieces of medium-weight paper between the loosened pins and the sides of the blade, then tightening the pins in place against the paper. When the paper is pulled out, the proper clearance remains. Be sure upper and lower pins are in line so the blade isn't pushed out of vertical. Pins should be adjusted to come just behind the blade teeth. If they touch the teeth, they'll dull the blade. If they're too far back, they won't be able to guide the blade adequately.

The blade support (ball-bearing wheel behind the blade) should be set $\frac{1}{64}$ in. from the back edge of the blade. If it runs in constant



Clean sawdust from table saw with vacuum. Dirt can pack against stops and affect depth of cut and angle-cutting accuracy.



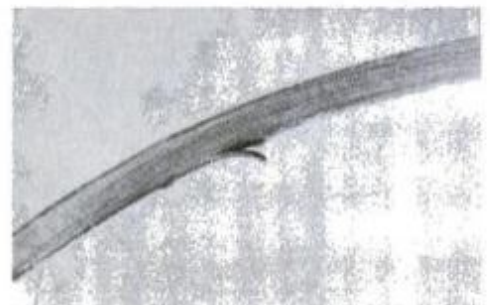
Clean rust from tool tables and lathe ways with rust remover. The right side of this saw table has been restored.



contact with the blade, it may cause case hardening and eventual blade breakage. With proper clearance, it runs in contact only when work is pushed through the saw. Tires on bandsaw wheels last almost indefi-



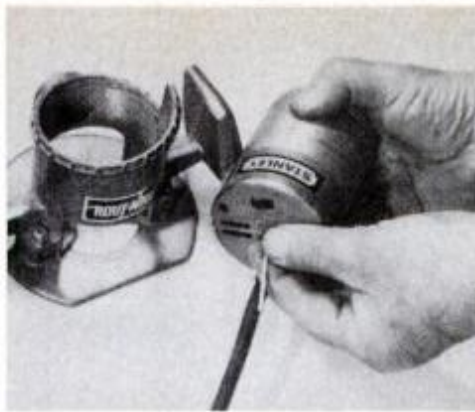
Swing cover plate clear to get at wick-packed opening for lubrication of shaft bearing on some saw models (left). Saturate wick, but don't over-oil. Reduce dust in motor with cardboard guard panel cut to fit around belt (shown above) and second panel cut with vent holes to cover front (not shown in photo).



V-belt is beginning to break down. Get longer use from belts by releasing tension when tool isn't in use. Check for chafing.

nitely as long as you keep them clean. If they're scored slightly from long use, dress them down a little with coarse sandpaper.

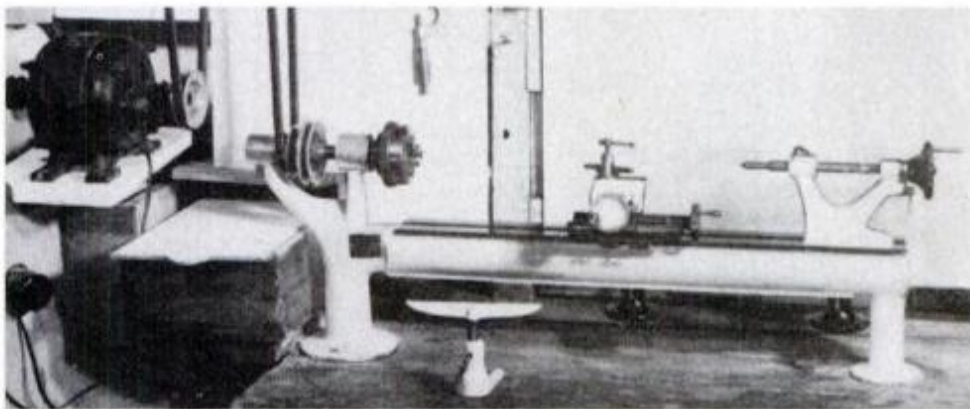
■ **Lathe:** The wood lathe is equipped with heavy-duty headstock



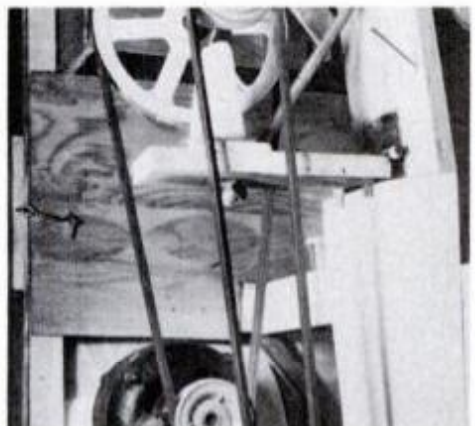
Use toothpick to remove dust blockage from clogged oil holes. Don't push it in deep or you'll push in dirt, too.

bearings because of the loads imposed. They may be roller, sleeve, or cone types requiring lubrication, or sealed "lifetime" ball types that require no additional lubrication. Follow the lube guide given earlier.

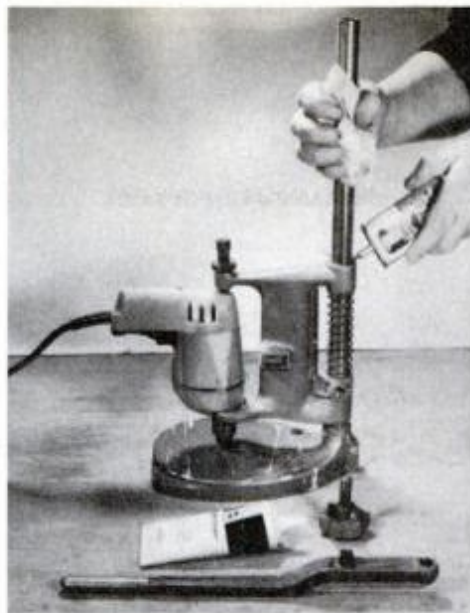
The lathe bed ways (smooth-ground upper surfaces) and those of the compound rest (if the lathe has one) all require an oil coating for rust prevention and for lubrication since they are precision parts. Feed screws in the compound rest and tailstock also require oiling. For belt maintenance and tension, see suggestions given earlier for belt-driven tools.



Well maintained 40-year-old lathe and motor are in fine shape. Weight of motor on hinged platform tensions belt to overhead jackshaft. Belt from jackshaft to lathe is tensioned by adjusting screw to reduce drive-belt load on bearings.



Hinged jackshaft platform is adjusted by tightening or loosening nuts on either end of 1/2-in.-dia. threaded rod.

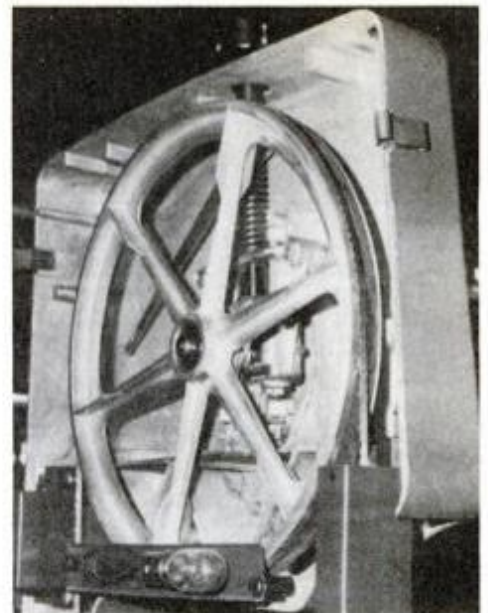


Use light oil to wipe rust-protective film onto drill-press column; use gear grease on the feed-lever mechanism.

Check the bed with a level at both ends. If any twist in the bed is indicated, use shims under the mountings to correct it.

Portable power tools

■ **Power drills:** Most power drills are easy to service. In "clamshell" form, the drill housing separates in two halves when assembly screws



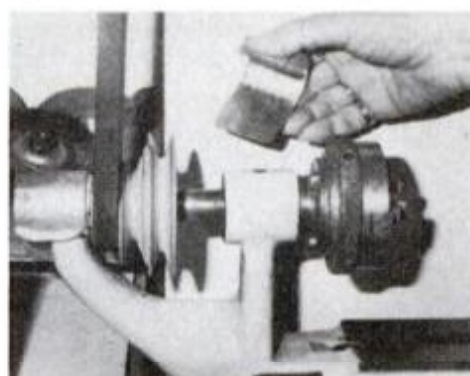
Bandsaw blade should be centered on tire, using wheel-tilting adjustment. Guard cover has been removed for photo clarity.

are removed. All internal parts are then exposed, including the grease in the gear case. The grease should be replaced after 100 to 200 hours of operation, or by a rule of thumb that calls for grease replacement after the second or third change of motor brushes. Scoop out most of the old grease with a screwdriver and wipe out the rest. The amount that comes out is a guide as to how much new grease you should put in, plus a little extra for the wiping cloth.

Use oil on the chuck shaft and in the rear motor bearing hole. The grease should be a tool type, formulated with enough viscosity not to work from the gear case into the motor. Black & Decker, Skil, Stanley and others offer such lubricants. They're sold in tubes and have a consistency like soft margarine. If the tool has a worm-gear drive, be sure the grease is suitable. Some companies make a special worm-gear grease. Don't use a free-flowing type like outboard motor lubricant.

On most tool motors, brushes should be replaced before they wear down to 3/16 in. in length. Any shorter, and the brushes may jam and break. They're easy to get at on most portable tools. In clamshell drills, they're in removable brush holders on opposite sides of the commutator. Change them in pairs, but take them out and replace them one at a time so the brush still in place serves as a guide for replacing the other. Try to hold the brush and holder together with your fingers so the brush contact spring won't shoot the parts around the room. If you can't match a set of brushes for

(Please turn to page 136)



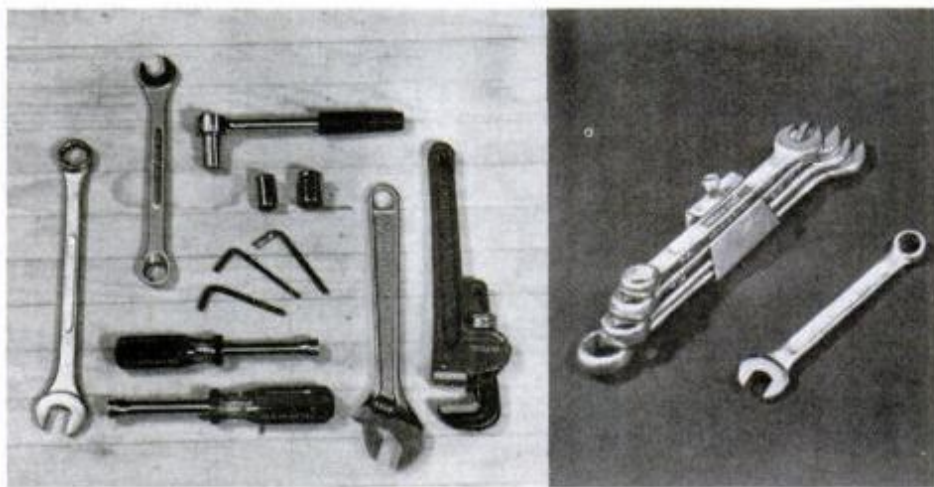
Make a cover to protect oil holes close to sources of sawdust or metal particles. Snap-on sheet-metal cover (shown in hand) is used over lathe headstock bearing. Cover lathe bed ways when grinding.

WORKSHOP MINICOURSE

WRENCH BASICS

Since wrenches are used for tightening and loosening, you will need one on any job where nuts and screws are used. Manufacturer's now offer a wide variety of wrenches to suit just about any task imaginable. But for most homeowners, a set of combination open-end/box wrenches is the wisest first-wrench purchase.

Though wrenches are hand-powered, you are well advised to use them safely. If you use an over-size open-end wrench on a frozen nut, for example, there is a strong possibility of the wrench slipping and your bashing your knuckles. Thus, the first two safety rules are: Choose the right wrench for the job, then use it as shown here.



Typical wrenches, starting at 12 o'clock: Hand socket, pipe, adjustable, nut drivers, open-end and box combination; in center, assorted Allen wrenches. Combo set, right, has five wrenches sized 3/8, 7/16, 1/2, 9/16 and 5/8 inches.



Wrong. Oversize box wrench will round nut corners and make it nonremovable.



Right. Correct size fully engages nut and will not slip off under pressure.



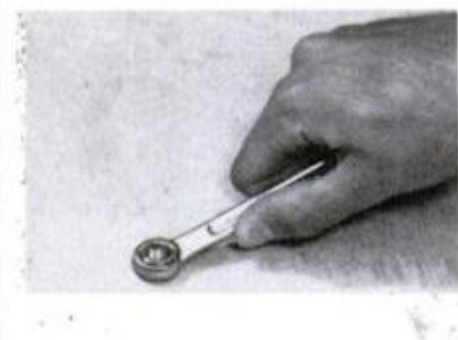
Wrong. You should never push on a wrench because a slip could mean a fall.



Wrong. Oversized open-end wrench will slip off, cause severe knuckle damage.



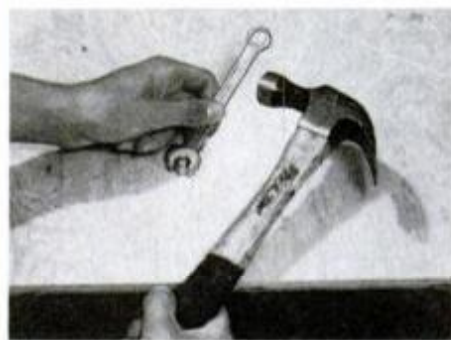
Right. Nut is fully seated in wrench; both wrench and nut will be spared damage.



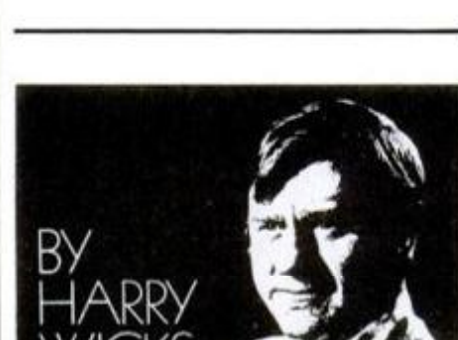
Right. Try to position yourself to pull whether loosening or tightening.



Wrong. Never use a pipe or other extension to increase wrench leverage.



Wrong. Never strike wrench with hammer unless it is of the striking-face type.



BY
HARRY
WICKS

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White sidewall tires and wheel covers shown are extra-cost options.

AMERICA'S FASTEST GROWING TRUCK COMPANY.

And between 1967 and 1977, Dodge Truck sales grew 357 percent. That's a lot faster than Ford's, Chevy's, or GMC's. Come and see your Dodge Dealer about buying or leasing a pickup. He can show you the base short wheel-base model with the lowest manufacturer's suggested retail price in America* (exclusive of destination charge). He'll help you get more pickup than you bargained for.

*Six-cylinder D100. Not available in California.

DODGE IS INTO TRUCKIN' LIKE AMERICA'S INTO JEANS.



"HEY, THAT'S MY DODGE."



New techniques promise super sounding audio

by Hans Fantel



New metal tapes and digital recording promise delightful sounds within a few years.

Forecasting, as any weatherman will tell you, is a risky business. But I'll lay heavy odds that two radically new recording methods will determine the shape of audio for the rest of this century.

These new techniques—"metal" tape and digital recording—have now reached the hardware stage and were lustily sounding off at the most recent Consumer Electronics Show in Chicago. The two are rivals and only one may ultimately survive when they hit the market in the near future.

The chief aim of both recording methods is to break the one remaining bottleneck in audio fidelity—dynamic range. This is the span between the loudest and softest sounds that can be put on a recording. In live music, the loudness range is about 90 decibels (db), yet even the best current recordings give you only about 40 db.

Several video tape recorder makers offer add-on devices for two-channel digital recording.



The lower limit is set by the inherent background noise of the tape. You can't record sounds so soft that they're swamped by tape hiss. Dolby noise-suppressors help, but they don't silence the background completely.

As for the upper limit, it is set by the magnetic properties of the tape material. Loud sounds magnetize the tape to the point of saturation. If you make the signal louder, it won't register properly and the sound distorts. To overcome these

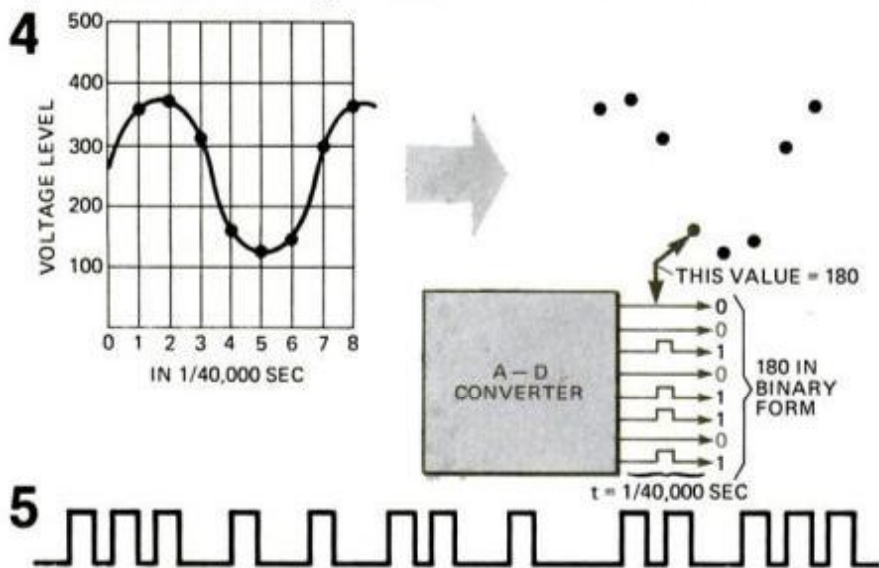
limits, the 3M Co. of St. Paul, Minn., has developed a new kind of tape capable of taking far stronger magnetic impulses. The other solution to the problem—more complex and more far-reaching—is digital recording. The two approaches are totally different and we'll examine them one at a time.

