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Popular Mechanics

PM DRIVE TEST:
3 American Sedans Give
Audi A Run For Its Money

DEADLIEST GAME: UNDERSEA HIDE-AND-SEEK

Step-By-Step:
Install Your
Own Tile Or
Laminate
Countertop

PLANS:
2 Victorian
Washstands
You Can Build

**How To Assemble
A Super Video
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1,561,800-MILE REPORT
Hot-Selling Nissan
Sentra Delivers On
Economy, Owners Say

PM's Pick:
14 Best New Boats

**7 Expert Ways
To Get Your
Best Shave Ever**



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On the cover

It's not like it was in those old World War II movies. Today's anti-submarine warfare has evolved into a deadly game played by computers and super-sophisticated technology. Read how we're secretly tracking Russian subs in the exciting account that begins on page 149.

—PM painting by Ed Valigursky

Popular Mechanics®

FEBRUARY 1983

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EDITOR'S NOTES

John A. Littleton

The gung-ho spirit of PM editors has no limits, we've decided. When our Home & Shop Editor (a former artillery officer) submits to a facial for the greater good of the magazine, he has given his all. More at home in the world of radial-arm saws, Harry Wicks (right) became our beauty for a day at New York's Christine Valmy Salon. It was done to produce *7 Tips On Surviving A Really Close Shave* (page 106).



Just routine for a Home & Shop Editor.



Science Editor Eskow under Hawkeye.



Flock of Hawkeyes on way to service.

Grumman has built some 70 Hawkeye flying radar stations, most of them for the Navy. Others have gone to such allies as Israel and Japan. When Science Editor Dennis Eskow learned the plane is also a key to the nation's war against Florida drug smugglers, he promptly assigned the story and, of course, inspected the plane. Read about it on page 79.



Smaller can be better, observes Shapiro.

Is the whole idea of personal computers more than you wish to cope with? (But, don't you wish you knew something about them—to communicate with your kids?) In this issue (page 94), Electronics Editor Neil Shapiro had author Herb Friedman pick the five friendliest computers on the market. They're easy to learn—and you can't be intimidated by their size (see the tiny Timex/Sinclair 1000 at right). If you're entering the world of computers, check out our story. **PM**

Log Splitter Parts



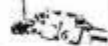
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Tie Rod	4x24	1 3/4	74	909424	140
HD Tie Rod	4x24	2	78	909724HD	150
Tie Rod	5x24	2	100	909530	204
Welded Tee*	4x24	1 3/4	49	90424	132

*These can be shipped U.P.S.

Quality Gas Engines



HORIZ	HP	SHAFT SPECS	ITEM#	WT	PRICE
Tecumseh	5	3/4" Recoil	6051	40	\$130
Briggs	5	3/4" Recoil	6052	40	130
Briggs	8	1" Recoil, model 190432	6080	50	198
Tecumseh	8	1" Recoil, cst iron slv	6081	50	182
Tecumseh	10	1" Recoil, cst iron slv	6010	50	220

VERTICAL

Briggs	5	7/8" Recoil, HD fly-wheel	7050	45	\$145
Tecumseh	5	7/8" Recoil, model	7051	30	125
Briggs	8	1" Recoil	7080	49	205
Tecumseh	8	1" Recoil, model VM80	7082	50	195
Tecumseh	8	1" Elec/Recoil, 12 volt	7083	55	239

3 1/2 18 HP available in horizontal & vertical

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5 HP Tecumseh & 11 GPM pump, #8050	\$265
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LETTERS TO THE EDITOR



Driving schools aren't all alike

Tony Assenza's article on safe driving techniques (*Asleep At The Wheel*, page 86, Nov. '82) was excellent, but, sad to say, it probably won't be read by the people who need it most. The statistics he cites on the high accident rate of driver ed graduates confirms what I've suspected for years—that the average high school type of driving course is virtually worthless.

All those idiot skid marks on the pavement and the tire screeches that sound throughout the night are evidence enough of mass driver incompetence. It's high time we made the driver's license something more than just an I.D. card and a birthday present.

CURTIS M. KINDGREN
ORLANDO, FLA.

Thank you for Tony Assenza's super story on safe driving. The Bertil Roos school he mentions sounds fine for race drivers, but are there any advanced courses for ordinary folks who just

want to improve their driving skills? I'm thinking ahead to when my young son will be starting to drive.

ELAINE POSTLEY
NEW YORK

Auto Editor Tony Assenza replies: Sorry if we gave the wrong impression. The Bertil Roos driving school located in Blakeslee, Pa., is open to the public and can definitely help to improve anyone's car-handling skills. (Roos does teach race drivers, but in a separate, more specialized course.)

Some other advanced driving schools that readers might like to know about are the Jim Russell School, Laguna Seca, Calif. (also branches in Riverside, Calif. and Mont Tremblant, Que.); Bob Bondurant School of High Performance Driving, Sonoma, Calif.; M-sport Racing School, Toronto, Ont.; Scotti School of Defensive Driving, Somerville, Mass.; and Bill Scott Racing School, McLean, Va.

Let's keep the old atom

That was a spectacular painting of the "new" atom (*Here's The Atom As You've Never Seen It*, page 76, Dec. '82). But I don't need a lot of mysterious new particles for which, as even Dr. O.W. Greenberg admits, "there is as yet no convincing evidence of existence." I'll stay with the old three-part atom, with simple electrons, neutrons and protons, until there is more proof.

ERIC R. ANDERSEN
PORTLAND, ORE.

Science Editor Dennis Eskow replies: The old atom may seem more comfortable to live with, but scientists can't explain such phenomena as beta radiation and magnetism with the traditional particles alone. If we want nuclear pulse rockets and super computer chips, we'll have to let them have their quarks, monopoles and weakons—at least until there's a better explanation.

Good winter project

I am writing to tell you how much we enjoy the Adirondack-style lawn bench



Harbinger of spring: The PM Adirondack lawn bench built by reader Ty Baltzell.

shown in your June '82 issue (*Build PM's Adirondack Lawn Furniture Set*, page 116). My husband Ty did the carpentry, I did the painting, and the job took only a few days.

Here's a photo (above) to show the result. We really like it and plan to make the matching chair and table.

ROSE BALTZELL
MENDON, OHIO

We're glad you like the bench. For others who may be interested, photocopies of the article are available for \$2.50 postpaid from Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101. For readers who would prefer greater working convenience, a set of enlarged drawings with detailed instructions is also available for \$5.95 postpaid.

It's coming, it's coming

Your October '82 issue contained plans for a terrific automotive tool dolly (*Build PM's Tool Dolly*, page 132). Now I'd also love to have that engine stand you showed in the same photo.

RICHARD A. PRECHT
CORTEZ, COLO.

You're in luck. Plans for an engine stand similar to the one shown (that was a commercial model) will appear in a future issue of PM.

Doing our bit to help

Congratulations on your article *How To Avoid The Most Common Shop Accidents* (page 120, Nov. '82). We are delighted to see you make a contribution toward accident prevention.

PHILIP A. WORKMAN
SUPERINTENDENT, SAFETY AND HYGIENE
INDUSTRIAL COMMISSION OF OHIO
COLUMBUS, OHIO

Gee, it was a good one, too

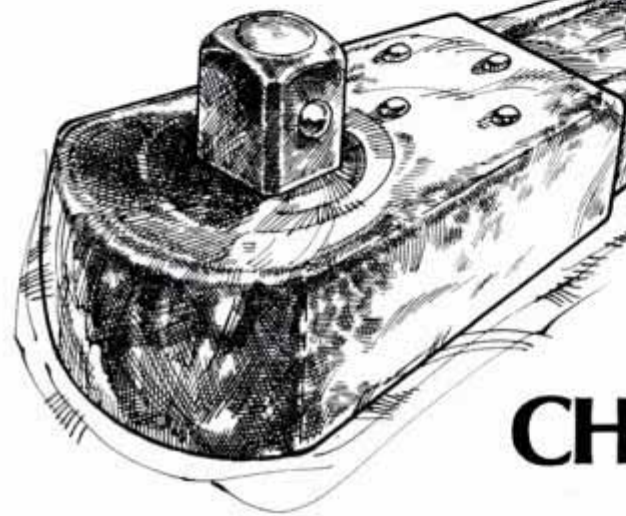
We are very pleased that PM selected a Brahma pickup topper for the conversion project in the November '82 issue (*PM Designs Two Utilitarian GTs*, page 174). I am sorry, however, to have to inform your readers that the molded bedliner, which you also recommended, is no longer being manufactured by us.

PETER D. MacEWAN
BRAHMA INC.
GRAND PRAIRIE, TEX.

The Brahma bedliner was available at the time we made the conversion. Readers seeking alternate liners from other manufacturers might get in touch with the RV accessories dealers who are listed in their classified telephone directories.

PM

OVER FORTY YEARS AGO, KEITH PAULEY'S GREAT-GRANDFATHER MADE A SEARS CRAFTSMAN RATCHET HIS CHOICE.

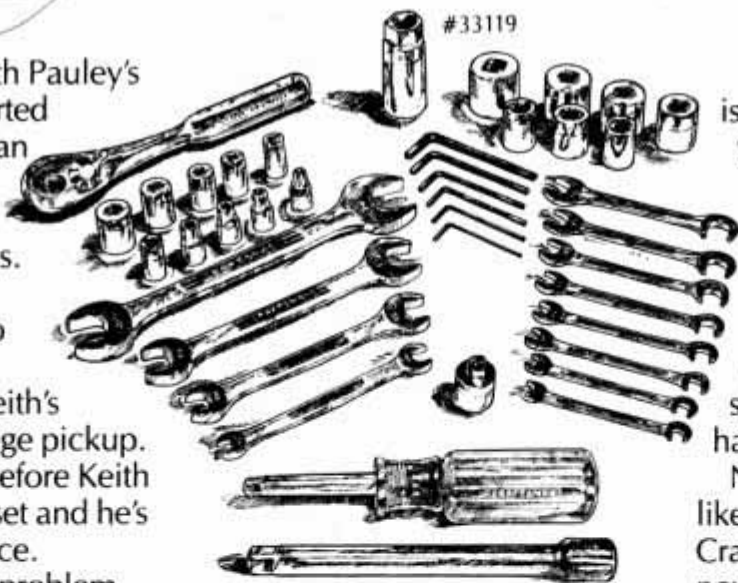


NOW THIS 40-PIECE SET IS THE CRAFTSMAN[®] CHOICE FOR FEBRUARY.

Back in the '30's, Keith Pauley's great-grandfather started out using his Craftsman mechanics tools on his horsedrawn hay rakes and wagons. The set was handed down to his son, who used it on all sorts of things. Then came Keith's Dad and the '36 Dodge pickup. Well, it wasn't long before Keith got his hands on the set and he's been using it ever since.

When Keith had a problem with the ratchet's drive shaft, after 40 some years of use, we offered to replace the entire ratchet under our full unlimited warranty. A warranty which says, "If any Craftsman hand tool or socket ever fails to give complete satisfaction, return it to the nearest Sears store in the U.S.

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and Sears will replace it, free of charge." Keith wouldn't hear of it. All he wanted was a new part.

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Of course, we can't promise your ratchet will last 40 years, but Craftsman mechanics tools are still made of tough alloy steel, then heat treated and tempered for durability.

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No wonder millions of people like the Pauleys have chosen Craftsman mechanics tools. And now this 40-piece tool set is the Craftsman Choice from January 30 through February 19. At a savings of over 50%, don't you think it's time you made it yours?

P.S. You'll be happy to know Keith got his part. And word has it, Keith's son is going to get the original tool set.

sears

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SCIENCE WORLDWIDE



Dead Sea decade yields new discoveries

After studying the 2,000-year-old Dead Sea scrolls for a decade, Israeli archaeologists are about to publish studies that are bound to stir excitement in the world of biblical archaeology.

Using sophisticated chemical tests, the Israelis have found that smudges and tears in the scrolls were probably caused by centuries of denaturation—a change in chemical structure—of a protein called collagen. It's found in the animal-skin parchments of the scrolls. Critics have accused the Israelis of mistreating the scrolls.

Another discovery: Yigael Yadin, whose translation of the largest scroll will be released in English next month, has concluded that Jesus was not a member of the ascetic Essene cult, despite long-held and widespread beliefs to the contrary.



Amino acid tests made on the Dead Sea scrolls (above) reveal their true age.

Stars for sale

The International Astronomical Union has found some shady groups in Australia with official-sounding names that offer to name stars after a person provided he pays a "research fee." The IAU, whose star registries are the only sources used by professional astronomers, cautions against buying a star name. If you find someone selling star names in your area, let me know.

Space suit snag

The Space Shuttle crew's planned November space walk was canceled because of failures in the astronauts' space suit air-circulation systems. But another kind of snag worries space experts: Can woven space-suit material get torn in orbit? To test a variety of materials, New York's Fashion Institute of Technology has developed a "mace snagger." It's a simple device for such a high-tech field. A spiked ball about



Mace snagger is used to test strength of space suits and other woven material.

the size of a Ping-Pong ball is anchored to the machine. The fabric runs along a belt, letting the spikes run across the material.

By counting the number of snags that are developed over a specified period of time, the clothing researchers can predict how a fabric will behave under specified conditions. **PM**

Here comes Halley!

Back in October, scientists at Mt. Palomar registered the faintest impression of a speck of light heading from the direction of Pluto toward our sun. It was the first sighting of Halley's comet. That's exciting, but even better is the fact that I—and possibly you, our readers—can be part of the International Halley Watch.

An amateur's telescope 8 to 10 inches in diameter could produce some very important photographs to be used by professional astronomers in learning more about Halley as it approaches naked-eye view in late 1984. The Halley Watch is being conducted by the Jet Propulsion Labs in California. If you have a telescope and want to take part, send me a self-addressed stamped envelope for details.

Solar dictionary

If you think a mean wind is something that brings misfortune, you need V. Daniel Hunt's *Solar Energy Dictionary* (Industrial Press, \$27.50). Here's how mean wind gets straightened out: "If no average interval is specified, such as annual mean wind, the reference probably indicates an averaging interval

just long enough to filter out turbulence in the wind, e.g., 15 minutes to 1 hour." That's plain English.

Iron-powered bees

Scientists have long suspected that flying animals get their sense of direction from the Earth's magnetic field. Now comes a paper from *Science* magazine that reports the discovery of iron-containing cells in the bellies of honey bees. The six researchers who wrote the paper think the iron may play a role in the making of certain honey bee body chemicals, and may also affect the direction of honey bee flight.









Imagine you're healed

Patients with diseases diagnosed as emotionally-caused tend to be unable to have fantasies or daydreams, according to research presented at the Marquette University "Power of the Imagination Conference." It was noted, however, that such patients given hypnotic suggestions of a daydream showed signs of improved health, and a few even recovered. Patients with illnesses ranging from cancer to ulcers reportedly responded to treatment.

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<p>D Only \$9.95</p>  <p>Girl Watcher Gray mirrored lenses, black frames. A \$20.00 value only \$9.95. 2 pairs for \$18.00.</p>	<p>H Only \$14.95</p>  <p>The Sportsman Sports-graphic on black metal frame. A \$25.00 value only \$14.95. 2 pairs for \$28.00.</p>	<p>L Only \$14.95</p>  <p>Professional Driving & Shooting Glasses Wide angle amber lenses brighten visibility. Gold frames. A \$30.00 value only \$14.95. 2 pairs for \$28.00.</p>

Style #	Quantity	Frame Color	Price
A		Black	
B		Brown	
C			
D		Black	
E		Black	
F			
G		Gold	
H		Black	
I			
J		Gold	
K		Gold	
L		Gold	

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IMPORTS & MOTORSPORTS



New Nissans

Trying harder goes with being No. 2. Nissan tried so hard with its Sentra line that it was the bestselling nameplate for several months last year. After its introduction in April, Sentra beat the Toyota Corolla 19,513 to 16,727 models sold for the month of June, and then edged it out again in July and September. At last count, the Sentra is still going strong and could give the Corolla a tough fight for top honors in '83. Sentra's appeal (aside from phenomenal fuel mileage, of course) is in its very contemporary styling: smooth outside and roomy inside, just like Stanza.



Pulsar NX is Nissan's new, dramatically wedge-shaped, front-wheel-drive coupe.

AM/FM four-speaker stereo and pop-up halogen headlights. Power is from Nissan's 1.6-liter ohc Four.

Sentras get the same 1.6-liter engine but the MPG model continues with the 1.5 liter). Stanza's new option is a three-speed automatic transmission with lockup torque converter.

The sporty 200SX hardtops and hatchbacks have power steering standard and SLs are available with leather seats.

The very smart-looking Maxima models have so much going for them that a lot of car buyers are being short-stopped on the way to their BMW dealerships. Nice refinement for '83 is a new rear suspension on the wagon (it doesn't intrude on the cargo space) that lets you drive it as if it were a sedan.

Last, but not least, are the 280-ZX models with larger tires (205/70s instead of 195s) and a new interior option package. Suspension is softened for improved ride on Turbos.



Maxima wagon, one of smartest-looking haulers around, now handles like sedan.

New for '83 is the Pulsar NX sport coupe, replacement for the 310. This dramatic wedge is controversial in its styling (chopped too abruptly in the rear), but it's a solid car offering a lot for the \$7,399 base price—sunroof,

second gears that let you do that, and a fifth that lets you net 55 mph while the tiny, 1,335-cc Four is turning 1,950 rpm, a fast idle. New to the FE this year is an upshift light that tells you when to shift for best fuel economy. (When you're having fun driving this ergonomically perfect little car for the sport of it, ignore the light.)

After a few hundred miles in the 1300FE Civic, I wondered what more satisfaction I could get when I switched into the new model for '83, the 1500S. Well, driving this GTO of Civics, I found that with the 1,488-cc engine you do shave a little time off your brisk sprint to 60 mph. That's satisfying. And with the S model's rear stabilizer, special shocks and Michelins, you're quicker through the slalom. That's satisfying. Also, the S models are great looking and great feeling with their fashionable interiors, four-spoke steering wheels and other identifying features. That's satisfying. But all of these S goodies are really not necessary. Honda has a delightful Civic even in its high-g geared, fuel-economy, FE model.

Turbo trucking



Mitsubishi sells its turbodiesel pickup here, but not this Pajero turbodiesel Jeep.

We'll have to follow up our turbo cars story (*Turbocharging—This Time It's Here To Stay*, page 71, Dec. '82) with a turbo trucks piece—not of the Mack variety, but those scaled for you and me. Late last year Mitsubishi gave us the turbodiesel pickup in two- and four-wheel-drive versions (and they have turbos we don't even know about, like the Japanese-market Jeep above). Now Subaru has a gas turbo in its Brat and 4wd sedans and wagons. They're just out and we plan to be driving them soon.

FM

Tale of two Civics

Driving Honda's 1983 Civic 1300FE (FE for fuel economy), you'd expect to slip the shift lever into fifth, settle down to a steady 55 mph and get between 46 and 59 mpg: They're the EPA numbers for estimated mpg and highway mpg. What you don't expect is to be able to squirt away from a lot of cars on the road—squirt up to 60 mph in 11 seconds. Honda gives you first and



Civic 1500S is new in '83 Honda lineup.

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DETROIT LISTENING POST



Four '83½ Chryslers unveiled

Chrysler just keeps spinning off innovative new products on variations of the versatile K-car platform. The latest four consist of a super-luxury, fwd New Yorker; a stretched Executive sedan; a longer-still limousine and a nostalgic "woody" version of the LeBaron convertible.

Based on the 103-inch-wheelbase E-Class sedan introduced last fall, the six-passenger, "formal"-roofed new New Yorker is not to be confused with the larger and much heavier old rear-drive New Yorker, which has been redesignated "New Yorker Fifth Avenue Edition" for '83.

It shares the company's 2.2- (newly fuel-injected) and optional 2.6-liter engines and comes standard with Chrysler's Voice Alert warning system and a travel computer.

The five-passenger executive sedan and seven-passenger limo, both derivatives of the fwd LeBaron, are being built by an outside contractor for '83.



In spring, you can get LeBaron convertible in limited-edition "woody" model.

but may be fully Chrysler-produced next year if sufficient demand materializes. The former's overall length is increased by 24 inches, the latter's by 31 inches, over the basic LeBaron. Both should deliver 20 to 30 mpg from their standard 2.6-liter engine.

The limited-edition Town and Country "woody" ragtop becomes Chrysler's most prestigious convertible and comes complete with the 2.6 engine, Mark Cross leather trim, rear decklid luggage rack and a long list of additional equipment. About 500 will be produced this year.

its turbo 2.2 for its '84 G-24 sports car (we've already had a chance to drive an engineering prototype with this engine and report the experience on page 65). AMC already has a turbo Fuego, and VW of America recently introduced a turbodiesel Rabbit option. GM's Chevrolet Div., for its part, is reportedly looking at Wankel-type, crankshaft-driven superchargers to boost the output of its 2.0-liter and smaller engines of the future.

Pontiac also would like to have its own high-performance turbo V6 to replace the 5.0-liter Chevy V8 as the top-of-the-line Firebird Trans Am option. Division engineers are working on an all-aluminum, port-injected, twin-turbo 2.9-liter version of Chevy's 60° V6 for just such an application, but don't expect it before the '85 model year.

Fwd T-Bird/Cougar for '86?

As soon as Ford's design people had completed work on the sleek, new '83 Thunderbird and Cougar last fall, they started on all-new fwd versions for possible '86 or '87 introduction. These will likely retain the rounded aero look but will be re-proportioned for conversion to fwd.

Ford is planning to follow Chrysler and GM in converting virtually all of its products to the more space-efficient fwd configuration, and its new fwd transaxle for mid-size and larger cars is slated to be ready by the '86 model year.

Another Ford program involves a larger version (2.5 or 2.6 liters) of the new 2.3-liter, fast-burn, swirl-combustion Four as a higher performance option for the soon-to-come fwd Tempo/Topaz compacts. The larger and more powerful engine should make these cars more competitive with GM's mid-size A-cars (which offer both gas and diesel V6s), and it may be ready as early as this fall.

All-new Rabbit for '85

Faced with diminishing sales of its decade-old Rabbit, VW is working full clip on a new one for introduction a year from this fall. Contrary to previous

(Please turn to page 16)

Turbo 2000

Turbochargers are all the rage these days, and rightly so. It's one of the few alternatives automakers have for combining the power and fuel efficiency requirements of downsized cars. All set to debut simultaneously with the mid-engined Pontiac Fiero, is a turbo-charged version of Pontiac's 1.8-liter, overhead-cam Four which will appear as an option on the 2000 (J-car).

Complete with throttle-body elec-

tronic fuel injection, hydraulic valve lifters and a new aluminum intake manifold, this will be the first, small, turbo-charged engine from any GM division since the mid-'60's turbo Corvairs. We drove a prototype in an '83 J-2000 last summer, and even with automatic transmission it was a real screamer.

Ford, of course, is scheduled to unveil its 2.3-liter turbo.Four (in a high-performance T-Bird) about the time you read this, and Chrysler is readying

Pontiac's P-car gets a name



We've been talking about Pontiac's P-car for what seems like ages. Photos appeared in DLP last month (see page 14). We've only been able to call it by its internal designation—P. Now, at long last, the vehicle has a name and, as a bonus, an appendage. Pontiac has officially called it the Fiero 2M4. Fiero, according to Pontiac, is short for Firebird and Aerodynamic. In Italian, they tell us, Fiero means "proud one." The 2M4 stands for two-seater, mid-engine, four-cylinder.

**Strong new reason
to pick Ranger!**

Ford's tough Ranger is already the best-selling 4-cylinder pickup built in America. Now it offers V-6 power and performance, too!

V-6 Ranger Driving Power. New optional 2.8L V-6 boosts driving power and excitement. And it's available in both 4x2 and 4x4 models.

More payload than Chevy S-10. Ranger's 1755-lb. payload option is the largest of any American-built small pickup.

*R. L. Polk & Co. CYTD registrations, August, 1982.

Ford's new Electronic Engine Control, EEC-IV, constantly monitors the Ranger V-6 for most effective performance. It can process a million commands a second!



Widest choice of engines. Only Ranger 4x2

offers two 4-cylinder gas engines and a V-6, plus a new diesel that the Chevy S-10 can't match.

FORD

FORD DIVISION



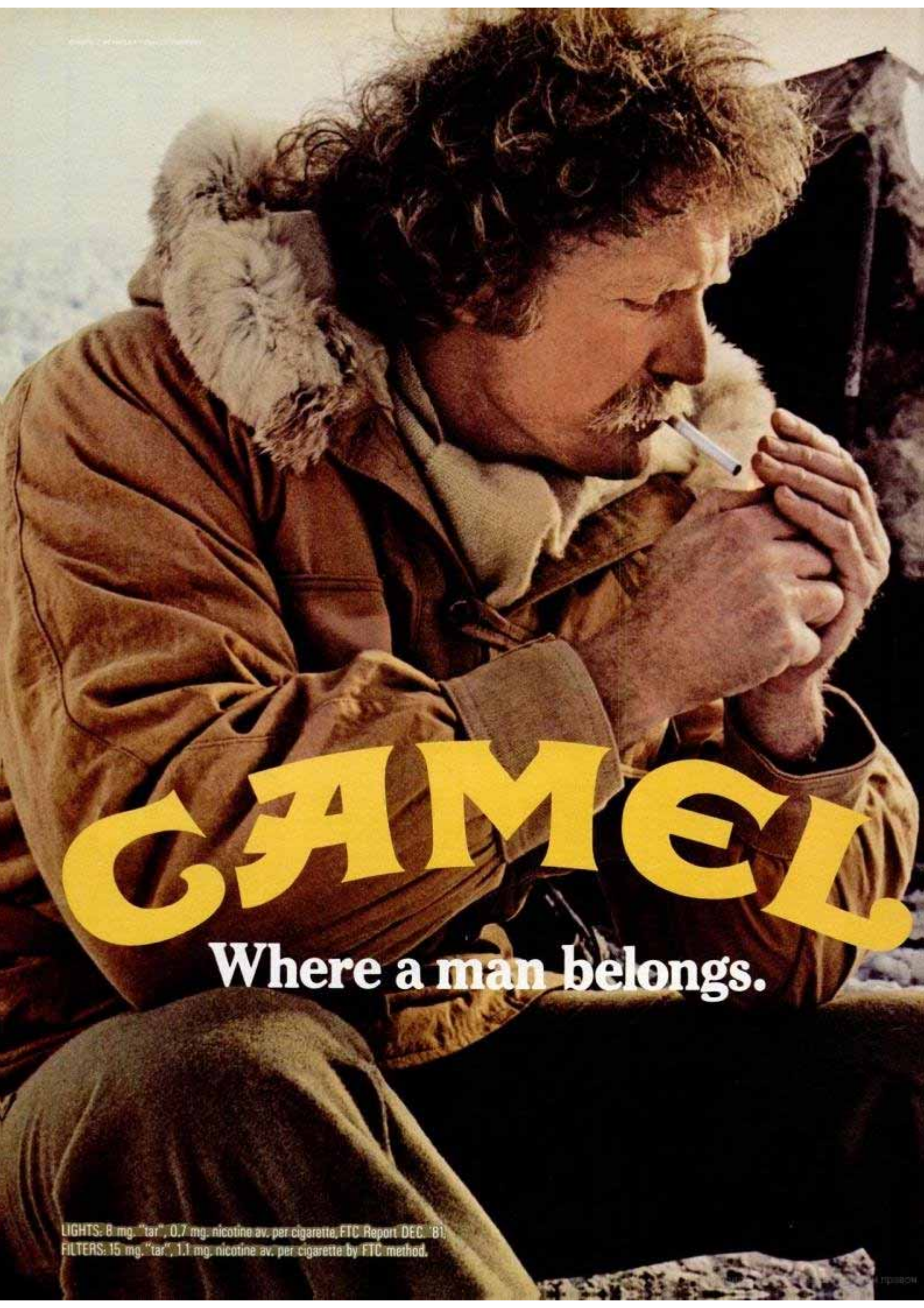
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Experience the
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DETROIT LISTENING POST

(Continued from page 12)

rumor, it will be more evolutionary than revolutionary in both style and engineering, and definitely will not be based on the teardrop-shaped, Auto 2000 concept car that's been touring the auto show circuit.

The '85 U.S.-built Rabbit will be slightly longer (both overall and in its wheelbase), more rounded, more wedge-shaped and far more aerodynamic than the current version, with a roomier interior and significantly better fuel economy. A large part of that econ-

omy gain will result from advanced electronic engine control and (probably beginning in 1986) a computer-controlled, continuously variable, automatic transaxle on some models, as well.

Meanwhile, VW of America is touting some 1,300 improvements to its '83 line; new Luxury GL, turbodiesel and high-performance GTI Rabbit versions; and its new, 12-month, unlimited-mileage warranty. A specially equipped '83 Rabbit diesel recently became the first production vehicle ever to top 50 mpg in EPA city testing and posted an astounding 67 mpg in the EPA highway test.

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Chevy's hot experimentals

At Chevy's press preview day at GM's Milford, Mich., Proving Grounds last summer, we couldn't help marveling at all the wonderful, experimental, non-production hot rod Chevys on hand, most of them available for driving. The Camaro group alone had a fuel-injected, V6-powered Z28 and three Dick Guldstrand-prepared Z-cars—one with a 5.7-liter aluminum V8; a second with a multipoint, fuel-injected 5.0-liter and independent rear suspension; and the third the very same 200-plus-hp Z28 race car we had barely beaten at Nelson Ledges (see *Only The Strong Survive!*, page 92, Nov. '82).

There was also a very fast V6-powered Chevette, which we keep hearing they may put into production one of these days. Also a fuel-injected V6 Cavalier (J-car) development vehicle, complete with a whole dashboardful of intricate instrumentation, knobs, dials, bells and whistles, and an engineer to demonstrate it.

Also a turbo V6 Citation (X-car) X-11. And a gorgeous, dechromed, candy apple red, HO V6 Cavalier coupe with special tires, steering, suspension, interior trim and more. This one, we submit, should already be in production to compete with Pontiac's STE, Buick's Century T-Type and the various high-performance imported sport coupes and sedans.

Under great pressure lately to improve the performance of its various production engines, Chevrolet seems to be saying: "Be patient, please. We're working on some really neat stuff for the future." Unfortunately, you can't buy any of it now. Maybe, someday.

The Tiger is back

Remember the Uniroyal Tiger Paw and the wonderful animated ad campaign that made it a household word in the 1960s?

Uniroyal, betting that you do, has recreated the character and a freshened version of the campaign after a 15-year absence.

It will be used to promote the Uniroyal name, in general, and at least three separate Tiger Paw tires: first, an existing all-season Tiger Paw radial; second, a brand-new, more expensive, high-traction, low rolling-resistance, long-wearing, all-season, steelbelted radial called Tiger Paw Plus; and third, an ultra-premium version of the Tiger Paw Plus, which uses the company's excellent Royal Seal puncture sealing system.

Uniroyal says its new Tiger Paw Plus eliminates the need for mud-and-snows, yet runs quieter than the usual all-season radial and wears 10 percent longer than its own Steeler. **PM**

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Seems like every time you turn around, somebody comes along with a new computer for home or business use. And what's made it all possible is the amazing microprocessor, the tiny little chip that's a computer in itself.

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This is only one of the growth factors influencing the increasing opportunities for qualified computer technicians. The U.S. Department of Labor projects over a 100% increase in job openings for the decade through 1985. Most of them *new* jobs created by the expanding world of the computer.

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on by so many people. And it's yours to keep for personal or business use.

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ence in the operation and application of computers to business and personal jobs. You're trained to become the fully rounded, new breed of technician who can interface with the operational, programming and service facets of today's computers. You're ready to take your place in the new electronic age.

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Attach the latch to stay

Listen up. Joe Bailey of Litchfield, Ohio, Mercer Clayton of Manasquan, N.J., and J.J. Lighter of Bowie, Md. You all wrote about the same trouble—latches falling off the front vent windows of your Volkswagens and the inability of VW mechanics to glue them back in place. Each of you was told to replace the vent window, which costs "\$40" (Clayton), "\$45-\$50" (Bailey), "\$75" (Lighter).

Those mechanics are not using the correct bonding agents or they're not doing the job properly. Here's the way to tackle it:

1. Clean the glass and latch with clear ammonia. See that all old adhesive is removed, but be careful not to

scratch the glass. The repair often succeeds or fails with this first step. Bonding agents won't work if they're applied to oily or dirty glass.

2. Dry the glass with a clean, lint-free cloth. Don't use a greasy shop rag and don't put your fingers on the spot once it's clean.

3. Apply Loctite 707 to the glass and metal. Allow the agent to set for three to five minutes.

4. Now, apply Loctite Speed Bonder 324 to both surfaces and immediately clamp the latch to the glass with a small C-clamp.

The adhesive needs 2 to 12 hours to cure. When I did the job on a friend's car, I gave it the full 12 hours.

week. The leak persists. Have you had other complaints about this? Is there a service bulletin? Please help.—Larry Roberts, Kansas City, Mo.

Since the answer to both your questions is no, there's only one conclusion to make: If the gasket is being installed properly, then the oil pan was mismatched and should be replaced. However, before doing this, let's talk about installing this gasket, which is a four-part assembly. If any one of the four parts isn't put on correctly, you'll wind up with a leak. This is how the job should be done:

1. Clean the oil-pan rails and engine area where pan meets engine.

2. Install the rear oil-pan gasket in the rear main bearing cap, securing it with a fast-drying adhesive.

3. Attach the front oil-pan gasket to the timing-gear cover with fast-drying adhesive. Press the tips of the gasket into the holes in the cover.

4. Apply fast-drying adhesive to the oil-pan rails and install the side gaskets on the rails. The grease retains the gaskets.

5. Give the adhesive some time to dry. Then, apply a 1/8-inch-thick by 1/4-inch-long bead of RTV silicone sealer along the front edges of the side gaskets at the points where the side gaskets will join the front gasket. Apply the

(Please turn to page 22)

Knockworst

Since the odometer turned 500 miles, the 4.9-liter (300-cu.-in.) engine in my 1982 Ford pickup truck has been knocking. The noise is noticeable as a light load is put on the engine with the clutch being feathered. However, it's most pronounced after a reasonably hard drive when power is applied in traffic. Oil pressure is normal.

My Ford mechanic used a sound probe to trace the noise to the front of the engine. He's concluded that the two metal timing gears are the cause. Is this a reasonable diagnosis?—Milan Wallace, Mountain View, Okla.

Yep—not only reasonable, but probably correct. The 4.9-liter engine is prone to this and other noises, including piston slap and camshaft tingle, but they don't affect driveability or durability. For my money, the 4.9 is one of Ford's most durable powerplants.

Metal timing gears replaced phenolic gears Ford used several years ago, because the phenolics didn't hold up. But metal gears may make noise as they mesh. So now, because of owner complaints, Ford has started installing phenolic gears once again. However, according to a Ford engineer, new resins supposedly make phenolic gears as durable as metal gears.

If you want, you can replace metal gears with phenolics, but you'll have to bear the cost. However, I wouldn't do

this if the vehicle is still covered by the warranty. You'll void it.