Metal tape

At first glance, an improved tape may seem a modest innovation. But, unlike the many tape formulations

Digital recording highs and lows

Randomly dispersed molecules of air are first shown (1). Sound causes a wave through the air similar to a wave through water (2). An oscilloscope (3) displays sound waves as a function of voltage level (the amplitude or volume of the sound) plotted against their frequency (number of complete sound waves in a set time). The wave is sampled every 1/40,000th of a second and each point assigned the value of its voltage (4). An analog-to-digital converter changes this value to a binary number—eight on-off values (5). Two audio tones represent these on-off binary components, and can be taped.



Metafine tape from 3M is first to use pure metal, not oxide, coating. On proper equipment, it can give unequalled response.

that, step by step, have upgraded tape performance to its present standards, 3M's new tape—to be marketed under the trade name "Metafine"—uses an altogether different type of magnetic particle to hold the sound. In the past, all tapes used metal *oxides*, either ferric or chrome. The limitations of such tapes stem from the inherent nature of these oxides. The new tape, by contrast, uses *pure metal* instead of oxides. This enables the tape to accept magnetic pulses more readily and hold them better, and results in superior frequency response and far greater dynamic range.

The advantage of "metal" tape—as the new type is generically called—has long been known. For years it was an open secret that, in addition to 3M, major firms like Philips in Holland and Fuji in Japan were pushing the development of such tapes. But everyone kept stumbling over difficulties.

One trouble is basic geometry. Large objects have small surfaces



relative to their volume, and vice versa. The pure metal grains that form the working parts of the new tape are very small (about 16 millionths of an inch in length and 3 millionths in thickness) so their relative surface is huge. As a result, they oxidize rapidly when exposed to air, undergo spontaneous combustion and burst into flame.

3M keeps very quiet about how they got around this, while their competition, presumably, is still

putting out small fires. The company has plenty of experience with all kinds of sticky coating materials, so my guess is that they somehow manage to seal the tiny flammable particles into a goo that keeps them from contact with air.

I heard the new tape played on 3M's own fancy equipment, and the result is truly remarkable. The bass convincingly reaches down to the very bottom, the highs sparkle, and the ultrasharp transients seem etched into the air. Above all, the expanded loudness range and quiet background give the music a startling dramatic impact. These impressions tally with the specifications for the new tape—a dynamic range 7 db greater than that of the best current tapes throughout the frequency range. It was the first time I ever heard a cassette sounding better than the best disc recordings!

The long-range implications of this single fact are enough to upset all kinds of audio appercarts. Ultimately, cassettes are likely to replace discs as the preferred medium for top-fidelity recordings.

There is, though, one big hitch. The new tape is only partly compatible with current cassette decks. It will play on some present equipment, but you can't record on it. Metafine tape requires higher bias and erase currents than present tapes. Moreover, the heads of present decks can't accept these high currents without magnetically saturating, so the heads have to be redesigned, too. At present, only one cassette deck—the Tandberg TCD 320, selling for \$1300—can record on Metafine, along with conventional tapes.

But 3M isn't worried, and plans to introduce the new tape almost immediately at a still undisclosed price. "When chrome tape first appeared a few years back," a 3M marketing executive told me, "it didn't take long for equipment manufacturers to come up with the right decks for it. So, if history repeats itself, the audio industry will adjust to Metafine just as fast."

He may be right. Just about every deck manufacturer is working around the clock to ready new models for Metafine. A few technical standards still need to be set, but, barring basic snags, Metafine decks in various price classes should be hitting the stores by mid-'79. Meanwhile, a well-known classical record company, Connoisseur Society, has already announced plans to produce



Tandberg's TD 20A (shown) and the cassette version, TCD 320, are—as this is written—the only machines that can record on Metafine tape. Other manufacturers are expected to get into the act soon. Tandberg's reel-to-reel sells for \$1300, while cassette deck is priced at \$650.

prerecorded Metafine cassettes which can be played on any deck—new or old.

Digital recording

The other attack on the present limits of audio—digital recording—is more radical, using a technology taken from the computer sciences.

Up to now, all audio recording operated on the analog principle: The actual sound wave was represented mechanically in the record groove, but a waveform can never be reproduced with absolute accuracy. This method is also troubled by background noise originating in the tape or disc itself. Digital recording gets around both these drawbacks.

At the last meeting of the Audio Engineering Society in New York City, a leading audio expert put the whole development in perspective: "A generation ago, the computer industry recognized the advantage of digital over analog techniques. The development of miniaturized, high-speed solid-state circuits in recent years now enables the audio industry to follow a similar path."

Digital systems can be defined as devices in which information of any kind (sound, images or alphanumeric data) are stored, transmitted or processed in the form of electrical pulses which represent numbers. Applied to music, this means that all audible frequencies and loudness levels are encoded as binary numbers, which computer circuits can handle. Translated into binary numbers, the signal becomes immune to noise and distortion, for numbers permit no ambiguity.

Putting it another way, the digital part of a recording system is incapable of telling a musical untruth. Frequency response and dy-

namic range—those tough challenges for analog recording systems—are no problem here. If you want wider frequency or loudness range, all you have to do is assign the extra numbers to represent the added information. The diagram on the facing page shows just how the digital equipment encodes a musical waveform.

Digital recording for the home is pushed mainly by the Japanese companies making home video recorders (VTRs). With their enormous recording bandwidth (about 3 MHz—3 million cycles per second—are needed to record video), VTRs can easily handle all the "bits" of numerical information that represent musical frequencies and their loudness levels. After all, it takes "only" about half a megahertz (500,000 cycles per second) for digital sound recording. So, naturally, Sony, Technics, JVC and Mitsubishi recently came up with special adapters that convert their VTRs into two-channel audio recorders.

The sound I heard from these ingenious gizmos can only be called superb. Still, I don't foresee digital recorders in their present form as household items. For one thing, outside of "live" music played by flesh-and-blood musicians, I know of no program source "clean" enough to justify the use of such a recorder. For copying records or taping off the air—program sources already "contaminated" by the usual technical bottlenecks—a conventional analog recorder will do just as well.

Besides, a \$1000 VTR may be affordable to some, but I don't see many audio fans shelling out another \$2000 or more for the digital audio adapter.

For the time being, digital re-

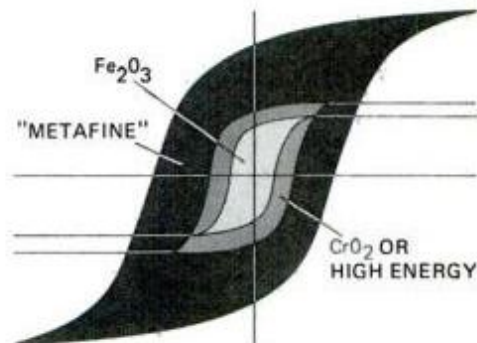
ording may appeal mainly to studio technicians for making master tapes of the highest possible quality. Among major record companies, it seems to be catching on fast. It's hard to believe that there is a long waiting list for 3M's 32-track digital studio recorder, which carries a price tag of \$150,000!

Could be in homes soon

Even so, digital audio may find its way into the home a lot sooner than most of us anticipate. The video disc—already in an advanced stage of development—may hit the market almost any time.

Like all other video recording media, the disc has a multi-megahertz bandwidth. This enables it to carry digital sound as well as video. Panasonic created quite a sensation at Chicago's Consumer Electronics Show last summer with an audio version of its proposed video disc. Spinning at 450 rpm, it held 30 minutes of stereo music per side. Panasonic predicts that a single playback unit, capable of handling both video and digital audio, will sell for about \$500.

In addition to Panasonic, a whole pack of competing companies are jumping on the fast-approaching video-disc bandwagon with various—and mutually incompatible—systems. Some, like RCA and Panasonic, use mechanical scanning by means of a stylus tracing a groove, as in a regular record. Others (notably Philips and Mitsubishi) use ultrasharp, wear-free laser beams to



A hysteresis loop shows how Metafine holds more of a magnetic charge than either iron oxide or chromium dioxide coatings used on present tapes.

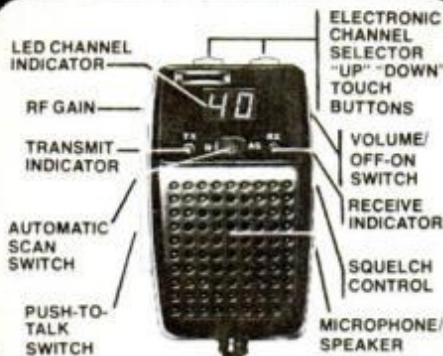
read out digital information.

All of these systems will be usable for digital audio as well as video, and their competitive race for a possible billion-dollar market will eventually bring down the price. At that time, the digital disc will emerge as a realistic rival to the Metafine cassette as the leading medium for top-fidelity sound. And it's *you* who will make this ultimate choice.

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14 CHRISTMAS DECORATIONS

(Continued from page 77)

awl and glue wire. Seal, prime and spray paint. Glue leaves and apples in place.

3. Tree candleholder centerpiece

Materials: 3/8-in.-dia. dowel (2 pieces 4 3/4-in. and 4 pieces 3 in.); 1 block of wood 4 3/4 in. sq. x 10 in.; 4 blocks 4 in. sq. x 10 in.; 2 blocks 3 1/2 in. x 6 in.; sealer; primer; green spray-enamel paint.

1. Glue up wood to create blocks (see materials list) for turning.
2. Turn blocks in lathe as indicated to make two small trees (S), four medium trees (M) and one large tree (L).
3. Bore candleholding hole while tree is in lathe. Or clamp tree to drill-press table to bore hole at center.
4. Bore holes for dowels on tree bases as marked. Use scrap wood beneath each tree plus hand screw clamps to assure tree being level (90° to drill bit).
5. Seal, sand and then finish by applying several coats of green spray enamel. Sand lightly between coats and wipe with tack cloth before applying next coat.

4. Rocking chair ornaments

Materials: 1/2-in. basswood; 5, 1/16x2 1/4-in. dowels for back; 2, 1/16x2 1/4-in. dowels for back; 4, 1/16x3/8-in. dowels for arms; 4, 1/2x1 1/2-in. dowels for legs; 2, 1/16x7/8-in. dowels for leg crosspieces; white glue; sealant; primer; spray enamel and bottled enamel paints.

1. Cut all dowels and basswood pieces. Sand edges smooth.
2. Use an awl or nail to bore holes for attaching dowels on chair back, arms, seat (top and under sides) and rockers.
3. Glue the two long dowels at the ends of the chair back with the five shorter dowels in between. Let the glue set several minutes and glue these dowels to the seat.
4. Glue the arm dowels into the arm and glue this assembly to the back and seat.
5. Glue the rocker assembly together. Let it set somewhat, then glue the cross dowels in place.
6. Glue the rocker and seat assemblies together.
7. After glue dries, seal, prime and paint following general painting directions.

5. Candy cane candleholder

Materials: 1 1/2x7-in.-dia. pine base; 1 3/8-in.-dia. dowels; 3/4-in.-dia. dowels; 7 small baby food jar lids; Permabond-Super Glue; Sherwin Williams Marvethane satin polyurethane varnish; primer; green and white spray enamel paints; 1/2-in.-wide red vinyl tape.

1. Cut pine base. Mark off dowel placement and bore holes 1/4-in. deep. Sand base smooth.
2. Cut dowels to size. Varnish and paint dowels white or leave natural as indicated on plan. Wind red vinyl tape around white dowels for candy stripe effect.
3. Glue dowels into base.
4. Spray paint jar lids green, glue lids in place, add candle cups and candles.

6. Wall sconce

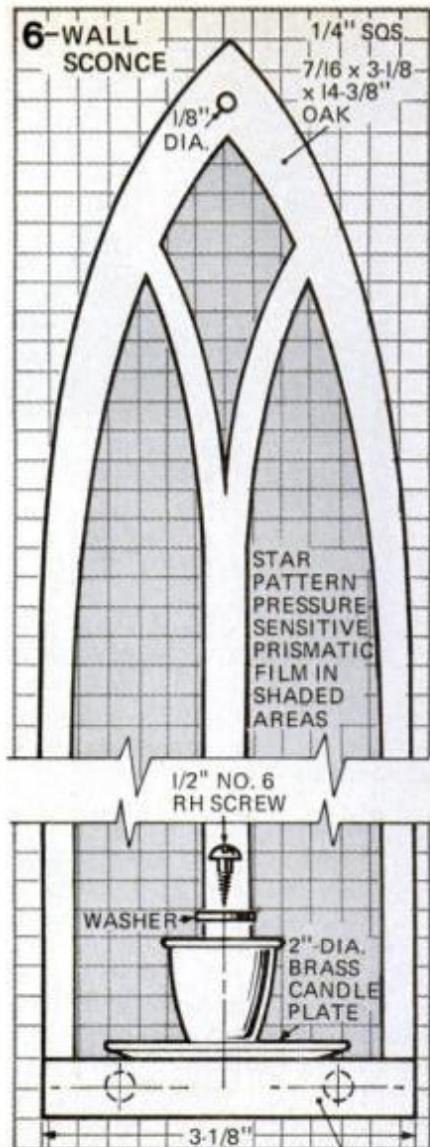
Materials: 7/16-in. oak or other hardwood; prismatic film; 3/8-in. brass candle cup and 2-in.-dia. brass candle plate; 1/2-in. No. 6 rh screw and washer; 2, 1-in. No. 6 fh screws; dark wood stain; polyurethane clear finish; white glue. See Shopping Information to order kit.

1. Cut wood pieces, stain and apply finish.
2. Mark prismatic film patterns on backing, checking that star patterns coincide on longer film cutouts. Use utility knife to cut.
3. Trace window outlines lightly on wood for proper placement. Peel off backing and press film; it will adhere instantly.
4. Attach the base to the back with glue and screws. Secure candle cup and plate. Bore hole to hang sconce.

7. Balloon ornaments

Materials: gutter strainer; 1x1 3/8-in. dia. dowel; 1-in.-wide colored vinyl tape; white glue, acrylic paints in several colors; Christmas tree hook; adhesive mailing label to make top flag.

1. Cut dowel to length.
2. Shape gutter strainer around dowel.
3. Secure with white glue and colored tape.
4. Hand-paint decorations on strainer band and vinyl tape.
5. Attach Christmas tree hook. Glue on mailing label and cut to flag shape.



7/16 x 3-1/8 x 4-1/2" CANDLE REST; FASTEN WITH 1" NO. 6 FH SCREWS THROUGH BACK

8. Veneer ornaments

Materials: Colored veneers (see Shopping Information)—white, blue, red, green, yellow, purple, gray, orange, pink (or color white with pink felt-tip pen); 1/4-in. plywood; white glue; off-white or other complementary color paint for plywood back and edges; clear spray lacquer.

1. Make drawings (see plan).
2. Cut three pieces of 1/4x3 1/2x6-in. plywood for Christmas tree, large bulb and church. Cut three pieces of 1/4x4x4-in. plywood for Santa, small bulb and star.
3. Cut and apply background veneers to the plywood: green (tree), blue (large bulb), orange (church), red (Santa), green (small bulb) and leave the star blank. To apply veneer lightly and evenly coat the plywood with white glue. Press down the veneers and weight or clamp. Don't clamp directly on the veneer—protect it with scrap wood.

Also cut five points and center for star. Glue center in place and weight or clamp until dry. Glue points one at a time, pressing until dry.

4. While panels are drying, cut out veneer overlays for all decorations. Cut with several passes with the point of a sharp utility knife. Cut small discs with paper punch for Santa's eyes and tree decorations.

5. When dry, cut out star along outside lines with a coping saw. Glue on center disc. Remove other panels from press and sand veneers smooth with medium, then fine-grit sandpaper. Use carbon paper and pencil to trace outline of church, tree, Santa and two bulbs on appropriate panels. Cut along outline of each design with coping or jigsaw. Apply veneer overlays to each decoration with very thin coat of glue, allowing it to become tacky before pressing into position. Apply clamps or weights.

6. When panels are dry, carefully sand edges (Please turn to page 121)

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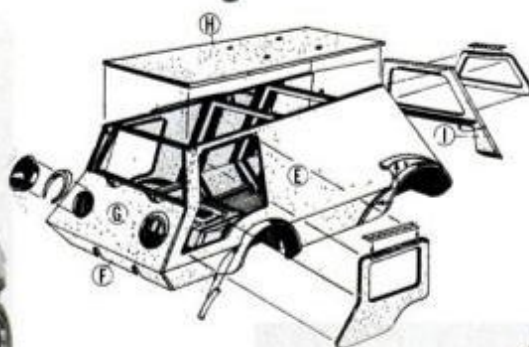


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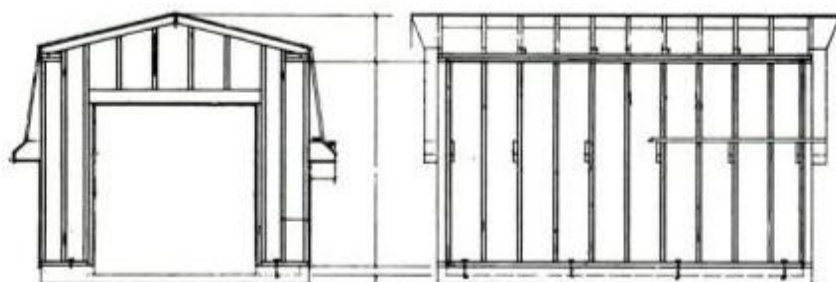
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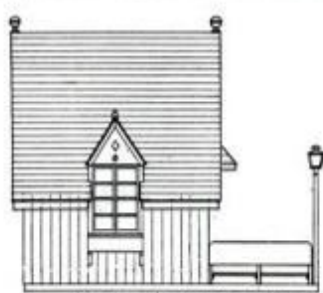
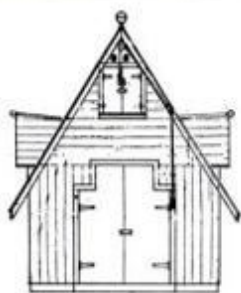
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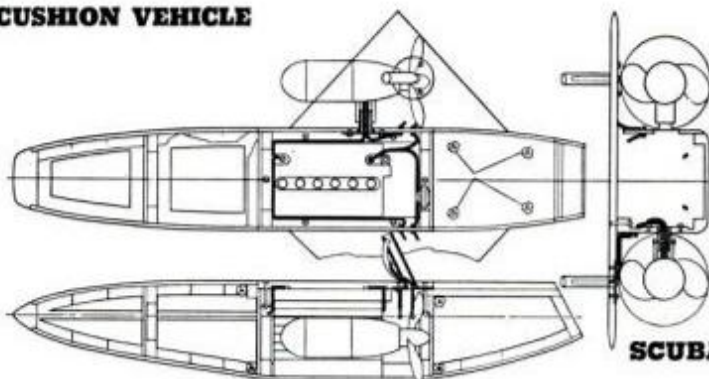
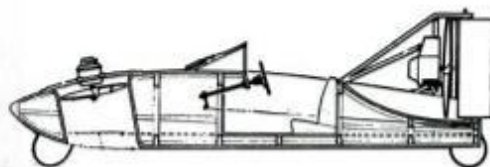
AND UNDER THE SEA



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14 CHRISTMAS DECORATIONS

(Continued from page 116)



Balloon ornament is gutter strainer shaped and taped around a 1x3/8-in.-dia. dowel.

and apply several thin coats of spray lacquer.
7. Carefully paint edges and back of ornament and bore a 1/16-in. hole in each to hang.

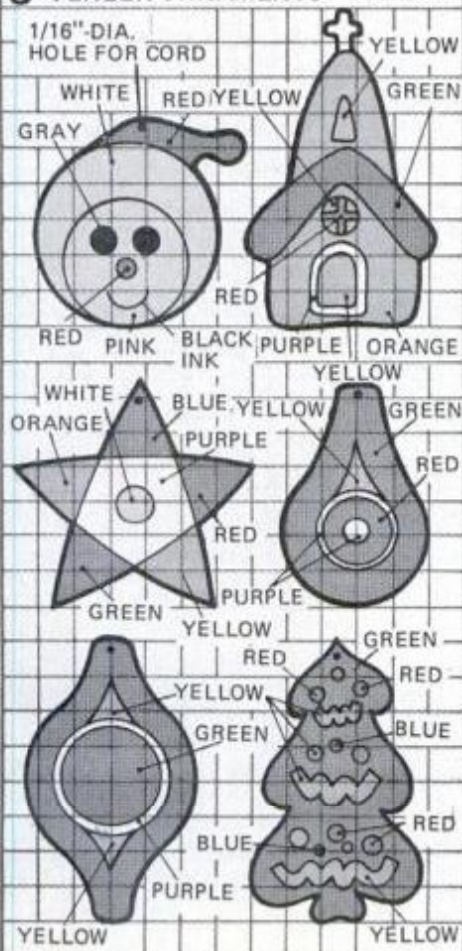
9. Top ornament

Materials: 1-1/16x2 1/2-in.-dia. hardwood top; 1x3/4-in.-dia. dowel; white glue; 3/8-in. tip of 8d common nail; sealant; primer; spray enamel paint; plastic tape; enamel paints in jars.

1. Turn the top on a lathe.
2. Bore a dowel hole and insert with glue.

(Please turn to page 122)

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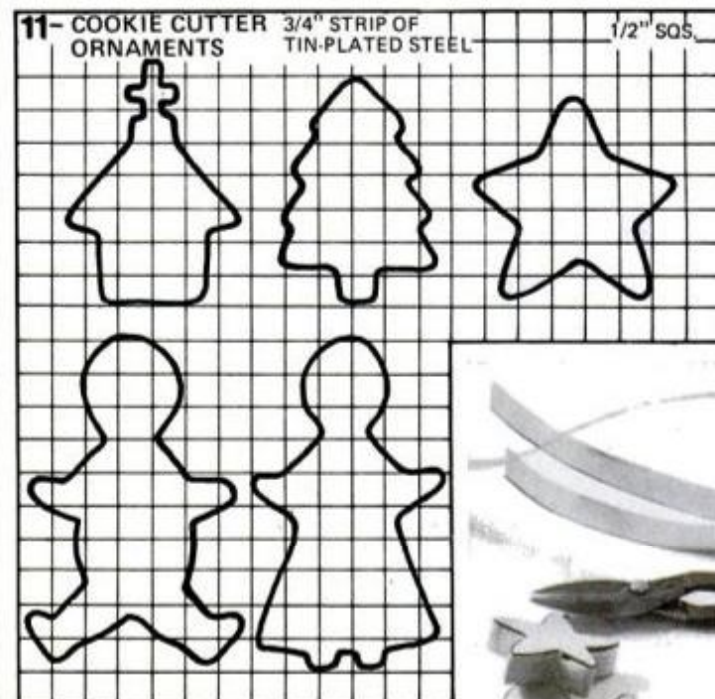
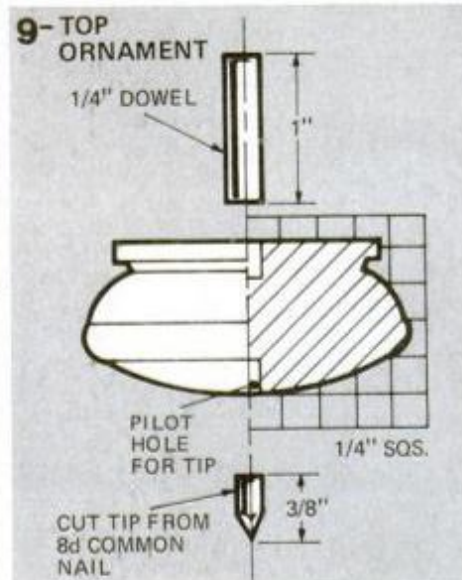
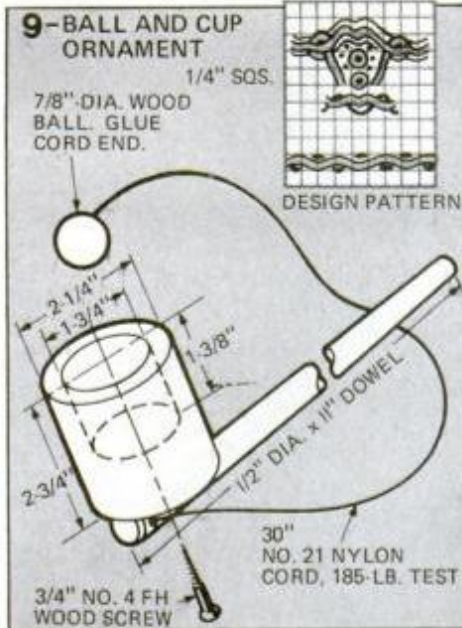
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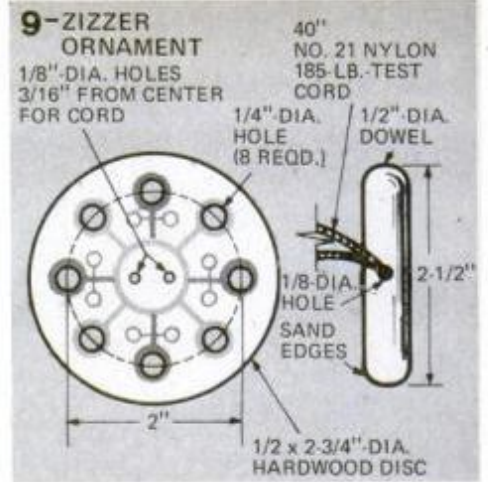
ARROW FASTENER COMPANY, INC.
271 Mayhill Street, Saddle Brook, N.J. 07662

14 CHRISTMAS DECORATIONS

(Continued from page 121)



With a three-square file, mold a tin strip around a shape cut of 3/4-in. stock. Overlap ends 1/4 in. and cut with tin snips. Secure with clothespins as needed while you solder the tin. Hang ornaments on the tree with red cord or ribbon. You can also cut wood initials and mold tin around them to make personalized cookie-cutter ornaments to hang or give as gifts.



3. Bore bottom hole and insert nail tip with glue.
4. Seal, prime and spray paint.
5. Use thin strips of vinyl tape to make stripes. Hand paint the decorative designs, using enamel paints.

9. Ball and cup ornament

Materials: 2 1/2 x 2 1/2 x 2 3/4-in. hardwood block; 1/2-in.-dia. x 11-in. dowel handle, 7/8-in.-dia. ball or macrame bead; No. 21 nylon twine, 185-lb. test, 30-in. long; 3/4 in. No. 4 fh wood screw; white glue; sealant; primer; spray enamel paint and decorative enamel paints in jars.

1. Turn both ball and cup on a lathe from hardwood. Either use a faceplate to hollow out the cup or bore it out later. If you don't have a lathe, roughly bore out the inside of the cup, then smooth it with a drum-rasp drill attachment, followed by sandpaper.
2. Bore a pilot hole in dowel and cup. Also bore hole in dowel and ball for twine. Attach dowel and cup with screw.
3. Tie one end of the twine after threading it through the hole in the handle and glue the other end inside the ball.
4. Seal, prime and paint as previously noted. Draw, then hand-paint decoration on cup.

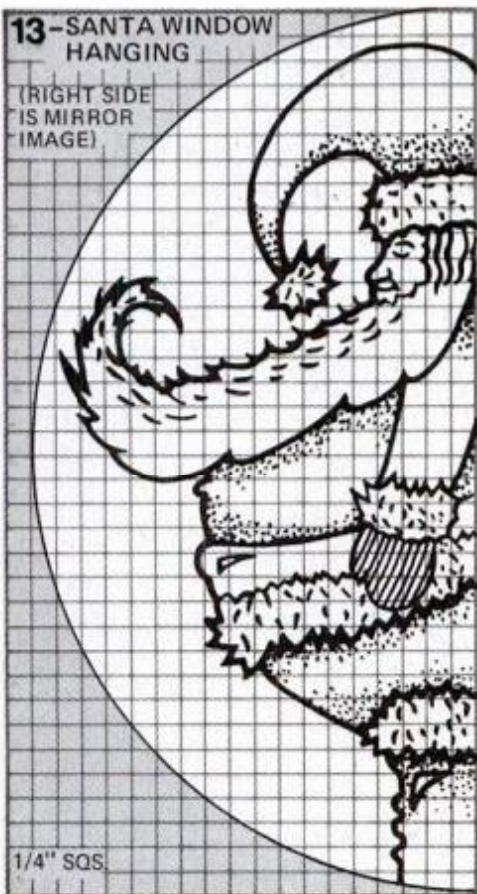
9. Zizzer

Materials: 1/2 x 2 3/4-in.-dia. hardwood disc, 1/2-in.-dia. x 2 1/2-in. dowel handles; No. 21 nylon twine, 185-lb. test, 40 in. long; sealant, primer, spray enamel and brush-applied decorative enamel.

1. Cut out the disc, sand edges and bore holes as needed.
2. Cut dowel handles, sand edges and bore center hole.
3. Seal, prime and spray paint. Hand-paint decorative designs.



10. Plastic tree ornaments are rings of plastic tubing with decorations embedded in resin that is poured inside the rings.

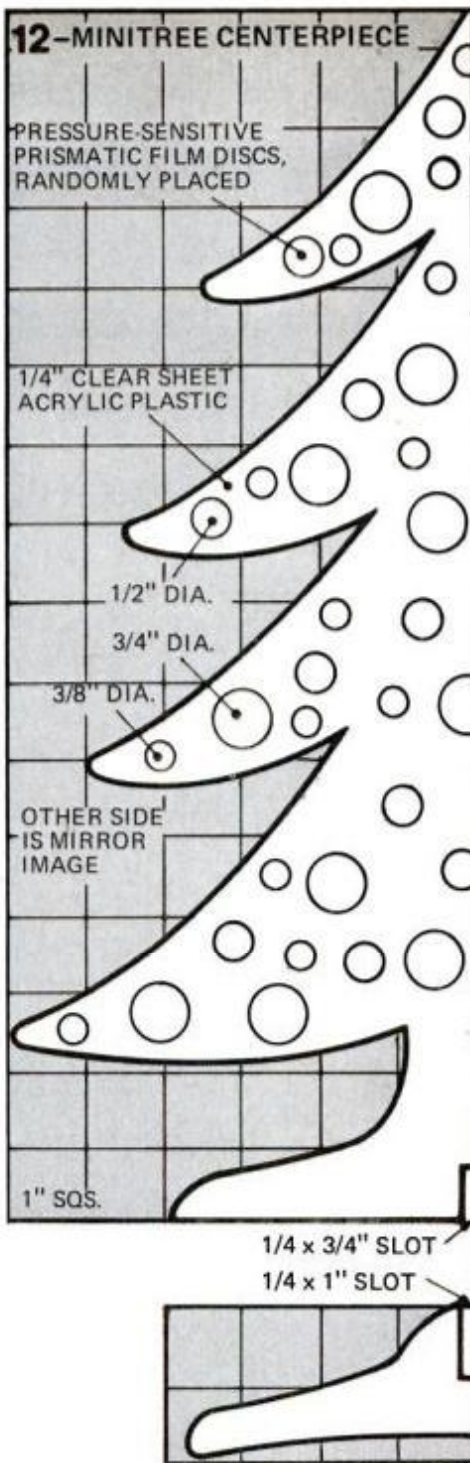


4. Thread cord through center holes of disc and handles; tie knot securely.

10. Plastic tree ornaments

Materials: 3-in.-dia. clear or colored acrylic tubing cut into 1/2-in. rings; clear casting resin and catalyst; embedments such as dried flowers, pine cones and evergreen, hangers. For your nearest plastic supplier check the classified directory under *Plastics—Raw Materials—Powders, Liquids, Resins, Etc.* You'll also need a dowel or other stirring stick, 2-lb. coffee can or other container that can be discarded (or use a plastic bowl—dried resin will chip off it); medium and fine-grit sandpaper; aluminum foil; felt polishing pad and polishing wheel; polishing compound for plastics; cement used on plastics. Work in a well-ventilated area.

1. Cut tubing rings.
2. Spread aluminum foil on flat surface, and place clean, dry tubing rings on it.
3. Be sure coffee tin or other mixing container is clean and dry. Carefully measure out resin—use about 1/2 lb. for every two tubing molds. Carefully measure out the amount of catalyst noted in the manufacturer's directions and stir.
4. Fill the mold halfway with resin. Hold the mold with one hand while you pour. Let it cure. (Temperature may reach 150° during this time so be careful where you place it.)
5. After first layer has cured (it will take two hours to become sticky, but let it cure until completely hard), position embedments. Make pine

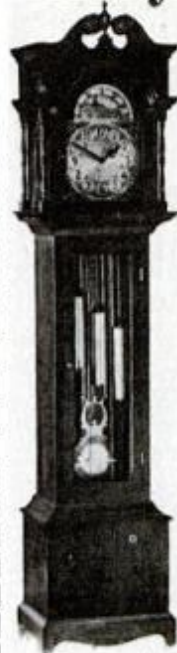


Add wire handles to clicker punches and cut film discs. Work on hardboard to get clean cuts.

cone flower by positioning petals individually in circle shape, overlapping in several layers.

6. Again mix resin and catalyst; fill molds to top—almost overflowing (steps 3 and 4). This layer will fill places where the first layer has shrunk away from the tubing.
7. After resin has cured, lift away from aluminum foil, sand and polish rough edges.