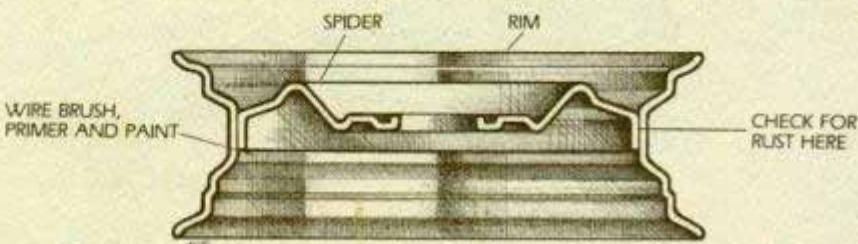
Pain in the pan

Since I bought the car (used), I haven't been able to stop a leak from around the oil-pan gasket of my 1980 Chevrolet Citation. It has a four-cylinder engine. I installed a new gasket but it lasted just a few days. Another gasket applied with sealer lasted almost a

Wheel of misfortune

Ed Croft of Englewood, Fla., wrote this tip, and it just may save your life. He describes a recent head-on crash that killed five people in his state. The investigating officer said that front-wheel separation—rim and spider coming apart—caused the accident. Two other accidents in Ed's town were also caused by wheel failure. Rust, you see, weakens the weld between the rim and spider.

Many of us are driving our cars longer before trading them in, so this problem may be more acute than is generally realized. It's a good idea, therefore, to remove wheels, dismount tires and examine the metal. If wheels are badly rusted, get new ones. If they're not too bad, wire brush, prime and paint them.



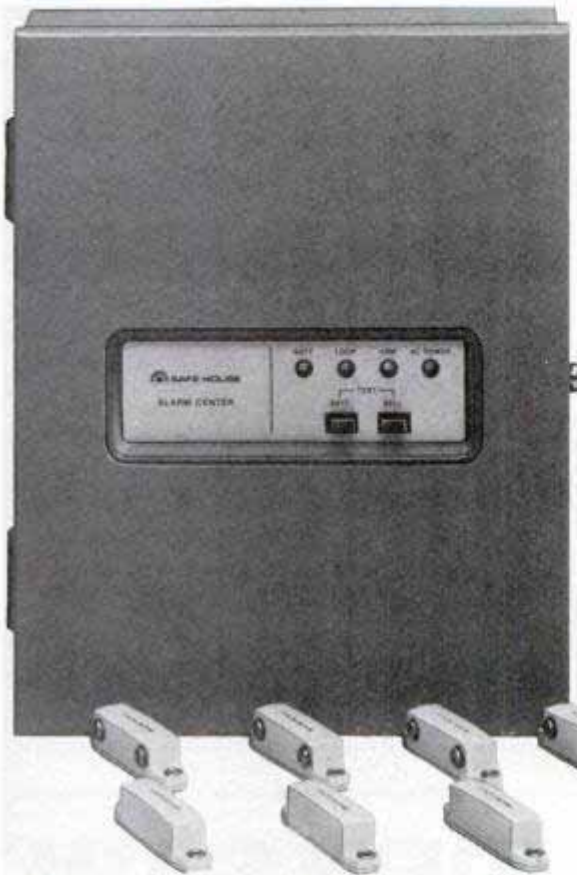
PM CAR CARE
TIP

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Save now on this perimeter alarm system package and protect your home with the same type of security system used by professionals. Everything you need for easy, do-it-yourself installation of full 24-hour protection is included. Alarm system panel. 100 feet of twisted wire. High-security key lock. Four magnetic switches for up to four windows or doors. And an electronic siren. It's so versatile—you can actually "custom-design" your system and expand your coverage any time. Add vibration sensors, glass-breakage detectors, security dialers and any of Radio Shack's complete line of security devices. Get up to ten arm/disarm key switches for different entrances. The system features two loops. One activates the alarm instantly, the other provides adjustable

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CAR CLINIC

(Continued from page 20)

same sealer in the depressions where the rear pan gasket engages the engine block.

6. Lift the oil pan carefully into place and bolt it to the engine. Install bolts holding the front of the pan to the timing-gear cover *last*. These bolts have to be installed at an angle, and the holes in the pan and those in the timing-gear cover won't line up until the rest of the bolts are snugly in place.

Crotchety clutch

We've just paid \$287 for the third clutch in 21,000 miles for our 1981 Plymouth Horizon Miser. We feel that there's a definite defect in this car, but haven't been able to get any help from our dealer or Chrysler Corp. in Detroit. What can we do?—Mrs. Angela McGuire, Bloomfield, N.J.

The most common cause of premature clutch failure is driver technique. If the driver rides the clutch pedal between shifts, the slight slippage that results quickly produces high temperatures, which soon destroy the disc, plate and flywheel.

There is no inherent problem with the clutch in the Horizon or Omni. If the

clutch is chattering, a reason may be that after the clutch went bad the first time, mechanics who installed the second and third clutches made a serious mistake that many mechanics are making. Because a clutch in a car with a transaxle is difficult to bolt into place, they let the transaxle hang by the clutch disc as they maneuver parts around. This bends the clutch disc and causes chatter and premature failure.

If the clutch isn't chattering, but is still burning out prematurely, then there are some possibilities you should look into. Perhaps some part of the self-adjusting mechanism has failed.

Was the pressure plate replaced when the clutch was replaced? And has the flywheel been resurfaced or replaced? A pressure plate that is warped or has weak springs will quickly eat up a new clutch disc. A flywheel that has been

PM CAR CARE

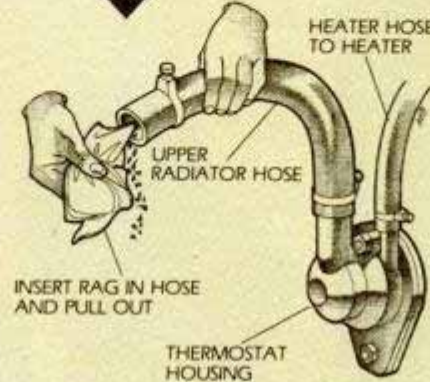
TIP

Undercover agent

There's no need to repeat how to inspect radiator hoses, right? If an upper or lower hose feels hard or mushy to the touch, cracks or bulges, leaks at a clamp or collapses as the engine is accelerated, replace the hose. These things are easy to spot.

But there is a failure that's simple to overlook. A hose can break down internally. When this happens, rubber flakes clog the radiator, plug coolant passages or keep a thermostat valve open. The inside of a hose is subjected to the severest conditions—pressure between 15 and 18 p.s.i. and an hourly circulation of about 7,500 gallons of coolant heated to around 280° F.

The time to find an internal problem is when you replace coolant. Remove hoses and shove a rag into them. Then, pull the rag out. If flakes of rubber fall to the ground, replace the sick hose.

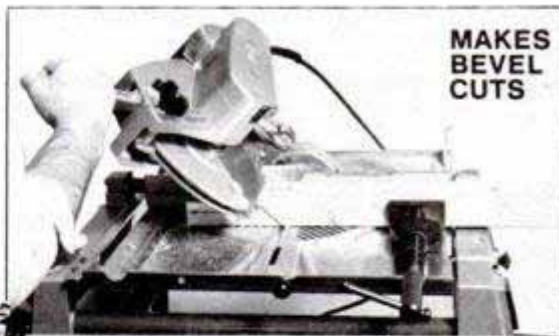
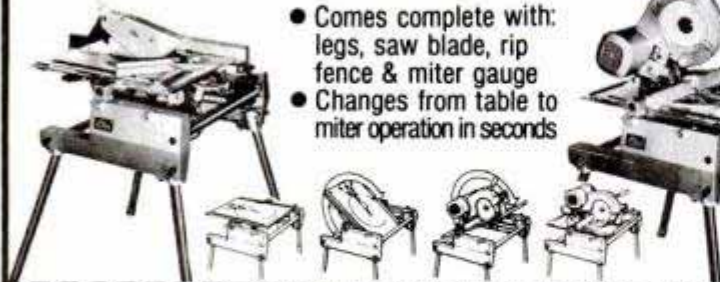


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heat-damaged or that has not been resurfaced will also kill the disc.

If the trouble is the result of improper repairs, you'll probably want to seek restitution from Chrysler. Ask the dealer to call the regional office to have a Chrysler field representative review the situation. If you aren't satisfied with his decision, tell him you want the case brought before the Chrysler arbitration board. The impartial members of this panel cast the deciding vote.

Would he kid you?

Since the first day, the 3.3-liter engine in my 1981 Ford Fairmont has had a spark knock until the engine warms up. The dealer adjusted timing and carburetor, and replaced the camshaft, but the knock is still there. On my last visit, the service manager told me, "Ford says it's normal to have a little spark knock." Can this guy be serious?—Ron Kurylo, Redford, Mich.

The guy is serious. Ford says a slight knock on acceleration is normal. Even your owner's manual states, ". . . the maximum fuel-economy benefit from the gasoline's octane rating is obtained under conditions of occasional, light spark knock."

A light spark knock is best described as a slight rattling noise that occurs as

you first depress the throttle to accelerate or whenever you place a heavy load on the engine at low rpm. A knock is excessive if it persists whenever the car is accelerated or if it lasts more than a second or two.

Your situation is unusual, however, because the knock occurs only while the engine is cold. That rules out the conventional causes like EGR failure, low-octane fuel, carbon buildup and overheating. The problem has to be related to cold-engine spark control.

Article No. 82-14-12 or service bulletin 82-14 discusses this problem on 1982 3.3-liter engines that are cold. A Ford engineer told me the repair also applies to 1981 3.3-liter engines.

According to the service bulletin, spark knock could result if the filter on the lower port of the vacuum regulator valve is restricted. This causes full manifold vacuum at the distributor rather than only 6-in. Hg. Full vacuum results in an overadvanced spark and a knock. The solution: Remove the filter and reposition the vacuum valve. **PM**

DO YOU HAVE A CAR PROBLEM?

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 discussed in the column.

SERVICE TIPS

■ A loud cracking noise on braking from the front end of a 1982 Olds Firenza may be caused by loose control-arm pivot bolts.

■ Advice to GM owners: Deposits inside gasoline engines may develop from the recirculation of blowby vapors entering the crankcase and from EGR gases. If deposits, which build up on intake valves, break off and drop on pistons, they can cause a noise resembling loose connecting rod bearings. The deposits can even cause the engine to seize. This can happen to engines having as few as 8,000 miles. If you experience a knock or engine seizure, use GM Top Engine Cleaner (part No. 1050002) before having the engine torn down. If the trouble is the result of deposits, this product will dissolve them and save you money and time.

■ How do you change the ignition timing in a car or truck that has the distributor locked in place? Such is the case with the 3.8-liter engine in 1983 Thunderbirds, XR7s, Continentals and F100s. According to article 82-17-16 of TSB 82-17, if spark knock occurs, you have to retard timing 3° by replacing the armature in the distributor with a new one (part No. E2PZ-12A099-H).

HOMEOWNERS' CLINIC



Continual security light

Since I'm away from my home six months each year, I like to keep a security light burning. The only problem with this is that my utility company charges me \$27 per month for burning one 15-watt bulb. Something is wrong. Do you know of any way to burn a small light and still shut off the electricity?—Fred Mikolite, Portsmouth, R.I.

Fred, I checked your figures with the utility company in my area. It would charge \$4 per month, plus approxi-

mately 6½ cents per day for a 100-watt bulb. This would mean a total bill of about \$5.95 per month. Are you sure you didn't leave the refrigerator or furnace on low while you were away?

I don't know of an alternative to public-utility power for your purpose. Instead, I suggest that you ask your electric company for a breakdown of your bill. This will help you pinpoint the additional expense. Perhaps a reader can suggest a viable alternative.

Humidifier with furnace

We want to install a humidifier in our home, since we've heard that moist air requires less energy to heat, is good for plants and might keep us from getting so many colds. We talked to our furnace repairman about installing a unit and he was adamantly opposed to the idea. He says that he's had to replace many \$1,000 furnaces because of a \$100 humidifier. He claims that small leaks develop in the humidifiers and water leaks into the furnaces, causing them to rust. I haven't checked the installer's stories yet, nor have I gotten a second opinion. What are your thoughts on this?—Susan C. Hoover, Pittsburg, Ohio

A humidifier is practically a must with warm-air heat. I'm afraid I can't agree with your repairman. In a Sears humidifier, for example, the tank or pan is on the outside of the duct. An overflow tube pipes any water overflow away from the furnace. The squirrel cage or paddle wheel is wired into the furnace blower, so it's almost impossible for water to be induced into the system and cause flooding.

Sears, as well as other manufacturers, has two models. One (which costs about \$110) introduces vapor into the return air duct. The other (about \$170) introduces the vapor into the discharge side.

My mechanical engineering consultant prefers the discharge-side unit, because the heated air can absorb more moisture. Although the installation is geared toward a do-it-yourselfer, Sears will install it for about \$65.

Remember, though, the humidistat (which turns the unit on and off to preset humidity requirements) must be fastened on duct's return-air side.

More on removing paint

In "Paint Spatters On Woodwork" (*Homeowners' Clinic*, page 40, July '82), I mentioned that I didn't know of a remover for latex paint spatters. I sug-



After testing Goof Off in an inconspicuous area, blot it on paint spots until they begin to soften. Then rub spot away.

gested using a conventional paint remover. Alert readers from all parts of the country came to the rescue, however. They reported on a product called Goof Off. This product not only removes latex paint drops, but also takes off decals, wax crayon, lipstick, tar, oil and grease. It even removes ballpoint and marking pen stains.

If you can't locate Goof Off, write: Atlanta Sundries, 6480 Chupp Rd., B-7,

Lithonia, Ga. 30058, for the name of the distributor nearest you. Suggested retail prices are: \$2.59 (4 oz.), \$5.99 (16 oz.) and \$14.95 (1 gal.).

Always test the product first in an inconspicuous area.

Saturated sandpaper

I am renovating the interior of a 40-year-old house using a belt sander to strip paint and finish off door facings. The original lead-based paint adheres to the medium-grade sandpaper I'm using. After several minutes of use, the paper becomes clogged and unusable; I'm using \$2 sanding belts at an alarming rate. I prefer not to use a stripper or heat gun. What do you suggest?—Ron Terry, Baton Rouge, La.

Rockwell International, in its excellent book, *Getting The Most Out Of Your Abrasive Tools*, mentions that tungsten carbide abrasive discs with widely spaced grains are good for removing old paint. In any case, use a coarse—not medium—grit.

The company makes a portable paint remover which, in essence, is a disc sander with special guides to keep the discs from gouging the work. According to a Rockwell spokesman, belts that accumulate sawdust may be restored by scrubbing with a brush in lukewarm water and laundry soap. Use a stiff brush to work the dust from between the grains then use a cloth to mop off the excess moisture. Place the sandpaper back in the machine to dry.

To remove accumulations of pitch, which is similar to your paint problem, Rockwell suggests: "Rub the abrasive with turpentine. Use a circular motion, then stroke the abrasive in one direction to remove dust and turpentine. Quickly air-dry the abrasive paper before solvent penetrates the backing."

Personally, I wouldn't subject my belt sander to the heat and motor strain of sanding paint. **PM**

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 the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send your order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.



No other tiller you can pick up is as good when you put it down.

Pick up a 2-hp John Deere 216 Tiller and you'll be pleasantly surprised: it weighs only 76 pounds.

But set it down on your favorite plot of ground and you'll be positively amazed: its exclusive dual-action Sod-Breaker™ tines cut through the surface, then lift and mix the soil thoroughly. Made of long-lasting, heat-treated steel, they'll till a 16-inch swath up to 7½ inches deep.

For larger gardens, there's the 6-hp John Deere 624 Tiller. It has 2-inch-wide heat-treated steel turbo tines that till a path 13- to 24-inches wide to a depth of 7 inches. Optional tine extensions increase tilling width up to 34 inches. Reverse drive is standard equipment.

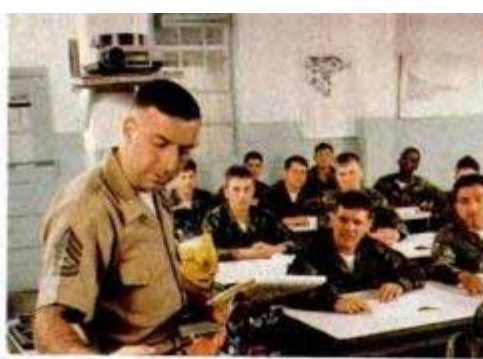
In addition, John Deere offers several easily-installed tractor-mounted rotary tillers. The newest and largest model has a full 48-inch tilling width and an improved housing with added clearance for more efficient operation.

For the name of the nearest dealer, or a free folder on John Deere garden tillers, call 800-447-9126 toll free (800-322-6796 in Illinois) or write John Deere, Dept. 62/50, Moline, Illinois 61265.

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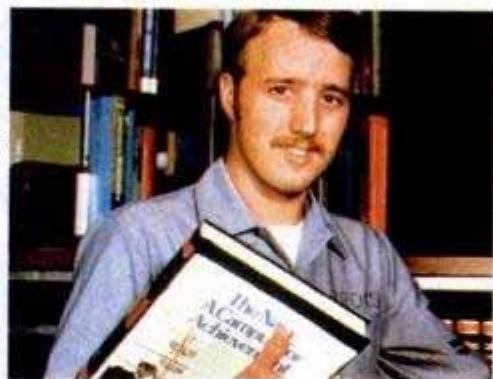
**Got what it takes
and really care?
There's a special life
you'll want to share.**



**You'll move up.
You'll feel proud.
You'll stand out
above the crowd.**



**Not all who try
fit the bill.
It calls for brains.
It calls for skill.**



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NAVY
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In addition, a good part of today's Services is highly technical. Not everyone has the aptitude for that kind of work. But if you do, the rewards are great. You'll work with terrific people. And you'll build a career with a future.



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To find out more about these opportunities, see your local Armed Forces recruiter or write Armed Forces Opportunities, P.O. Box C 1776, Huntington Station, N.Y. 11746.

IT'S A GREAT PLACE TO START

THE PM GARAGE



Taming of the screw

Tightening and loosening screws is a considerably less tedious process with Vaco Products' new T-head ratchet screwdriver.

The shanks are held in position with a friction fit so they're easy to change. Just pull it out and push in another one. In order to reverse the ratchet action, you simply turn a knob in the T-head.

I found this tool unique and very effective. It should stand up to hard use because it comes with professional-quality screwdrivers in a large assortment of types and sizes, and it benefits from a heavy-duty ratchet design.

The tool costs about \$18 and includes the T-head with one slot and one Phillips shank.

It's manufactured by Vaco Products Co., 1510 Skokie Blvd., Northbrook, Ill. 60062.—T.A.



Heavy-duty ratchet screwdriver makes use of large assortment of shank types and sizes.

four ounces, and is little thicker than a pancake. In use, I found that the unit flashed for almost four hours, and could be seen for nearly a mile. The secret of this flasher is its flat battery developed by Polaroid for its film packs. I just slid the battery into the back of the flasher and it was ready to go.

The flasher is available for approximately \$4, and is made by Polaroid. You can find it at auto-parts outlets and discount stores.—T.A.

Clamping tool

An extra hand is always welcome around the garage, and I found one in the Zip Grip tool. This adjustable C-clamp provides a quick and effective way to hold work firmly in place. The tool is made of high-strength steel, and looks like it can take years of punishment.

Zip Grip allowed me to preset the grip tension and it held the adjustment.

Grime fighter



Plastic-coated absorbent cloth keeps oil from leaking through to surface below.

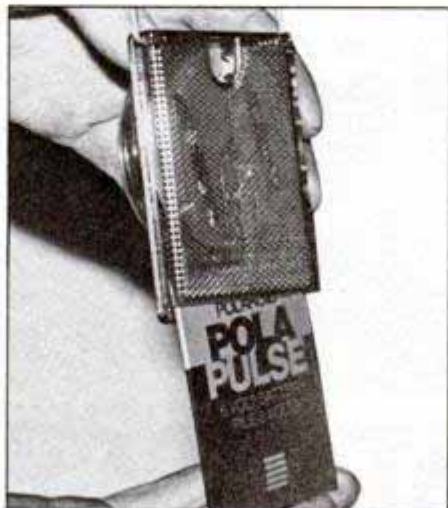
You can prevent grease, oil and dirt from messing up your garage floor or driveway with the disposable Auto-Matt Shield drop cloth. It measures 44 x 35 in., a convenient size to spread under a car or drape over it.

Auto-Matt is made of plastic-coated waffleboard, a special paper that absorbs oil. The plastic coating prevents oil from leaking through to the surface

undereath. Auto-Matt is about \$1.50 at auto-parts stores. It's made by Seal-right Co., 605 West 47th St., Kansas City, Mo. 64112.—Cliff Gromer

Lightweight flasher

Battery-operated hazard flashers usually are fairly large and heavy because of the size and weight of the battery. The Pola-Pulse, however, weighs only



Compact flasher employs lightweight flat battery that provides four hours of use.



C-clamp with adjustable tension holds work firmly and maintains adjustment.

It will work for production as well as one-time projects. The tool costs about \$32.

If you can't find Zip Grip at your local hardware store, you can contact the manufacturer directly: Aulner Manufacturing, Box 932, Hastings, Neb. 68901.—Joel Breault

15 mg. "tar", 1.1 mg. nicotine av. per cigarette, FTC Report DEC. '81.

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APPLIANCE CLINIC



Stopped clock on range

I have a Frigidaire electric range, Model RC1B-635-2, serial No. 44C46459R. The clock stopped one day, and then I noticed that the appliance outlet was dead. I checked the fuse under the left rear burner and it was good. Before I call a serviceman, is there anything I can do?—Fred C. Trager, Barberton, Ohio

Sounds as if your problem may be with the clock motor of the switch assembly that automatically turns on the range to a preset time. My suggestion is to disconnect the electrical power to the range. Then check the back of the switch assembly. Look for broken

wires or possibly a loose connection. Check the clock mechanism; it may be binding. Finally, move the controls on the switch to make sure the electrical contacts are opening and closing.

If all of the above check out okay, and the clock still doesn't work, you'll have to replace the entire switch assembly. It comes as one unit. Unfortunately, the clock motor itself is no longer available for your model range. The part for the switch assembly is No. 75-24728 and it costs approximately \$75. The part is still available from your local authorized Frigidaire parts service center.

match the dial, you'll have to adjust the thermostat. Simply pull off the thermostat knob and make the adjustment in the center of the shaft using a small screwdriver. To lower the oven temperature, rotate the adjustment screw in a clockwise direction—that's right to lower, left to raise. Turn the screw only a little, then recheck the temperature.

Active frost-free

Please help! My Kelvinator no-frost, side-by-side refrigerator/freezer, Model FCKC209DN, serial No. 3D572385, runs from defrost cycle to defrost cycle. It defrosts three times in a 24-hour period, about one-half hour each defrost cycle, and runs 22½ hours in a 24-hour period. The thermostat has been replaced twice, but the problem remains. The freezer runs 18° to 20° F. below zero. Please advise.—Stanley E. Spurgeon, Champaign, Ill.

On your model refrigerator, the thermostat is located in the freezer, mounted above the evaporator. When the refrigerator begins to defrost, moisture collects in the thermostat. My bet is that the moisture is freezing the control in the ON position when the refrigerator goes back into the refrigeration cycle.

To correct this problem, Kelvinator introduced heater part No. F-112416. This small, square heater can be taped to the side of the thermostat and wired across the thermostat terminals. It keeps the thermostat warm, thereby preventing moisture from building up in the control.

After you've installed the heater, wrap the whole assembly with refrigeration insulation tape, available at any refrigeration supply company. Not only will this hold the part in place, but it will also keep moisture away from the control. You can order the heater by writing to the Kelvinator parts distributor in your area: O.E.M. Parts Distributor, 919 South Des Plaines St., Chicago, Ill. 60607. The approximate price is \$6, plus tax, shipping and handling. **PM**

If you have a problem with any appliance, send your question, along with the model and serial numbers, 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.

Calibrating a range

I own a Kelvinator 40-in. electric range, Model RR45LWO, serial No. 026-S81284. The oven temperature on this range never matches the thermostat setting. If we set it to 350° F., for example, an oven thermometer shows that the temperature is somewhere around 320° F. Is there anything I can do to adjust the setting so that the oven will heat to the proper temperature?—Kennard Jones, Spokane, Wash.

To check the oven temperature, you'll need a high-quality mercury oven thermometer. Place the ther-

mometer in the center of the middle rack in the oven and turn the oven thermostat knob to 350° F. Record the following cut-in and cut-out oven temperatures, when the thermostat turns the power on and off: second cut-in, third cut-out, fourth cut-in and fifth cut-out. Don't record the initial cut-out temperature, because a cold oven will overshoot its setting by approximately 50°. Divide the sum of these four readings by 4. This will give you the average oven temperature.

If this figure matches your thermostat dial, you're okay. If it doesn't

SERVICE TIP

Most of us, at one time or another, have called a service technician to repair an appliance, only to discover that the problem was a blown fuse, a disconnected plug or a simple repair we could have done easily ourselves.

To help you avoid the expense and embarrassment of such calls, the Maytag Co. is offering the 12-page booklet shown at right entitled *Before You Call*.

It lists a number of things that you should check when an automatic washer, dryer, dishwasher, microwave oven and gas or electric range doesn't operate correctly. The booklet also contains suggestions on when to call the serviceman and what to tell him when you do.

For a free copy of *Before You Call*, write to: Consumer Information Center, the Maytag Co., Dept. 206YG-PM, Newton, Iowa 50208. The booklet will be available for the next six months.





A true story by
Wilton Hildenbrand

**"This is the business
that turned our
dreams into reality"**

I never made "real money" until I quit working for someone else and started my own Duraclean business

"When I was with the New York City Fire Department—with a wife, and three children to raise—I felt I spent most of my time putting out financial fires at home! It occurred to me that I could never achieve the financial security and independence we craved working for someone else. The obvious answer—start a business of our own. But what? Sure, we had been able to



put a little money aside, but nowhere near what it takes to start most businesses. I looked for something I could get into with a small amount of borrowed money.

So Easy to Get Started

"Marge, my wife, discovered the perfect answer. She had run across a Duraclean story—a message much like this one—and we looked into it. Well, believe me, when we saw the superior Duraclean service demonstrated and found out what a low investment it took, we were sold.

"With a fireman's schedule, I was able to start out in my spare time. (I didn't want to burn all my bridges behind me.) Marge and I mailed out company provided mailings describing our service and soon the phone began to ring. She made the appointments.

I rendered the service. When we discovered how much money there was to be made in a Duraclean dealership, I took early retirement from the fire department. Before long, I had to hire part-time servicemen. Soon, profits paid for our first van. Now most of the work is done by our four servicemen. Marge schedules the jobs, sends out mailings and does the bookkeeping. I do the job estimating, special spotting jobs and contact new prospects."

Now at this point you're probably asking yourself, what is this Duraclean business Wilt Hildenbrand keeps raving about? Well quite simply, it's a unique, superior system for cleaning upholstered furniture, rugs and carpets (don't confuse it with "steam cleaning" or ordinary shampooing methods). It not only cleans but restores and revives colors. It does not wear down the fiber or drive the dirt into the base of the rug as ordinary cleaning methods do. Instead it *lifts out* dirt by means of an absorbent dry foam.

Today the Hildenbrands provide cleaning for banks, country clubs, churches, offices, hotels, motels, funeral parlors, theaters and homes.

Carpet and furniture stores gladly recommend Duraclean to customers. It helps them close sales. 45% of the Hildenbrand's business is from customers' referrals and repeat orders.



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Would you like to have the freedom and independence enjoyed by the Hildenbrands? You can. Let us send you the facts. Mail the coupon, and you'll receive all the details, absolutely without obligation. No salesman will ever call on you. When you receive our illustrated booklet, you'll learn how we guide you STEP BY STEP to get customers; and how to convince your customers to recommend additional customers.

Wilton Hildenbrand mentioned the small amount of cash you need. You can start a dealership for as little as \$3,488. Another option is a \$11,588 full cash investment, and if you qualify, Duraclean can work out financing for half of this amount.

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Send in the coupon today. With no obligation, we'll mail you a 32-page booklet explaining the business. Then you, and you alone, in the privacy of your own home can decide. Don't delay. Get the facts while your service area is available. Mail the coupon now.

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Without obligation send free booklet that tells how I can have a Duraclean business. No salesman will call.

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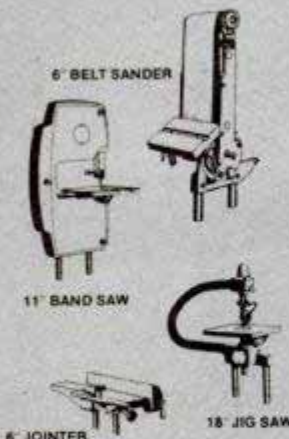
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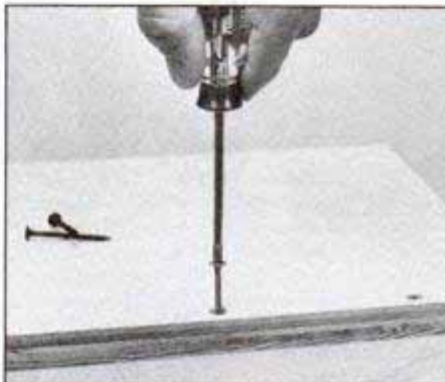
Dealership Available

HINTS FROM READERS

Low-cost screws



Pictured for comparison are (from left to right): 1 1/4-, 1 3/8- and 2-in.-long dry wall screws, No. 7 (wood), No. 6 (sheet metal) and No. 6 (wood) screws. The latter three are each 1 1/2 in. long.



In this wood project, dry wall screws are a thrifty substitute for wood screws.

There is a way of turning back the clock on costs for some commonly used screw sizes. Dry wall screws are less expensive than wood screws, because they're generally purchased in bulk. And they can be used in woodworking projects.

Dry wall screws are commonly available with flat Phillips heads and come in 1 1/4-, 1 3/8- and 2-in. lengths; there are about 250, 200 and 150 dry wall screws per pound, respectively.

For strength, dry wall screws are made of hardened steel. This makes their Phillips heads suitable for use with power drivers, such as 3/8-in. variable speed drills. Under similar conditions, the heads of nonhardened screws would tear.

The relatively slow taper on the sharp, pointed end of a dry wall screw makes it easy to start. You can turn one without boring a pilot hole.

Purchased by the pound, 1 1/4-in.-long dry wall screws cost \$1.44 per gross at my local building supply store; 1 1/4-in. No. 6 wood screws cost \$3.15 per gross.—*B.T. Willman*

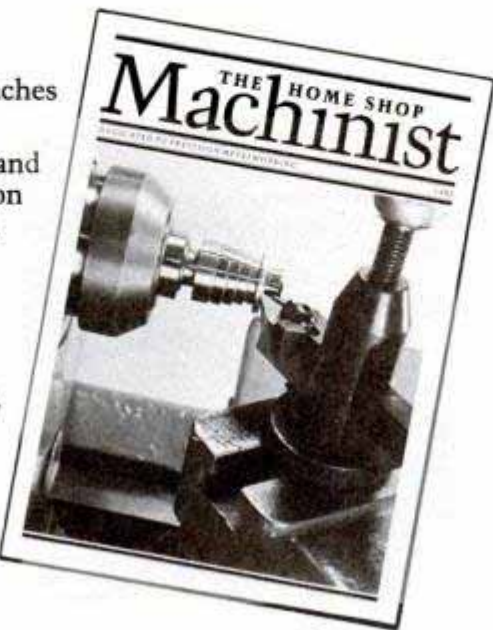
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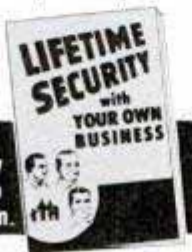
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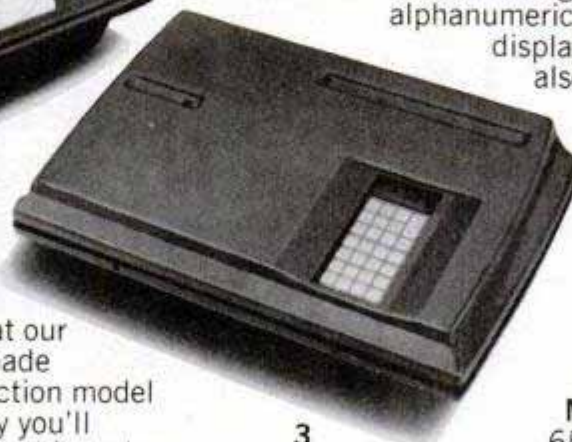
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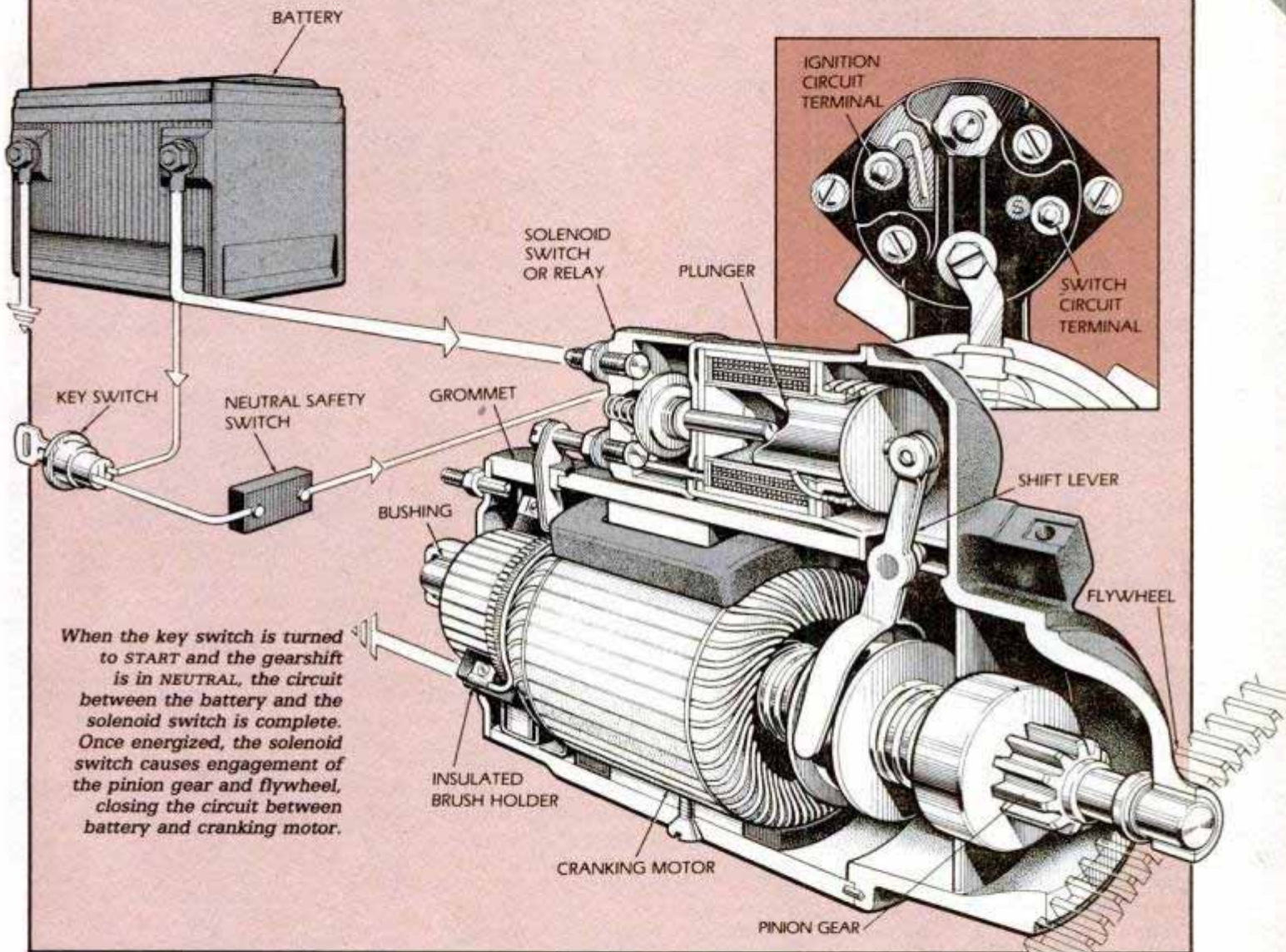
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(V20700)

Troubleshooting Starting System Problems



When the key switch is turned to START and the gearshift is in NEUTRAL, the circuit between the battery and the solenoid switch is complete. Once energized, the solenoid switch causes engagement of the pinion gear and flywheel, closing the circuit between battery and cranking motor.

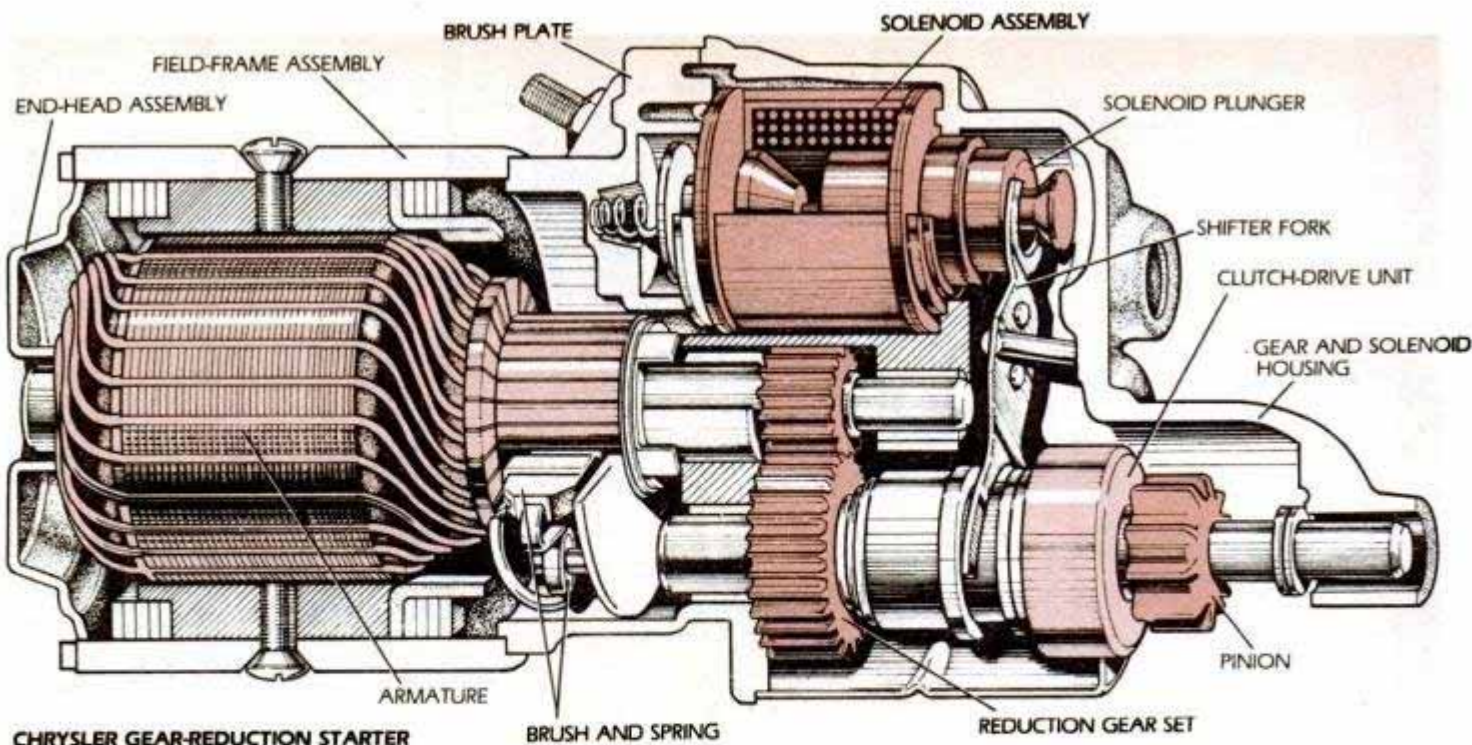
It usually happens when you're in a hurry. You've got a lot on your mind, maybe an important business meeting or a long-awaited social event. You move quickly to your car, slide in behind the wheel and turn the key. Nothing happens. The starter motor, that basic device, won't run.

The cranking circuit consists of these major components: the battery, battery cables and terminals, switch, neutral safety switch or clutch switch, solenoid switch or starter relay, cranking motor, the pinion and its drive, and the flywheel. The battery cables, starter and solenoid are wired together in a low-

resistance circuit that carries large amounts of current. The key switch, neutral safety switch and solenoid switch are wired into a comparatively high-resistance circuit that carries much less current.

Most GM products and some Fords and Chryslers use a solenoid switch unit that is mounted on the outside of the starter motor. Other Fords have a relay switch somewhere in the engine compartment and an integral engagement mechanism within the starter motor. Most Chrysler starters have the solenoid built into the end of the starter motor.

The engine won't spin when you turn the key unless a number of things happen. The battery has to provide sufficient energy (voltage) in an adequate amount (amperage). The key switch must close a circuit between the battery and the solenoid switch. The neutral safety switch must close the same circuit. The current that flows through this circuit must then energize the winding within the solenoid switch or relay. This produces magnetic energy which moves a disc across two contacts, closing the low-resistance, high-amperage circuit that connects the starter to the battery. The solenoid also pushes



CHRYSLER GEAR-REDUCTION STARTER

This Chrysler Corp. cranking motor has a reduction gear that's set between the motor's armature shaft and the pinion gear shaft. This reduces the rotational speed at the pinion, but provides substantially increased cranking torque. The increased torque helps to eliminate hot-start problems on high-compression engines. The solenoid assembly is built into the end of the gear reduction starter. Consequently, the motor must be disassembled in order to repair the solenoid.

the pinion gear into the bell housing, where it engages the flywheel ring gear. On cars that have a relay rather than a solenoid, there is a magnetic device within the starter that engages the pinion before the circuit to the motor is completed.

If one of those components fails, you'll be left holding the key.

Dead silence

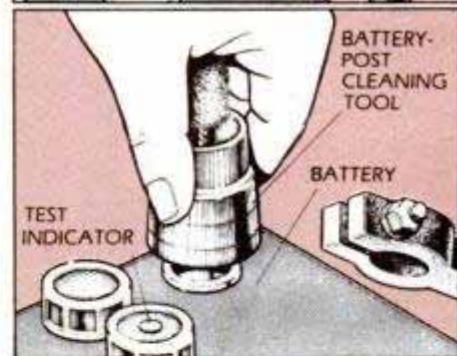
If absolutely nothing happens when you turn the key, there may be a problem in the high-resistance circuit that links the battery, key switch, neutral switch and solenoid switch. The battery may be completely dead or, in cases where the high-resistance circuit does not begin at the battery, there may be no voltage available at the point where it begins.

You can rule out a completely dead battery by simply switching on the lights. If the lights glow brightly, try starting the car again with them on. If they remain bright with the key in the start position, wiggle the gearshift selector or clutch pedal (on manual transmission cars) while you try again. If this makes the engine crank, the problem is a defective neutral safety switch or clutch switch. If wiggling doesn't help, use a test lamp or voltmeter to check for current at the neutral safety switch or the clutch start switch. In most cases, it will be found on the steering column, transmission or clutch

pedal. Chrysler usually has a neutral relay mounted under the hood on the driver's side of the firewall. Connect the negative lead of your test instrument to a good ground and touch the positive lead to each side of the switch or relay with the car in PARK or with its clutch pedal depressed. Hold the key in the START position. Current should be available on both sides.

If current is available on only one side of the switch, it should be replaced. If current isn't available on either side of the switch, you probably have a defective key switch. If the dash indicators light with the switch in the ON position, you can rule out the last possibility.

If voltage is available on both sides of the neutral switch, check the terminal where the small wire of the high-resistance circuit is attached to the starter relay or solenoid switch. Most relays or solenoids will have two small wires. One is the trigger voltage from the switch. The other usually joins the coil to the starting circuit and provides a high-voltage charge to the ignition primary circuit to help start the car. With the key in the START position, voltage should be available at the terminal that is connected to the key switch circuit. If you're using a voltmeter, you should find more than 7 volts. If voltage is not reaching the solenoid or relay, there's a problem in the wire joining the safety switch and solenoid, or in the bulkhead



Many batteries have been replaced needlessly when a cleaning of terminals and posts would have solved the problem.

connector where the underhood wiring loom plugs into the passenger compartment wiring.

You should also check for loose or corroded connections at the neutral switch or relay.

If voltage is available at the solenoid switch of a GM or Ford with starter-mounted solenoid, but the solenoid won't even click when the key is turned, the solenoid is defective and must be replaced. Most Chrysler products have a solenoid that is built into the starter motor. If this solenoid fails, the starter must be disassembled for

repair or replaced with a new or rebuilt unit.

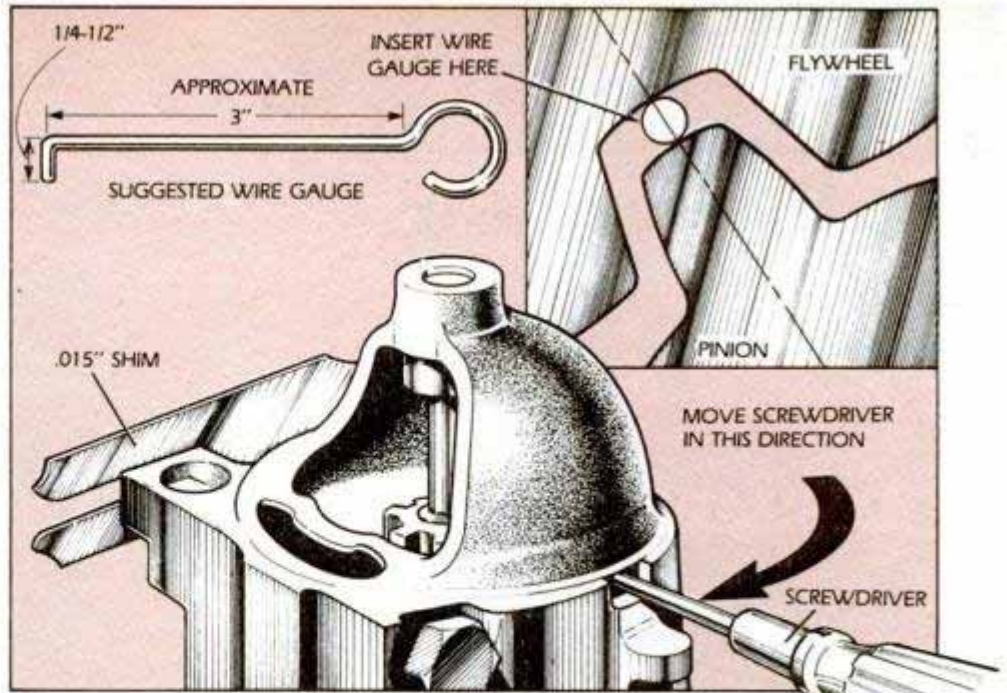
If you found voltage at the switch terminal of a Ford relay, check to see if a charge of at least 9.6 volts is available at the larger terminal of the relay with the key in the START position. If this is so, there is an open circuit between this point and the starter terminal or the starter is defective. If no voltage is available, replace the relay.

Click, click

If you heard a good solid click when you first tried to start the car, try it again with the headlights on. If the headlights remain bright, the starter motor itself is probably defective, but the solenoid is okay.

If you heard a series of clicks, a weak click, or a click and a slow growling noise, try again with the lights on. If the lights go out completely or dim considerably, the battery may be dead, there may be excessive resistance in the circuit, the starter motor may be difficult to turn due to internal resistance, or the engine itself may be hard to turn due to internal damage. However, you can be certain that the principal problem is not in the switch circuit.

The best place to start with this type of starter problem is at the battery and its connections and cables. Check the battery for cracks or other obvious damage. Remove the terminals and check for corrosion or looseness. Replace any cables with terminals which have eroded or won't tighten. Don't replace the terminals. If your car is already equipped with replacement terminals (the kind that clamp the cable under a bolt-on strap), check the connection for corrosion. Even a little bit of corrosion at the point where the cable contacts the terminal can result in a no-start. Check the other end of the cables for proper connection also.



To adjust pinion-to-flywheel clearance of a GM starter, use a screwdriver to push pinion into engagement with the flywheel. Then, using a .020-in. wire gauge, measure clearance between pinion teeth and flywheel as shown.

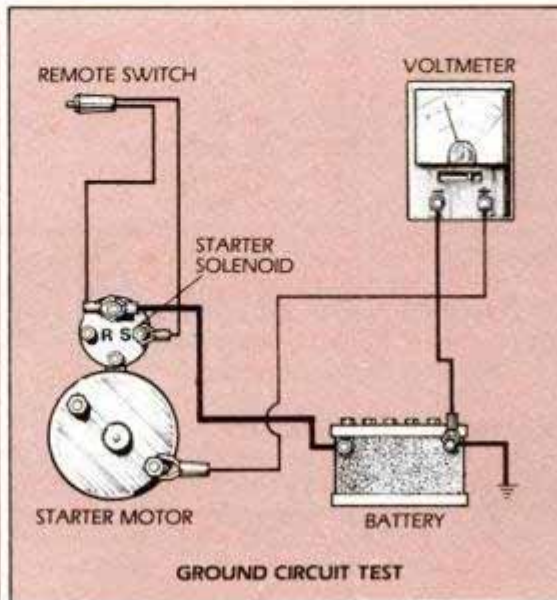
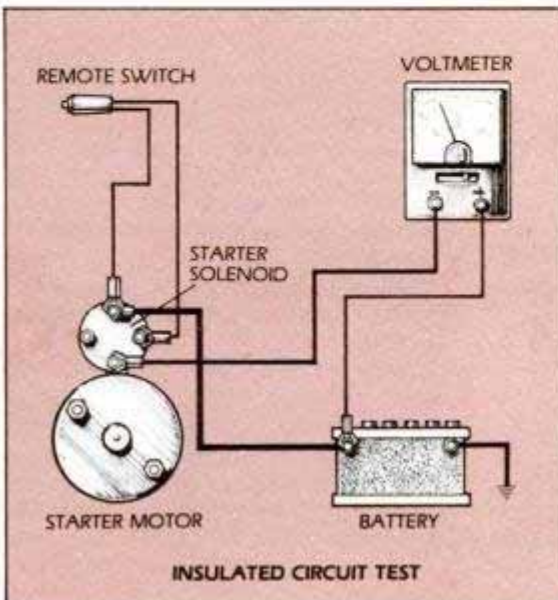
You can make a precise voltage-drop test for excessive resistance in the battery cables and connections with a voltmeter that reads in tenths of a volt. Connect the positive lead of the voltmeter to the positive battery post and the negative lead to the starter. On starters with external solenoids, connect the negative lead to the large copper connector that joins the solenoid to the starter. On other starter motors, connect it to the terminal where the cable attaches. Attempt to crank the engine with the meter attached. The voltmeter should show less than 1/2 volt if the connections are good.

If a vehicle with an external solenoid fails this test, repeat the measurement, but this time attach the negative probe

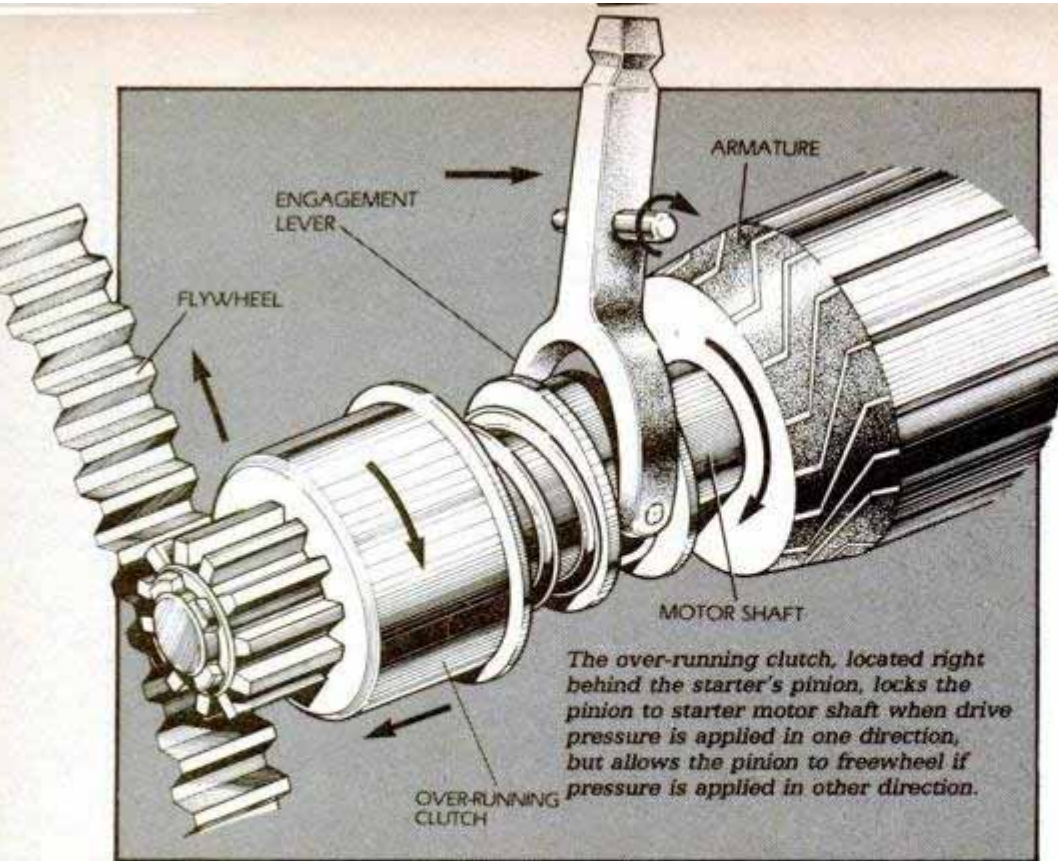
of the voltmeter to the terminal on the solenoid where the cable attaches. If there is less than 1/2 volt to this point with the engine cranking but there was more than 1/2 volt at the solenoid/starter connection, then the solenoid has excessive resistance and should be replaced.

To check ground-circuit resistance, connect the negative voltmeter lead to the negative battery post and the positive lead to the starter housing. Make sure it makes contact with the bare metal of the starter housing. With the key switch in the start position, the ground-circuit voltage drop should measure less than 0.2 volt.

If either ground or positive circuits fail the resistance test, clean and tight-



To test system for too much resistance in the positive (insulated) circuit, connect the voltmeter's positive lead to the positive battery post, negative lead to the starter's positive terminal (far left). To check ground circuit resistance, connect the negative voltmeter lead to the negative battery post and the positive lead to the starter housing (left). Both are done by cranking the engine with meter attached. Meter should read less than 1/2 v. on the insulated circuit test, less than .2 v. on the ground circuit test.



disengage and freewheel. Once the starter has been removed from the car, you can detect a faulty clutch by attempting to turn the pinion in both directions. It should turn freely in one direction, but not move at all in the other. The starter drive assembly can be replaced without replacing the rest of the starter, but the starter must be disassembled in order to do this.

Repair or replace

Once you've determined that the starter is the source of your problem, remove the negative ground cable from the battery before attempting to remove the starter. Support the front of the car on jackstands. The rear wheels must be blocked, the emergency brake applied and the transmission in park. Determine how the starter can be maneuvered past other components before loosening the bolts.

Sometimes the wiring connections are easier to remove from above. On some applications with in-line engines, the starter is also removed from above. On GM applications, check for shims under the starter mount. These shims determine pinion-to-flywheel clearance. If there are any, they should be reinstalled with the new or rebuilt starter.

If you replace the starter motor on a GM car, you may have to adjust pinion-to-flywheel clearance. A sign of incorrect pinion clearance is a high-pitched whine during cranking or a high-pitched whine after the engine fires. To check pinion clearance, disconnect the negative battery cable, then insert a screwdriver in the small hole in the bottom of the starter's case at the pinion end. Use this screwdriver to push the starter pinion into engagement with the flywheel. Then, using a hooked wire gauge of 0.020-inch thickness, measure clearance between the peak of the pinion gear's tooth and the space between teeth on the flywheel gear. If clearance is less than 0.020, the starter should be shimmed away from the flywheel. The GM part number for 0.015-inch shims is 9785608.

If the clearance is more than the specified 0.020 inch, check again with an 0.080-inch gauge. If clearance exceeds 0.080 inch, the starter should be shimmed toward the flywheel by installing a shim, GM part No. 1246249, on the outboard starter mounting pad.

Before you ever lay a wrench to a cranking system, remember that a great number of problems will produce the same type of poor cranking performance. Don't be too quick to condemn expensive parts. Make all appropriate measurements and evaluate them based on what you've observed.

FM

en connections and repeat. If the problem persists, you can make the same measurements progressively closer to the battery until you find the problem area.

Once you've determined that the cables and connections are okay, check the battery's specific gravity.

Measure the battery's specific gravity following the instructions on the hydrometer. If it is low, charge the battery with a trickle charger. If the battery refuses to take a charge, it's no good.

Some of the recently produced maintenance-free batteries have built-in hydrometers that indicate state of charge by changing colors. Usually a green eye indicates a full charge, while a dark eye means that the battery is defective and should be replaced.

Once the battery is fully charged, connect the leads of a voltmeter to the positive and negative terminals of the battery. You should find roughly 12.5 to 14 volts. Turn the ignition to the START position. If voltage remains at or above 9.6 and the starter just clicks or turns slowly, the starter is defective. If the voltage drops below 9.6, either the starter is defective, the battery is defective or the engine is hard to turn.

That last cause is very unlikely, but you can check quickly by attempting to turn the engine by hand. Disconnect the negative terminal from the battery and try to turn the engine, using a socket and breaker bar on the front hub bolt. Some engines can be cranked on the front hub of one of the accessories. If the engine turns with only medium difficulty (60 to 90 pounds breakaway torque with a wrench), it's probably

okay. If you have to pop sinews just to budge it, you better check internal engine condition.

As for the other two causes, a defective battery or bad starter, you can attempt a common sense judgement call. If your battery took a charge, has no discolored electrolyte and is in good physical condition, the starter is most likely the problem. Attempting to jump-start the car can help confirm this. If the battery is the cause of your problems, the jump start should make it crank faster. You might also turn on the lights, windshield wipers and heater motor and then attempt to blow the horn. If your battery can handle that much of a load, it is probably not the source of your difficulty.

If you have access to a volt/amp meter with a built-in load device, you can test the battery capacity and compare it to specifications. This is the only way you can tell for sure that the battery is not at fault.

Most starter motors are equipped with an over-running clutch of some type. This device is right behind the pinion and prevents the starter from being spun and possibly damaged by the engine once it has started. It locks the pinion to the starter motor shaft when pressure is applied in one direction. The over-running clutch, in combination with the pinion and compression spring is sometimes called the starter drive or "Bendix."

If the over-running clutch fails to engage, the starter will spin, but it will not engage the engine. An over-running clutch that is on the verge of failure will engage briefly each time you attempt to start the car, but will soon



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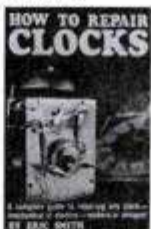
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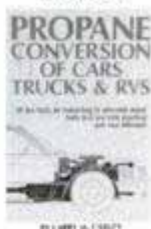
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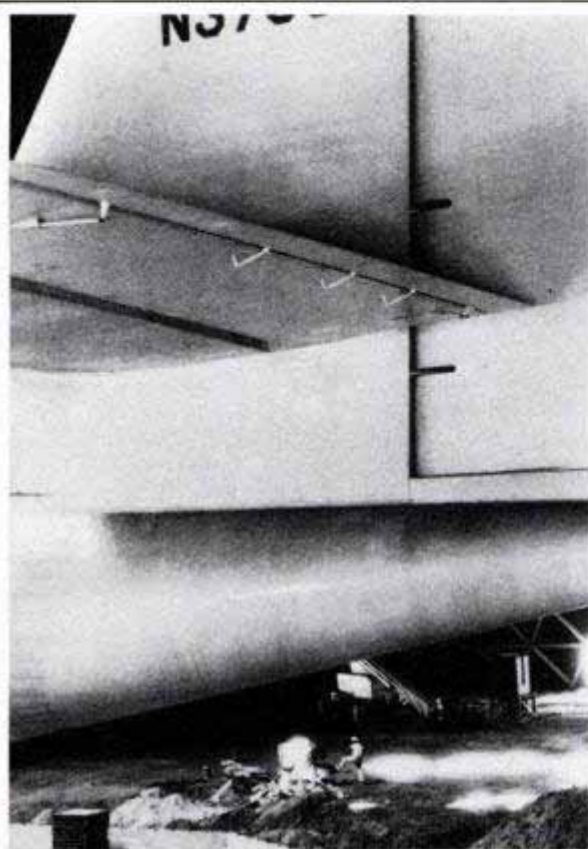
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PM BRIEFS



PM's Whatsit

Somewhere, deep within the bowels of a top secret defense establishment, lies the one weapon... Great for an old-time radio script, but most PM readers will know that it doesn't appropriately caption this picture. If you don't have a clue as to what's going on, turn the page.

What—and leave show business?

Horticulturists and serious gardeners have known for some time that elephant manure is something special. Properly composted, it provides long-term soil enrichment. Traveling circuses never have any trouble disposing of what otherwise might be a problem.

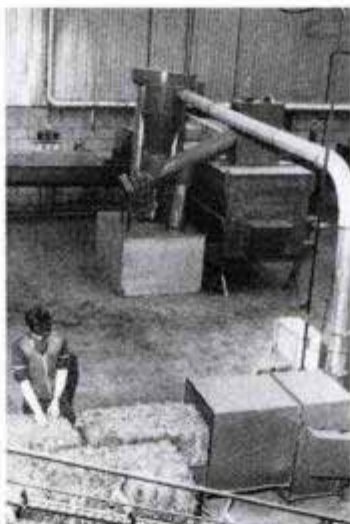
When officials at New Jersey's Brendan Byrne Arena decided recently to publicize an elephant manure giveaway to promote the appearance of Ringling Bros., Barnum & Bailey circus there, however, things got out of hand... sort of. At the appointed hour, more demand materialized than the elephants, troupers all, could satisfy. In the words of an Arena spokesperson: "People just waded in with bare hands and fought over it. The event was a tremendous success."

Clutching at straw

Traditionally, English farmers burn off wheat straw in the fields after harvest. About 10 years ago, Englishman Ken White began thinking of straw as an alternative energy source, but a decade later it has become a factor input.

Straw Box Systems (17 Eurolink Estate, Sittingbourne, Kent, ME10 3RN, England) manufactures nonreturnable produce market boxes from chopped straw and other fibrous materials impregnated with resins. The boxes are just one of the products that White's tinkering with straw has yielded; sheets suitable for interior partitions are also being tried.

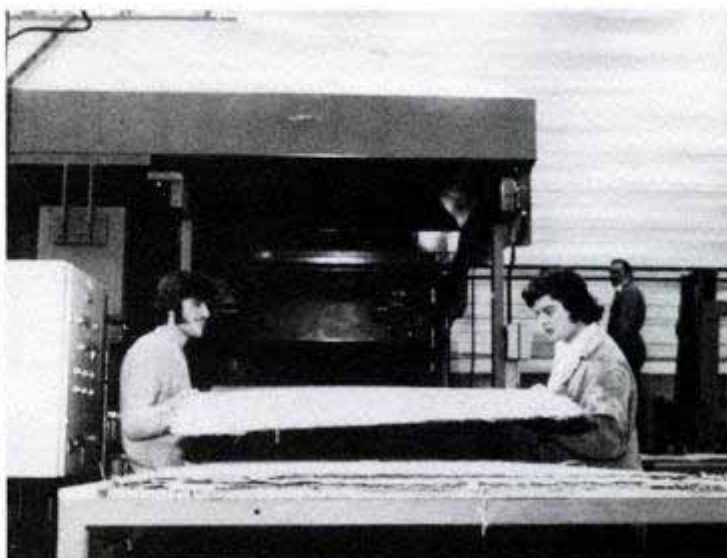
But the market for fruit and vegetable boxes in England alone exceeds 100 million units. Straw boxes are less expensive than those made of other materials, yet they are tougher and stand up in the rain. The Straw Box process can use waste fibrous matter of many kinds; the technology is being licensed around the world.



Bales of straw being fed into process equipment at England's Straw Box Systems.

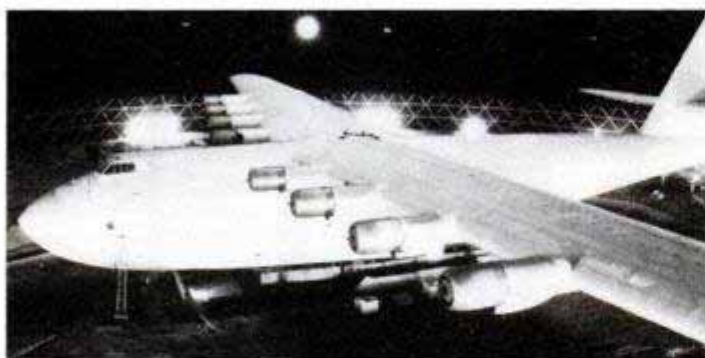


Straw Box general manager Graham Rowe demonstrates strength of produce box.



Resin-impregnated fibers emerge as sheets, can be wet-handled.

PM BRIEFS



Whatsit revealed

Howard Hughes's famed *Spruce Goose* seaplane is now a bona fide public attraction. Housed under one of the world's largest clear-span domes, the Goose is situated adjacent to the *R.M.S. Queen Mary*—once a ship, now a hotel—at the Port Adventure complex, Long Beach, Calif. Opening ceremonies are scheduled for this month, and the plane will be open to the public year-round.

Minicircus Maximus

Many visitors to last year's World's Fair in Knoxville, Tenn., were impressed by an unexpected exhibit: It was a miniature circus, carved in precise, painstaking detail, occupying a table area of 30 by 64 feet.

The circus is actually the combined work of two hobbyist woodcarvers, flooring company executive Howard Tibbals of Oneida, Tenn., and Harold Dunn, a circus buff who has built and exhibited miniature circuses for over 30 years. Tibbals got started carving

miniatures after reading a *Popular Mechanics* article on the subject in 1947. He corresponded with Dunn because he knew of the latter's vast photographic research based on the Ringling Bros. circus. Both woodcarvers use Dremel tools extensively; just one circus wagon, with full ornamentation, can take as many as 300 hours to finish.

Tibbals exhibits his miniatures at home in an environmentally controlled room—which also protects original posters and circus artifacts—designed by General Electric Co. Dunn plans to take his circus on the road again, for the 1985 World's Fair in Japan.



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Sam Walker Prichard, Alabama



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ALL OUTDOORS

The fastest outboard ever

Last October, British racing driver Bob Spalding topped 140 miles an hour and set a new world's record for outboard-powered craft. In runs through a one-kilometer course on Lake Windermere



Bob Spalding races through the traps to set a new outboard record of 139.66 mph.

he clocked 137.742 and 141.578 for an average of 139.66, two mph faster than the previous record. Spalding, 41, a boat and motor dealer from Ipswich, was driving his Cees Van der Velden plywood racing tunnel hull with Johnson's eight-cylinder outboard having a reputed 400-plus hp. It was the same boat and motor we tested exclusively last spring at over 100 mph. Asked what it would take to up his new record, Spalding advised, "A lunatic."

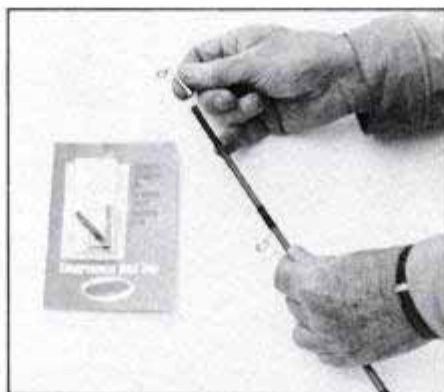
On big cat feet

Catamaran hulls, with their twin keels, broad beam, stable ride and shallow draft, are not a new invention. On calm water they get quickly up on plane and skim the surface, rather than displacing water by pushing it out of the way. Recently tunnel-hull cats have been successful in closed-course racing and larger cats have outraced deep-Vs.

But now Cougar Marine, of North Miami Beach, Fla., is introducing a big, 58-foot aluminum Cougar catamaran hull that can be finished as a luxury yacht or all-out attack craft. With two large Detroit diesels for power, and surface piercing props, the beamy craft has been clocked at 55 mph while drawing only three feet. At rest, the 22-foot-wide craft needs only 4½ feet of water. Empty weight, with 10 tons of engines, is 20 tons.



Cougar Marine's massive aluminum catamaran can top 55 mph with twin diesels.



A new tip-top guide from Mildrum fits in place quickly using heat-shrink tubing.

Quick fixes for fishermen

Many an angler has spoiled his day by slamming a car door or stepping into a boat before he noticed there was a rod in the way. Or he may try to break his hook loose from a snag and snap off the tip-top guide of his rod instead. One handy new aid is a Mildrum Emergency Rod Top, from Mildrum Mfg., East Berlin, Conn. It's under \$4 at tackle shops, comes in a small box, and fits tightly on your broken rod tip with its heat-shrink tubing that can be sealed on with a match.

Carry strapping tape and one of the cyanoacrylate cements like Crazy Glue in your tackle box, as well. They can also help repair broken rods, guides, lures and waders when they break or leak, as they often seem to, far from home.

Outdoors indoors

Fortunately, sportsmen have the choice (and sense enough) to stay inside this time of year when the weather turns unpleasant. Equally fortunate is the publication of fine books that can recreate the outdoors for off-season readers. Two recent excellent examples are *Ted Williams Fishing The Big Three*, published by Simon & Schuster (\$15.95), and *Sand Rivers*, from Bantam Books (\$11.95). Williams, the Splendid Splinter of baseball, writes with John Underwood about his techniques fighting his choice of the most sporting of fish: tarpon, bonefish and Atlantic salmon. In words and pictures, the book captures the enthusiasm of this colorful perfectionist.

Peter Matthiessen's *Sand Rivers* is a safari into the Selous Game Reserve, an almost unknown area that is the largest wildlife sanctuary in Africa. Thirty-six species of animals are found in the preserve. Superb animal photography in color by Hugo Van Lawick helps make this perhaps the most expressive book on Africa today.