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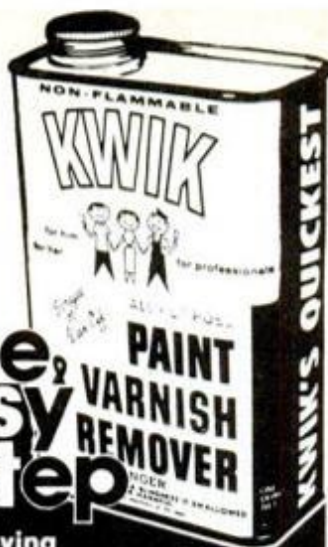
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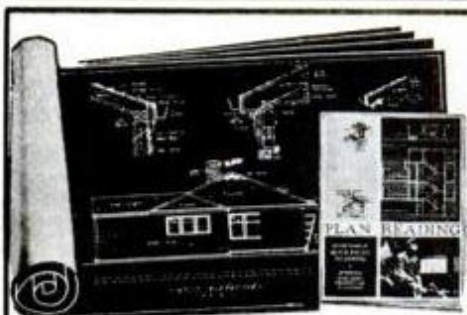
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14 CHRISTMAS DECORATIONS

(Continued from page 123)

8. Bore a small hole at top for hanger and secure it with cement used on plastics.

11. Cookie cutter ornaments

Materials: 3/4-in. pine stock for patterns; 3/4-in. x 18-in.-long tin-plated steel strips (check classified directory under Tin plate or refer to Shopping Information at the end of the story); solder with rosin-flux core.

1. Draw patterns on pine stock and cut out.
2. Cut tin strips to length.
3. Shape tin around patterns, pressing in place with three-square file to get sharp bends. Overlap ends 1/4 in. and cut excess.
4. Hold with clothespins or clips while you solder at overlap.

12. Minitree centerpiece

Materials: 1/4x10 1/2x18-in. sheet acrylic and prismatic film. (For kit including punches to make decorations see Shopping Information below.)

1. Trace outline of tree and cross brace onto sheet acrylic. Draw on the protective masking and don't remove it until all cutting and polishing is done.
2. Cut the outline with a fine-tooth blade in jig or sabre saw. Carefully cut the rectangular notches somewhat undersize and file them to size for an accurate slip fit.
3. Scrape out the saw ripples on the tree edges with a sharp knife blade or the back of a hacksaw blade with its back edge ground flat and corners sharp.
4. Sand the edges smooth using abrasive papers with grits up to 600.
5. Polish to a high gloss by hand using a damp cloth and polishing compound or with a power buffing wheel. If you polish by hand, hold the work firmly in a vise and work the cloth in the same manner as polishing a shoe. Finish off with some passes of a dry cloth. Remove paper.
6. Cut the film discs with scissors or, for speed and accuracy, with punches. Use saddler's punches, paper punch or clicker punches. Press discs into place.

13. Santa Claus window hanging

Materials: 1/4x9-in.-dia. acrylic disc. (Have this cut by your supplier.) You'll also need a Dremel or other flexible-shaft tool with these attachments: Tungsten carbide cutter (No. 9909, 118 or equivalent) to cut outlines; small round engraving cutter (No. 107 or equivalent) for detail work; twist drill to bore hanging hole; plus an indelible-ink felt-tip pen to transfer drawing.

1. Enlarge design. Place it under the acrylic disc and draw design on disc with felt-tip pen.
2. With carbide cutter in Dremel tool, go over all lines as if retracing them.
3. Use same cutter and round engraving cutter to give texture where areas are darkened on plan.
4. Use twist drill accessory to bore hole for hanging.
5. Polish away pen markings with toothpaste on a soft cloth.

14. Wreath window hanging

Materials: clear casting resin and catalyst; embedments such as pine boughs, cone, dried



14. Pine bough window hanging is made of casting resin that is molded in a pie tin to produce the attractive rippled edges.

flowers; hanger. You'll also need a frozen-pie tin; dowel stirring stick; coffee tin or bowl that can be discarded; Dremel or other flexible-shaft tool with tungsten carbide cutter (No. 9909 or equivalent). Work in a well-ventilated area.

1. Carefully pour about 2 lbs. resin into bowl and add catalyst according to directions on package; mix.
2. Pour half the mixture into the clean, dry pie tin.
3. Position the embedments in the resin.
4. Slowly, so as not to disturb the embedments, pour rest of resin in the tin. Use mixing stick to submerge the embedments if needed.
5. Allow the resin to cure (it may heat up to 150°, so use care in placing it). When it is hard and completely cured—it will be cool—remove it from the tin.
6. Sand off rough edges.
7. If you add a greeting, first mark it on the disc with an indelible felt-tip pen.
8. With a Dremel tool and tungsten cutter retrace the pen lines.
9. Remove excess pen marks with toothpaste and a soft cloth.
10. With twist-drill accessory in flexible-shaft tool, bore a small hole for the hanger on disc top. Cement hanger in place. **PM**

SHOPPING INFORMATION

No. 6, wall sconce kit, \$4 postpaid, Capro Craft, Box 18, Greenlawn, N.Y. 11740; 8, dyed wood pack of 12 veneers 1/40 in. thick, 1 sq. ft. each, order No. 112, \$8.60 postpaid, Albert Constantine and Son Inc., 2050 Eastchester Rd., Bronx, N.Y. 10461; 11, 12 strips of 3/4 by 18-in. tin plated steel, \$3.95 postpaid, Fleetwood Tin Shop, 17 West Spruce St., Fleetwood, Pa. 19522; 12, acrylic tree kit (three clicker punches included) \$4.50 postpaid, Capro Craft, Box 18, Greenlawn, N.Y. 11740.

GOLF'S SECRET WEAPONS (Continued from page 80)

upwind, downwind, long holes, short ones, etc."

And there's still one small aerodynamic fly in the ointment: On most popular golf balls in the place where the maker proudly stamps his trademark, several dimples are either omitted or rearranged from the nor-

mal pattern.

Tests have shown that distance differentials of 10 percent or more regularly result, depending on orientation of the trademark when the ball is teed up. The USGA is looking into it further, but meanwhile, friends, an edge is an edge. **PM**

LITTLE IS BIG IN SNOW REMOVAL THIS YEAR (Continued from page 97)

than mowing the grass in 110° heat.

No matter at what speed you use it, a power snow-removal machine is quicker and pleasanter to use than a shovel. Since doctors warn that you

shouldn't lift a shovel of snow unless you regularly exercise by walking at least a mile a day, a snow-removal machine may even save your life. **PM**



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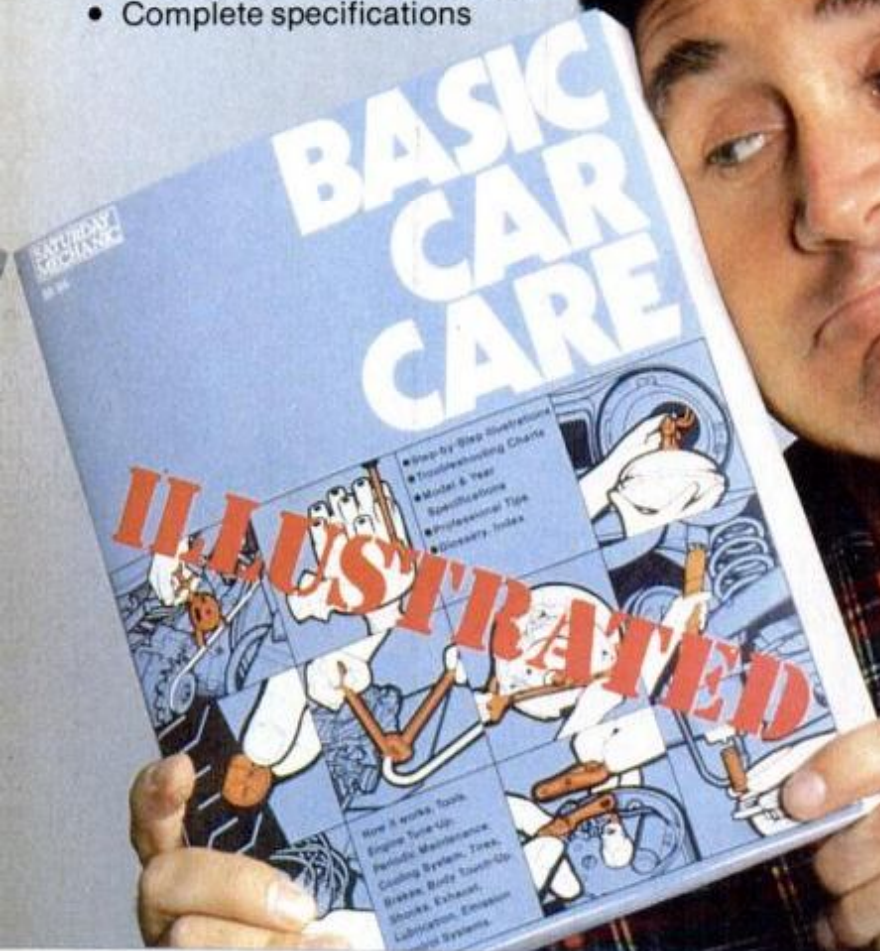
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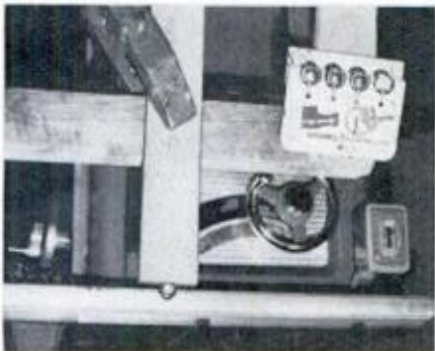
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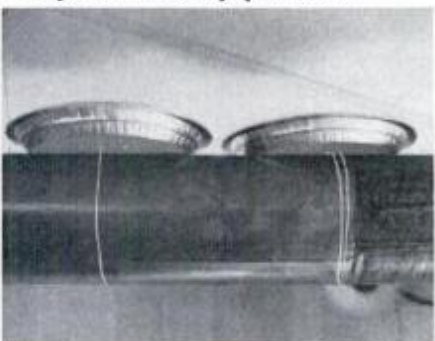
HINTS FROM READERS

Aid for sawing plywood sheets



Use this simple device to support large sheets of plywood when cutting them with a table saw. Drive a ball-bearing caster (type with a protruding nail) into one end of a piece of one-inch stock. Clamp wood to a sawhorse with ball end on top, keeping caster level with height of saw table. To increase support area, clamp on more boards with casters. Hang boards on table saw when not in use.—*Emery J. Loissette*

Pie pans direct pipe heat



Radiate extra heat into a room from a horizontal stovepipe by wiring aluminum pie pans to the top of the pipe. Punch two holes in each pan, thread wire through holes, wrap around pipe, twist ends together.—*Richard Hoskin*

Cure for noisy pipes

Sometimes installing an air chamber doesn't silence banging water pipes. We discovered that the sounds in our pipes were caused by a faulty water meter, which the water company replaced free. Next time you have banging pipes, put your ear to the water meter. If it makes a faint ticking sound, the meter probably has a worn-out part and the noise is being amplified throughout the pipes.—*William H. Bishop*

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*Lawrence Stevenson
E. Syracuse, New York 13057*

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*Farris Cornelius
Wellington, Texas 79095*

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*V. O. Miller
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*Frank Sartin
Grandview, Washington 98930*

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Exhaust system quiz

by Mort Schultz



Dual exhaust systems double the time, effort and money it takes to do your own replacement work.

Subterfuge? Maybe. But taking a decoy car from one repair shop to another is one way to tell how much you can save replacing an exhaust system yourself.

Sure, I know this isn't your everyday change-the-oil kind of job. It's dirty. Not complicated, mind you—just dirty. A lot of guys would rather pay an extra \$10 or \$20 to have it done.

But how much *more* than \$10 or \$20 will you have to pay? This is what I wanted to find out when I drove a '74 Ventura that needed a complete exhaust system to a Pontiac dealer, a Midas Muffler Shop and a gas station. I was told:

- Dealer—"No more than \$150."
- Midas—\$110
- Gas station—"95 or so."

The current Sears catalog lists a complete exhaust system for this car at \$41. Yes, mufflers for American-made vehicles purchased from stores such as Sears are warranted for as long as you own your car, just as mufflers are from shops such as Midas.

If you're convinced that replacing an exhaust system yourself is worth the effort, there are 15 questions you first should have answers to. They are the most frequently asked questions from novices and experienced hands alike.

"Doesn't the kind of car I own dictate whether I can do this job myself?"

No. Follow the same basic steps whether the car has a single exhaust system, dual exhaust system, one or two catalytic converters, or resonators. For instance, a dual exhaust system is two single exhaust systems, each serving a set of cylinders on one side of a V8

engine. You work on one system and then the other, if need be, treating them separately.

The only difference between replacing a single exhaust system and a dual exhaust system is that doing the latter takes twice the time and costs twice as much.

"From the standpoint of nuisance value and labor, am I not better off replacing an entire exhaust system when one part fails?"

Because of the labor required or the difficulty involved in separating rusted components, it is often easier to replace the complete system rather than just faulty parts.

Ask yourself two questions when presented with the problem of whether to replace all or part of a system:

1. Which parts are still in good, usable shape, and what do they cost? I don't believe it's economical to replace an entire system if only the tailpipe, which costs \$12.50 for our decoy '74 Ventura, is bad. On the other hand, I think it's ridiculous to try salvaging a 75-cent clamp or a \$1.50 bracket.

2. Will salvageable parts last for a reasonable period of time or will I have to replace them soon? In making the decision, keep in mind that exhaust systems tend to wear out from the rear of the car forward. If the car needs a new tailpipe, can the muffler be far behind? A close examination can tell you.

"How can I tell if parts have failed?"

Look for pin-size holes. And excessive rust is a sure sign that a part has seen better days. Excessive rust is defined as flakes that settle in your palm as you run your hand over the part.

Caution: Be sure parts are cold. Hot exhaust system parts can cause severe burns.

When examining a muffler, pay attention to both end plates. They are particularly vulnerable. Push gently on each plate as you look for breaks around the perimeter and around the tube.

Mufflers normally deteriorate from the inside out, so damage may not be visible. Therefore, when examining a muffler, listen for excessive exhaust noise. Noise is a sign of damaged baffles or clogged flow tubes.

Tap the muffler with the heel of your hand or lightly with a metal tool. Listen for pitter-patter sounds made by falling flakes of rust and for rattles from loose tubes or baffles. A muffler that has deteriorated internally often emits a dull sounding noise rather than a metallic ring when tapped with a metal tool.

A bracket can fail, causing major components to bang against the chassis or body. A rattle coming from under the vehicle is the clue. To find the faulty bracket, gently force major components up and down to see which one is hitting. This step, taken as soon as a strange noise is heard, can save you the cost of replacing expensive components.

"How can I be sure of getting

(Please turn to page 130)

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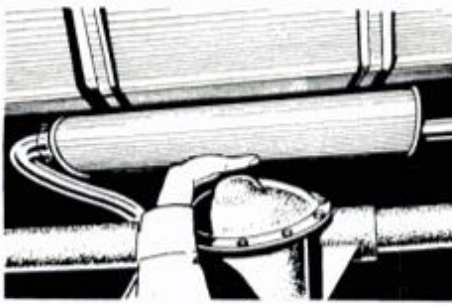
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Brackets must be secure to hold mufflers, catalytic converters and resonators.

EXHAUST SYSTEM QUIZ

(Continued from page 128)

the correct replacement exhaust-system parts for my car?"

Tell the salesperson the year, make and model or the vehicle identification number, which is usually on top of the dash, driver's side. When you unpack parts, check for any special instructions on or inside the carton.

"Is there a safe way to raise the car or should this job be done with the four wheels on the ground?"

If you don't have the use of a lift at a friend's service station, raise the two rear corners of the car with bumper jacks. Place safety blocks or jack stands under the frame. Lower the car on the jack stands or blocks. Do the same up front. Do not support the car by the rear axle, which must hang free in some cars to install the tailpipe. In other cars, your work is made easier if the rear axle hangs, and the rear wheel and tire assembly are removed.

"How do I loosen frozen parts?"

This is the toughest part of the job. Saturate all clamp and bracket studs and nuts with penetrating oil, and let the oil soak in. Be patient.

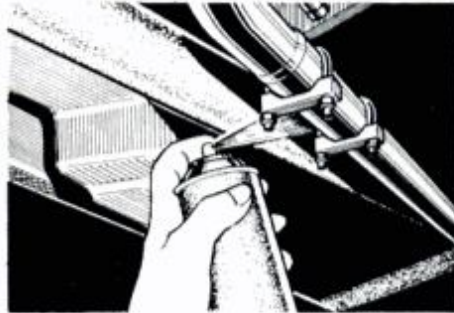
You can make life easier for yourself at the exhaust manifold by warming up the engine before tackling the exhaust pipe connection. But don't touch the hot manifold!

You will probably find that nuts

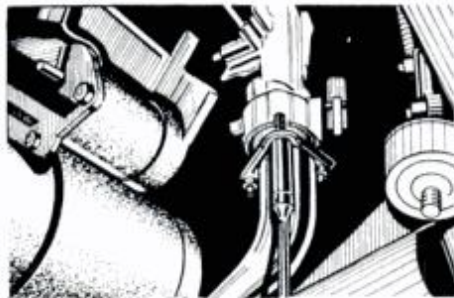
are easier to remove by using a set of deep six-point sockets instead of 1/2 or 9/16-inch open box wrench combinations. If you are working on a foreign car, metric-size tools are probably needed.

If a nut stays frozen, apply more penetrating oil. Try not to force exhaust manifold/exhaust pipe connections. You might break off a stud.

Incidentally, if you are replacing an exhaust system that does not have a catalytic converter, cut the system into two or three chunks with a chisel or saw. It will be easier to handle.



Apply penetrating oil on all exhaust-system nuts, bolts before starting job.



A socket set will make your work much easier than open-end wrenches.

Note: You should have figured out by now that this is a job requiring goggles to protect your eyes from falling flakes of metal and rust, and drops of oil. And keep your mouth shut.