New sharp sheath

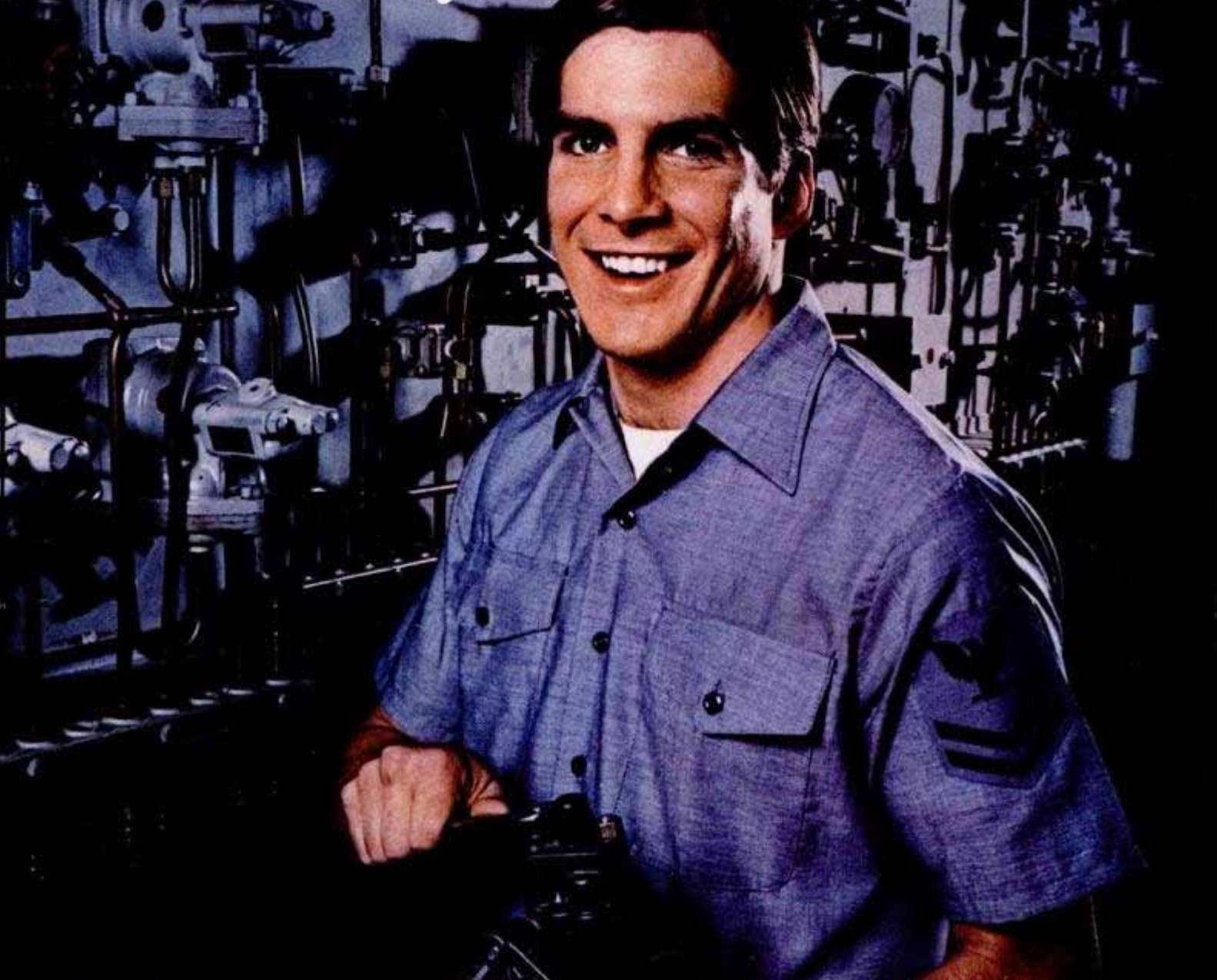
From Finland, birthplace of much fine cutlery, comes a \$17.95, stainless-steel, high-carbon Fiskars Fillet Knife



A slot in the sheath of new fillet knife is lined with twin ceramic sharpeners.

with a slotted sheath holding aluminum-oxide ceramic rods. Pulling the knife across them sharpens the blade at the proper angle for skinning and filleting any fish. Importer is Fiskars Mfg., Hopkins, Minn. **PM**

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PM ELECTRONICS MONITOR



Room in the sky?

While they are not yet stacking satellites like so much flying cordwood, it has been feared for some time that we are running out of "room" to orbit very many more communications satellites. Such geosynchronous satellites must be placed within a "window" in space and each must be a minimum angular distance from all others. These choice orbital locations are running out fast.

Bell Labs recently announced that company researchers had developed a way to double the number of television signals that can be transmitted by a single satellite. Up until now, each satellite transponder could send only one TV signal. But Bell demonstrated the expanded capability on its Comstar system by sending two TV signals, at almost the same time, from one transponder with no loss in signal quality.

The system is based on a process called time-frequency multiplexing. According to Barry Haskell of Bell's Radio Communications Research Dept., "We were able to send a single TV channel in half the usual transmis-

sion time, which is another way of saying we can send two TV signals in the same amount of time as one."

As satellite technology progresses, we can expect to see an increasing number of applications of this concept in the life of the average consumer. Right now, it's the cable companies, networks and large corporations that could benefit most from the increase in the capability of satellite transmission. But, as direct-broadcast satellite TV becomes a reality, this new concept may have many benefits for the private citizen, as well.

Direct-broadcast TV presupposes the use of inexpensive, small (2-foot) dish antennas installed on the roofs of private homes. But instead of picking up their TV signals from the airwaves, these direct-broadcast antennas will be trained on satellites sending consumer video directly to the homeowner.

The ability of each transponder to send more signals should, eventually, result in a cheaper and more accessible form of video enjoyment in our homes.

Real action

Remember those dingy and often decrepit instant-photo booths in the arcades and amusement parks? You know the kind. You and your girl, laughing in the dimness behind a faded velvet curtain, posed and mugged to be immortalized forever—or at least until your buddies ripped the photo from your gym locker door.

Now, video technology has stepped forward to fill this photographic void with the Videomat. These booths allow you to record and even play back 10 minutes of video action in as close to living color as you might feel the morning after a night before.

The Videomat Corp. (of Troy, N.Y.) obviously hopes that these \$14,950 booths will be sold to arcades and parks throughout the land. And—who knows?—video just may break the ice on many future dates.

Educational software

Commodore International has announced that it will place 656 computer programs for the Pet and Vic computers into the public domain. The programs, designed for the educational market, are available through dealers and Commodore's Education Resource Centers.

For more information, check with your local dealer. **PM**

Age of Aquarius

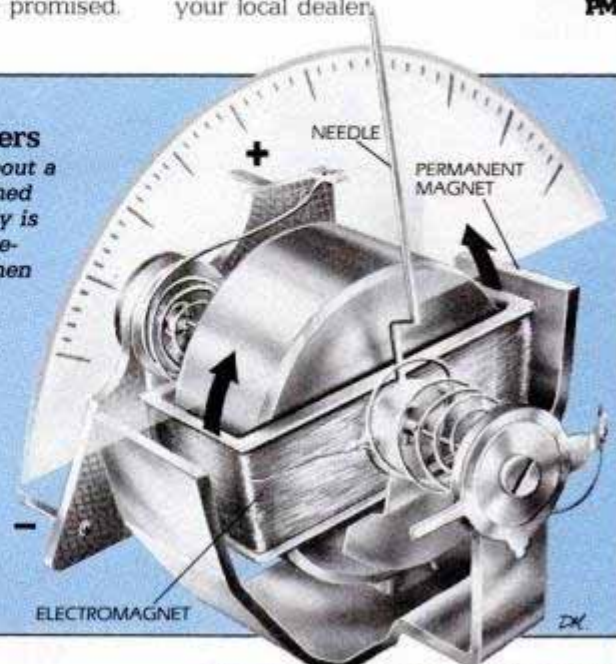
When Mattel announced a keyboard for its popular Intellivision game system three years ago, everybody took note. The add-on was supposed to offer a way to turn a game into a computer. The keyboard never quite made it from the drawing board to the marketplace, and now, Mattel seems to have rethought its strategy. The company recently announced the introduction of a new, full-featured home computer at a very affordable price.

The Aquarius system should be introduced in "early 1983," which means it might be available by the time you read this. Mattel says the \$200 unit will feature "CP/M capability, built-in Microsoft BASIC, 16-color graphics and the ability to display a total of 256 different characters on the user's television screen. Peripheral products include a 40-column thermal printer, a data recorder and the Aquarius Mini Expander, which accommodates a memory cartridge and game cartridge and provides two hand controllers for

enhanced game play." The unit does sound exciting. Now let's see if Mattel can deliver this one with the features and price, and at the time promised.

Direct-current meters

A coil of wire, wound about a metal core, has an attached needle. The coil assembly is suspended within a horse-shoe-shaped magnet. When an electrical current is applied to the coil, it becomes an electromagnet. The reaction between the electromagnetism of the coil and magnet makes the coil rotate, moving the needle on the scale. Amount of movement can be regulated by tension on the coiled spring.



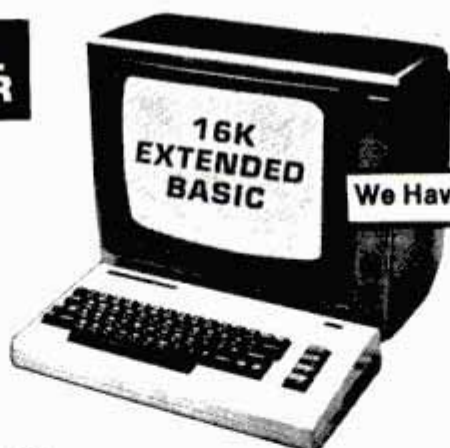
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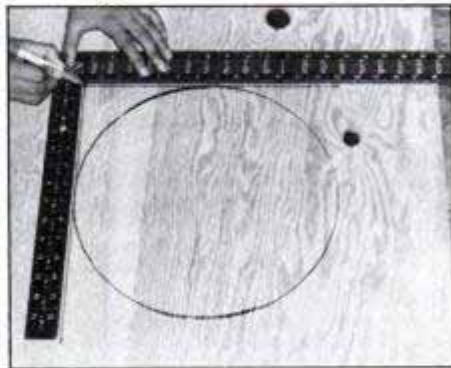


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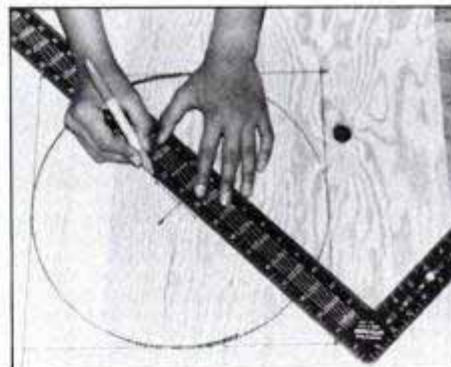
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HINTS FROM READERS

Finding a circle's center



Lay carpenter's square, with inside edges tangent to a circle; draw along edges.



Next, using the square, draw intersecting lines from opposite corners. Exact center of the circle is where the lines cross.

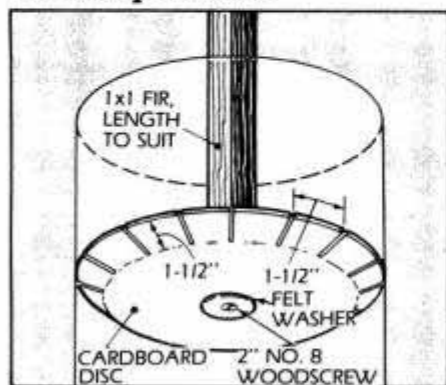
When you want to locate the center of a circle, you can do so by first squaring the circle. Lay a carpenter's (steel) square on the circle with both inside edges of the square tangent to the circle (see photo). Draw along these edges to make the first two sides of the square. Next, use either of the two sides as a base for the carpenter's square, and draw the third side of the square tangent to the circle. After the fourth side is drawn, run diagonal lines from both pairs of corners; circle center is where lines intersect.—*Rick Dole*

Flag says stop

One way to avoid hitting the garage wall when pulling your car in is to staple a paper flag to a 5-ft. "pole" of $\frac{1}{4}$ x 1-in. wood. Tape the pole to a coffee can weighted with sand and park it at the head of your parking space. When the bumper touches the pole, the flag will bob.—*Harry Loudon*

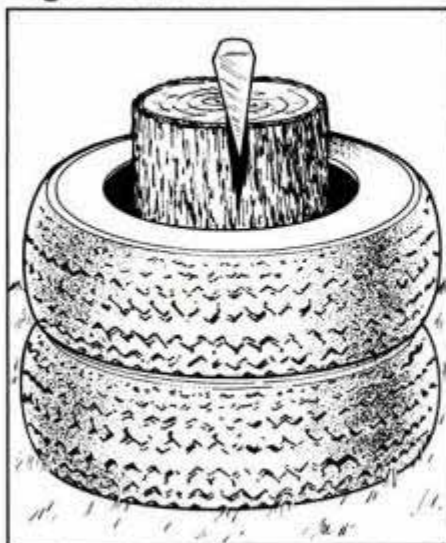
HINTS FROM READERS

Chimney cleaner



To clean a round metal chimney, I made a disc chimney cleaner of a heavy, corrugated cardboard disc—cut $\frac{1}{2}$ in. larger than the inside diameter of the pipe—with $1\frac{1}{2}$ -in.-deep radial cuts every $1\frac{1}{2}$ in. around the perimeter. Secure the disc to a 1x1-in. fir handle (equal to the length of the chimney) with a screw and felt washer. If a single piece of wood isn't long enough, you can make the handle of two wood pieces held together by screws in an end-lap joint. Push the device down the chimney until it reaches bottom, then pull it back up.—Ken Brooks

Logs stand tall



Because log end cuts are generally uneven, logs often won't stand upright for splitting. To solve this, put the log to be split inside a pair of old tires.

—George A. Mayerchak

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The 100 page, full color Leichtung catalog is crammed with tools for woodworkers, metalworkers and hobbyists of all kinds.

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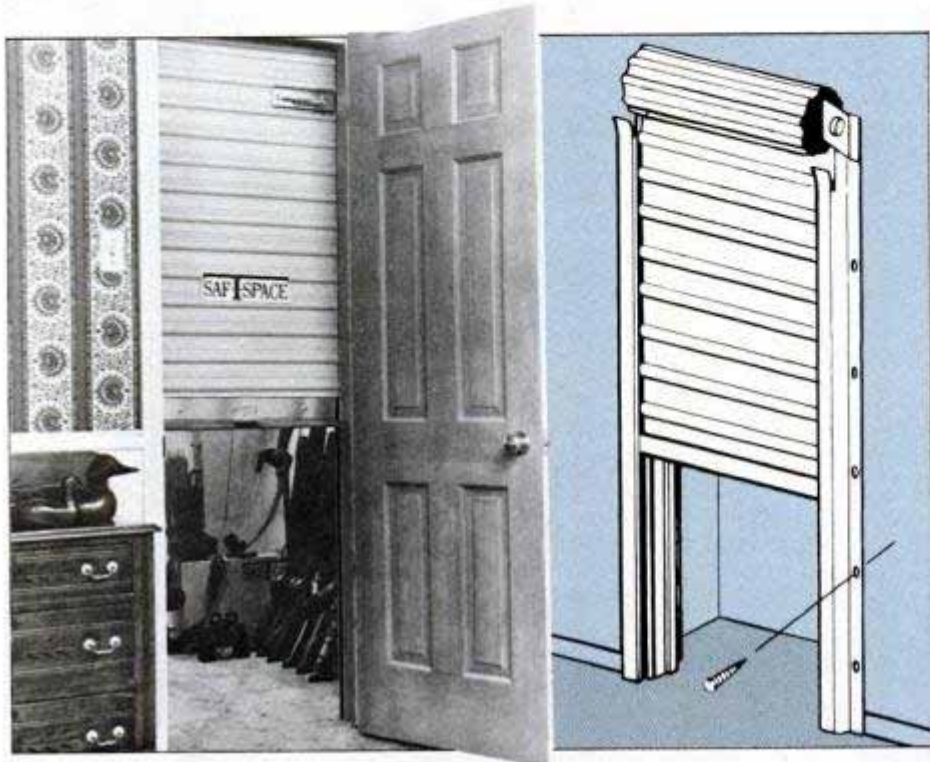
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We own land.
 Enclosed is \$1.00 for priority handling.

Hardware turns closet into vault



Here's a new way to provide protection for your home valuables—the Saf-T-Space roll-up door. Made from 26-gauge steel, Saf-T-Space doors are bolted directly to the closet door jamb. The maker claims a do-it-your-

selfer can install this security door in about an hour with ordinary woodworking tools. It comes in widths of 24 in. (\$325), 30 in. (\$350), 32 in. (\$365) and 36 in. (\$375). Write Saf-T-Case, Box 5472, Irving, Tex. 75062.

More heat from less wood

Sierra now offers a woodstove it claims is engineered to deliver more heat with less wood, while producing less creosote. The Hearthstone contemporary Turbo-Burn stove (\$655) has specially designed baffles that promote more complete combustion and direct more heat into a room. The stove is constructed of 1/4-in. welded plate steel with cast-iron doors that have thermal-shock glass windows fitted with fiberglass gaskets. Sliding draft controls are handy. For information and a list of dealers, send \$1 to Sierra Mfg., Box 1089, Harrisonburg, Va. 22801.



Bathing beauty for your bath



Kohler's latest bathtub surround will make it easy for a do-it-yourselfer to finish a tub installation, says the maker. Dubbed Perma-

Wall, the finishing system comes in a kit that includes five wall sections of ABS plastic, adhesive, color-matched caulk and sealant, and complete instructions for performing a professional job. Perma-Wall is designed to be compatible with most 5-ft. bathtubs and requires woodworking tools for installation. It features a built-in grab bar and two molded-in soap dishes.

Available through Kohler distributors, Perma-Wall comes in white—for \$189—and seven colors—for \$200 each.

For a list of local distributors and product information write: Kohler Co., Advertising Dept., Kohler, Wis. 53044.

Heat pump taps ground water

A pair of heat pumps recently introduced by Lennox uses the thermal energy of ground water for heating and cooling homes. The WHP1 (horizontal model) and the WVP1 (vertical

model) have heating capacities that range between 21,000 and 43,000 B.T.U. per hour and cooling capacities ranging between 18,000 and 40,000 B.T.U. per hour. Energy savings derive from two characteristics of the Lennox heat pump: 1. a single piece of equipment is used for both heating and cooling; and 2. these Lennox heat pumps increase the heating/cooling potential of available thermal energy by a coefficient of 3. To find out if your well and home heating system are compatible with these heat pumps, contact an independent Lennox dealer or write Lennox Industries Inc., Dept. PM, Box 400450, Dallas, Tex. 75204.



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SAVE

- Food
- Nutrition
- Time
- Money

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Vita-Mix® — the one that throws nothing away — grinds grain — makes 3-minute bread — makes total juice with whole fruits and vegetables — cooks — freezes — makes yogurt, salads, purees, baby foods, peanut butter, cakes, special diets, party drinks — grinds meat — chops ice — over 800 recipes.



Out—Total Foods for Less Cost



Make TOTAL JUICE

Uses a patented impact method which juices whole fruits and vegetables, unlike the old separation "throw-away" extractor-strainer method.

	extracted juice only*	peel and everything*
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APPLES (Vit. A)	160 I.U.	380 I.U.

*Per pound of fruit
†Fresh ripe Valencias

Grind any Grain easily, and MAKE BREAD Fast.

GRIND whole kernel wheat into cereal or flour and immediately MIX and KNEAD it into BREAD DOUGH (all in one simple three-minute operation, with precious vitamin oils and fiber retained).

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instantly . . . without artificial color or filler.

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THE PM WORKBENCH



A glue that delivers

Loctite Corp. has introduced the Squeez-It applicator, which is claimed to deliver "glue without glop."

The new applicator is featured on a two-tube package (1.2 grams total) of Duro Super Glue. For one-drop-at-a-time control, just squeeze the tube to break the inner seal and dispense glue with pin-point accuracy. Super Glue is said to bond instantly to most nonporous surfaces, and the inner seal keeps glue fresh longer. It's about \$2. Loctite Corp. is at 4450 Cranwood Ct., Cleveland, Ohio 44128.—J.T.

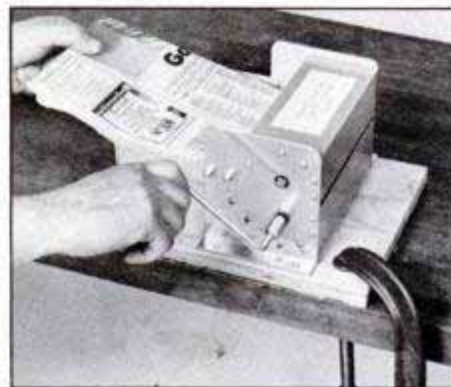


Dispense glue with greater accuracy, thanks to Loctite's Squeez-It applicator.

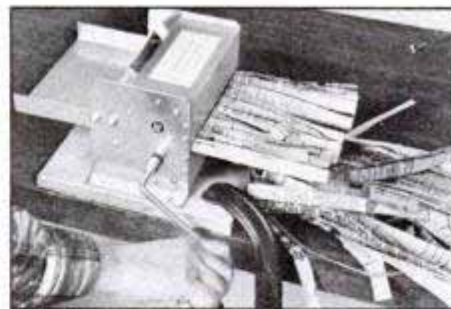
You shred it

Since many garden experts recommend using shredded newspaper (black ink only) for mulch, I recently tested a hand-cranked paper shredder by the Kinsman Co.

The little shredder's 20 self-sharpening blades can slice 12 paper thicknesses at once into 1/2-in.-wide strips. You can feed the 7 3/4-in.-wide tray to shred paper for use as a compost ingre-

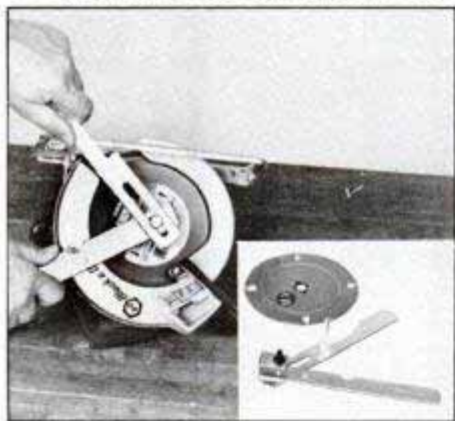


As you feed the shredder, crank handle to drive the circular cutting blades.



Two sets of blades counter-rotate to draw the paper in and slice it cleanly.

Wrench off stubborn blades



Wrench design provides adequate leverage, plus snug fit on arbor bolt (inset).

When I spotted this wrench, I figured it was a gimmick. It turned out to be very useful and is now in my saw box.

The wrench provides a fast and easy way to change blades, and it's safe. The motion of the saw blade tightens the arbor bolt as the saw is used, so it is necessary to use a tool which provides sufficient leverage when locking the blade in place. With this wrench, the handle is held in one hand while the slide bar engages the teeth to hold the blade. The wrench eliminates the age-old stunt of pushing the blade against a wooden edge while the arbor nut is tightened. It fits 3 1/2- to 7 1/2-in.-dia. blades and is available for 1/2- and 3/16-in. arbor bolts. It's \$9.95 postpaid from A & I Bassett Industries, Box 16453, Portland, Ore. 97216.—H.W.

Add bite to stripped holes

If you've ever been frustrated while trying to tighten a screw in a stripped or oversized hole, then Screw Wedge is an item you've been waiting for.

Just slip a length of Screw Wedge into the stripped hole, break it off flush with the surface and retighten with the original screw. You don't have to reposition the hole; the Wedge works in wood, plastic and most metals.

Each package contains four 6-in.-long Screw Wedge strips in two diameters (.5 and .15 in.), enough for about 12 average-sized holes. Made by Fibre Glass-Evercoat Co., 6600 Cornell Rd., Cincinnati, Ohio 45242, it's \$1.79 at hardware stores and home centers.

—Rosario Capotosto



Screws once again fit tightly in enlarged holes when you use Screw Wedge (inset).

dent, a packaging material or as animal bedding. Also use the shredder to destroy personal papers. Fasten the shredder to any work surface with screws or C-clamps.

You can get the shredder at garden centers or by mail. Send \$49.95 plus \$3.00 for delivery to the Kinsman Co., PM 283, River Rd., Point Pleasant, Pa. 18950.—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.

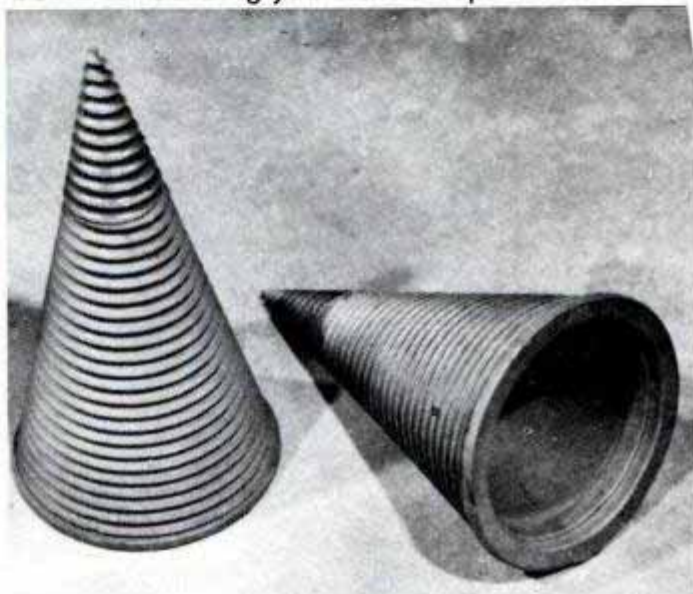
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in splitting of knotty grain twisted legs. No swinging of sledge, simple maintenance and less costly to operate than hydraulic systems. Made of long lasting tool steel and has a threaded replaceable tip. The splinter is a log splitting woodscrew that bolts onto a axle hub or PTO model which slips onto 1 3/8" Tractor shaft. The splinter has a one year, workmanship warranty. **CONE** for building your own setup.

\$160.00 US Funds.

Car-Truck model on a garden tractor (frame not supplied by factory.) Five lug (4 most common bolt hole patterns - 4 1/2, 4 3/4, 5, 5 1/2 inch). Best to enclose a pattern on piece of paper from spare rim.



\$70.00 US Funds

The cone is 8" long, 5" in Dia, and runs clockwise.

Extra Tip \$20.00

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3 pt. fit Category I hitches.

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2 pt. extension with PTO



PM OWNERS REPORT: NISSAN SENTRA

BY MICHAEL LAMM WEST COAST EDITOR

*"Outstanding comfort,
front and rear."*
WISCONSIN PURCHASING AGENT

*"Can't get the wheels
to stop shaking."*
TENNESSEE INSURANCE AGENT

*"Incredible
legroom."*
ILLINOIS
SOFTWARE ENGINEER



*"Sentra outclassed
everything we looked at.
I couldn't be happier."*
WISCONSIN LEGAL SECRETARY

*"The shifter is
very rough."*
FLORIDA SECRETARY

*"IT NEEDS BETTER
VENTILATION."*
NEW YORK SALESPERSON

Despite a few mechanical problems, most owners would buy it again.

Nissan's new Sentra whispers those three little words most car buyers want to hear these days: Economy. Price. Roominess. No wonder the Sentra became one of the few hot sellers in a slow automotive season.

According to our survey of Sentra owners, the car delivers economy in abundance. The price is also right, especially considering its quality and standard equipment. And there's room for an average American family, including the pooch.

A Utah chemical engineer told us, "What sold me on the Sentra was its combination of front-wheel-drive traction, five-speed gearbox, and space for five people, all at a reasonable price. And I'm getting 37 mpg in town!"



Owners had nothing but good things to say about the interior room and comfort.

"So far the TV ads are right," agrees a New York administrative clerk. "I did need this car. I've had my Sentra four months and am getting excellent mileage."

A few respondents, though (6.9 percent) felt betrayed by the Sentra's advertised fuel-economy figures. Here's why. The EPA rates the super-high-mileage MPG Sentra at 40-mpg

city and 55-mpg highway. The MPG is the price-leading model Nissan spotlights in its Sentra ads.

The MPG, though, *isn't* the car most people buy. Only 1.5 percent in our survey owned it. Unlike the Sentra's three other models—standard, Deluxe, and XE—the MPG uses a 1.5-liter, ohc Four instead of the more popular 1.6, and the MPG comes only as a two-door sedan with a four-speed manual.

A NATIONWIDE SURVEY BASED ON 1,561,811 OWNER-DRIVEN MILES

So while it might be advantageous for Nissan to talk about the MPG's 40/55-mpg EPA rating, it would be more realistic to cite the standard sedan with five-speed and 1.6-liter engine. This more prevalent Sentra carries an EPA

(Please turn to page 62)



Get in on the PROFITS in SMALL ENGINE service and repair Start your own money



BEAT INFLATION!

Cash in on the huge demand for small engine repair.

Work part time, full time right at home - we help you every step of the way.

making business!

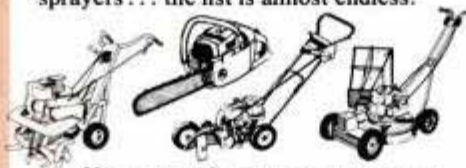
In just a short time, you can be ready to join one of the fastest growing industries in America...an industry where qualified men are making from \$10.00 to \$15.00 per hour...and that's just for labor. Parts, engines and accessories add even more to the profits.



Because the small engine industry has grown so quickly, an acute shortage of qualified Small Engine Professionals exists throughout the country. In fact, it's not unusual for a good small engine man to be three to four weeks behind in the summer and at least a week behind in the winter. When you see how many small engines are in use today, it's easy to understand why qualified men command such high prices—as much as \$17.50 for a simple tune-up that takes less than an hour!

65-million small engines are in service today!

That's right — there are over sixty-five million 2-cycle and 4-cycle small engines in service across the U.S.A. That's the official count from the Engine Service Assn., and new engines are being built at a rate of one-million per month! With fully accredited and approved Foley-Belsaw training, you can soon have the skill and knowledge to make top money servicing these engines. Homeowners and businessmen will seek you out and pay you well to service and repair their lawnmowers, tillers, edgers, power rakes, garden tractors, chain saws, mini-bikes, go-carts, snowmobiles, generators, snowblowers, paint sprayers... the list is almost endless.



No experience necessary.

You don't need to be a 'born mechanic' or have prior experience. If you can read, you can master this profitable trade right at home, in your sparetime, without missing a single paycheck. Lessons are fully illustrated—so clear you can't go wrong.

You receive trade secrets and business plans.

We guide you every step of the way, including tested and proven instructions on how to get business, what to charge, how to get free advertising, where to get supplies wholesale...all the "tricks of the trade"...all the inside facts you need to assure success right from the start.

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"I've had about 8 years experience repairing small engines... but repairs were only minor... until I started the Foley-Belsaw Course."



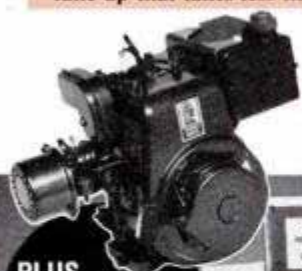
Walter H. Strick Campbell, California

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PM OWNERS REPORT: SENTRA

(Continued from page 60)

rating of 35/50. That's a lot closer to the 36/44 mpg turned in by the majority of the Sentra owners we surveyed.

As mentioned, only 6.9 percent of our owners expressed disappointment with fuel mileage. The others were more pleased. Economy stood out to an unprecedented degree as the Sentra's most appreciated feature. No fewer than 83 percent of the owners we queried put economy at the top of their best-liked list.

High fuel mileage, though, almost always means some sort of compromise. In the Sentra's case, it's horsepower. "The engine shakes a lot and has almost no power," observed a New York merchandising manager, who added, "... hills are the Sentra's worst enemy."

An Illinois butcher commented, "I'm used to driving large American cars, and I miss that immediate surge of power when I press the accelerator."

Another minor performance glitch had to do with the automatic transmission. The Sentra's automatic keeps going back and forth between third and top range. An Army captain from Tennessee summed it up this way: "I bought the Sentra with automatic and air for my wife. The lockup torque converter has a habit of kicking in and out between 40 and 53 mph, which gives a constant push-pull action."

"Also, because of the engine's low horsepower, the air conditioner makes itself felt each time the compressor kicks in. I'm sure Nissan has the know-how to correct both problems, perhaps with a larger engine."

As it happens, Nissan has raised the

1983 Sentra's horsepower from 67 to 69 at 5,200 rpm. Torque is up by 7 ft.-lb. According to Nissan, these new ratings don't cut mileage.

In the quality corner, 91.0 percent rated the Sentra *good to excellent* on workmanship. That's a score not many automobiles in any price range can match. A New York teacher stated, "Inside and out, the Sentra is finished better than most of the more expensive cars we looked at."

A truck driver from Wisconsin: "I'm very particular and picky, and I haven't found *anything* on this car not made right or put together properly."

An unemployed Louisianan: "Despite a muffler rattle and a loose plastic



Some owners complained about rough or erratic idle which dealers couldn't fix.

cap on the hatch hinge, I'm greatly impressed with its overall quality."

Most owners praised the Sentra's comfort and spaciousness. An Ohio restaurant manager: "I'm 6-3, 270 pounds, and I fit up front very comfortably. The rear seats are adequate."

Handling impressed a third of our owners, but we heard some gripes. "Handling has been Americanized," said an Ohio salesman, "and isn't as precise as my '79 Datsun 310. Sentra feels loose on winding roads."

A California supervisor: "Needs tighter suspension up front to flatten cornering." And a New York producer: "Takes bumps poorly; bottoms over hard dips, especially with a load."

Two other consistent annoyances involved the oil filter and out-of-round or imbalanced tires. A Texas traffic engineer told us, "The oil filter is hard to reach and also too near the oil-pressure sending unit. The sender is easy to break off when the filter wrench slips." A Rhode Island salesman added, "I was surprised that we couldn't find any aftermarket oil filter for this car. Only Nissan makes the exact replacement."

The Sentra's commonest mechanical complaint revolved around tire imbalance and, in some cases, out-of-round wheels. Most of the people who mentioned this owned XE models, which come with 175/70SR-13 steel-belted radials.

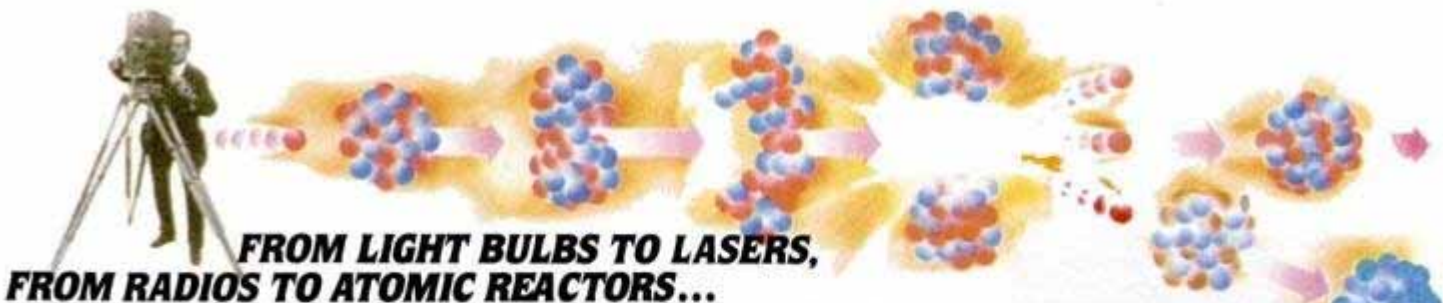
The Sentra's virtues, however, outnumbered complaints by a wide margin. A Texas electronics engineer observed, "The Sentra is a good, basic, economical, no-frills car. It gives excellent gas mileage and, considering the engine size, decent acceleration. I'm glad I bought it."

And finally, a data-processing supervisor in California wasn't alone in taking a broad view of the car. "It's a matter of value. I feel the Sentra represents the best value for the money due to a combination of low price, good gas mileage, five-person seating, performance, quality and easy mechanical maintenance (except for the oil filter). I think the Sentra's real virtue lies in its total balance. At \$6,800 delivered, it can't be the best car in the world, but it's consistently good over a broad spectrum. I'm really pleased with it." **PM**

SUMMARY OF 1982-83 NISSAN SENTRA OWNERS REPORTS*

Total miles driven 1,561,811	Handling..... 33.0	Comfort opinion (front seats):	Good..... 45.8
Average miles per gallon:	Styling..... 26.6	Excellent..... 58.1%	Average..... 15.8
Manual five-speed	Roominess..... 25.5	Good..... 39.3	Poor..... 11.1
In town..... 36.0	Specific dislikes:	Average..... 2.6	Number of vehicles owned:
On the highway..... 43.9	No complaints..... 21.1%	Poor..... 0.0	This car only..... 36.1%
Automatic three-speed	Not enough horsepower..... 8.0	Comfort opinion (rear seats):	Two cars..... 51.3
In town..... 29.2	Rattles and noises..... 7.4	Excellent..... 44.1%	Three cars..... 11.5
On the highway..... 39.5	Cold starting..... 6.9	Good..... 45.2	Four or more cars..... 1.0
Transmission choices:	Mpg lower than expected..... 6.9	Average..... 10.2	Makes of other cars owned:
Manual five-speed..... 81.2%	What changes would you like?	Poor..... 0.6	Chevrolet..... 23.0%
Automatic three-speed..... 18.3	No changes..... 15.3%	Had any mechanical trouble?	Datsun/Nissan..... 16.4
Manual four-speed..... 0.5	Better quality materials..... 12.3	No..... 65.8%	Pontiac..... 11.5
Body style:	Fully reclining seats..... 5.5	Yes..... 34.2	Ford..... 10.7
Two-door sedan..... 43.5%	Interior light package..... 3.7	What type of trouble?	Oldsmobile..... 8.2
Four-door wagon..... 21.7	Better rear vision..... 3.7	Front tire balance..... 15.4%	Volkswagen..... 8.2
Four-door sedan..... 20.1	How much did you pay?	Induction system..... 9.2	Age distribution of owners:
Hatchback coupe..... 14.7	Under \$5,000..... 1.7%	Electrical system..... 7.7	15-29 years..... 27.8%
Why did you choose this car?	\$5,001 to \$6,000..... 19.8	Air conditioner..... 7.7	30-49 years..... 53.5
Economy..... 71.1%	\$6,001 to \$7,000..... 29.4	Transmission..... 7.7	50-plus..... 18.6
Price..... 37.4	\$7,001 to \$8,000..... 38.4	Dealer repairs satisfactory?	Would you buy another Nissan?
Styling..... 20.5	More than \$8,000..... 10.7	No..... 54.7%	Yes..... 94.7%
Roominess..... 13.7	Workmanship opinion:	Yes..... 45.3	No..... 5.3
Owned Datsuns before..... 8.9	Excellent..... 45.5%	Dealer service opinion:	Would you buy another Sentra?
Specific likes:	Good..... 45.5	Excellent..... 27.5%	Yes..... 88.6%
Economy..... 83.0%	Average..... 6.3	Would you buy another Sentra?	No..... 11.4
Comfort..... 38.3	Poor..... 2.6		

*Percentages might not equal 100% due to rounding or insufficient data.



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FROM RADIOS TO ATOMIC REACTORS...**

3000 INVENTIONS THAT HAVE SHAPED THE 20th CENTURY

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\$5 OFF
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In 1900, who could have guessed...
That the simple box camera children loved to play with that year—Kodak's Brownie—would lead to photography that didn't need film?
Or, that the discovery of blood types would someday make it possible to replace nearly every organ of the human body?

Or, that the flashlight, paperclip, and hamburger—all debuting in 1900—would soon become part of everyone's life?

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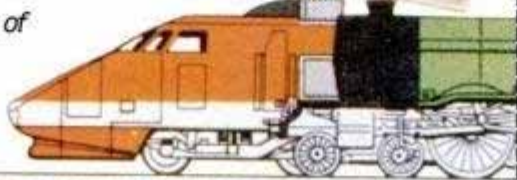
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EXCLUSIVE PREVIEW

CHRYSLER'S G-24 SUPER SPORTS CAR



The Swiss cheese wheels will be capped with 195/60R15 Goodyear Eagle GTs, the biggest tires on any front-drive Chrysler.

This exciting newcomer is what happens when you let kids run the store.

BY TONY ASSENZA
AUTO EDITOR

In the coming months and years, sports car fans will be treated to a veritable orgy of cheap thrills. Right around the corner is the anxiously awaited Corvette, which is the hottest handling car ever spawned from an assembly line. We've already driven that one—full report next month. Soon thereafter will come the Pontiac P-car—mid-engine, fat tires and all—to be followed from across the Atlantic by a turbo Porsche 944. And there are rumors of tweaked Mazda RX-7s and even hotted-up little EXPs/LN7s, not to mention the SVO turbo Mustangs from Ford which you'll read about in our April issue.

Chrysler doesn't want to be left out of the G-force wars about to erupt. And it comes as no surprise, either. Lee Iacocca, after all, was the man at Ford who in 1962 torpedoed an econocar project called the Cardinal and substituted for it something called a Mustang, signalling the start of the ponycar wars.

This latest round of hostilities could rightfully be called Son of Ponycar Wars. It won't be fought with mega-

cubes and four-bolt mains, but rather with turbos puffing into little motors, light, responsive chassis, and all of it sprung from the stickiest suspensions this side of an Indy car. Enough said.

In this corner is Chrysler's entry, weighing in at 2,450 pounds, the challenger from Highland Park, Mich., wearing a red coat of enamel with blackout trim. The Chrysler G-24.

The G-24 sits on a 96.9-in. wheelbase, which tells you right away that the platform for this 2+2 coupe is from Chrysler's successful K-car. In fact, the basic suspension design is identical to the K-car. Where it differs from the K is in chassis tuning and the motor. And those differences, in this case, make all the difference in the world.

For instance, spring rates for the K are 85 lb./in. at the front and 160 lb./in. at the rear. The G-24's rates are 120 and 240 respectively. Shock absorber

jounce and rebound specs have been recalibrated accordingly. The front stabilizer bar is 1 1/8-in. diameter while the back gets a solid 1-in. bar. Previously, the biggest bars available from Chrysler were on the E-bodies—Dodge 600ES, Chrysler E-class—which get a 1-in. solid bar up front and a 1-in. hollow bar in the back.

The bushing material that holds the bars and all the other suspension pieces together has also been updated from a 50 durometer to a 70 durometer hardness. This slightly harder bushing enhances handling and feel by being less compliant and having inherently less deflection when an input load is applied. According to Jim Finck, the engineer responsible for the suspension, Chrysler's goal of meeting and exceeding the Porsche 924's ride quality was achieved. The 924, in fact, was

(Please turn to page 66)

PM photos: Peter Tenzer



The hood vent (left) is functional on the turbo version and cosmetic only on the non-turbo version of the G-24. Rear end (right), with trapezoidal side glass, is almost reminiscent of Porsche's 928. It has a Cd of .38.

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CHRYSLER'S G-24 (Continued from page 65)

the design objective for virtually every aspect of the G-24's performance and handling. After a brief drive in a K-car fitted with the G-24's turbo motor and the suspension, the package was at least as responsive as a Porsche 924.

A number of different tires were evaluated in development work. After running through Pirelli, Eagle GT, Eagle NCT and Firestone HPR tires, the handling evaluation jury picked the Eagle GT as the standard tire for the G-24. And even at that, Chrysler had Goodyear make four specification changes to the tire so it would work in better harmony with the rest of the suspension. The ultimate tire size selection was a 195/60R15, which is the biggest tire Chrysler has ever put on one of its front-drive cars.

Caster, camber and toe-in were left unchanged from the K specs, but the ride height was lowered 1/2 in. in front and 1/4 in. in back.

With this much handling potential built into the chassis, it followed naturally that the G-24 needed good brakes and quick steering. The G-24 gets both



Assenza and engineer James Finck with Aries mule car equipped with G-24's turbo motor and the hot suspension pieces.

in the form of a bigger rotor, bigger caliper with more brake-swept area and a different brake booster than the K uses. The G-24 also gets a unique proportioning valve which is biased toward front wheel initial lockup. The design load was calculated for a two-passenger weight distribution rather than three-passenger, which is the design norm for the rest of the Chrysler lineup. The steering ratio was quickened from 18:1 to 14:1.

All these specifications read like a page from a road racing chassis tuning manual, and, in the brief ride at Chrysler's Chelsea Proving Grounds, the car felt as good as the specs sound on paper. The G-24 rides and handles unlike any Chrysler ever built.

Turbo 2.2

The standard propulsion unit for the G-24 is a normally aspirated 2.2-liter Four with throttle body fuel injection. A

turbocharged version of the same motor is optional.

A three-speed automatic and five-speed manual will be available with either engine.

The nonturbo engine should make about the same power it's making

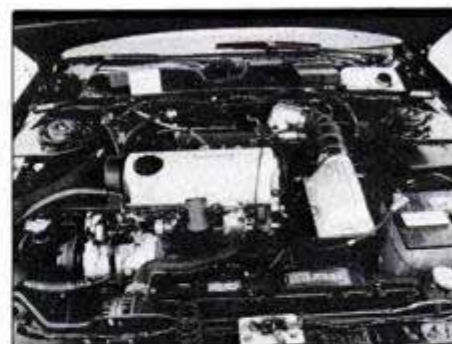


G-24 is scheduled to start production in August 1983. It will be introduced in the fall of '83 as an '84 model.

now—94 hp. The turbo will kick that up to 147 hp at 5,600 rpm and 160 ft.-lb. of torque at 3,600 rpm. For comparison, the five-liter HO Mustang in '82 produced 157 hp, Chevy's HO 2.8-liter V6 pumps out 135 hp and Buick's 3.8-liter V6 makes 180 horses.

You might expect tremendous amounts of torque steer with all that power going through a chassis that wasn't designed for it. Forget it. There is hardly any. The reason, according to Finck, is the reduced ride height.

"We had some problems with torque steer due to the different lengths of the driveshafts. The angle of the shorter shaft changes quicker than that of the longer shaft. But lowering the car kept



The turbocharged 2.2-liter Four delivers 147 hp. Car will be available with three-speed automatic or five-speed manual.

the relative angle changes the same. That solved the torque steer problem."

According to Chrysler, the G-24 also solves any performance image problems the corporation may have. Chrysler engineers claim 8.9 seconds for 0-to-60 mph for the G-24 Turbo, versus

(Please turn to page 68)

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CHRYSLER'S G-24

(Continued from page 66)

9.3 for the Porsche 924 Turbo and 9.6 for the Camaro Z28. We didn't get a chance to verify those numbers, but a quick calculation of the power-to-weight ratios would tend to make those figures believable.

In just two years, the Chrysler-built 2.2-liter Four has already gained a reputation for being as bulletproof as the venerable Slant Six engine was in the 1960s and '70s. In its transformation to turbocharged form, the compression ratio was dropped from 8.9:1 to 8.0:1. Boost pressure is limited to 7 p.s.i. by a waste gate, and a detonation sensor will retard spark timing. In the development stages of the powerplant, no thought was ever given to a mechanical supercharger because, according to Richard Geiss, the engineer in charge of this program, the mechanical supercharger is too parasitic—it takes too much power from the engine just to run itself—and too expensive.

Geiss says that the engine, even at 147 hp, is still understressed and could deliver more power if they wanted it.

The turbo-engined G-24s get a functional vent halfway up the hood. This is a low-pressure area, so the vent will scavenge hot engine air only, not take in cool outside air.

The turbo will not use an air-to-air intercooler, like the type found on the Renault Fuego. It's simply too expensive, and Chrysler engineers don't feel the engine needs it anyway. The engine will have an oil cooler, however, and a larger capacity oil pump.

The EPA numbers are expected to be 24 mpg city and 33 to 35 mpg highway for the turbo motor. And maybe even better for the nonturbo setup.

Youth Committee input

The development of this car is interesting in many ways, not the least of which was the establishment of a Youth Committee within the corporation to get things rolling. The committee was made up of men and women from various Chrysler divisions picked on the basis of their varied backgrounds, driving habits and age. They were all right around 25 years old.

Before any major decision was made on any aspect of the G-24 program, the pros and cons were funneled through the Youth Committee and it had the final word after reaching a consensus.

Obviously, Chrysler has set its bomb sights right at the heart of the sports car-buying market and is trying to do all it can to ensure success. If the car can make it to the street at that weight, with that horsepower and with the handling ability I experienced at the proving grounds, it can't miss. **PM**

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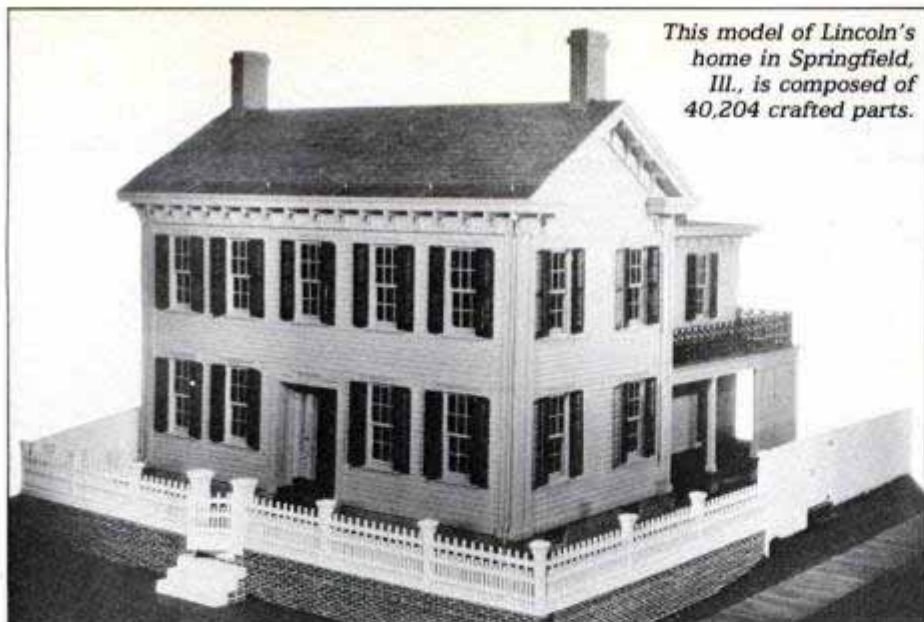
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This model of Lincoln's home in Springfield, Ill., is composed of 40,204 crafted parts.

Amazing Model Of Lincoln's Home

A consuming interest in Abraham Lincoln led Thomas J. Dyba to research and construct this 1/12th-scale model of the Springfield, Ill., home where Lincoln lived before becoming President. Over the past decade, Dyba has spent more than 6,200 hours on the project, building it to duplicate the original home exactly—from the earthen basement floor to the wooden shingles on the roof.

Dyba has fabricated such parts as brick for the foundation, a fence, a front sidewalk, sill beams, floor joists, studs and lath. In one of the few deviations from the original, Dyba used thin paperboard over the lath instead of plaster, because he feared moisture problems.

Examples of the exacting detail in duplicating the home follow:

- Dyba made 270 separate frame and louver components and reproduced minute scale hinges to assemble the 27 window shutters.

- Windows in the Springfield home don't have balances (sash weights). They're held open and closed by small wooden pegs. Dyba's model also uses such pegs, though they must be removed with fine tweezers.

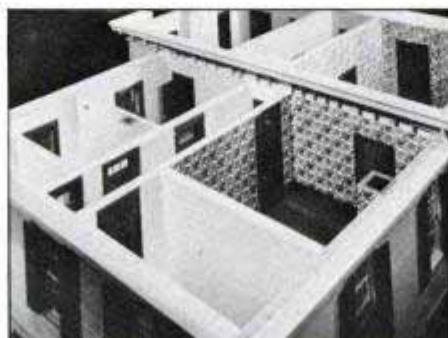
- The front doorbell of the Lincoln home has a pull that jiggles a spring-mounted bell via a system of wires. The bell on the model is so tiny, however, that it cannot be heard.

- The roof on the front of the model is covered by 2,780 wooden shingles. The back roof is made of zinc plates.

Not satisfied with completing this model, Dyba is now recreating the furniture that was in the home when Lincoln lived there.—David A. Warren

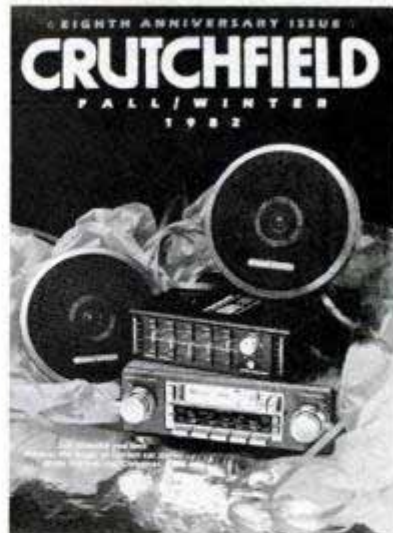


This close-up view through the window above the front door shows a marble-topped table holding a vase, and the newel post on the stairs. Dyba fabricated the wallpaper in the house by copying patterns that were there when Lincoln occupied it, and popular patterns of the day.



With the roof removed, the interior of the second floor is visible. The model can be disassembled for transporting.

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4 GOOD LITTLE HOME IMPROVEMENTS

Spool And Tape Rack Upgrades Sewing Center

Whenever handicraft is practiced, it's a good idea to keep things organized. This wall-mounted sewing rack will do just that. The top of the rack stores bias tape or card-packaged sewing items. Below the rack are 48 pegs for storing large spools of thread.

Make full-scale layouts on thick cardboard of the patterns for the top of the backboard and sides. Transfer the pattern for the top of the back to a piece of $\frac{1}{4} \times 12\frac{1}{4} \times 18$ -in. plywood. Trace the pattern for the sides twice onto a piece of plywood $\frac{1}{4} \times 10 \times 11$ in. Cut with a band saw or portable sabre saw.

Plow $\frac{1}{8}$ -in. rabbets $\frac{1}{8}$ in. deep at the bottom of each side piece. (You need both a left- and a right-hand side.) Tack the sides face to face and sand edges.

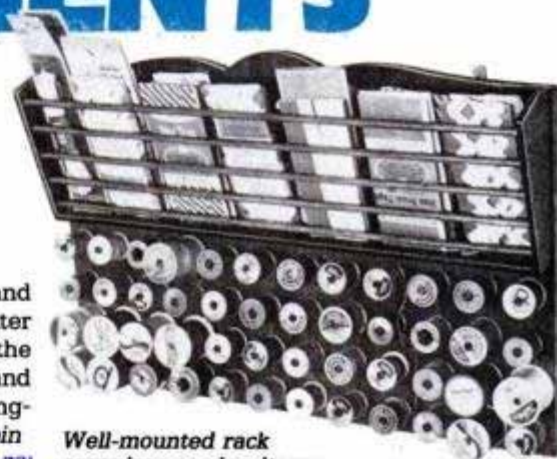
Draw a line parallel to the angled edge of the side set back $\frac{1}{4}$ in. Find the center of that line and mark it with a cross stroke. Then make two marks on either side of the center mark spaced at intervals of 1 in. to lay out center marks for the five $\frac{1}{4}$ -in. holes. Bore holes through both sides at once.

Cut the plywood bottom for the tape rack; bevel the front edge 15° . Glue and force-fit the dowels in the side holes. Attach bottom with glue and brads.

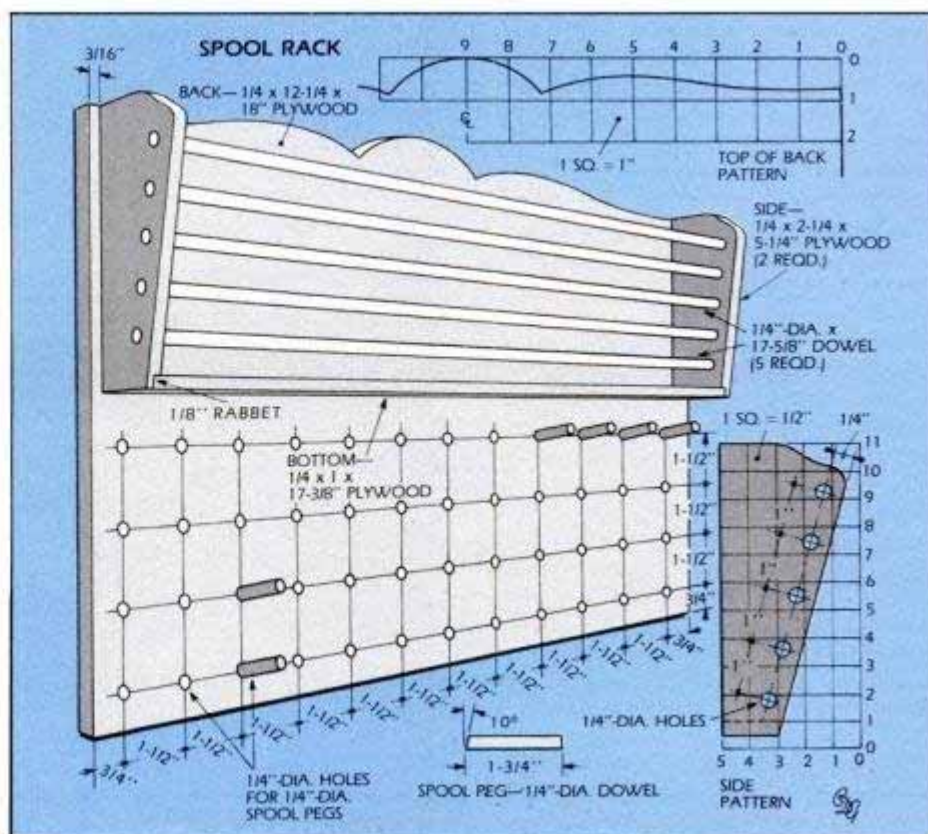
Lay out and bore holes in the backboard for the spool pegs, angling them 10° toward the top. If your drill press lacks an adjustable table, shim the piece to get the correct angle—or set a wedge under your portable drill guide.

Cut dowels for the spool pegs and force-fit them in the backboard. Center the tape rack on the top section of the backboard and fasten it with glue and brads. Attach hooks or other wall hangers to the backboard.—*M. R. Kirstein*

(Please turn to page 72)



Well-mounted rack organizes sewing items.



Is Lower Back Pain Making You An On-Again, Off-Again Cripple?

by Eugene Griffin

Read how one man freed himself from this crippling pain.

It happened aboard a Lufthansa flight to Frankfurt, Germany where I was going for a business meeting. The plane hit an air pocket and suddenly my back "went out." If you've ever suffered from lower back pain, you know what this can mean. In my case, the stewardess had to lead me off the plane when we landed. "This is the first time this has happened?" she asked. When I told her no, she said:

"Oh, then you should have a Prosana Belt." She then told me she had lower back trouble, too, and without the Prosana Belt, she didn't think she could hold her job. "It practically saved my life!" she went on.

I'll be sure to get one, I told her. But what I was really thinking was how could a belt that helped her—a woman about 110 pounds—help a slightly overweight guy of six feet like me? Besides, I thought, I've tried practically everything short of an operation. So I went to my hotel room, took a hot bath, several aspirin and laid down for the night hoping for the best.

Couldn't get out of bed

The next morning the pain was worse than I could ever remember. I had to roll out of bed onto my knees and crawl to a doorknob to get to my feet. Again, I took a hot bath and some aspirin, but again, it didn't do much good. If I had been back home, I would have called and canceled the meeting. But here I was in Germany and scheduled for a meeting with five other businessmen I had set up. So there was nothing I could do but go through with it.

Lunch Included, Too!

The pain must have been apparent the moment I walked into the room because the first man I met smiled sympathetically and said, "You look like your back is bothering you." It is, I answered. "Haven't you heard of the Prosana Belt?" he asked. I nodded yes. "And you don't have one?" he persisted. No, I said, continuing around the room, anxious only to get the meeting over with and go back home.

After the meeting, the man who asked me about the Prosana Belt suggested I join him for lunch. Since he was the key man on the deal, I accepted. But instead of driving me to the restaurant, he took me first to a surgical supply store where he bought me a Prosana Belt. I had no other choice but to put it on right there, though all I

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could think of after thanking him was to say, Is that it?

"That's it," he replied. "Now let us take a little walk to a nearby restaurant I know you'll enjoy."

The Most Amazing Walk Of My Life

If I had known the "little walk" was going to take almost a half hour, I never would have gone—business deal or no. But that was all part of his plan! Because by the time we reached the restaurant, my pain was gone! I even reached down and touched my shoelaces just to see if I wasn't imagining things. I can't believe it, I said. It's like a miracle. "Yes, I know," he answered. "I said the same thing when I first wore the Prosana Belt. Occasionally," he added, "I still say it, although any troublesome condition or pain that persists should be brought to the attention of your doctor."

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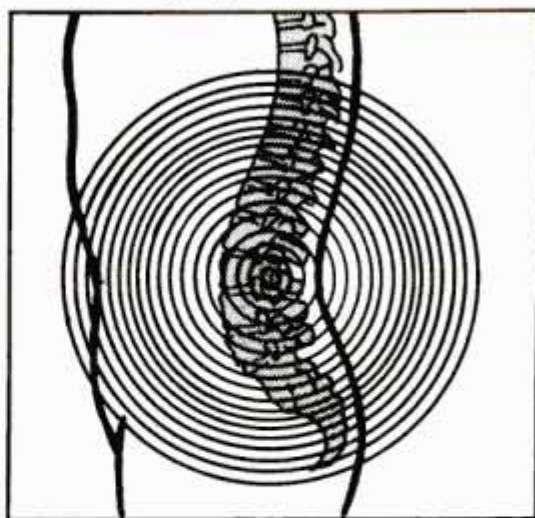
Over lunch my friend proceeded to tell me about the Prosana Belt. How it was invented by a doctor, tested and proved in hospitals and clinics; even on people so crippled with lower back pain, they had to wear steel braces! How it was, and is, used throughout Europe by tennis champions, Olympic bobsled medalists, soccer players—by all kinds of people who are constantly putting incredible strains and stresses on their backs. In fact, he concluded, its effectiveness has been so proven, its purchase is included under Germany's national health coverage plan.

Save \$14.00! Special Free Trial Offer!

When I returned home, I told all my friends with bad backs about this marvelous belt. But when they tried to buy one, they found no one in the United States had even heard of it! So, I called my friend in Germany (incidentally, I got that order) and told him I'd like to import some Prosana Belts. He told me the cost of one in Germany was \$44.00 in American money. Since I would have shipping costs, taxes, handling and so forth, I decided to see if I could make a special bulk importing deal with the manufacturer. And, I'm happy to add, I was able to. Yes, you can now try the Prosana Belt for only \$29.95—\$14.00 less than what you would pay in Germany. What's more...

You Can Prove Its Effectiveness To Yourself Risk-Free For 30 Days!

If you suffer lower back pain like me, you've probably tried every "cure" there is and so you're probably skeptical. Which is why I'm making this iron-clad, no-risk guarantee: If you're not convinced that the Prosana Belt relieves your lower back pain fast...that it works where other methods and devices have failed...that it lets you bend over, garden, do household chores, even play sports pain-free, I'll return your money in full.



If You Read Nothing Else Read This Doctor's Report:

"I've turned from my initial skepticism, indeed rejection of the Prosana belt, to an eager proponent of it. I now have checked more than 40 cases from my practice and after studying a file with more than 100 statements, I have no doubts about the effectiveness of the belt." Dr. Ludwig Hecht

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Mr. D. Sturza, Swiss Tennis Champion

"Often I could tolerate the pain only with strong medication. The Prosana Belt has freed me from taking pills."

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Make These Needlepoint Frames

You'll find it's easy to produce craftsmanlike needlepoint and tapestry if you have either of these stands to work with. On both, the backing is affixed to the frame, which keeps your hands free. And you can leave your labors at will, without having to pack up.

The two frames shown have adjustment holes in the arms to set the space between the rollers. The table model accommodates needlework up to 18 in. wide; the floor model holds work up to 29 in. wide. Removable feet on the larger model make it easy to store.

The frames were made from common pine, but for greater rigidity, oak or cherry can be used. Specifications for the tabletop frame are given in the drawing. To build the floor model, use the dimensions in the materials list.

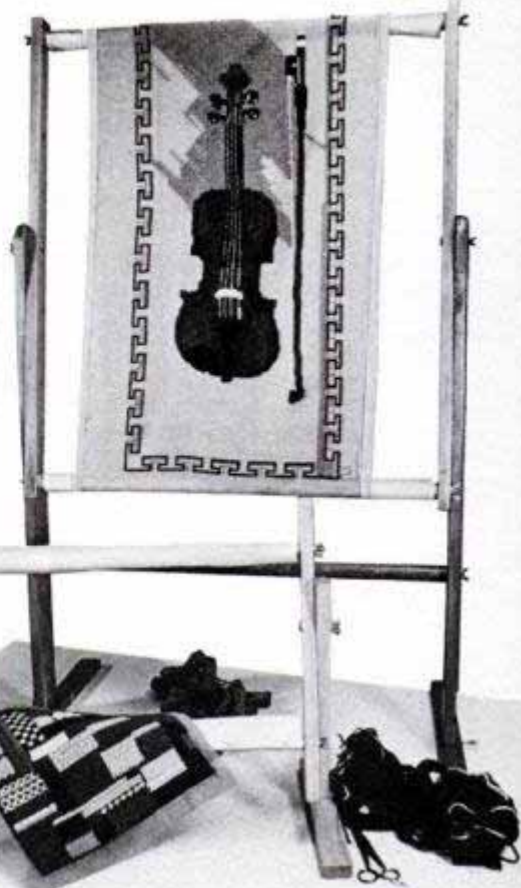
Start by cutting pieces for the uprights and base. For the table model,

bore pilot holes in the base and bottom of the uprights for the screws that will join them. To make the floor-model base removable, cut a mortise in the center of each foot. Position the uprights and bore a 1/4-in. blind hole through the outside edge of each foot and into the upright for a dowel pin.

Cut the two arms to length and bore holes as indicated on the drawing to allow for roller adjustment. Spacing for adjustment holes on the floor model, measuring from one end, is: 1, 7, 13 1/2, 22 and 28 in.

Cut dowels for scroll rollers to size. Find the centers at each end and bore pilot holes for the hanger bolts. Threading two wingnuts face to face on the machine-threaded end will make it easier to turn the bolts into the dowel ends. Sand all frame parts, first with medium-, then fine-grit sandpaper.

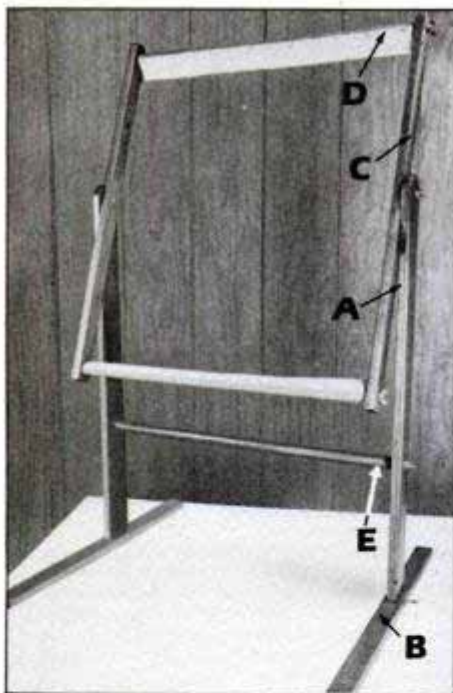
To darken wood, stain it. Finish with two coats of polyurethane varnish. When dry, staple heavy twill tape to the scroll rollers. Canvas ends of



Stretching needlework on a frame results in a craftsmanlike, professional-looking finished product.

needlework are stitched or pinned to the tape for stretching.—Ed Vivier

(Please turn to page 74)

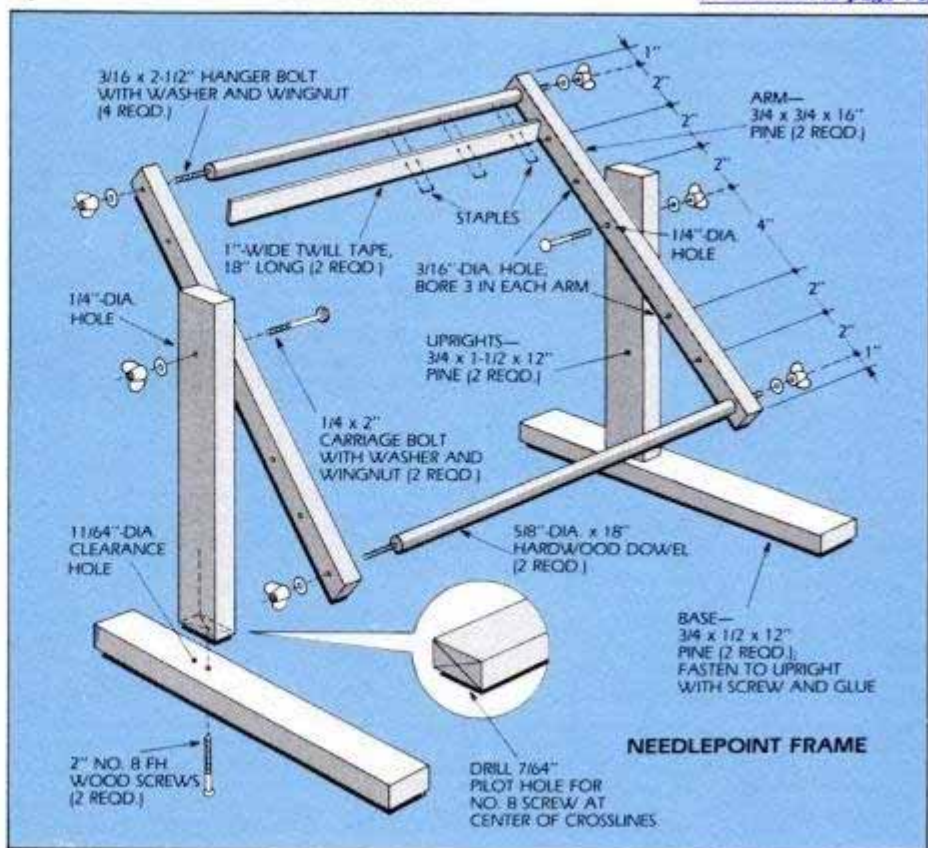


Floor model parts indicated in the photo correspond to the materials list below.