"Suppose I do break off a manifold stud. What then?"

If the stud is sticking out far

Do be cautious: Work safely by placing jack stands under the frame of your car.

enough, grab it firmly with a pair of locking pliers. Apply heat with a propane torch to the area of the manifold surrounding the stud. Try working the stud loose with the locking pliers.

If the stud is uncooperative, drill



Locking pliers may remove broken stud if there's enough left to get a grip on.



If stud can't be pulled out with locking pliers, you will have to drill it out.

it out. Knock a pilot indent in the stud with a center punch. Use a drill bit a little smaller than the stud and start drilling. The broken stud will usually come out of its hole as you back the drill bit out. Then, use what's called an E-Z-Out tool to remove any part of the stud that remains. E-Z-Out tools are generally available from hardware stores and from auto parts dealers. With the broken stud out of the way, screw the new stud into place.

"I've heard a lot about the heat riser. Isn't it part of the exhaust system?"

Yes. The heat riser valve (exhaust manifold heat control valve) assists the engine in warming up. It closes off the exhaust manifold, trapping hot gases in the engine. As the engine gets warm, the valve opens.

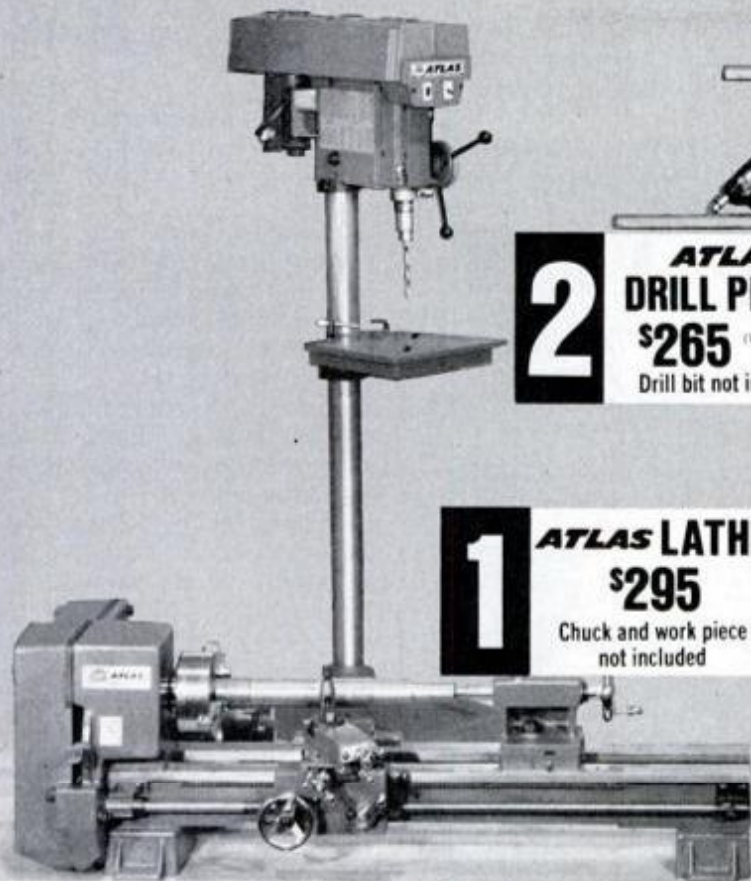
If your car has a heat riser, it's positioned right below the exhaust manifold in a spacer block, or it's inside the manifold. A good time to service the heat riser is when you replace the exhaust pipe. A sluggish heat riser causes excessive back pressure, slow warm-up and stalling.

Apply penetrating oil to the heat

(Please turn to page 132)



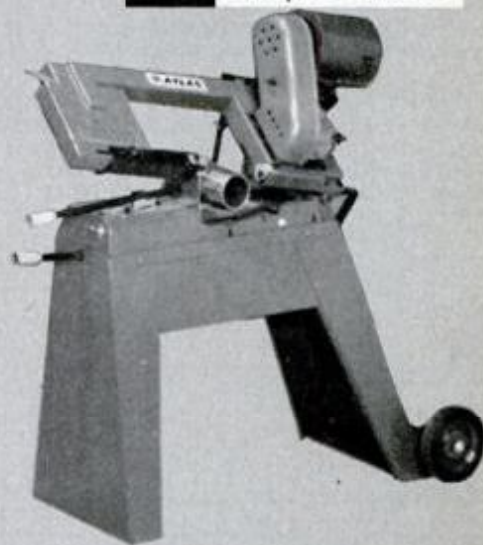
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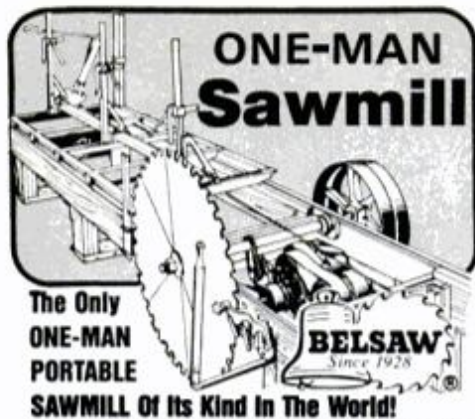
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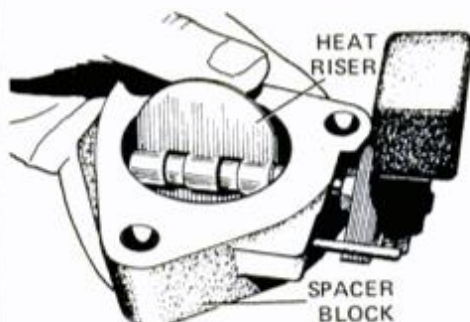
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EXHAUST SYSTEM QUIZ

(Continued from page 130)

riser valve shaft. If the heat riser is in a spacer block, place the spacer block and a new gasket on the exhaust manifold and stretch a rubber band across the studs. The rubber band keeps the spacer block in place as the exhaust pipe is



Some heat risers are inside a spacer block, easing the replacement process.



Rubber band keeps heat riser spacer block secure as you install exhaust pipe.

installed. It will burn off when you start the engine following exhaust system repairs.

"The exhaust system in my car uses a resonator as well as a muffler to reduce noise. A replacement resonator is expensive. Can I do away with it?"

Maybe yes—maybe no. Resonator eliminator pipes are sold in some areas as low-cost replacements, but they cause noise to increase. It may be difficult to eliminate the resonator and still meet noise regulations in your state. A number of states, including California, Florida, Maryland, Colorado, Hawaii, Idaho, Indiana, Pennsylvania and Washington, have noise standards. Better check this out.

"I'm going to replace the tailpipe, but I'm going to try to salvage the rest of the system. Any advice?"

Restore the roundness of pipes you are reusing with a pipe shaper, which you can buy or borrow. Some parts outlets will lend you special tools, so ask.

You may have to use a chisel or hacksaw to cut away the tailpipe

where it connects to the muffler tube. If the muffler is welded to the pipe, cut with a hacksaw at the weld line.

Coat pipe connections with exhaust-system sealer. Fit them together and place a U-clamp over the joint. Tighten, but not too much. You may crush pipes.

"How can I make sure that exhaust system parts won't bang against other components after the new system is installed?"

Follow these steps:

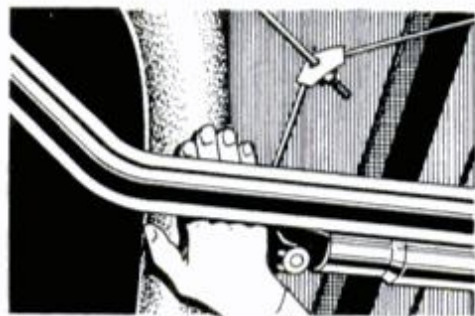
1. Starting at the exhaust manifold, install parts in order—exhaust pipe, muffler, tailpipe. In other words, work from the engine end of the car toward the rear.

Important: Do not tighten nuts. Install the system loosely. You will need movement to adjust for clearance and alignment.

2. Starting at the front of the car, make your way toward the rear as you assure that each part lies straight and true with its associated parts. There should be no "twists" in the system.

Check for clearance by putting your hand between each component and other components adjacent to it. Your hand should fit easily between the two, and there should be ample room to permit a one to two-inch up-and-down movement.

3. When tightening brackets, adjust them so they have a slight forward preload. This is necessary to compensate for the tendency that an exhaust system has to expand up



Check clearance of exhaust-system components so they don't get bashed.

to 1/2 inch in length toward the rear as it gets hot.

4. Clearances around the rear axle and gas tank are most critical. Be sure there's ample room for movement, but don't leave anything to chance. Rear axle and gas tank clearances tend to change as the body and frame move on the suspension, so check clearances again when the car is lowered to the ground.

5. When alignment and clearance adjustments have been made, tight-

(Please turn to page 134)

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EXHAUST SYSTEM QUIZ

(Continued from page 132)

en components securely, but not enough to crush pipes. You can get an indication of any problem areas by sharply jarring the system with the heel of your hand. Gross interferences will be evident, but, again, leave nothing to chance. After you bring the car back to the ground, take it for a road test and listen for rattles and squeaks. Readjust where necessary.

"What about after-installation exhaust leaks? How do I guard against them?"

Assuming that the new system is defect-free, an exhaust leak can occur only if a clamp is loose or improperly positioned. Test for leaks with the engine running by placing your hand around pipe joints. Don't touch the pipe. If there's a leak you'll feel it. Or you will hear it hissing. Relocate the clamp. And tighten it securely.

"I heard that a good way to make a leak more evident is to stuff a rag in the tailpipe. Is this true?"

Don't believe it. Stuffing a rag in the tailpipe causes excessive back pressure that might produce a leak which would not occur under normal circumstances.

"A catalytic converter is part of my car's exhaust system. What advice do you have concerning the way I should handle it when I install an exhaust system?"

Be extra careful to prevent damage to the converter and its attached pipes, which are usually stainless steel and expensive. Other than this, there is no advice. The converter and its pipes will probably not have to be replaced when you replace an exhaust system. For more information concerning the catalytic converter, see page 88, July '78.

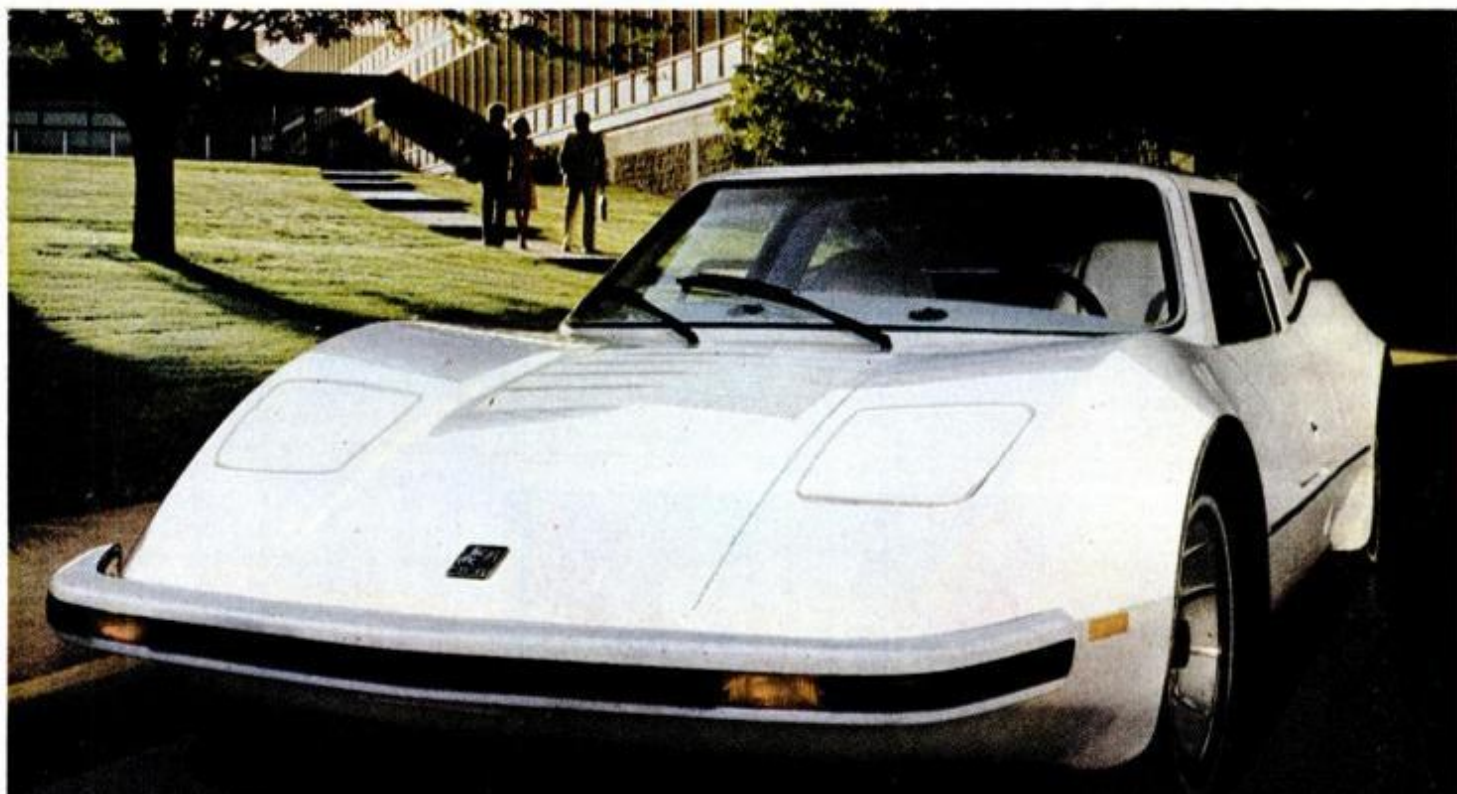
Incidentally, the catalytic converter is technically not part of a car's exhaust system. It's an emissions system component.

"What does a so-called performance muffler do for a guy?"

A performance muffler, which is installed in place of the car's original muffler, often improves a car's acceleration by reducing engine back pressure.

Performance mufflers are more expensive than conventional mufflers and may be prohibited in your area because of noise.

The same installation procedures discussed in this article are used to install a performance muffler. **FM**



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an orphan tool, you can flat-sand a larger size down to fit.

On some drills, brushes are accessible from the outside by removing plastic caps on each side of the motor housing. On others, you remove a few screws to take off the back of the handle or a section of it to expose the brushes.

■ **Sabre saw:** Sabre-saw brush replacements (usually from outside the housing) and lubrication are much the same as for drills.

To get to the grease, remove the plunger housing at the front of the saw. This may also require removal of the tool handle. Before the plunger is moved out of position, note how the crank mechanism engages the plunger so you can fit the parts back together after the grease job. The typical amount of new grease you'll need is two tablespoons.

Don't force parts together when reassembling the saw. *If you do it correctly, no force is needed.* Use oil

in the oil hole for the rear motor bearing. Also oil the felt seal (if present) at the bottom of the plunger housing.

■ **Portable circular saw:** Lubrication varies with the make and model, but most require occasional light oiling of the rear motor bearing through an oil hole.

To give your portable circular saw a grease job, first disconnect it from the power source and remove the blade. Next, unscrew the upper guard cover and disconnect the retracting spring of the lower (swinging) guard. Remove the dust cover that closes the side of the upper guard to expose the gear housing. Unscrew the gear housing cover screws and pry off gear housing cover to get at the old grease. Renew the grease following steps described for power drills. The typical amount in a 7-in. Stanley saw is 1/2 oz.

You can thoroughly clean the gear housing with kerosene if you're careful not to let it enter the sleeve bearings. Then reassemble the saw by reversing the order of part removal.

Brushes on portable circular saws are usually accessible from outside the motor housing.

Clogged vent holes can cause overheating. Keep them free of sawdust accumulations.

■ **Router:** This is one of the simplest tools to maintain. Many have sealed ball bearings that require no further lubrication. If yours has oil holes, use a few drops of light oil in them at intervals. And check the collet that holds the bits just in case it is starting to show signs of wear. One important servicing measure: Use an air hose or pump to blow out any sawdust or chips that may have lodged in the motor.

■ **Sanders:** The attention a sander needs depends to some extent on when it was made. Many recent models require no lubrication as all bearings are sealed and permanently lubricated. Some older ones with self-lubricating bearings are much the same. The orbital model shown in the cord replacement photo has been regularly used for 25 years without lubrication. Your best bet, lacking the service manual, is to look for oil holes or fittings and oil them lightly. If brushings are visible and the tool has been in use for considerable time, light oiling is helpful.

It's wise to blow or vacuum sawdust accumulations out of the tool frequently. Check the brushes at intervals and replace them if necessary.

PM

Most shade-tree mechanics begin here.



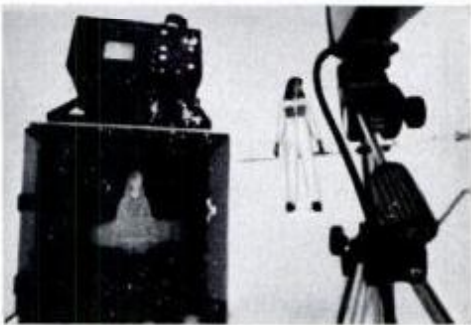
NEW FIBER THAT'S BETTER

(Continued from page 83)

day, too few would create chills when it's cold. The activities and personal metabolism of each individual also cause variations in what you want to wear.