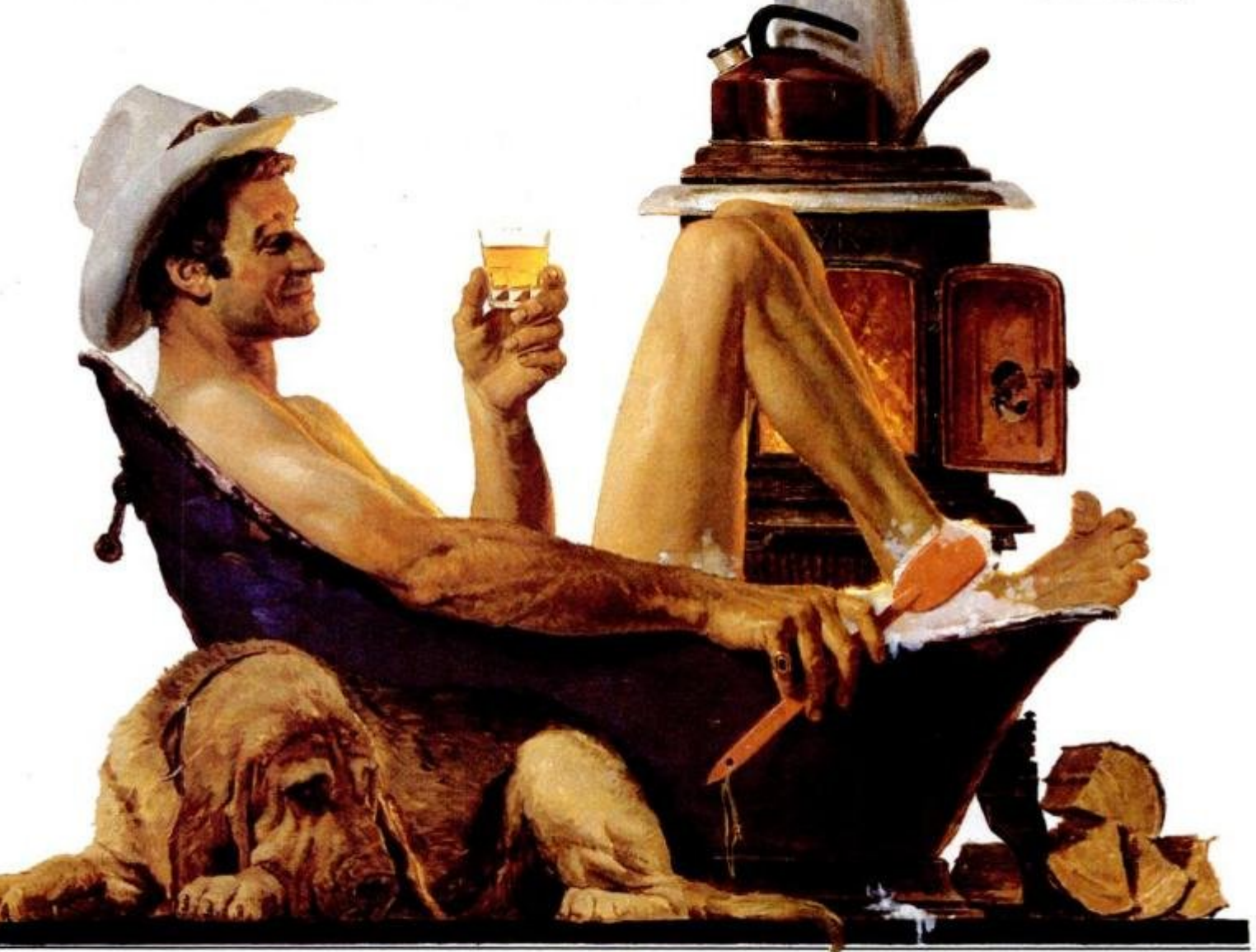
MATERIALS LIST—FRAME

Key	No.	Size and description (use)
A	2	3/4 x 2 1/2 x 32" pine (uprights)
B	2	3/4 x 1 1/2 x 24" pine (base)
C	2	3/4 x 1 1/2 x 29" pine (arms)
D	2	1 x 24" hardwood dowel (rollers)
E	1	1 x 25 1/2" hardwood dowel (cross brace)

Misc.: 1/4 x 2" dowels (2 reqd.); 1/4 x 2 1/2" hanger bolts with washers and wingnuts (6 reqd.); 1/4 x 2" carriage bolts with washers and wingnuts (2 reqd.); 1 1/2"-wide twill tape, 48" long; staples.



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WEEKEND WORKSHOP

(Continued from page 72)

Pine Napkin Holder Keeps Table Neat

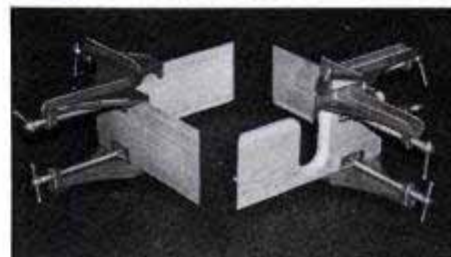
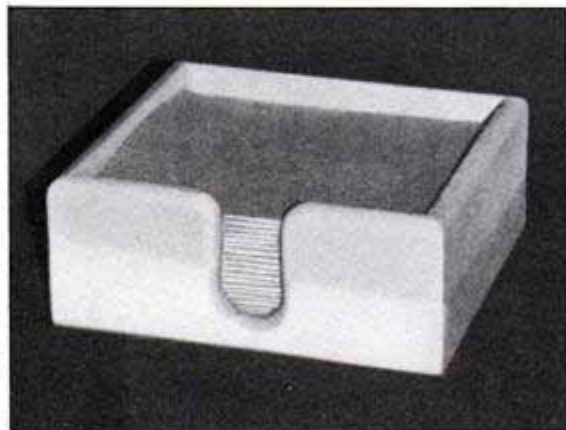
A napkin holder that dispenses napkins singly—without requiring two hands to keep the whole stack from plopping in the soup—is difficult to find in stores. Fortunately, you don't have to search for one. You can build this napkin holder in just a few hours.

The dispenser holds the most common size napkins ($7\frac{1}{4} \times 7\frac{3}{4}$ in.) found in neighborhood supermarkets. And with its mitered corners, rounded edges and rabbetted bottom, it's attractive enough for any table.

Begin with a 3-ft. length of clear pine $\frac{3}{8}$ in. thick and $8\frac{1}{4}$ in. wide. Use either a router, table saw or radial-arm saw to cut the rabbet along one edge. Round the other edge with a router and a rounding-over bit; or use a wood rasp. Sand the rounded edge smooth with 80-grit, then with 120-grit sandpaper.

Cut the sides mitering the ends 45° as shown. The dimensions given are for the longest faces of the mitered pieces. Then, cut the finger slot with a band saw or sabre saw. Round the edges of the notch and sand as you did the top edges of the stock for the sides.

Apply glue to the mitered ends and fit them together carefully. Drive brads through the corners. Square the box and take measurements for the bottom from the rabbet perimeter. Cut out the



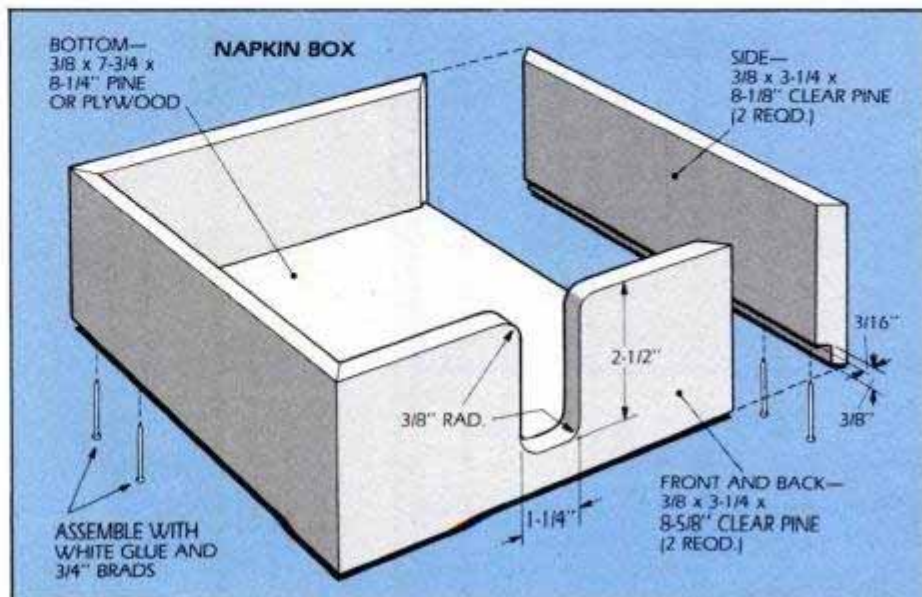
Miter clamps are very useful for holding joints tight while you do the nailing.

bottom and fasten it with glue and brads.

Smooth all surfaces and flatten all square corners slightly with 120-grit paper. Dust and wipe with a tack cloth.

Apply stain, if desired, and finish with two coats of polyurethane varnish, rubbing lightly with fine steel wool between coats.—Linda Freedman

(Please turn to page 76)



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Use the Shrink Wrap System™ to reduce your waist,
your hips, . . . everywhere, completely at our risk!

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Here are the impressive stories (all sworn and notarized) of a few outstanding users. Everyone may not do as well, but if they can do this well, just think how many pounds and inches you will lose quickly with the Shrink Wrap System!

Doug Fink of Asheville, North Carolina



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"I've lost 5" from my waist and 6" from my hips over a 12 day period. My weight loss was 18 lbs."

Dr. J. Lee Briers of New Castle, Delaware

"I lost 5 inches off my waist & 5 inches off my hips! I am amazed at the way the Shrink Wrap System works. I'll recommend it to everyone!"

Helena Smith of Vandalia, Michigan

"I lost 9 pounds & 4 inches off my waist in 2 weeks! It's just unbelievable that it took so little time and effort to produce such amazing results!"

Robert N. Nilsen of Mechanicsburg, Pennsylvania

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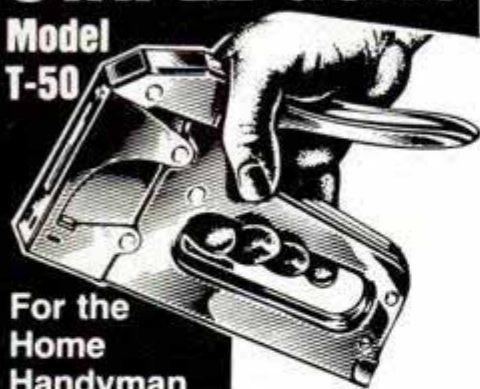
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WEEKEND WORKSHOP

(Continued from page 74)

Indoor Plant Stand

This plant stand is well within the capabilities of a woodworking beginner, yet its details are fine enough to warrant admiration from an expert.

Select high-grade redwood. Start by cutting pieces for the rails and legs. Since redwood is easy to work with, you can use hand tools if you don't have power tools.

Next, cut rabbets for joining the legs and rails. Lay out rabbet cuts for the legs carefully to ensure making two right and two left legs.

Connect the legs to the side rails. Clamp pieces together, and check for square and good fit before gluing them up and screwing them together.

Prebore and countersink pilots for screws through the end rails. Attach them to the sides of the rail-leg assemblies. Set and fill nailheads with matching filler. Conceal screws in end rail faces with dowel plugs.

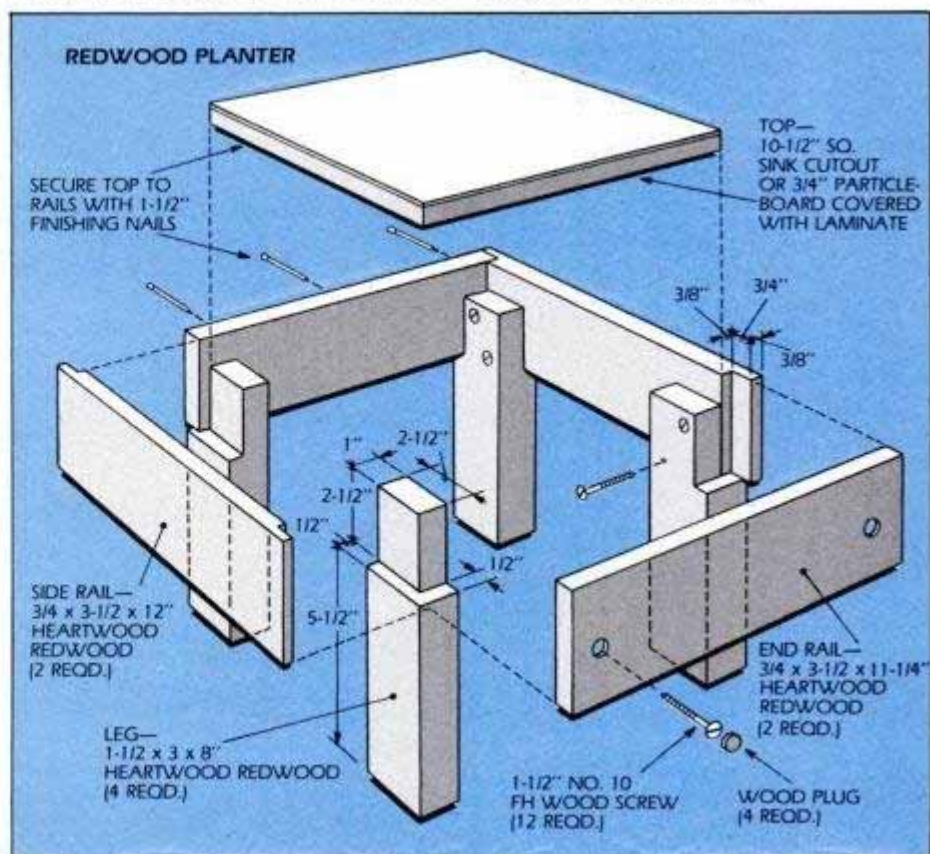
Cut the tabletop from a discarded sink cutout from a laminate countertop. Or, you can laminate the top yourself (see *Working With Plastic Laminate*, page 105). Take the inside dimensions between the rails of the assembled



Made from redwood, fitted with laminate top, plant stand resists water damage.

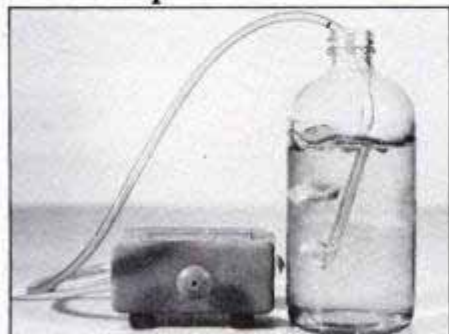
base to establish the correct size for the top.

Round all square corners slightly and sand the base with fine paper. Finish the wood parts with two coats of clear tung oil.—Frank H. Day



PM PHOTO HINTS

Bubble up



Aerating the bleach solution of Ektachrome E-6 for five minutes is a tedious and messy procedure. An inexpensive fish tank air pump can be used to do the job, as shown here.—*Jorma Hyypia*

Gray scales



When trying out black-and-white film, check its response to various colors by making up a swatch board of paper or cloth. Shoot under various lighting conditions.—*Robert Hertzberg*

Funnel feature



You can make a large wire loop by simply bending an old wire clothes hanger. Fasten it with two screws to the wall over the darkroom sink. It will hold a funnel within easy reach, while letting it drain.—*Louis Hochman*

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250 m.p.h. (a force greater than any maritime vessel is ever exposed to). Each of these marine life-time tarps also features double stitched hems, reinforced triangular corners, rust-proof grommets every 3 ft., nylon naval rope; and are so watertight they are hurricane-proof!

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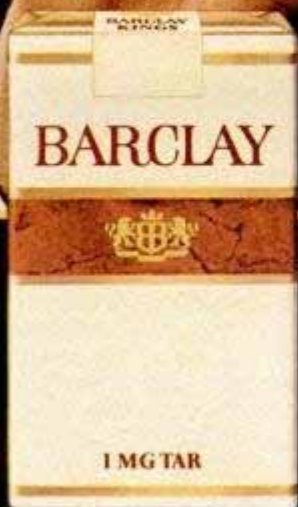
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'HAWKEYE' TERROR OF THE FLORIDA DRUG SMUGGLERS!

The latest addition to America's antidrug arsenal, a flying radar station, can spot a smuggler 250 miles away!

BY SOLANGE DE SANTIS

Desperation is spending a warm May afternoon flying 1,000 feet over the coast of southern Florida, hunting small aircraft and boats that sneak tons of drugs and other contraband from South America into the United States. Go ahead—you try to pick off a tiny craft creeping under the radar net somewhere along thousands of miles of coast and islands. But on one such afternoon last year, U.S. Customs pilot Bill Perry wasn't about to despair. Sure, he and his copilot riding shotgun were the only Federal drug agents airborne that day. Yet they were far from alone.

Cruising high above Perry was a Navy E-2C Hawkeye, the flying radar station. Its rotodome looks like a dinner plate sitting atop that craft's fuselage, and houses the world's most sophisticated radar systems. The Hawkeye was on a secret mission that day: to help drug enforcement officers choke off smuggler traffic that was growing at a cancerous pace. Homestead Air Force Base was disappearing below and behind Perry when the Hawkeye's three radar crewmen signaled a prospective "kill"—



Forced down on abandoned runway in Florida after his airplane was spotted by a Hawkeye flying radar station, a drug smuggler attempts to escape. During this arrest last May, a U.S. Customs Dept. King Air pursued smuggler's craft and put down right behind it as an Army Cobra helicopter from the Jacksonville base homed in on the site, also having been directed by high-flying Hawkeye.

PM art: Dean Ellis

the first one they had encountered that day.

Perry turned his Beachcraft King Air toward the Miami air traffic approach area as soon as the Navy crew reported the slow-moving target coming over Cuba. Among south Florida pilots, it's rumored that drug traffickers can buy protection in Cuba. They supposedly land their craft for refueling, an illegal act under Fidel Castro's much-publi-

cized antidrug rules. But bribed officials are said to look the other way.

Still, Customs pilots don't chase after rumors. Bill Perry needed something more solid to justify pursuing the Hawkeye's radar blip. And the Hawkeye provided that, too, when its powerful on-board Advanced Radar Processing System (ARPS) computer quickly analyzed the quarry's position.

"His route of travel didn't sound

quite right," Perry said. "When he came up over Cuba, he turned toward Bimini, which is the wrong way to go. He should have stayed on the same heading, right over the top of Miami."

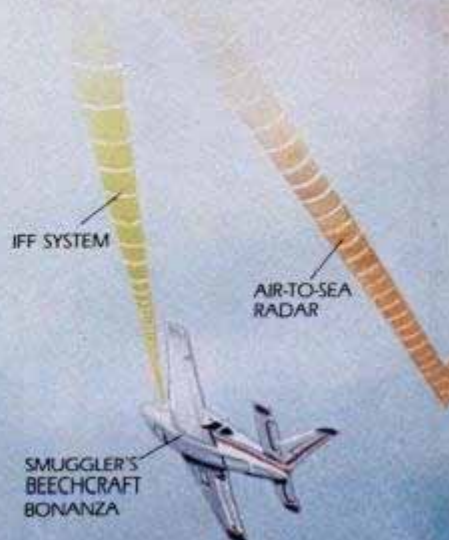
Even worse, the Hawkeye's receivers, capable of picking out a signal 250 miles in any direction, couldn't detect anything from the smuggler's transponder. All foreign aircraft approaching Miami are supposed to have a tran-



AN/APC-125
RADAR ROTODOME

Hawkeye's trial by fire: 86-0 for Israel

The Hawkeye's first combat test came in Vietnam, but much of the radar in the plane's rotodome has been added only in the past five years. Thus, U.S. Navy officials watched carefully as Israel sent up a fleet of Hawkeyes during the Lebanese conflict last summer. Circling in the sky about 100 miles from Syria, the Hawkeyes were credited by officials in Tel Aviv with detecting 86 Syrian MIG fighters just minutes after the jets left their bases in Syria and before the MIGs could fire any missiles. The Israelis also credit the Hawkeyes with helping them destroy all 19 Syrian Surface-to-Air (SAM) missile launchers defending the Bekaa Valley. The Israelis flushed out SAM sights by sending remote-controlled aircraft over the valley. These drones carried "Fuzzbusters" to identify Syrian radar and relay the data to the Hawkeyes, which, in turn, gave Israeli F-16s the correct frequency to jam the SAM radar. Hawkeyes spotted for ground-based artillery support troops which launched barrages as the fighter planes moved in. Israeli rockets dropped shards of aluminum around the SAM sites, jamming ground-based radar as the F-16s came in for the kill. That's when the MIGs became airborne. But they were sitting ducks for the Israeli F-15s and F-16s, because the Hawkeyes could follow the MIGs from the moment they taxied down their runways. Israel isn't the only Middle East nation with Hawkeyes. Egypt recently received a shipment of four Hawkeyes for \$30 million each.—S.D.



sponder. Its continuous signal or "squawk" gives officials more than a radar blip to go by. And planes flying under Visual Flight Rules (VFR) are supposed to use the universal 1200 frequency until ordered by Miami air traffic control to "squawk 1875," or 1650, or whatever four-digit code has been assigned for identification.

The suspect airplane was running
[\(Please turn to page 156\)](#)



Three radar operators sit in the fuselage of the Hawkeye. Using light styluses, they "lock in" a target on the screen and run a check on it with the craft's high-speed, on-board computers.



You can run, but you can't hide

A Hawkeye like this one flew about 20,000 feet over the area where a U.S. Customs Dept. King Air was chasing a smuggler's Beechcraft Bonanza (shown below left). The Bonanza ducked into some puffy clouds for a moment, but, using a military Identification Friend or Foe (IFF) radio beam, the Hawkeye followed the smuggler through the cloud, allowing the King Air to stay on his tail. Hawkeye-to-King Air radio conversations kept the Customs pilot right on target. Even while the Navy crew of five pursued the smuggler, the rotodome atop the craft scanned the skies for 250 miles in every direction, and sea-scanning radar watched the nautical traffic off the Florida keys. The Hawkeye is reportedly sophisticated enough to handle all the commercial air traffic flying between Boston and Washington, D.C., and probably beyond.

COCKPIT-TO-COCKPIT
RADIO

U.S. CUSTOMS DEPT.'S
BEECHCRAFT KING AIR

Sporty four-doors? From America? Impossible. A sporty four-door is a contradiction in terms.

Not so in Europe. In Europe, a door is a way to get inside your car, not a reflection on your manhood. It's perfectly possible to own a sleek, luxurious five-passenger sedan that will blow the doors off a Z28 on either a straight or winding road—your choice. That makes it perfect for the frustrated racer hidden inside of every family man, whether he lives in Bonn or Beverly Hills.

Right now, the car of choice is Audi's turbocharged 5000, which has been rolling up Car of the Year and World's Best Sedan awards ever since it was introduced in 1977. The big Audi has also been rolling up sales in the United States.

Which brings us to the American European sports sedan. For 1983, Buick, Dodge and Pontiac have all drawn a direct bead on Audi's high-performance 5000, complete with head-to-head advertising which compares each new American challenger with the Audi.

But how do the American upstarts stack up in the real world, away from the high-intensity TV lights? To find out, we called the combatants together for a pitched battle—Audi 5000 Turbo versus Buick Century T-Type, Dodge 600 ES and Pontiac 6000 STE.

These cars, by definition, have dual personalities. On one hand, they're meant for safe,

comfortable travel with your kids, luggage and amply upholstered mother-in-law. But with their taut suspensions, high-revving engines and superlative brakes, they're just a step away from the racetrack.

So we tested them in both venues—on the street, and at Waterford Hills, a 1.5-mile road racing course north of Detroit. We also spent a day at Milan Dragway in Milan, Mich., compiling our normal performance data.

Audi 5000 Turbo

The 5000 is the flagship of Audi's sedan fleet and, except for the awesome but expensive, limited-production 4wd Quattro, the fastest and best handling car the German

Pontiac, Buick and Dodge go head-to-head against Audi's \$20,000 best—and come surprisingly close.

BY GARY WITZENBURG DETROIT EDITOR
AND RICH TAYLOR



Does Twice The Price

PM's PERFORMANCE—

	1/4-mile Acceleration (sec. @ mph)	Braking 60 to 0 mph (ft.)	Slalom (mph)
AUDI 5000 TURBO	17.08 @ 79.08	131	59.76
BUICK CENTURY T-TYPE	19.22 @ 71.90	133	52.24
DODGE 600 ES	18.59 @ 72.11	151	56.90
PONTIAC 6000 STE	17.44 @ 80.07	135	59.99

Slalom is speed in mph through seven cones spaced 100 feet apart with an entry speed of 60 mph. **Interior sound** is measured in decibels. **Interior space index** is (front headroom x front elbowroom x front



DODGE 600 ES

BUICK CENTURY T-TYPE

PONTIAC 6000 STE

AUDI 5000 TURBO

Mean Twice As Good?

TEST RESULTS

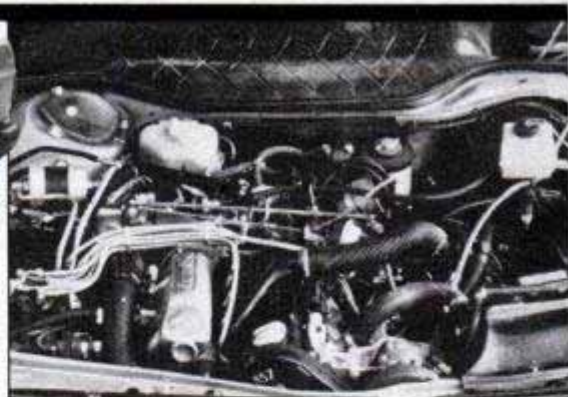
Fuel Economy (mpg)	Interior Sound Level		Space Index		Fastest Lap (seconds) (1.5-mile road course)
	Constant 30/60 mph	Full Throttle 30 to 60 mph	Interior	Trunk	
12.98	66/73	72	163.6	174.6	1:31.50
12.94	66/75	68	167.4	183.0	1:41.18
19.54	66/75	72	165.4	129.4	1:35.48
8.12	68/76	70	169.6	150.3	1:32.96

legroom plus (rear headroom x rear elbowroom x rear legroom) divided by 1,000 with front seat set at 40 inches of legroom. **Trunk space index** is (car length x circle-turning diameter) divided by 1,000.

After two days of testing at Milan Dragway and Waterford Hills Race Circuit, the three Detroiters came within a whisker of knocking the Audi off its perch. Overall, the Audi was the best balanced and most refined. But then again, it costs nearly twice as much as the American challengers.



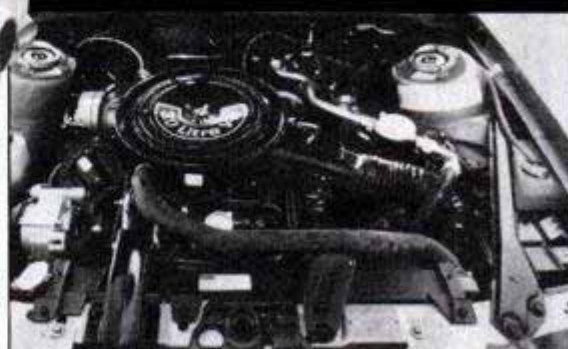
AUDI 5000 TURBO



Audi's turbocharged 2.2-liter motor is as sophisticated as they get. It even has a fan to cool injector nozzles.



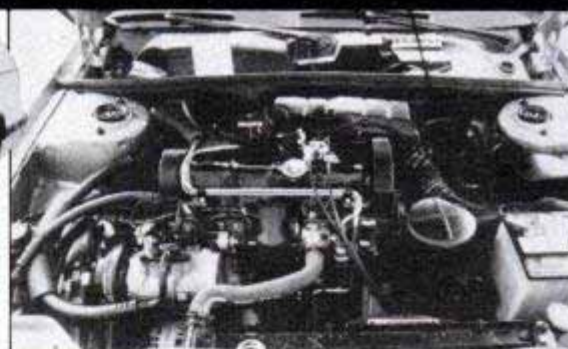
BUICK CENTURY T-TYPE



Buick's 3.0-liter V6 has adequate power, but needs more to take on Audi. With turbo, it would be superb.



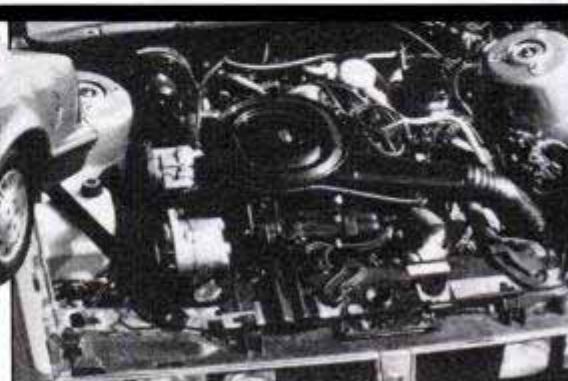
DODGE 600 ES



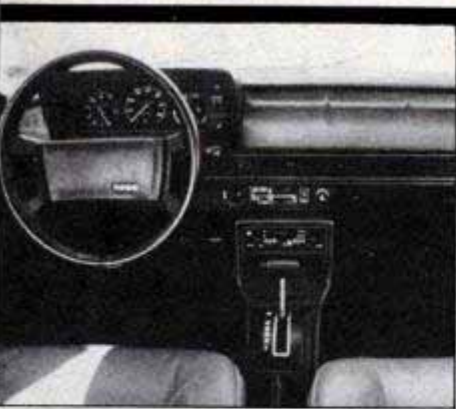
Dodge 2.2-liter is a good motor in a good chassis and, providing almost 20 mpg, it is the most economical.



PONTIAC 6000 STE



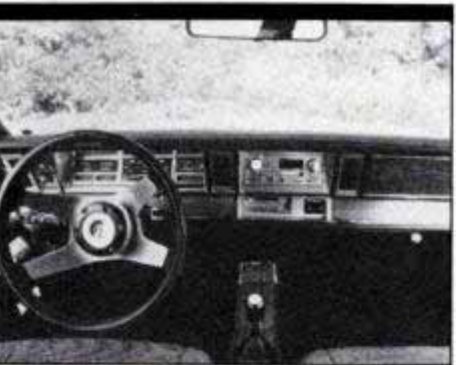
Pontiac's HO V6 is tire-smoking powerplant, but least economical. It's so much fun, though, you don't care.



Interior is typically German—high quality, restrained; it's an efficient place to conduct business of driving.



Century's interior was best of the lot. Buick's done a great job of classing it up without the gingerbread.



600's interior is traditionally American and a bit overdone. What it lacks in styling it makes up for in volume.



Not as done-up as the Buick's, the STE's interior is nonetheless classy and full of nice touches.

maker sells here. Its turbocharged, 2.1-liter, five-cylinder engine generates 130 smooth hp with very little turbo lag between pedal down and blast off. Its compliant but athletic suspension sponges up bumps and ripples, and generates extreme cornering forces with equal aplomb. The car's four-wheel, power disc brakes glue tires to pavement time and time again without a trace of fade or lock-up. (Like all Audis, however, its brake pedal feels too soft and spongy.)

On the outside, the 5000's shape is as cleanly chiseled as a four-door can be—a tad dated, perhaps, with its blunt nose and nonwedge profile. But that will be taken care of when its replacement arrives late this year (see *Imports & Motorsports*, page 12, Apr. '82).

On the inside, it's restrained in typical German fashion, far from plush, but more functional than any domestic car on the market. In addition to the large (by U.S. standards) glovebox, it features some useful console storage and positively cavernous bins built into both front door panels—something the American makers stubbornly refuse to provide. The spacious rear cabin even features twin door-mounted lighters and ashtrays.

Instrumentation—speedometer, tachometer, water temperature, oil temperature and turbo boost (but no oil pressure or voltmeter)—is businesslike and highly legible in a three-circle nacelle.

On the negative side, the Audi's German-built stereo was difficult to use with its tiny pushbuttons and multifunction controls. Its digital dial was hard to see in daylight, and its sound was good, but inferior to that of the domestic units. And it turns on and off independently of the ignition switch—a pain.

The Audi's optional-at-extra-cost leather seats were comfy for cruising, but lack side support for cornering and offered only fore-aft and recliner adjustments. Its steering wheel was a bit high and mounted on the only nonadjustable column of the four cars tested. In addition, its four separate stalk controls were somewhat difficult to find and decipher at first.

On the tight, twisty, 1.5-mile Waterford Hills road course, the Audi felt slightly slower than the gutsy Pontiac, but turned in a best time nearly 1.5 seconds quicker. Its superiority came from higher ultimate straightaway speed and better, more stable braking from high speeds. On the other hand, it tended to understeer more than the three domestics when cornering at full power, and its tail-end was more easily tricked into oversteering slides.

But the 5000 Turbo's single worst



In the glamorous world of road testing, we actually spend more time taking notes or torquing lug nuts than driving.

feature, compared to the American challengers, is its price—over \$20,000. It is a lot of car. But that's a lot of money for most people who may be able to find more car per dollar elsewhere.

Pontiac 6000 STE

Seeking a European-style driver's car image, Pontiac considers the new STE (Special Touring Edition) version of the 6000 sedan its flagship for 1983. And rightly so. Offered in highly equipped, four-door form only, its only options are a sunroof, leather seats and a choice of six, subtle, two-tone color combinations.

It's the only GM A-car available with Chevy's muscular, 2.8-liter, HO (high-output), 60° V6, which puts out 135 very healthy horses. The STE's specially tuned suspension operates through aggressive Goodyear Eagle GT tires on porosity-free aluminum wheels. Standard electronic ride control automatically adjusts the rear height for varying road and load conditions, with a 10-second delay to factor out transient changes.

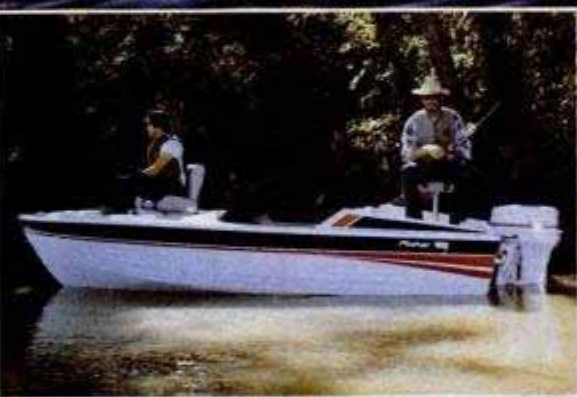
Outside, it's distinguished from more mundane 6000s by its six-light front end—the inside pair are fog lamps—and full-width, smoked-glass-look wrap-around taillamps. Inside, the STE features multiadjustable bucket seats and full instrumentation. The dash instruments are done up in high-interest orange with red lighting. A programmable driver information and service reminder center keeps track of everything except when your

(Please turn to page 134)

The Best For Boating '83

Lighter hulls go heavier on efficient power, slick looks and multipurpose performance.

BY BILL MCKEOWN BOATING EDITOR



Sweet 16 Fishabout from Fisher Marine of West Point, Miss., combines runabout and bass boat features in a light aluminum hull.

The lines of a fast runabout with open-foredeck seating and padded aft sundeck are features of the Hammond V-1750. A trailerable 17-footer, it accommodates economical four-cylinder power options from 120 to 170 hp. Transom boarding steps are a convenience for both swimmers and skiers.



Top speed won't be the measure of top performance this spring. For many boats, a number of features must fit together when we're looking for the best.

There is enough marine power around today to push almost any hull to new records. The latest outboard racing motors from Evinrude, Johnson and Mercury, with their secret top-end potentials, have been edging speeds of competition tunnel hulls close to world records on the straightaways. Stern-

drives push offshore racing craft up to 100 mph when the seas are flat. And any pleasure boatman can overpower his runabout or bass boat if he wants to spend the money, live dangerously and take a needless pounding when the water gets rough.

Instead, the new trend is to buy the torque to pull skiers up from a deep-water start or run rapidly down-lake to a favorite fishing spot; no one wants a gas-gulper with useless punch to burn. Mating the right engine to the suitable rig this year is consid-



ered both economical and smart. Some outboard boat companies, in fact, are considering offering prerigged boat-and-motor packages to their dealers, just as inboard builders have always done. It might start a trend.

The right boat-motor combination this coming season will be aimed for performance that's suitable, reliable and comfortable. Light hulls of riveted or welded aluminum require less gas, of course, but now they're getting further refinements to make

- 1** Chris-Craft's expanding line includes an open fisherman with center console; it mounts outboards up to 180 hp.
- 2** Formula Two LS from Thunderbird is a sterndrive-powered 19½-footer that has optional boarding platforms.
- 3** Hydra-Sport, one of the first to offer light Kevlar hulls, now has a fishing model with a cuddy cabin forward.
- 4** Forrest Wood's Ranger fishing boats, long favorites of B.A.S.S. tournaments, now have soft-riding, deep-V hulls.
- 5** Only 11 feet long and 4 feet wide, Crawdad by Coleman Marine can mount 5 hp aft and trolling motor forward.

them better looking and easier riding. The flat bottom of the metal johnboat is being replaced with deeper vees for smoother running in rougher water. Wyandotte Boats, in Bellport, N.Y., and Fisher Marine of West Point, Miss., are both introducing aluminum models of this type.

Stylish comfort is shown aboard Hammond and Murray Chris-Craft runabouts with their upholstered sundecks aft, a trend imported from the posh yacht harbors of the Riviera. Larger bowrider

hulls—from Cobia, Bayliner, Thunderbird Formula and others—are adding more freeboard to prevent beam waves from slopping aboard. Open-water fishing craft, like those from Aquasport, Ranger, Grady White and Hydra-Sport, are combining increased freeboard with the outriggers and downriggers of the big sports fishermen; some of them are even mounting the famous Rybovich-type tuna towers.

An above-deck styling addition for several larger



1 High style for the 26-foot Chris-Craft Stinger 260 SL includes an optional flying-wing radar arch over the stern.

2 High performance is design goal of new Howmar Phase II sailboard, a 12-footer from Howmar Boats, Edison, N.J.

3 Lightweight 75-pounder that's easy to handle, 8-foot Polywog from O'Brien International takes outboards to 2 hp.

4 Center console of Viking's 170 Sprint Sportdeck has ample maneuvering space for fishermen aboard 17-footer.

5 Designed for younger paddlers, 7½-foot Trainer Canoe from Venture-Highlite weighs 50 pounds, carries 250.

6 Cobia's Odyssey 195 II is bow-rider with fore-deck seating, but sides high enough for safe offshore running.

7 A large lightweight with offshore ability, 26-foot 'Cuda from Wyandotte Boats, can top 40 mph with 150 hp.

8 Cruiser styled with a radar wing, Bayliner 2850 Contessa Sunbridge is 23-footer with separate stateroom aft.

9 Rated for up to 140 hp, CVX-17 Glasstron/Carlson runabout and ski boat is available with a matching trailer.



runabouts and cruisers is the Aronow-type flying arch that can mount a radar's rotating antenna or simply look like the flashy horizontal fin from a race car. Survivors of overboard accidents know the full benefit of transom platforms, but swimmers, skin divers and skiers are currently learning their advantages, too.

Sailboards are now the most popular of wind-powered craft, but small sailboats are also favored. Howmar, in Edison, N.J., has added a 12-foot How-

mar Twelve sloop, by America's Cup designers Sparkman & Stephens, to its line, which includes the popular, 8-foot sailing dinghy.

This year, the biggest use for exotic titanium, boron, graphite and other space-age materials will be in 12-meter yachts for the defense of the America's Cup.

However, you can expect to see increased use of these materials in the power boats and sailboats of the future. **FM**



GET TOGETHER WITH VIDEO COMPONENTS

Bold and beautiful, new video/audio equipment combos are making home entertainment centers more versatile than ever.

BY FRED PETRAS

If you've ever wished your TV set had the same kind of sound quality that your stereo system has, your day has come. If you've heard about the marriage of audio and video and wondered if that means you can buy combinations of audio and video equipment, here's your answer. Yes.

Making all this possible are component system television and component audio/video—the latest in the world of home entertainment.

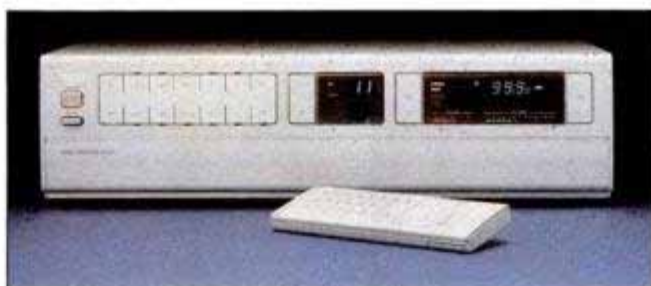
If you're envisioning a nightmarish mess of equipment, as in the early days of hi-fi, with all sorts of dangling cords and connectors and awkward-looking widgets and gadgets to mess up your tidy home decor, have no fear. The new combos are neat assemblages that resemble any good-looking hi-fi outfit. In fact, some manufacturers have even designed complete TV/audio/video systems of cosmetically matched equip-

ment housed in furniture-style deluxe cabinetry. At the moment, at least a dozen companies are making such equipment. Soon, many more will be doing so.

The new picture

Component TVs are color monitor sets that are essentially metal-encased picture tubes (CRTs), some with, and some without, tuner and audio circuit-

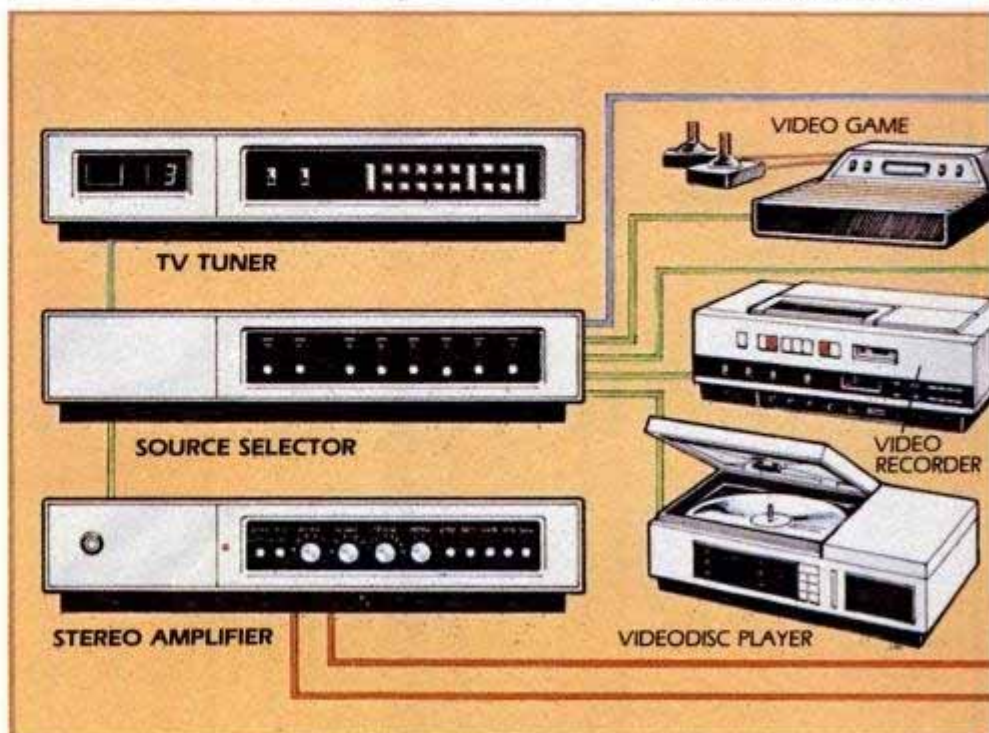
ry. The units are direct descendants of the high-resolution monitors used in TV recording and broadcasting studios. Their overall performance is superior to that of conventional TV sets because they're manufactured with great care and use top-quality parts. Some monitors also include picture enhancement features, such as comb filters for better resolution, and various circuits for improved contrast and color rendition.

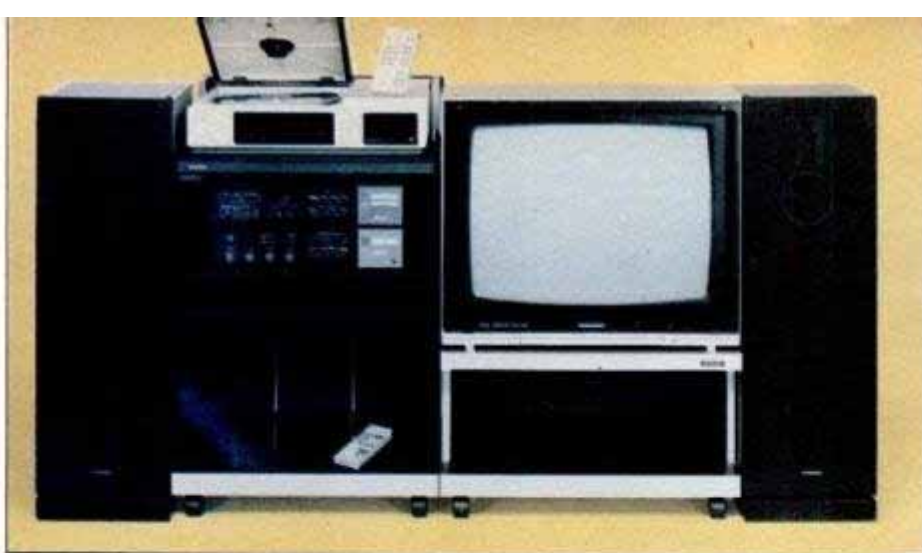


The Jensen AVS-1500 (left) is a combo audio and video receiver. Panel controls let you switch from AM/FM to phonograph, to two choices of video. The unit exemplifies the audio/video marriage.



Diagram shows how the components of an audio/video system interconnect. The heart of the system is the source selector which governs what image and sound sources are finally combined. The TV tuner is separate from the main TV picture, which is now a high-resolution monitor. Kenwood's KV-901 recorder, shown above, atop the KVA-502 audio/video amplifier, combines components.





Pioneer's Foresight 7000 package is a total audio/video center. It includes top-quality units like the LD-1100 videodisc player, TVM-250 monitor, the SA-V700 audio amp and the VC-T700 TV tuner.

The straight monitors have related components, such as TV tuners, which usually feature frequency-synthesized digital tuning. Audio preamplifiers or amplifiers, along with switching facilities and connections to other video and audio equipment, including video games and computers, can also be found. The newest companion units are

audio/video amplifiers and audio/video receivers. Because of their versatility and capabilities, we predict a bright future for these types of combined units. You'll be seeing lots of them in the months ahead.

Some component TVs are available with appropriate audio and audio/video units and specially designed speakers

as total, self-contained systems, offering high-quality sound. These systems are capable of dual-channel mono, simulated stereo and true stereo. Some systems may be added to an existing audio component system and housed with it.

Because of the variety of choices, you can build your dream system one step at a time.

Packaged systems

If you want to take the easy way to a complete one-brand audio/video outfit, Sanyo's Pro-Ponent Series could be one answer. The ensemble comes in two matched cabinets—one for the 19-in. TV monitor and tuner/video control system with remote control; the other for

(Please turn to page 141)

Zenith's stunning audio/video component system (right) has a TV tuner, source selector, stereo amplifier and videotape deck with a 25-in. color monitor and Allegro 150 speakers. (Zenith does not number its models; they're simply referred to as video component system units.) Two hand-held remote controls on top of the right-hand speaker let you control the videotape recorder or TV from across room.



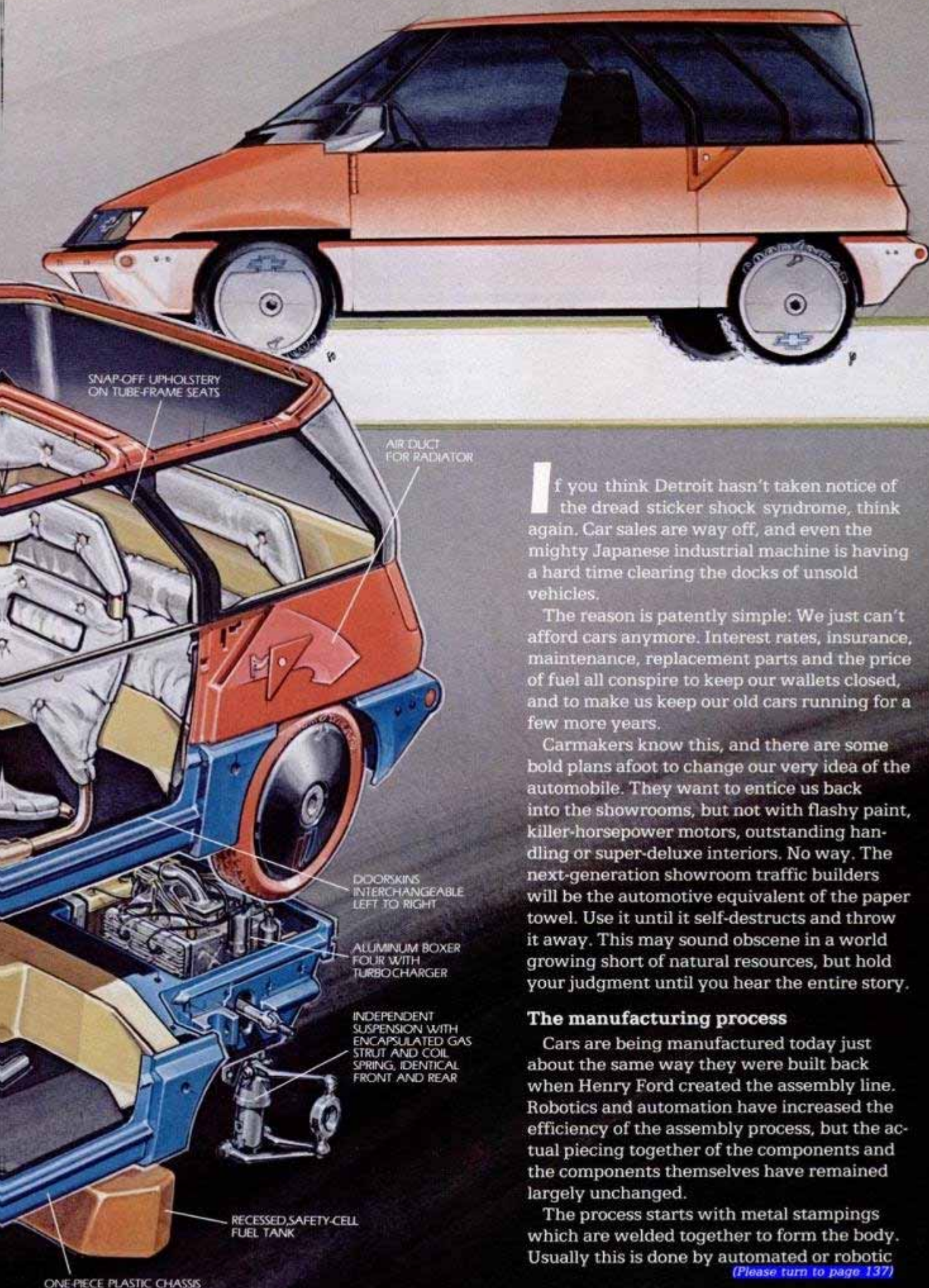
CABLE TV BOX

COMING SOON: THE \$4,000 THROWAWAY CAR

It won't be fancy, fast or durable, but you can throw it away like an old pair of shoes.

BY LEN FRANK





If you think Detroit hasn't taken notice of the dread sticker shock syndrome, think again. Car sales are way off, and even the mighty Japanese industrial machine is having a hard time clearing the docks of unsold vehicles.

The reason is patently simple: We just can't afford cars anymore. Interest rates, insurance, maintenance, replacement parts and the price of fuel all conspire to keep our wallets closed, and to make us keep our old cars running for a few more years.

Carmakers know this, and there are some bold plans afoot to change our very idea of the automobile. They want to entice us back into the showrooms, but not with flashy paint, killer-horsepower motors, outstanding handling or super-deluxe interiors. No way. The next-generation showroom traffic builders will be the automotive equivalent of the paper towel. Use it until it self-destructs and throw it away. This may sound obscene in a world growing short of natural resources, but hold your judgment until you hear the entire story.

The manufacturing process

Cars are being manufactured today just about the same way they were built back when Henry Ford created the assembly line. Robotics and automation have increased the efficiency of the assembly process, but the actual piecing together of the components and the components themselves have remained largely unchanged.

The process starts with metal stampings which are welded together to form the body. Usually this is done by automated or robotic
(Please turn to page 137)

Whether you're 5 or 50, you can get a solid foundation in computer literacy with entry-level computers. They're the relatively inexpensive models (in the \$100 to \$500 range) that are intended specifically for newcomers to personal computing. We'll examine the various features of five friendly computers—the Timex/Sinclair 1000 (\$100 list, \$87 discounted); the Commodore VIC-20 (\$200, \$169); the Atari 400 (\$300, \$250); Texas Instruments' 99/4A (\$300, \$200) and the Radio Shack Color Computer (\$400 to \$500, depending on options). First, let's see what they have in common:

Entry-level computers always consist of a single cabinet with a built-in keyboard similar to that of a standard typewriter. And they all can use a standard black and white or color TV set as a monitor. This is possible because entry-level computers use a very low-power TV transmitter, called a modulator, that "broadcasts" the computer information as a TV picture.

Either as a built-in or as an accessory, the modulator is *always* part of the initial computer purchase.

The Five Friendliest Computers

Computers don't have to be a mystery.

Any of these five easy-to-master units can be an ideal introduction to an exciting new world of at-home entertainment and learning.

BY HERB FRIEDMAN

Texas Instruments 99/4A



Atari 400



Timex/Sinclair 1000



A standard TV set has an inherent limitation when used as a computer monitor: Its computer image resolution is considerably less than that of conventional video monitors. Commercial computer displays are generally 80 characters wide by at least 24 or 25 lines high, and the characters are clear and sharp as a knife-edge. TV receiver displays are not all that sharp, so to ensure legibility, the characters are made larger. The screen display size depends on the particular computer, but the range varies from 20 to 32 characters wide and approximately 16 or 18 lines high.

All entry-level computers provide some form of input/output connections that allow programs to be recorded (saved) on cassette tape or loaded into the computer from cassette tape. Depending on the particular computer, the cassette recorder can be any inexpensive model, or it might be a more expensive, specially wired model, sold as an optional accessory.

Except for the all-in-one cabinet and TV modulator features, manufacturers have their own ideas of what best makes an entry-level computer.

Other than using a built-in computer language called BASIC and providing some way to create graphic characters on the screen, none of these computers are alike.

BASIC allows you to give instructions to the computer using English words and phrases. For example, using BASIC, if you want the computer to print something on the monitor screen, you simply type the word PRINT.

The object of learning BASIC at entry level is not to make a programmer out of you, but rather, to let you write your own programs at a level of comprehension that you can understand. By writing a simple program that keeps track of your family's finances, for example, you'll get a broad insight into how business programs work. The same thing applies if you create a computer program for a family inventory for insurance purposes.

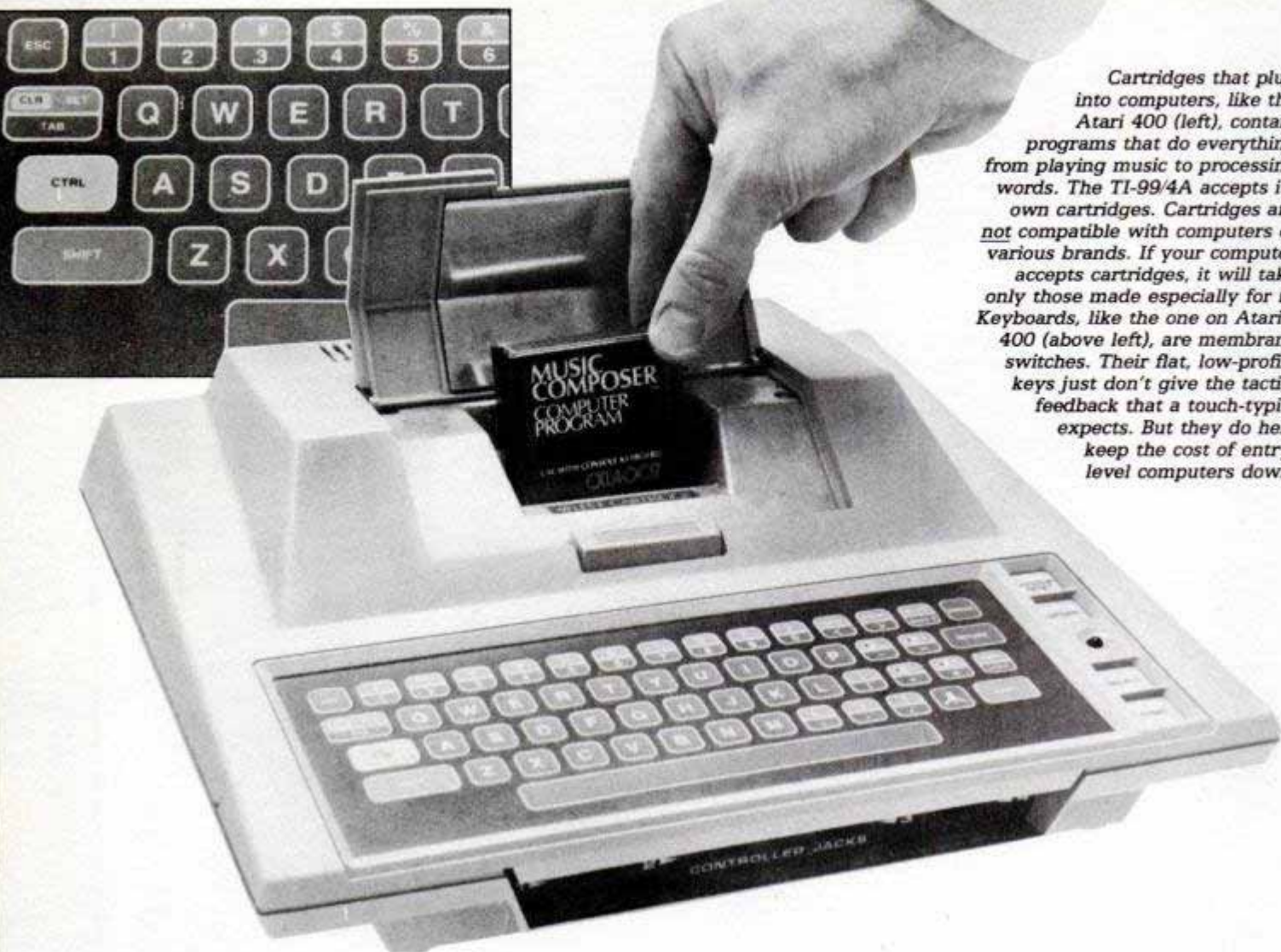
After you've written your own programs, then what? Well, all entry-level computers have connections for a cassette recorder that allow you to save your programs on tape. Type the word SAVE and the computer will record the program on tape; type in the word LOAD, and the recorder will load

Here are the five computers which, we think, are the easiest for the beginner to master. The 99/4A from Texas Instruments features great full-color graphics and positive-feeling keyboard. The Atari 400 can achieve very colorful displays and has a wide selection of ROM-cartridge programs. Tiny Timex/Sinclair features complete BASIC language and the keyboard allows for one-touch typing of multiple-lettered command words. The Radio Shack Color Computer is the most advanced in some ways, but it is also the most expensive of this group. The Commodore VIC-20 is a super entry-level machine with a real keyboard; it's very easy to program and use graphic shapes.

Radio Shack Color Computer



Commodore VIC-20



Cartridges that plug into computers, like the Atari 400 (left), contain programs that do everything from playing music to processing words. The TI-99/4A accepts its own cartridges. Cartridges are not compatible with computers of various brands. If your computer accepts cartridges, it will take only those made especially for it. Keyboards, like the one on Atari's 400 (above left), are membrane switches. Their flat, low-profile keys just don't give the tactile feedback that a touch-typist expects. But they do help keep the cost of entry-level computers down.

the program into the computer. Yes, it's really that easy.

Even youngsters can benefit from entry-level computers. A grade schooler can write or use simple programs to practice arithmetic, vocabulary, a foreign language or whatever is giving him a hard time in school.

Settling on which friendly computer to take home depends on your own needs. Here are their features:

Timex/Sinclair 1000

The Timex/Sinclair 1000 is about the size of four cigaret packs set side by side. It generates only a black and white display and has 2K (approximately 2,000) bytes of RAM (random access memory). One byte can store one complete character, such as the letter "A" or the numeral "1." BASIC is built in, and there are some modest graphics—screen designs—which can be generated from the keyboard. Though a printer will be available soon, it will be a miniature unit that will use rolls of adding-machine-type paper. The printer's primary purpose will be to provide a listing of pro-

grams, or the results of a "run"; it won't be adequate for word-processing applications.

Instead of a conventional typewriter keyboard, the Timex/Sinclair 1000 has a "membrane" panel-type keyboard that consists of two plastic sheets with the switch contacts sandwiched between them. The "keys" are imprinted on the panel. When you press a key, the switch directly under the imprint closes. Obviously, touch-typing isn't possible, but Timex has gotten around this problem by having the computer recognize when a full word is necessary. When writing BASIC programs, a single touch of a key will enter an entire word, such as PRINT, SAVE, LOAD, LIST, FOR or NEXT. Though the membrane keyboard is a bit inconvenient when programming, the BASIC is dynamite—one of the best versions for entry-level learning. And the instruction manual is exceptional.

The only problem with the Timex is its limited memory: 2K of RAM runs out quickly. The Sinclair ZX/81, which is essentially the Timex/Sinclair 1000,

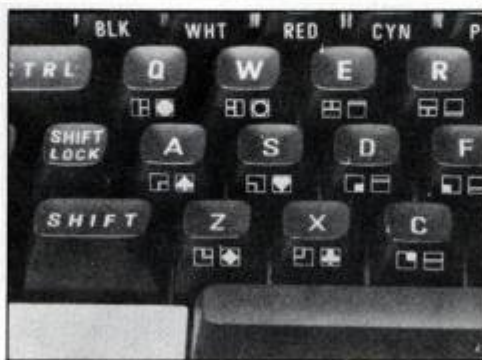
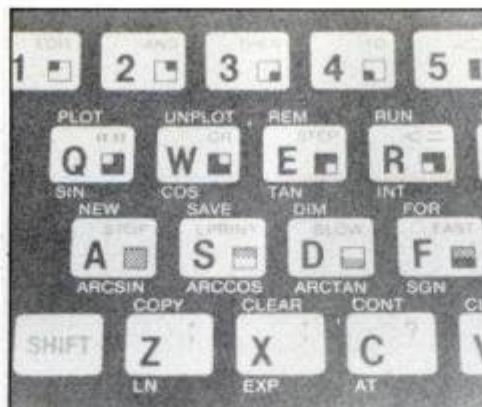
but with only 1K of RAM, runs out even faster. For larger programs, there is a memory module (\$50) that plugs into the back of the computer. This option provides a total of 16K RAM, which is large enough to run rather complex programs, including a \$20 program called "Vu-Calc" that's an excellent trainer in financial project planning. Other prewritten software—games and elementary school arithmetic drills, for example—is available on cassette tape for approximately \$16.

Commodore VIC-20

The Commodore VIC-20 is a real heavyweight among entry-level computers. Its keyboard has standard typewriter-size keys; extensive graphics are indicated directly on the keys; and it can print characters, background and graphics in eight colors and reverse colors. It has four musical "voices" that can simultaneously reproduce as many as four notes through the TV speaker. It can control the volume of these sounds and it even has a white-noise generator that



The Radio Shack Color Computer (above) features large, calculator-style keys. The Timex/Sinclair 1000 computer (top, center) sports special keys which, in certain modes, will type entire words with only a keystroke. VIC-20 keyboard (right) has keys with graphic symbols.



The Texas Instruments 99/4A (above) has a keyboard like a typewriter's; some of the keys control the direction of the entry cursor on the screen. A keyboard is very important—it's how a person "connects" to his computer. Be certain you'll be comfortable with your choice.

can create sound effects within your program. And the VIC-20's version of BASIC, written by Microsoft Inc., is essentially the standard-of-reference BASIC for personal computers.

The Commodore unit has 5K of RAM that can be expanded to 32K, which is enough to run many commercial-quality business programs. Other features include ports (connections) for game joysticks and paddles, ROM program modules, a printer and a cassette recorder.

The optional cassette recorder is designed especially for the VIC-20. Prerecorded software can be loaded through the cassette or through a

ROM (read only memory) program module, which resembles a small plastic case and contains a preprogrammed memory that can't be modified by the user. The ROM module plugs directly into a connector on the back of the computer and loads its program into the computer much like a video-game cartridge. Modules are available in several areas, among them: arcade-type games, home programs, educational aids, business programs and computing aids.

The Commodore VIC-20 approaches a full-blown computer in features and performance. In fact, a similar full-blown model, called the

MAX, is available for close to \$600. The MAX appears to be an expanded VIC-20, with an enhanced version of BASIC, a music synthesizer and 64K of memory. But the MAX has too many features and too high a price tag to be called an entry-level computer.

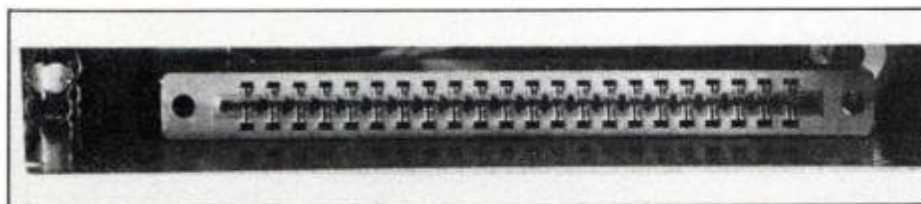
The VIC-20 comes with an excellent manual that explains the computer's many features, and it also serves as an excellent introduction to color computer graphics and electronic music. However, it doesn't teach BASIC. If you want to learn programming, you must purchase a package called *Introduction To Computing . . . On The VIC* and another called *Introduction to Basic Programming*. Add their prices to the cost of the VIC-20 if you want to do your own programming.

The TI-99/4A

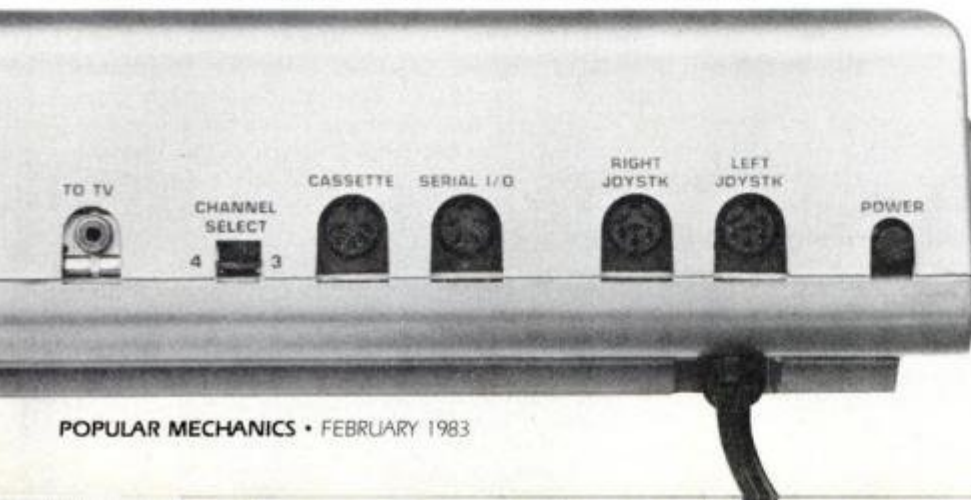
The Texas Instruments TI-99/4A is very similar to the VIC-20 in features. It has a typewriter-style keyboard that's slightly smaller than a standard keyboard, a built-in BASIC (special TI BASIC) and color graphics, though the graphic symbols aren't printed on the keys. The computer comes equipped with 16K of RAM that can be expanded to 64K. It accommodates a matching optional cassette recorder. It also has connections for joysticks, a voice-synthesizer accessory, ROM modules, a printer, and "professional-type" accessories.

An unusually large selection of game and instructional software is available in ROM modules. Some of the ROM module software packages

(Please turn to page 133)



The back of the Color Computer shows some of the styles of "ports" where accessories and peripherals attach. At top is a special plug that accepts a printed-circuit connector for expansion memory. Ports below show various other options.





PART 2



Auxiliary table takes strain out of handling oversized workpieces, while allowing accurate cutting. This piece is 8 ft. long. Plans for table are given.

Use Your SCROLL SAW Like A Craftsman

Last month we covered tool and technique basics. In this installment, we show all the bonus cutting you can do with this versatile tool.

BY ROSARIO CAPOTOSTO PM photos by the author

Last month, in Part 1 of *Use Your Scroll Saw Like A Craftsman*, we discussed the basic techniques of using a scroll saw safely and effectively. If you practice and perfect the basic scroll saw techniques, you'll find it much easier to master the more complex, sophisticated operations presented in Part 2. In this installment, we discuss cutting techniques that will allow you to utilize the scroll saw to its maximum, thus making it more valuable to you as a craftsman.

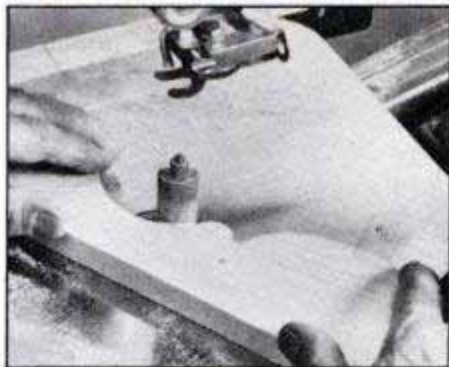
Cutting metals.