Instruments 3M used to compare CLO ratings included a guarded hot plate surrounded by a secondary temperature-control unit so that heat could not escape out the sides, and a metal hand to test how a completed garment would function. Both recorded the amount of current used to maintain a thermocouple-measured surface temperature. Testing was also done with thermocouples on the skin of test subjects wearing Thinsulate-insulated and other clothing in arctic conditions.

Most interesting of the tests were the thermography studies by Thermovision camera, a unit employed by industry to locate unseen hot-spot conditions, and by power companies to study areas of heat loss from houses. Head and 3M prepared jackets with Thinsulate in one side and down or fiberfill in the other. Colors on the video screen were



Set up in snow, 3M's Thermovision camera shows infrared readout on its monitor.

adjusted to study areas where heat was escaping through the materials. For PM's experiments, we observed jackets of Thinsulate, down and polyester, and in spite of the varying metabolisms of our subjects, it was obvious that the new 3M material surpassed the others in heat retention. And garments did lose warmth along seams required to keep down in place.

Down with down?

Laboratory analysis showed that for equivalent thickness, Thinsulate had a relative warmth rating of 1.8 compared to 1.0 for down and .9 for polyester fiberfill, wool felt and pile. Apparently the much finer fibers of 3M's invention make the difference. The nonwoven batting is now being made in one version where low weight, drape, softness and compressibility are important for ski wear and backpacker garments. Another type has added re-

sistance to compacting for use in gloves and boot liners.

In true down, the little dandelion-shaped plumule pods from geese and ducks are still lighter than synthetics. They lose this advantage, however, when quilted or sewn into baffles to keep them in position. And once removed from the waterfowl, they can lose their wetness resistance when washed. Thinsulate insulation and the popular fiberfills, however, absorb practically no water, can be safely laundered repeatedly, maintain their breathability, and retain their compression

recovery even when they are wet.

Down should continue to be popular, but most comes from China and costs zoomed recently with prices between \$15 and \$35 a pound. Quality has also been dubious, and recently the FTC specified that "down" must have at least 70 percent down-pod clusters and no more than 30 percent fibers, feathers and residue to rate that name.

Meanwhile, if reports from Thinsulate users continue enthusiastic, look for it shortly in sleeping bags and more backpacking gear. It should have a warm future. **PM**

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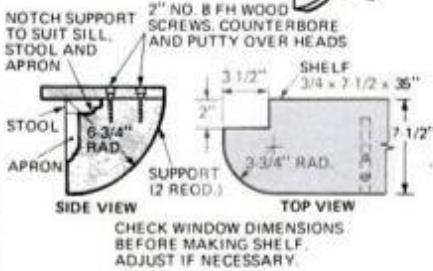
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ELECTRONIC FUNMAKERS FOR GIFT GIVING (Continued from page 73)

had a marketable item and field-tested the prototype in various places, including some very adult bars. The reactions were favorable and have since been reflected in the game's sales figures.

It wasn't long before just about every old-time toy company (and a raft of newcomers) entered the market. Today, it isn't unusual for a child to have more than one computer in his toy chest. Every type of game has seen computer modernization. Adult games and children's toys have all been programmed into a new level of sophistication.

Let's take a look at chess and "Battleship," two games that certainly appeal to different audiences,

wisecracks. Besides that, he plays an excellent game of chess.

It is all in the *programmability* of a computer. The Battleship game is programmed to make noises under certain conditions and to keep track of hits and misses. Boris, more sophisticated, is programmed to look ahead one to four moves (user's choice) and pick the move that gives him the best winning chance.

The true genius is not the computer, but the unsung guy who thought up the program. The computer only does what someone has programmed it—told it—to do.

Programmability, by the way, does not always need a computer, though it is based on computer



Spelling B from Texas Instruments asks child to spell a word pictured in a book. The spelling is entered through the keyboard and scored right or wrong. \$30.



Texas Instruments also produces **First Watch**. This uses a digital watch to help teach time-telling. Costs \$20 with guide.

and see how the concept of programmability ties them together.

Battleship is just short of baseball in popularity with the under-12 age group. It's been the bane of the classroom teacher since time immemorial. Who hasn't spent many a happy hour hiding an imaginary fleet on a sheet of graph paper while an opponent did likewise? Remember all those imaginary broadsides bursting among the enemy's ships?

Fun on graph paper—but a computer adds an eerie sense of realism to Milton Bradley's Battleship game. A computer keeps track of where every ship is hidden and not only scores, but adds sound effects for believability. Loud explosions and flashing lights provide more feedback than the missile officer receives aboard a real destroyer.

Computerized chess

Many sports are touted as The Sport of Kings, but chess is certainly the oldest contender. In the thousand-plus years it has been played, only in the past one has anything other than a human been able to call "Checkmate"! Boris, from Chaffitz, can not only cry "Mate," but has an entire repertoire of comments and

concepts. Meg's 2-XL is a talking robot that asks questions and supplies answers. He does this by means of an eight-track tape, on which the child changes tracks by pressing one of the answer buttons. The tape is timed—programmed, in a way—so the responses are accurate.

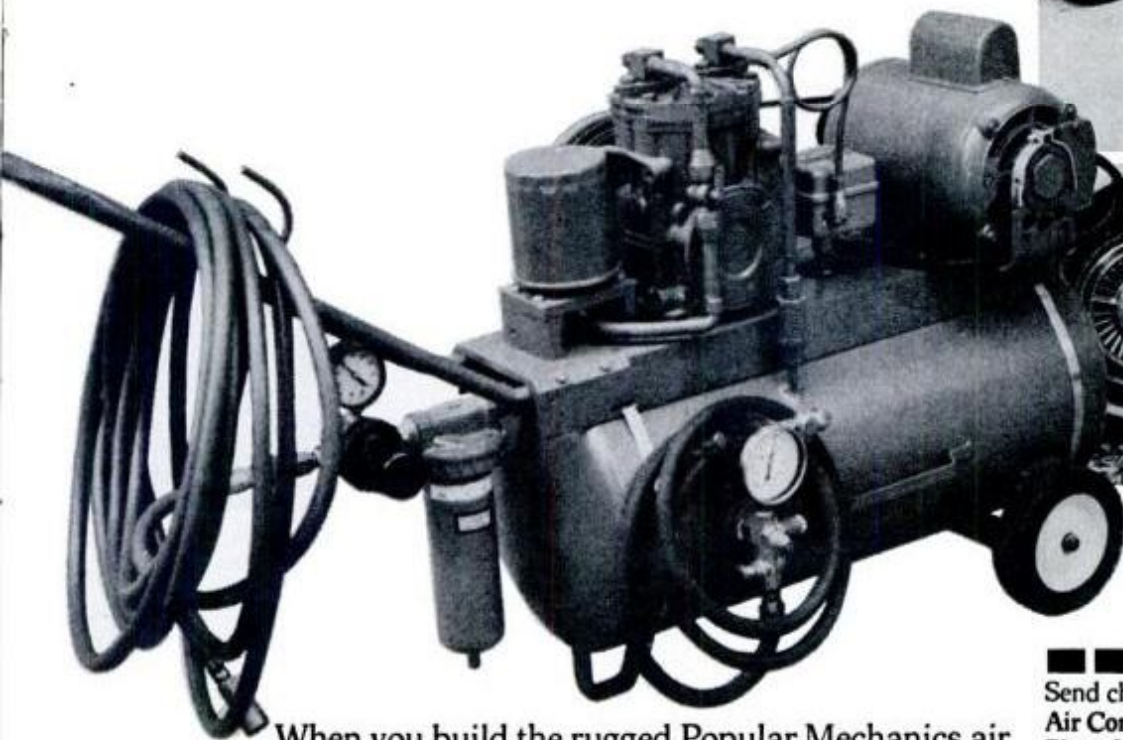
Alphie, from Playskool, is also a robot, but he works more like a programmed computer. He can play music, run a Chutes and Ladders-style game, both as referee or opponent, and do many other things.

One of the newest computer toys is the Speak and Spell from Texas Instruments. This toy actually *speaks* a word. The child tries to spell it at the keyboard and is then scored. Computer speech is certainly a new advance in home technology. What's more, it has added new dimensions to fun and games—and learning as well.

What does the future hold? Look for more and more computer games capable of ever more complex tasks. The only limit now is that of the human imagination. **PM**

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WINGS

(Continued from page 69)

years into a highly refined, mathematically defined outline of optimums.

Originally, it was an attempt to reproduce the cross section of a bird's wing, very thin and highly curved. It didn't take long for engineers of earlier days to recognize that a fixed wing and a flapping wing worked in different ways to produce lift, and that what worked well for the bird would not necessarily work well for the airplane. Airfoils became thicker, to provide more height for the internal wing beams needed for strength. They were rounded at the leading edge to keep the flow smooth at high angles of attack and to reduce chances of an abrupt stall. Their contours were altered, by math or a draftsman's guesswork, and the characteristics changed accordingly.

Going supersonic

When the first jet fighters began to run into trouble with what was then called the "sound barrier," there was a sudden, unexplained increase in drag, controls seemed to "reverse" themselves, and in some cases test aircraft went out of control in a screaming dive. The symptoms initially seemed to indicate a finite limit for flight somewhere around the speed of sound.

Back to basics: An airplane disturbs the air it is flying through. If it moves relatively slowly, little pressure waves are generated by its passage, and they reach out well ahead of the wing's leading edge and tell the air to "think" about getting out of the way. But if the airplane moves fast enough, the pressure waves can't race ahead, because they move at a fixed speed depending on the density of the air. That speed conveniently happens to be the speed of sound under the same atmospheric conditions, because sound itself is just a special form of pressure wave. If the airplane is moving at the speed of sound or faster, there is no preparatory disturbance in the air ahead that "says" it is coming, and the air resists its passage. A heavy shock wave forms, and there is a sudden drag increase.

The speed at which that drag rise occurs is called the critical speed, or *critical Mach number*. Mach number, the ratio of airplane speed to the local speed of sound, is named after Ernst Mach, a 19th century Austrian mathematician.

Actually, since a shock wave forms wherever a localized airflow

exceeds the speed of sound, it may form on the aircraft's fuselage or canopy or wing. On wings the shock wave generally forms on the upper surface at about the 40 percent point of the chord, where the wing curvature is often greatest and the local flow is moving fastest.

On a thick wing, this happens at lower speeds than on a thinner wing. Thus, a thin wing has a higher critical speed than a thick one.

Supercritical airfoil

In the mid-1960s, NASA's Dr. Richard T. Whitcomb began studies and wind-tunnel tests that led to development of a *supercritical airfoil*. This special shape (see page 65) delays the formation of the shock wave and the drag rise at near-critical speed. And happily, the concepts of supercritical aerodynamics also lend themselves to uses at low speeds.

One reason is that the supercritical airfoil is considerably thicker, for a given lift/drag ratio, than a conventional airfoil producing the same lift. So a designer has two options: By adopting a supercritical form, he can maintain the thickness of a given wing and reduce its drag, or he can maintain the same drag and increase the thickness.

Thick wings are great for low-speed performance; they have excellent lift characteristics, they don't stall as abruptly or as soon as thinner ones, and they have more structural depth and can therefore be made lighter. So Whitcomb's supercritical technology, somewhat modified, has become the basis for both jet aircraft at high Mach numbers and a group of wing sections for much slower general aviation.

As noted, the Wrights turned their airplanes by literally twisting the wing structure out of alignment. In the jargon of time, they used "wing warping" for lateral control. The system worked reliably, but became obviously impractical for higher performance aircraft. Ailerons were devised as an alternative to wing warping. (Not incidentally, a way to get around restrictive language of the Wrights' formidable patents.)

Ailerons have hinged surfaces located near the wingtips that work in opposition; when one deflects upward, the other deflects downward. Another hinged surface likely to be used on any wing is a wing flap, used to increase lift at low speeds and thus contribute to safer, easier landings. Flaps add curvature and sometimes area to the wing, and both contribute increased

(Please turn to page 144)



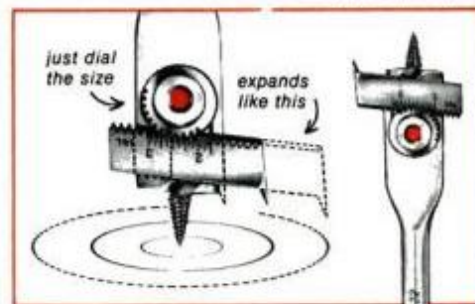
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WINGS

(Continued from page 143)

lift. The flaps push the air downward through a greater angle.

Conventionally, flaps are found at the trailing edge of the wing, inboard of the ailerons. But a specialized form, the Kruger flap, is mounted at the leading edge of some contemporary transports, like Boeing's 727 and 737 series. These flaps deflect down and forward to make the leading edge of the wing very blunt and highly curved. They produce a major increment in lift.

Wing slats: tip from birds

Near the wingtip at the leading edge you may find wing slats, an idea pioneered by birds. Ornithologists call the bird's wing slat the alula; it is to the birds' wings what our thumbs are to our hands. It guides air over the wing and makes the wing more efficient at low speed and at high angles of attack, delaying the stall. On contemporary airplanes, the wing slat is a movable surface that fits smoothly against the leading edge of the wing in flight. At low speeds, it automatically pops out ahead of the wing a short distance, creating a slot between itself and the wing. Air enters at the bottom of this slot gap and rushes out the top, directed along the upper surface of the wing to help maintain lift.

Paradoxically, there are times when it is necessary or desirable to rapidly reduce or eliminate lift. Landing on wet runways is one. Spoilers, or lift dumpers, provide that service. These hinged surfaces generally will be found on the upper surfaces of wings, forward of the flaps and inboard of the ailerons. They deflect upward as much as 90°, and the instant they are raised, much of the wing's lift vanishes in the mass of turbulence generated.

Twisting wingtip vortex

Air always flows from high- to low-pressure regions, causing a potentially dangerous phenomenon, since the lower surface of a wing in flight must have a higher local pressure than the upper surface. So air flows from lower to upper surface by making an "end run" around the wingtip. If you could see that air, you'd see a swirl coming from the lower surface, turning toward the upper and blowing backward off the wing simultaneously. Behind a plane's right wingtip, this flow would be counterclockwise; behind the left, clockwise.

In level flight, this twisting

(Please turn to page 146)

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WINGS

(Continued from page 144)

flow—the *wingtip vortex*—is relatively weak. In low-speed flight, when flaps are down and the wing is generating a lot of lift from strong low-pressure areas on its upper surface, the vortex strength increases several fold. It can trail aft of a heavy airplane like a Boeing 747 for miles, and it is powerful enough to seriously affect even a moderately heavy aircraft flying into it.

That is why there is a long separation between successive landings at major airports handling many heavy jet transports. The separation maintained by air traffic controllers is necessary for the dissipation of most of the energy in those trailing vortices.

Scientists long have been trying to find how to reduce or even eliminate the wingtip vortex. Not only is it dangerous to following traffic; it also robs the wing of energy, draining potential lifting forces to generate a vortex that adds to wing drag.

One promising tested scheme is the winglet, a small wing mounted at carefully determined angles to the main wing chord plane and to the local airflow at the tip. Properly designed and aligned, the winglet—another development credited to NASA's Whitcomb—reduces strength of the wingtip vortex and improves overall efficiency of the wing. The result is lower fuel consumption in cruising flight and a weakened, less dangerous tip vortex.

On radically sweptback wings, air tends to slide out toward the tip instead of staying on a fore-and-aft streamline. Thus, the flow over ailerons may be so strongly affected that they become almost useless. Somebody thought of an ingenious way to prevent this: They built an air dam on the upper wing surface to hold back lateral airflow. Called fences, these dams now are installed on many jet airliners and fighters.

These added devices—flaps, slats, spoilers, winglets, fences—are only methods to keep the airflow over the wing relatively smooth, or to disturb it in a controlled way at a specific point. Other methods of flow control require additional power; what we have described so far are aerodynamic devices working solely on energy of the passing air.

But some airplanes have been built and successfully flown with powered boundary-layer control (BLC) systems which attempt to keep the thin layer of slow-moving air nearest the wing surface from breaking away into a turbulent

flow, increasing drag and triggering a stall. Blowers have blown, suction systems have sucked, and enormous values of lift have been generated in wind tunnels and on test aircraft. But such schemes are often defeated by dirt, surface roughness—and insects. Narrow slots that blow air across a wing's upper surface, or suck it away from the regions where stall occurs, eventually clog.

Skeletal structure changes

Now let's look under the skin, at the internal structure that carries the lift and drag loads on the wing.

For many years after the Wrights, wings continued to be built from wood and fabric. Air loads on a wing dictate its skeletal structure. Spanwise beams, or spars, were developed to resist the lift loads that tended to bend the wings upward. Drag loads—in a fore-and-aft direction—were imposed on compression members between the spars, and sometimes reinforced by wire bracing. Torsion loads were handled by compression struts and wires in tension. Wing ribs gave the surfaces aerodynamic contours and provided some closely spaced structure to hold the covering and resist local loads.

As speeds climbed, structural design kept pace. Diving speeds sometimes tore the fabric from wings in World War I combat, so thin plywood was used to replace the fabric on leading edges. In time, that plywood skin moved farther aft, often to join with the top and bottom of the front wing spar.

Weldable steel and aluminum alloys at first were treated simply as structural improvements. The basic layout didn't change much; beams, ribs and fittings became all-metal instead of mostly wood, and fabric still covered the structure. But innovative designers found that metals had intrinsic values in unique structural schemes, such as thin-walled shells of very light weight and high strength. The simple cylindrical sections used as wind-tunnel test specimens soon made the metamorphosis into fuselage forms and wing shapes.

The earliest monoplanes were externally braced, with struts and often wires to carry the loads, a technique surviving today in many high-winged monoplanes for general aviation. But for less drag, the bracing had to go inside, and the cantilever wing made its debut.

It was pioneered in wooden form by Anthony Fokker, the Dutch innovator, in his World War I fighters. His later commercial aircraft

(Please turn to page 148)

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WINGS

(Continued from page 146)

and those of other designers used similar techniques. But the crash of a Fokker transport (see top of page 68) summarily ended the era of the wooden wing, and the all-metal structure filled the gap. It exploited the high strength-to-weight ratio of the new metals in clean surfaces of aluminum alloy skin curved over and riveted to ribs and spars pressed out of aluminum alloy and riveted together. Wings were smooth, maintenance-free, and needed no hangar protection against weather.

High speeds bring thick skins

Speeds continued to rise, and in the late 1950s wing structures had to change again to keep pace. Airplanes were moving at such high speeds that wing skins had to be quite thick to resist suction pressures generated on upper surfaces. It was reminiscent of the problem of tearing fabric on World War I pursuit planes. Thicker skins used to carry the increased air loads also lent themselves to new integrated structures, where the skins began to carry major portions of the loads.

They became, in effect, extensions of the upper and lower flanges of wing beams. They were fabricated from solid sheets of high-strength aluminum alloy and bolted to a rugged internal framework of multiple spars and heavy forged ribs. With much internal volume freed of encumbering structure and fewer skin joints, most of the interior of a wing could be sealed against leakage and used as a fuel tank.

Where do wings go from here? At this moment, the *Gossamer Condor* manpowered aircraft, with its filmy, extreme high-aspect-ratio wing, co-exists with the *Enterprise*, the space shuttle which has wings but generates much of its lift from the lines of its flat-bottomed body. Antique airplanes share airport ramps with the swept-wing Mach 2 fighters. High-wing lightplanes still show the basic wing format of the 1930s, and hang-gliders soar on airframes that would have been at home at Kitty Hawk in 1903. And somewhere out there, someone must be building an ornithopter, a flapping-wing creation he is sure will solve the problem of bird-like flight.

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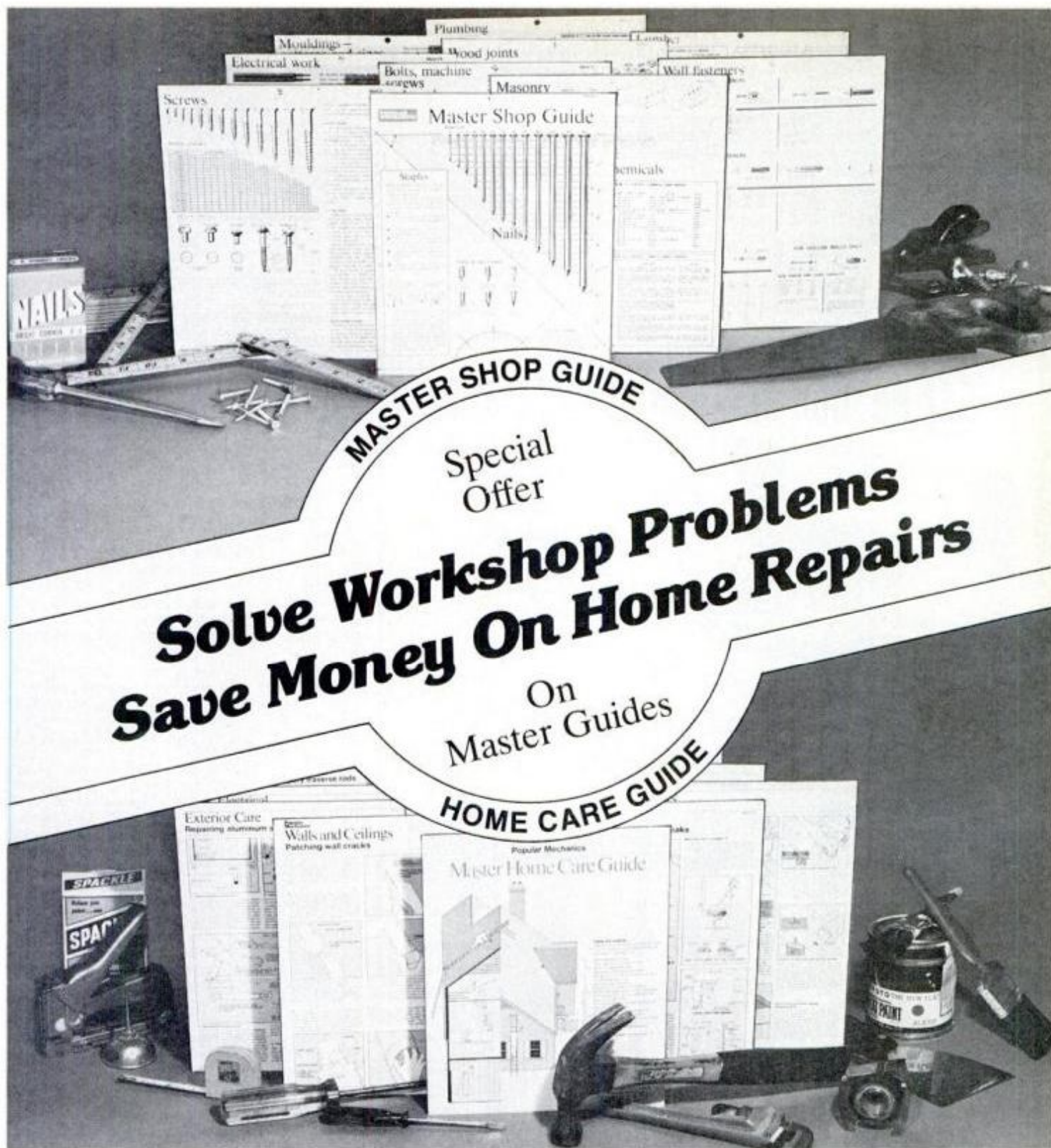
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4 MIRRORS YOU CAN BUILD

(Continued from page 104)

1. Contemporary mirror

Cut the plywood back to size. Outside cuts can be made on a table or radial saw and the inside cutout with a sabre saw guided by a clamped or tacked-on fence. Next, install the inside frame that the half-round moldings will butt against. Since its corners are mitered, note that the fourth piece must be trimmed (notched) on both ends in order to slide it in from the front.

For the easiest assembly, lay the plywood back on your workbench and glue the cut lengths of half-round molding as quickly as you cut them. Cut the pieces slightly over-length and let the excess hang over the plywood edges. For neatness, trim all ends

at the same time later. Use a miter jig on the table saw to cut left- and right-hand miters at the corners. On the prototype, all half-round molding is held in place with glue only. To do this, apply an even, thin coat of white glue to the mating surfaces and leave them exposed for several seconds so the parts will grip on contact and not slide about. To speed production, cut four or five pieces of molding and glue them in groups. Check each group with a combination square to see that moldings remain at a right angle to the inner frame. With all moldings in place, carefully position several wide pieces of plywood over moldings and weight with a heavy toolbox or the like. Leave undisturbed at least overnight. Next day, after measuring the offset of your portable circular saw shoe (distance between shoe edge and blade),

clamp a guide strip to the first edge along the first frame side. Set the saw-blade depth to cut through the moldings and plywood.

Repeat the cutting procedure for the three other sides. Then cut and fasten outer frame members (C), using white glue and 6d finishing nails. Install the cleat on the back for the screw eyes and insert four screw eyes.

Thoroughly dust the piece, seal with shellac and let it dry overnight. Finish the frame as described earlier. When dry, measure the opening for the mirror and cut (or order) a 1/4-in. mirror to suit. Allow a little leeway; the mirror should slide in and out without binding. Install the mirror and back it up with a hefty piece of cardboard or 1/4-in. plywood held with 4d finishing nails. Use stout picture hangers to mount the mirror.

2. Wood-lath mirror

You can make this quickie for very little money and can size the frame to suit a mirror you have on hand. Cut the plywood to size. Then, to cut the opening for the mirror, bore a 1/4-in. entry hole in each corner of the cutout and complete the cut with a sabre saw guided by a clamped fence.

On the prototype mirror we used wood lath as it comes from the bundle, though we did sort out any particularly waney pieces.

Rip several lengths of lath to width for the outer frame (B). Attach frame parts with glue and 1 1/4-in. brads. Use miters at corners. Next, rip lath to width for the facing frame, miter corners and install with glue and brads. Finally, lay out four diagonal segments, cutting four identical lengths at a time, one for each segment. Install strips as shown. The overhang at the cutout holds the mirror.

On the prototype, a coat of gray stain and two coats of satin-finish varnish gave a weathered look. For a natural look, skip the stain. Do not sand the lath.

3. Colonial mirror

This is the easiest of all to make. Buy a mirror and build the frame to suit. Cut the back to shape using a jigsaw, bandsaw or sabre saw. Slightly round all front edges. Sand the piece smooth and bore rope holes.

Position the mirror on the back panel and trace its outline in pencil. Use these dimensions to cut the half-round moldings which become the mirror frame. Cut the molding to length after cutting the mirror-holding rabbet on one edge. Install three lengths of molding with glue and 1 1/4-in. brads. Insert the mirror and install the last length of molding. For authenticity, add several carpet tacks to match nails on the original mirror.

After covering the mirror with masking tape, coat the wood parts with pine stain. Let this set 10 minutes, wipe off all excess and let dry overnight. Add "rust" to exposed nailheads by dabbing on burnt umber pigment direct from the tube. Next day apply a sealer coat of thinned shellac and let dry for 24 hours. Finish with two coats of varnish. Insert cord or a leather thong through the holes and knot it in back. Loop the cord over a nail or picture hanger.

4. Infinity mirror

This will awe your friends when it's lighted and serve as a regular mirror when it's not. It has four basic parts—an outside frame, inside frame, rear-mounted mirror and one-way mirror in front.

To build the inside frame, cut two pieces from 1/2 x 2 3/4-in. pine 32 in. long and two pieces 21 in. long. Draw a centerline down each piece. Measure in 1 in. from each end of the 21-in. pieces and mark every inch along the centerline. Measure in 1 1/2 in. from each end of the 32-in. pieces and mark each inch on the line. There should be 20 marks on each 21-in. piece and 30 marks on each 32-in. piece.

Measure the outside diameter of a light

(Please turn to page 152)

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4 MIRRORS YOU CAN BUILD

(Continued from page 150)

socket from a Christmas-tree string and drill all 100 socket holes. Butt-joint inside frame together using 1/4-in. nails and glue so its outside perimeter is 22x32 in. and inside is 21x31 in.

Next, construct the outside frame by cutting two 34-in. lengths of the same pine, also two 25-in. lengths. Butt-joint them like the inside frame. This frame should be 25x35 in. on outside perimeter, 24x34 in. inside.

Cut two 25x35-in. pieces out of a 4x8-ft. sheet of 1/2-in. hardboard (rough side up). Lay the two frames on one piece, squaring-up both frames as much as possible and leaving a 1-in. space between them on all sides. Outline the 21x31-in. inside frame on the hardboard, remove the frames, and cut out the 21x31-in. opening. This is the front of the mirror housing. The solid 25x35-in. piece is the rear of that housing.

Now remove all bulbs from the tree strings. Note the starter or fuse bulbs, usually at the start of a string and having red or green tips. Starting at the lower-right-hand corner or the inside frame, push all 50 sockets of one string into the inside frame from the outside edge so all sockets are flush with inside surfaces of frame. Repeat with other 50-light string, starting at the same corner. Epoxy any loose sockets.

Lay the inside frame, with lights, inside the outside frame and tuck all wires in the 1-in. space. Attach the hardboard front piece, with opening, to both frames, using 3/8-in., 16-ga. brads and glue. Be sure the smooth side is up and edges are square. Before sanding edges, apply masking tape over socket holes.

Remove masking tape and cover the frame with Con-Tact (see materials list, page 105). Do opposite sides first, starting at the rear, then inside frame, front of frame, outside edge of frame, returning to rear side. Repeat for the remaining two sides. Tuck any overlap of Con-Tact in the rear. Using a razor blade or hobby knife, carefully cut away the adhesive paper covering all 100 socket holes. Do not cut or damage sockets.

Next, drill 11 1/2-in. holes about 1/4 in. in from the edges and around the perimeter of the remaining 25x35-in. hardboard. Notch the lower right-hand corner, rough side up, for the line cord. Cover the back (smooth side) with Con-Tact; overlap if necessary. Fold paper over and onto rough side to cover the 21x31 in. outline. Measure 1 in. from the top edge of the hardboard and 4 in. from each end, and drill 1/8-in. holes where the lines intersect at two points. Attach a 3/16-in. steel washer to heavy picture wire, thread the wire through one 1/8-in. hole and run it along the back of the board into the second 1/8-in. hole, pulling it tight. Secure the remaining 3/16-in. washer as shown.

Lay the finished frame over the hardboard back, square it up, redraw outline. Remove frame and let assembly dry overnight.

Install Christmas-tree bulbs, with sure starter or fuse bulbs in correct locations. Connect to a 9-ft. extension cord and tuck connection neatly between the frames. Install a snap-on line switch 6 to 10 in. down cord from frame. Plug in cord. If lights don't work, recheck the socket connections.

Next, cut, notch and file the polished aluminum trim so each piece can be bent to cover two sides, one 35 in. and one 25 in. Bore four holes in each 35-in. side; three in each 25-in. side. Bend pieces as shown.

Place the 1/2 x 25 x 35-in. glass on top of the front of the frame. Make sure the mirror side faces inside. Secure this glass to the frame with aluminum trim and roundhead wood screws. Turn frame over and attach the rear cover, with mirror, to the back of the frame, using 5/8-in. No. 6 flathead wood screws through predrilled holes. Hang mirror with two 50-lb. picture hooks.

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discs in the front only; also the body side molding should be lower to ward off parking-lot dings. I find the Audi very comfortable and easy to handle, but consider the rear head restraints dangerous because they block visibility."

And a New Mexico realtyman: "It's a mechanical jewel! Front-wheel drive, fuel injection, electronic ignition, and it runs on regular gasoline. It's also one of the prettiest, best-proportioned cars available today."

"The entire car is superbly engineered. Doors fit, the paint is excellent, and the engine is a thing of beauty. I'd like a slightly larger displacement—say 3000 cc. We live at 7000 feet in hilly country, so the engine has to work pretty hard."

And a California career officer: "After considerable shopping, the Audi seemed the best buy for quality, safety, ride and comfort. Workmanship compares with, or exceeds, every car I examined at prices from \$4000 to \$18,000. And, after a three-week trip with my family from Alabama to Washington State and California, I cannot say enough good things about the 5000's comfort. The car also has superior ease of handling, outstandingly sound construction, an exceptional ride and gas mileage to compare with any economy car."

Or how about this sales rep from California: "I'm a road salesman and average 30,000 to 40,000 miles a year. I've owned a few cars in my time, but nothing like this Audi. Not one single thing has gone wrong with it mechanic-

ally during my first 21,750 miles.

"It has plenty of pep for freeways, plus the economy and roominess I need. I average 22 mpg combined city and highway driving. Mechanically, the Audi is excellent, but body and trim work is average. My only suggestions for improving the car would be to eliminate the space-robbing central mini 'console.'"

A Florida court reporter: "He's the only dealer I ever enjoyed dealing with. Gave me \$1000 off



Trunk of the 5000 is handsomely carpeted and praised for its roominess.

with no trade or hassle. The other dealer I tried offered to 'throw in a radio.' Quality is superior to American cars. Comfort likewise. But a car with five cylinders ought to get better gas mileage. I get only 16 to 17 mpg in town and 20 to 23 on the highway. I expected better. Front-wheel drive makes the Audi a joy to drive in bad weather. The car does stall on occasion, though, and the cruise control doesn't always work."

These notes from a New York business analyst: "The transmis-

sion lost third and reverse gear at 4000 miles. The dealer took two weeks to repair this. No help from the salesman in getting faster repair or a loaner. I find the headrests too high—they impair rear vision.

"The car handles very well in the city, however, and the front-wheel drive is excellent in snow. The airconditioner seems to be putting a considerable strain on the engine. I can feel it cut in and out."

And a Colorado auto mechanic reports, "I'd been driving T-Birds, New Yorkers and Cadillacs, but the Audi 500 handles so much better on icy and snowy roads and has proved much less tiresome to drive. I like the ride, although it's different from Cads and T-Birds. Dealer service is very satisfactory—I get prompt attention. Inside fit and finish are much nicer than in the 1977 Coupe de Ville I traded in. I especially like the Audi's size, handling and performance. Of the 40 new cars I've owned over the years, this Audi is the best."

A Minnesota architect: "Nice handling, excellent balance, good cornering with front-wheel drive. I also like the aesthetics—a highly competent design, visually exciting and clean. It is economical, especially since it burns regular fuel. After extensive test driving, I judged the Audi to be a most rational sedan—excellent workmanship at a fair price equals good value.

"On the minus side, the rear offers comfortable seating for two adults only. A 5-speed gearbox

(Please turn to page 156)

SUMMARY OF 1978 AUDI 5000 OWNERS REPORTS*

| | | | |
|------------------------------------------|---------------------------------------|--------------------------------------|-----------------------------------------|
| Total miles driven 3,017,655 | Ride 21.4 | Fair 0.6 | Good 35.2 |
| Average miles per gallon | Specific dislikes: | Poor 0.6 | Average 14.5 |
| Automatic transmission | No complaints 22.9% | Comfort opinion (rear seats): | Fair 6.8 |
| In town (EPA, 17 mpg) 18.6 | Lack of power 16.5 | Excellent 52.5% | Poor 10.0 |
| Long trips (EPA, 24 mpg) 23.0 | Poor dealer service 9.0 | Very good 37.2 | Number of vehicles owned: |
| Four-speed manual transmission | Headrests too high 7.4 | Good 9.0 | Audi 5000 only 24.5% |
| In town (EPA, 15 mpg) 19.5 | Airconditioner saps power 6.5 | Fair 0.7 | Two cars 54.0 |
| Long trips (EPA, 22 mpg) 24.7 | What changes would you like? | Poor 0.7 | Three cars 16.8 |
| Type of transmission: | More horsepower 11.6% | Had any mechanical trouble? | Four or more cars 4.7 |
| Automatic 81.7% | Lower headrests 10.3 | Yes 57.1% | Makes of other cars owned: |
| Four-speed manual 18.3 | No changes 9.6 | No 42.9 | Volkswagen 14.8% |
| Why did you choose the Audi 5000? | Less power-robbing a/c 6.3 | What type of trouble? | Chevrolet 14.8 |
| Styling 35.2% | Workmanship opinion: | Airconditioner 22.0% | Audi 10.3 |
| Economy 21.3 | Excellent 68.8% | Cruise control 19.2 | Ford 9.9 |
| Handling 21.0 | Good 27.8 | Gas gauge 13.7 | Oldsmobile 9.5 |
| Size 15.7 | Average 2.5 | Electrical 7.1 | Age distribution of owners: |
| Front-wheel drive 15.1 | Fair 0.3 | Brakes 5.5 | 15-29 years 11.2% |
| Specific likes: | Poor 0.6 | Dealer repairs satisfactory? | 30-49 years 49.8 |
| Handling 65.4% | Comfort opinion (front seats): | Yes 68.2% | 50-plus 39.0 |
| Styling 43.4 | Excellent 68.5% | No 31.8 | Would you buy another Audi 5000? |
| Comfort 38.4 | Very good 25.6 | Dealer service opinion: | Yes 87.7% |
| Economy 33.6 | Good 4.6 | Excellent 33.5% | No 12.3 |

*Percentages might not equal 100% due to rounding or insufficient data.

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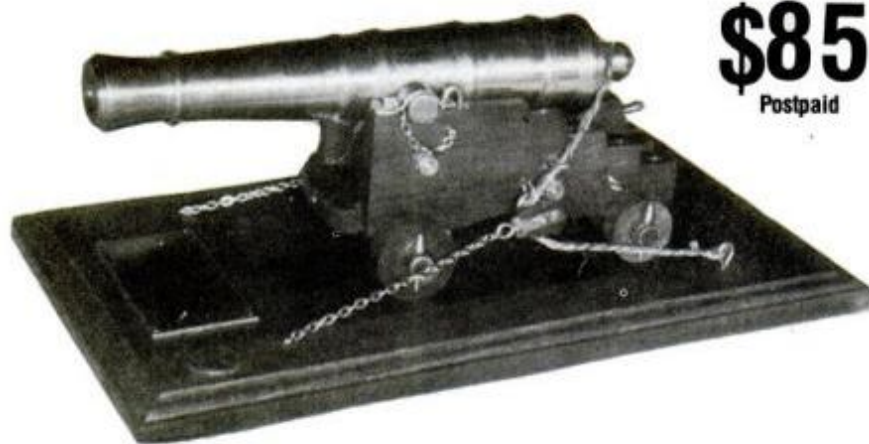
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PM OWNERS REPORT: AUDI 5000

(Continued from page 154)

would be nice, especially since there's excessive engine noise at 60 mph. And a turbocharger would improve midrange performance."

And now a California banker: "We wanted to replace our 1975 Tornado with another fwd vehicle, but this time we wished for a luxury car with good gas mileage. The Audi 5000 met our requirements.

"It is solidly constructed. We find the interior pleasing to the eye and very comfortable. The car is a good size, with easy handling and traction, excellent roadability, a good-sized trunk and satisfactory gas mileage.

"Would like to lower or eliminate the rear headrests. They cut down visibility and are very dangerous when trying to back out of parking spaces."

A Tennessee homemaker: "Reports we read indicated that an Audi compared favorably with higher-priced cars. My husband says the Audi represents workmanship at its best—on a par with Mercedes, BMW. What I like best about the car is its styling. After that, in order of performance, comes interior roominess, trunk capacity, front-wheel drive and comfort. The relative distance between the steering wheel, pedals and seat is extremely well engineered.

"However, the headrests in the back are dangerous, and the inside door handles and armrests are too low for short people (I'm 5-1):

"The dealer rates tops, because the car needed a new radio, and he replaced it under warranty with no hassle. He was courteous when we bought the car, but gave absolutely no discount."

And finally, a California pharmacist states: "The Audi has the quality of a Mercedes at a fraction of the price. It handles almost as well as a sports car. Beautiful, functional interior, lots of trunk room, and the engine is very quiet.

"It's the closest I could come to a Mercedes and still afford the price. Also, the resale value doesn't depreciate as much as American cars. And that 'spartan' look of so many German cars isn't noticeable in the Audi.

"The dealership had sent mechanics to 5000 school a year before the car was imported into this country; thus they were very familiar with it.

"The salesman applied no pressure, perhaps because he didn't have to sell me. I knew what I wanted and what I was getting. Considering what I paid, I feel—no, I know—I got a very good car." **PM**

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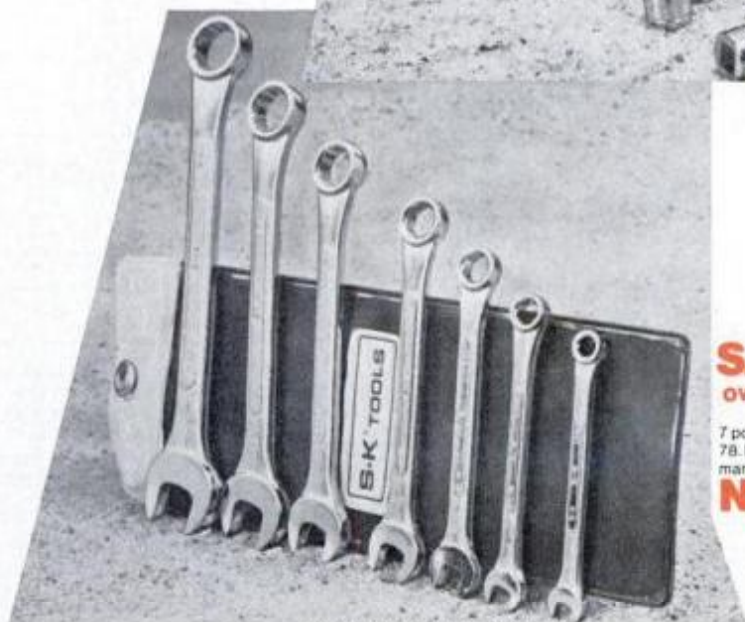
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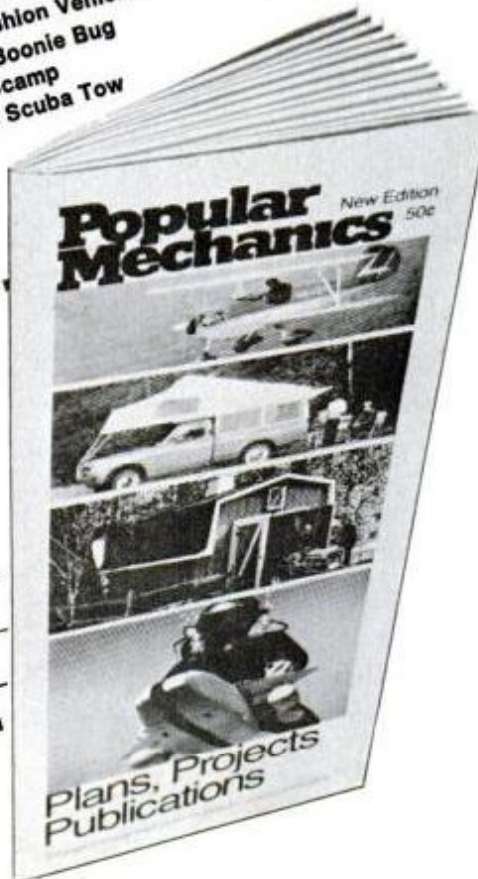
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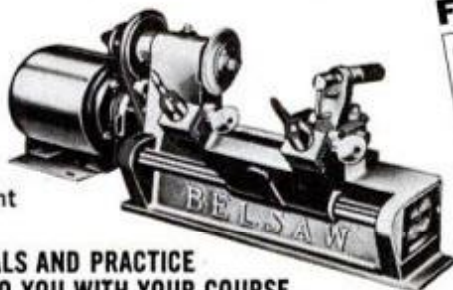
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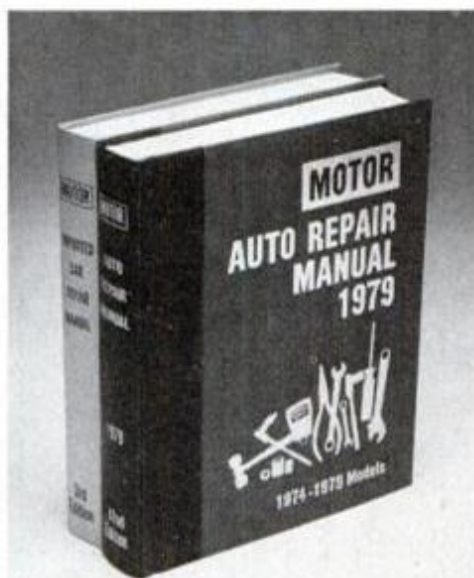
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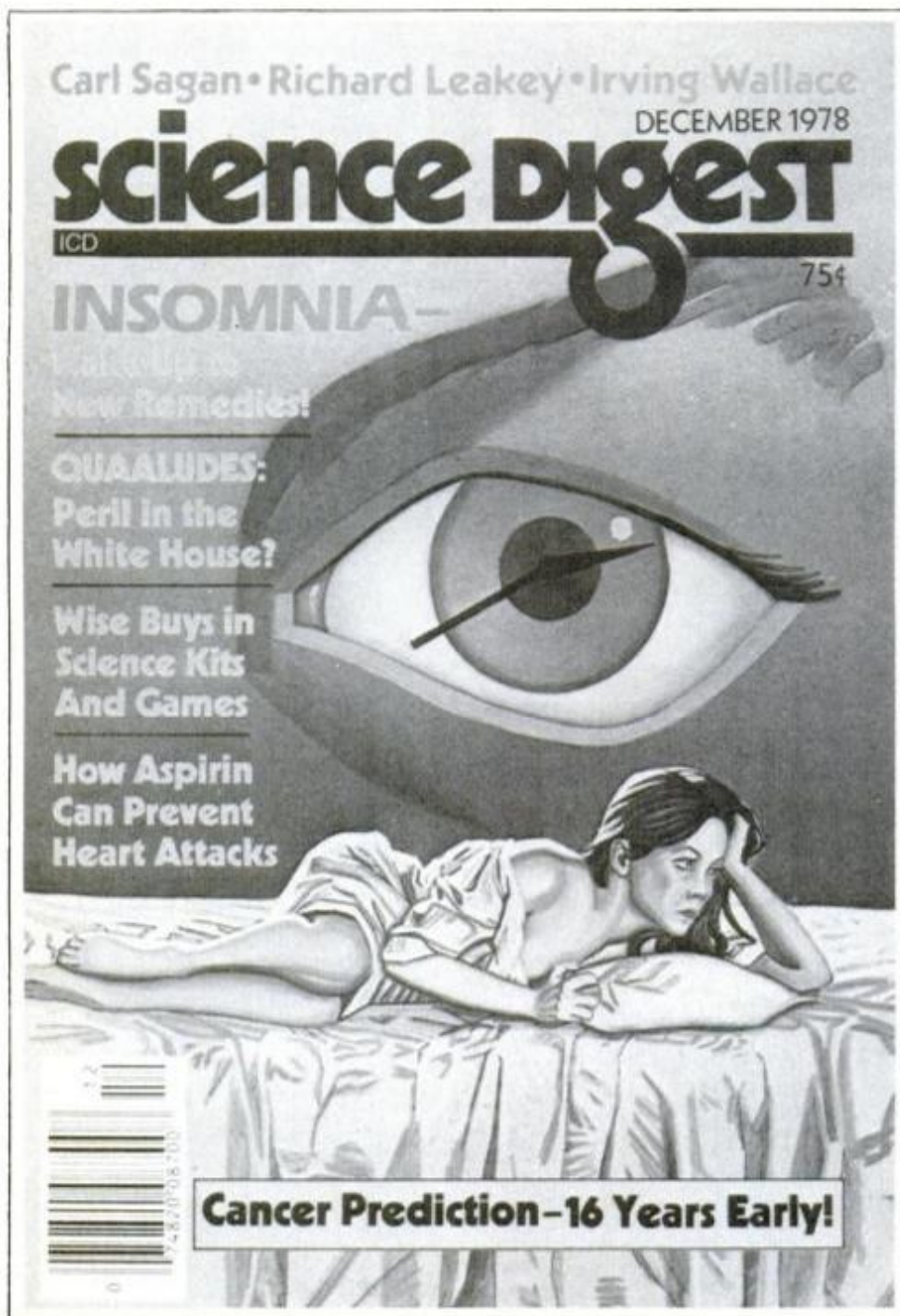
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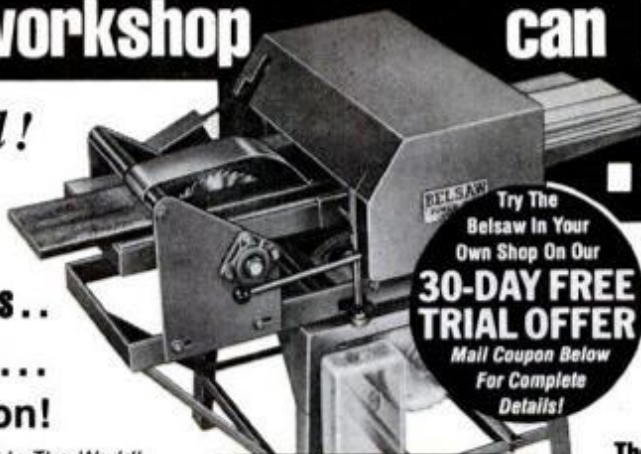
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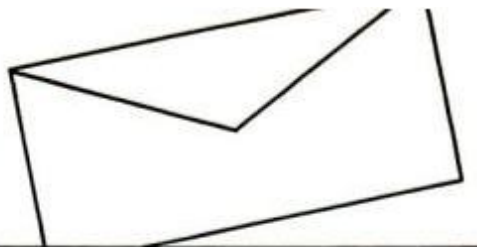
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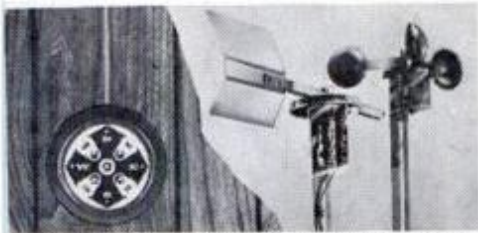
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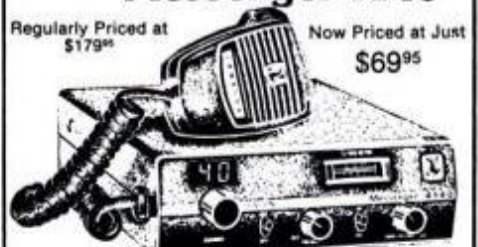
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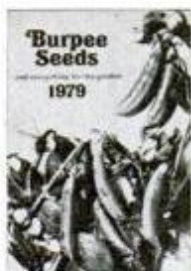
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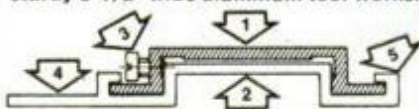
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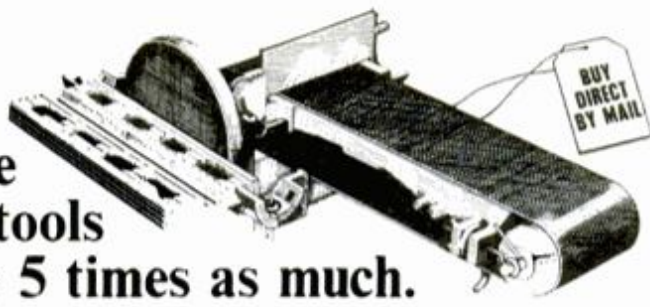
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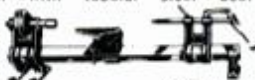
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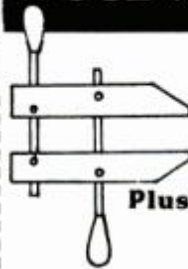
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