Cutting iron and steel up to 1/8 in. thick presents no problem to the scroll saw, provided an appropriate metal-cutting blade is used. When cutting metals, the saw is operated at low speed; the work is fed slowly and is never "forced" into the blade. The open space between the blade and the regular table insert may permit burring on the underside of sheet metal, and extra-thin metal will be deformed downward around the cut. To avoid this

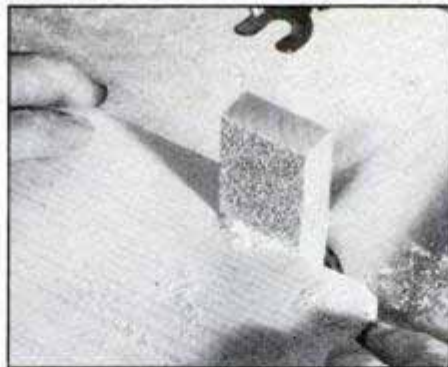
problem, cut halfway to the center of a saw-table-sized piece of 1/8-in.-thick hardboard. Tape this panel insert down to the saw table, then cut the metal. The hardboard serves as an oversize table insert with no space around the blade. The result is clean, smooth cutting.

Precisely fitting joints can be made in metal tubing when one piece of tubing abuts another at an angle. Proceed by inserting the tube to be cut into a snug hole in a block of wood. Mark the top

ACCESSORIES FOR MULTIPURPOSE JOBS



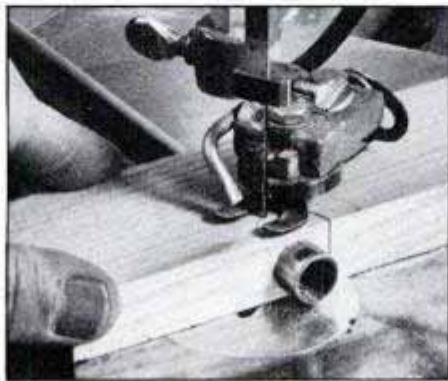
Accessory sanding attachment makes it easy to smooth irregular shapes. Flat back section is used on outside curves.



This homemade sanding attachment has coarse grit on one side, medium on the other. Blocks can be made in many shapes.



This is typical use for one of accessory machine files available for metal work.



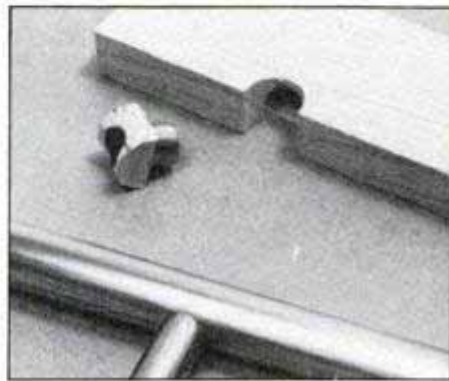
A wood block is used to hold copper tubing during the radial cutoff operation.

surface of the block with a circle equal to the radius of the second piece of tubing. Then make a scroll cut on this pencil line. Wear safety goggles.

Sanding and filing

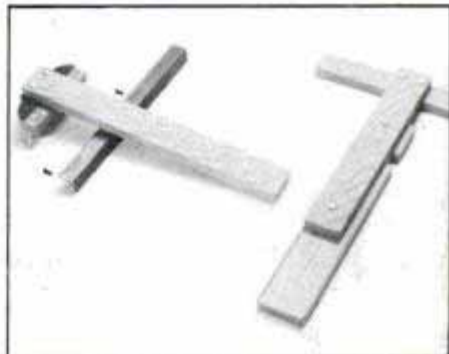
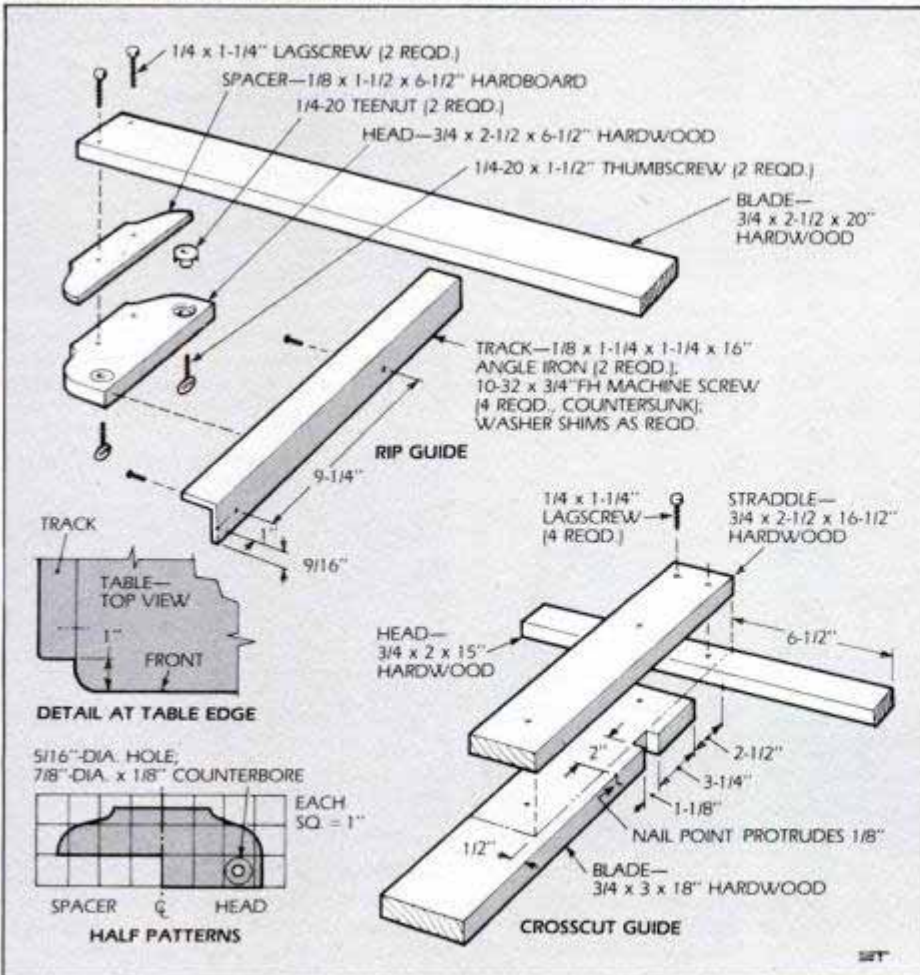
Scroll saw accessories include a semicircular sanding attachment—for smoothing flat and curved surfaces—plus a variety of machine files. The files and sander are held in the V-jaw of the lower chuck, and both operations are performed at low speed.

You can also make sanding blocks to suit a particular job. Start with a large, flat sanding block for squaring corners and smoothing the sides of stock. Make

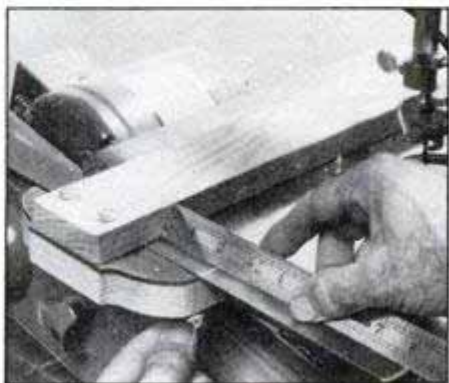


Tubular joint is ready for soldering. Same method can be used for wooden dowels.

VERSATILE CUTTING GUIDES YOU CAN BUILD



Rip fence and piggyback crosscut guide are shown with small notch in front edge of guide for blade clearance. Nail point in front edge keeps work from slipping.



Tighten thumb screws to lock rip fence in place. Measure from the blade to centerline marked on angle-iron rail.

your own sanding block from a piece of wood $\frac{3}{4} \times 1\frac{3}{4} \times 2\frac{1}{2}$ in. Insert the wood-screw threads of a $\frac{1}{4} \times 2$ -in. hanger bolt into the end of the block. The hanger bolts' protruding machine-screw threads are then gripped by the saw's lower chuck. Apply adhesive-backed abrasive paper (such as 3M brand, available at hardware stores) to both faces of the sanding block.

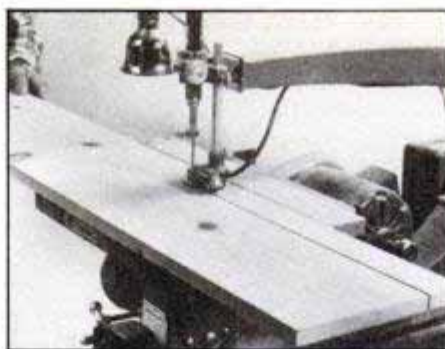
Ripping and crosscutting

While the scroll saw is essentially a tool designed for freehand cutting of irregular shapes, it can also be used for fine ripping and crosscutting. The trick is to use a guide.

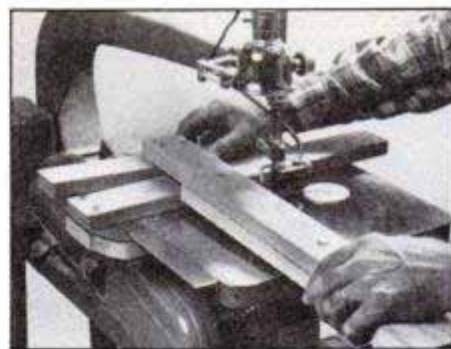
The basic guide is the rip fence; the crosscut guide rides piggyback on the rip fence. As shown in the plans, construction is simple. Take great care in joining the cross members—they must be at precise right angles.

The angle-iron guide track attaches to the left side of the saw table with two screws threaded into holes bored and tapped in the table edge. You'll note that the table edge is not machined square, and actually slants inward (a result of the casting process). There-

(Please turn to page 139)



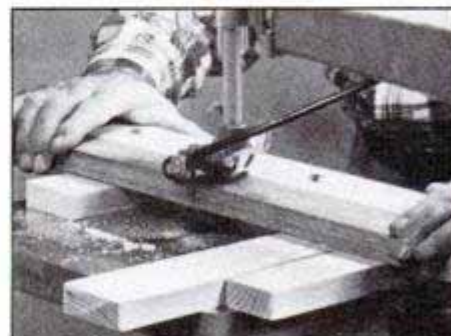
Blade chucks are rotated 90° when ripping long boards. Use a coarse, wide blade and feed the workpiece slowly.



Crosscut guide is shown fitting over the rip fence. The guide should be sealed and all contact edges waxed.

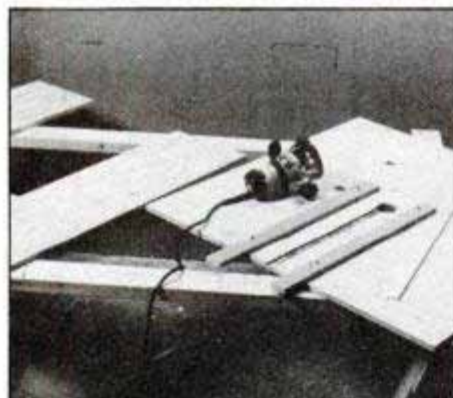


When cutting workpieces on saw table, cutoffs are limited to 3½-in. length.

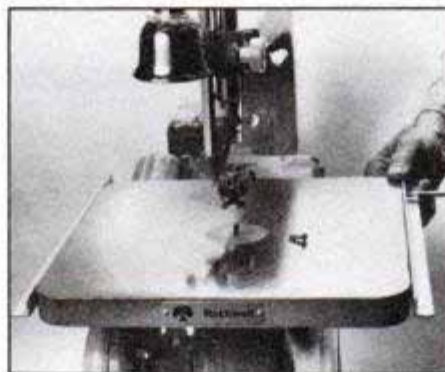


With workpieces up on ledge of the crosscut guide, 23½-in. cutoffs can be made. Scrap block at left props up work.

AUXILIARY TABLE HANDLES OVERSIZED STOCK



Auxiliary table is made with two ½-in. plywood panels. Groove for pivoting bar is shaped by a router with a mortising bit prior to assembling panels.



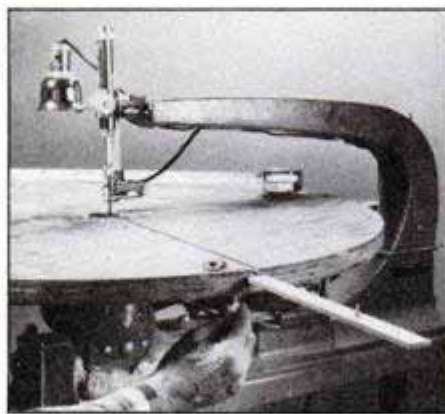
Attach aluminum angles for use as tracks for the auxiliary table. The mounting screws tap into holes bored through the saw table edge. Install washer shims if necessary to keep tracks parallel.



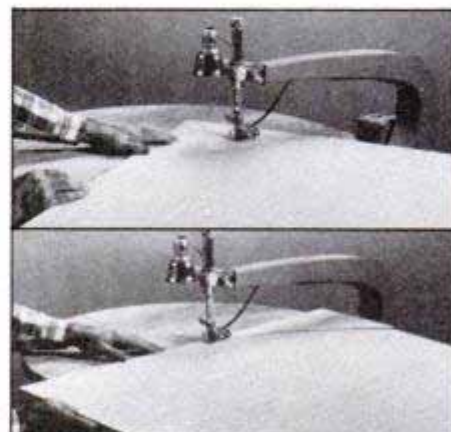
Saw table is removed to install hardwood track runners accurately. Rabbits cut in the runners allow some play, but shoudders fit snug against the track.



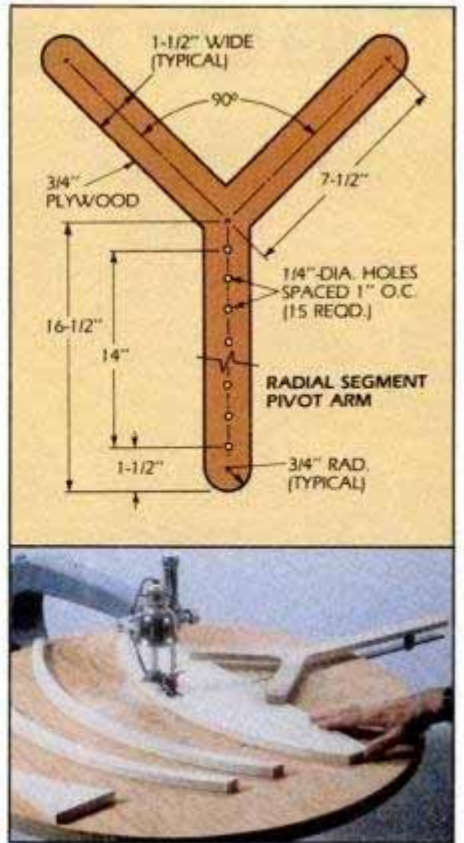
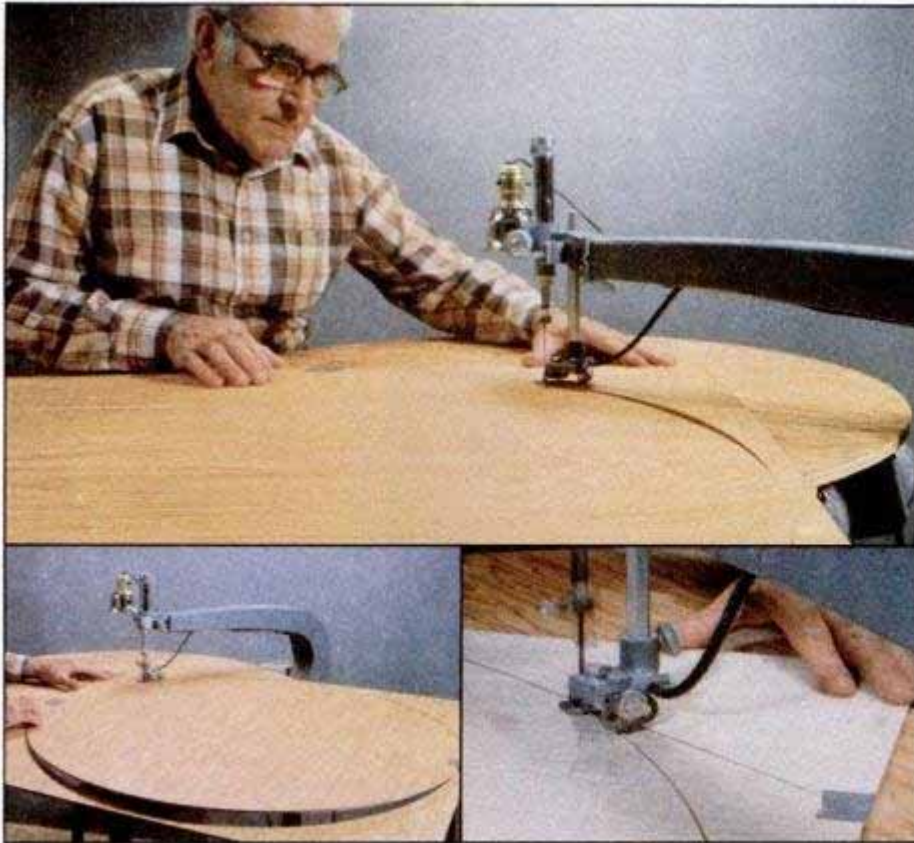
Underside view of the table as it slides into place. The eccentric cam is secured by a carriage bolt and wingnut.



The pivot arm is adjusted for the desired cut, then locked in place by tightening the thumbscrews threaded into Tee-nuts installed prior to assembling the table.

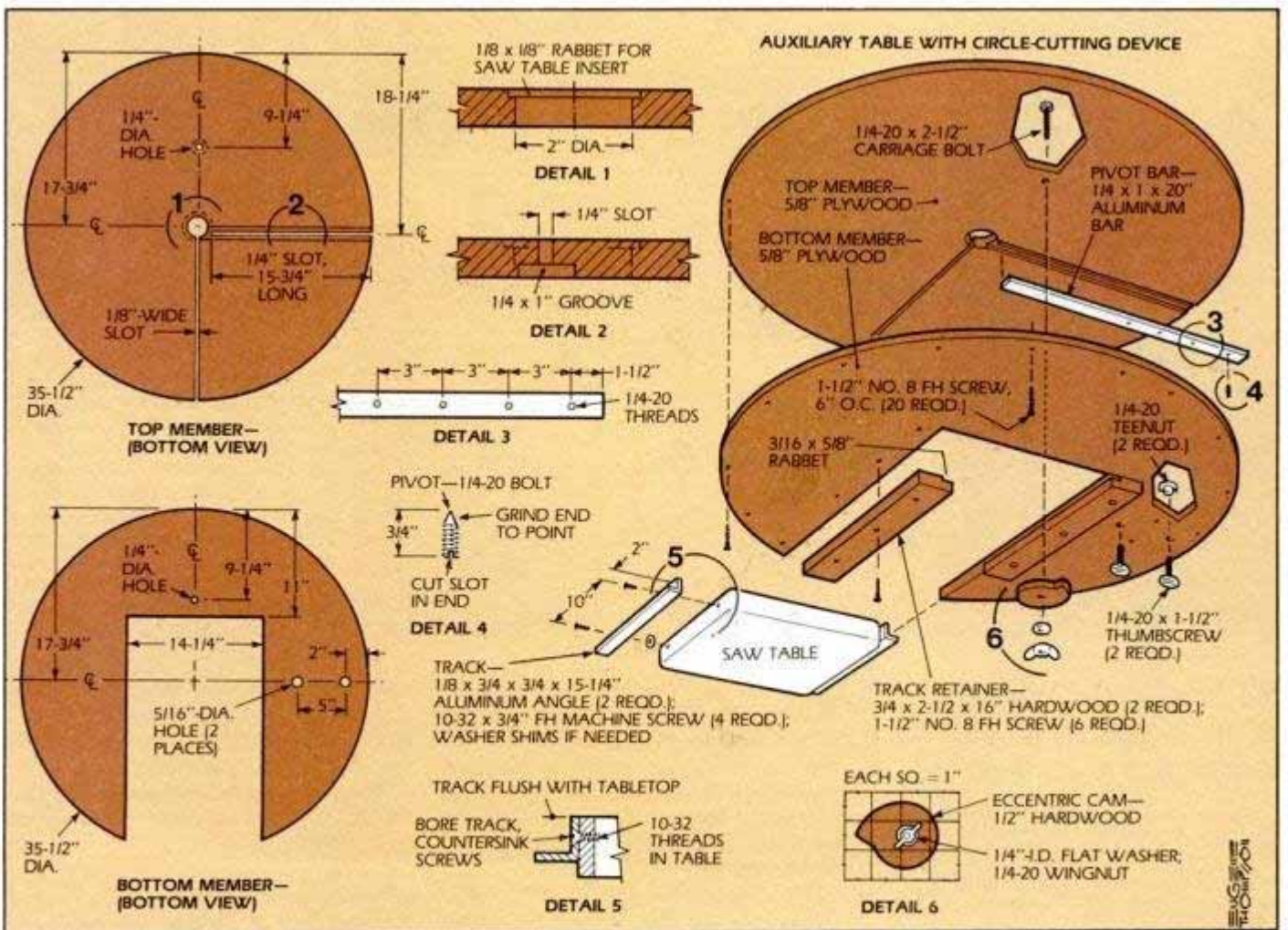


Start lead-in cut by sliding the table forward (top). When the table comes to a halt, slowly rotate workpiece (bottom).

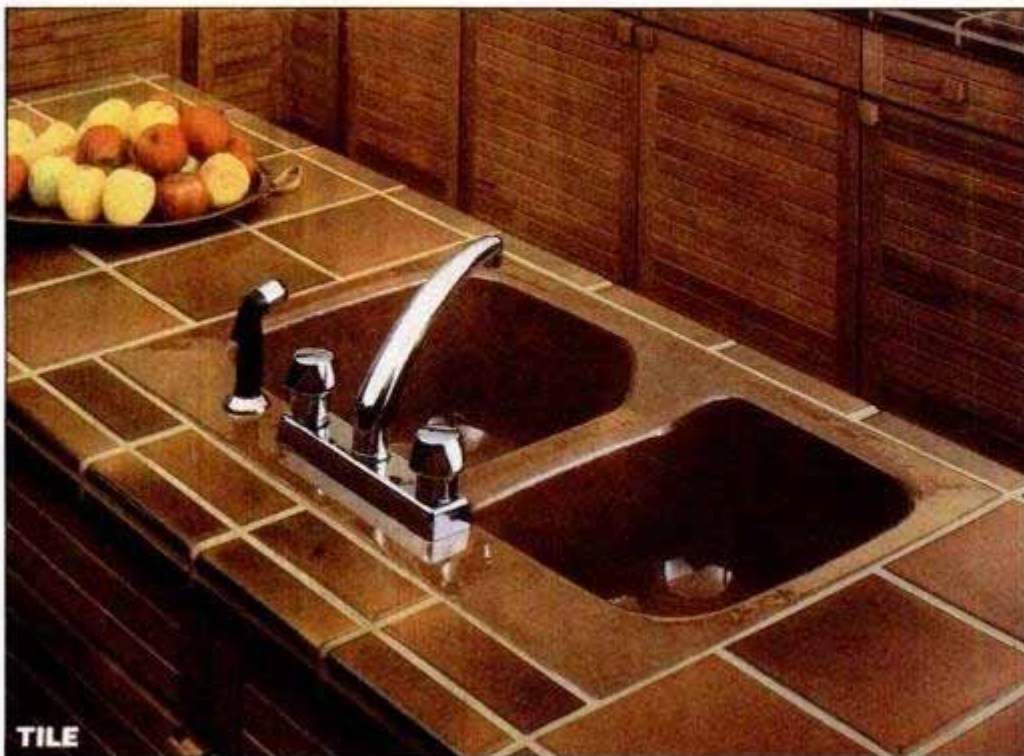


Smoothly rotating on the pivot point, this 38-in. plywood disc nears completion (top). Note that tape is used to prevent the scrap plywood from sagging (above, left). In the final stretch, the lead-in kerf is met perfectly by the saw blade (above right).

Cut precise circular segments with this pivoting-arm jig. Keep the Y-shaped arm level by placing washers over the pivot.



Tile Or Laminate Countertop?



TILE



Many people consider tile to be the most luxurious material for countertops. With the variety of colors, sizes, shapes and textures, tile's design effects range from elegant to rustic. Whichever style you decide on (glazed tiles shown above are from American Olean), the only skills you'll need to master are cutting and fitting the plywood base and gluing the tiles down evenly in a preplanned layout.



LAMINATE



Functional, durable countertop materials can also be elegant looking; high-pressure plastic laminates prove that point. And you can install them yourself. Laminate is available in a wide range of colors, patterns and finishes. Many workshoppers prefer to use a portable router for edge trimming (above), but even if you don't own one, you can achieve professional results with the hand tools shown.

PM teaches techniques to install the two best countertop materials.

BY ROSARIO CAPOTOSTO

PM photos: All tile photos, American Olean; Laminate color, WilsonArt; laminate black and white, Rosario Capotosto

The material you choose for resurfacing a kitchen counter has got to be really special: It must be able to stand up to impact, heat and frequent cleaning with strong detergents. It must resist scratching and staining and the finish must be stable enough for food preparation. It's got to be affordable and good-looking.

Ceramic tile and plastic laminate

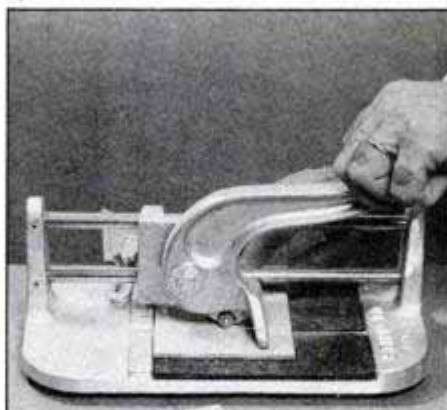
both meet these requirements. Both are super-hard and come in many designs. And they're fairly easy to install. Each requires only a few special tools.

While you might pay about \$10 per sq. ft. to have a standard laminate countertop made, you can do it yourself for about \$3 per sq. ft. It's harder to generalize about costs for tile tops, but you will save by doing it yourself.

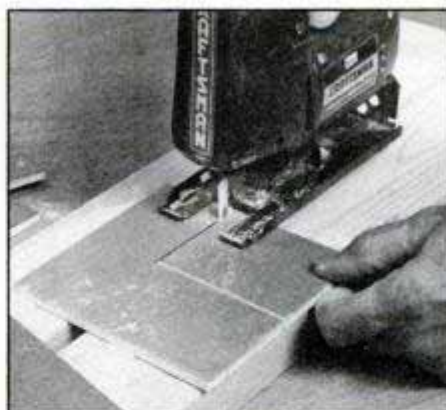
Here's How To Do Both



1 Basic tools and materials for doing a tile countertop are tile adhesive, grout, notched-edge trowel, rubber-faced grouting trowel and a sponge.



2 For straight cuts, use a tile cutter like the one above. After the tile is scored, press down firmly on the handle to snap the tile along the mark.



3 To make inside cutouts or other irregular-shaped cuts, use a portable sabre saw with a carbide-grit blade. Support the full tile to avoid possible breakage.



4 Tile nippers are also useful for shaping tiles to fit around cutouts, pipes and fixtures. They're designed to break off small bits without damaging tiles.



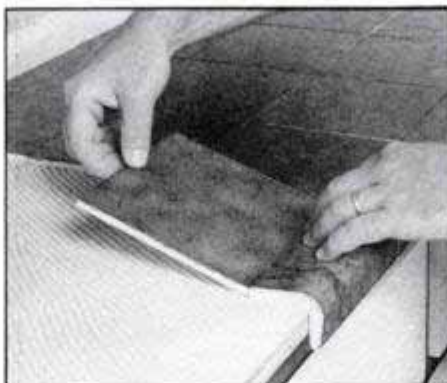
5 Use 3/4-in. exterior plywood for ceramic tile base. Consider clearance for under-counter appliances when setting base height. Most units require 3 1/2 in.



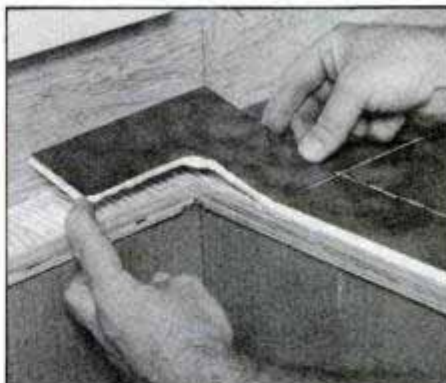
6 Make a trial layout working from the front edge toward the counter back. Allowing space for grout joints, make a cut mark on tile closest to backsplash.



7 Apply a thin, even coat of adhesive with a smooth trowel edge, then rake it with trowel notches. Glue up small areas until you can set tiles quickly.



8 Press tile firmly into adhesive, starting with the edge trim and working back. Some tiles have self-spacing edge tabs. If yours don't, get plastic spacers.



9 Tiles around sink openings should be cut back a bit from the edge. The space should be small enough to be concealed by Hudee rim or sink's shelf rim.

Working with ceramic tile

Ceramic tile comes in such a wide variety of shapes, sizes, colors and textures that you can create a tile countertop to complement any home decor. Prices vary widely, but one of the largest American tile makers estimates material costs at between \$3.30 and \$6.50 per sq. ft., depending on style.

POPULAR MECHANICS • FEBRUARY 1983

Imported tiles can run as high as \$30 per sq. ft.

There are three types of tile: glazed, unglazed and quarry tile. In manufacturing of glazed tile, the surface of the tile body is first coated with color and then with a glass-like substance that serves to seal the porous clay. Glazed

tiles are the softest and easiest to cut.

In unglazed tiles the color permeates the tile body. The density of the clay makes them extremely stain resistant. Porcelain tiles are unglazed tiles that are the least likely to stain.

Quarry tiles are more porous and, therefore, more likely to stain. Polyurethane sealers are often used to protect quarry tile, though it may not be desir-

able to use it on surfaces where food is prepared. For countertop installations, it's usually best to use a latex wall and floor tile adhesive.

Grout is used to seal the joints between tiles. It is available in powdered form. There are cement-based grouts and those made to be mixed with a latex solution. Both types are suitable for countertops, though the latex-base grout resists mildew and deterioration somewhat better. Grout color can either blend or contrast with the tile to create varied effects. Test the grout first to be sure it won't stain the tile surface, particularly if you're working with unglazed tiles.

Build the counter base first, using 3/4-in. exterior plywood. Do not substitute particleboard. Make cutouts for sinks and countertop ranges.

To prepare for setting tile, skim-coat the base with tile adhesive, using the flat edge of a trowel. Allow it to dry thoroughly (about four hours). Make a trial layout with the tiles. For tops without cutouts for sinks or ranges, start the layout at the center of the front edge. When the top has a sink cutout, start at the cutout center and work toward

either side. Then apply a thin, even coat of adhesive over the skim coat and rake it with the notched trowel edge. Cover only as large an area as you can set with tile in 20 minutes. If skin forms on adhesive, scrape it off and spread a fresh coat. Place tiles immediately.

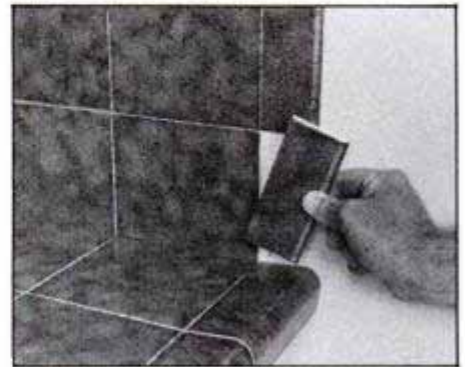
Allow adhesive to set for at least 24 hours before grouting. Following maker's instructions, mix the grout and apply it to the tiles with a sponge. Then force it into joints with a rubber-faced

trowel. Strike the joints with a popsicle stick or similar tool. As grout begins to set, clean excess from the tile with a clean sponge, rinsing the sponge frequently. Work quickly—grout left on tiles for longer than an hour is almost impossible to remove.

Let grout set for at least 24 hours before exposing it to water. Remove grout haze with a soft, dry cloth. Protect joints from mildew by saturating them with lemon oil furniture polish. **FM**



10 Grout joints on backsplash should align with those of countertop. If a course needs to be cut to fit under hanging cabinets, it should be top course.



11 Front edge of backsplash is trimmed with a bullnose-edged piece. With unglazed tiles, you can form bullnose edges yourself with a belt sander.



12 Allow adhesive to set at least 24 hours before grouting. Use a rubber-faced trowel or squeegee to press grout into joints and remove excess from tile.



13 Use a tongue depressor or similar tool to compact grout and remove buildup at the edges. This technique is referred to as "striking the joints."



14 When the grout begins to set (30 to 60 minutes), clean any excess from the tile surface with a damp sponge. Rinse sponge often with clean water.



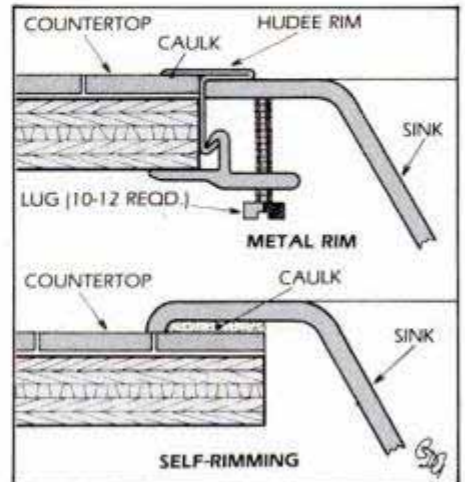
15 Allow grout to dry thoroughly. The grout residue remaining on tiles can be cleaned off with a soft, dry cloth.



16 Finished tile surface can be kept like new with household cleaners.

SOURCES—TILE

For information, write: Tile Council of America, Box 326, Princeton, N.J. 08540, or any of the following: American Olean Tile Co., 1000 Cannon Ave. Lansdale, Pa. 19446. Cambridge Tile, Box 15071, Cincinnati, Ohio 45215. Monarch Tile Mfg. Inc., 834 Rickwood Rd. Box 999, Florence, Ala. 35630. U.S. Ceramic Tile Co., 1375 Raff Rd. S.W., Canton, Ohio 44711.



17 Sink with Hudee rim is most popular. Both types are installed in a bed of caulk around the perimeter.

Working with plastic laminate

Plastic laminate sheets are available in a wide range of solid colors and decorative patterns and in several surface finishes, including gloss, satin and textured. For ease of cleaning, you should avoid textured or deeply embossed patterns. Dark colors are more likely to show scratches.

There are two grades of plastic laminate: standard and vertical. The stan-

dard grade, $\frac{1}{16}$ in. thick, is the choice for counter (horizontal) applications because it is more durable. Vertical grade is $\frac{1}{32}$ in. thick and is used for cabinet sides, doors, furniture and wall treatments.

Stock sheet sizes are as follows: Widths are available in 24, 30, 36, 48 and 60 in. Lengths run 60, 72, 84, 96, 120 and 144 in. Actually, the laminates

come slightly larger than these stated sizes to permit flush trimming to standard-size, core materials. The standard depth (width) for kitchen countertops is 24 in. overall.

While plastic laminate is quite hard, it is thin and rather brittle. Thus, it does not have practical strength or high impact resistance until it is bonded to a solid core material. It can be bonded to solid lumber, plywood, particleboard or

(Please turn to page 143)



1 Lamination can be done with keyhole saw, tin snips, plastics scriber, paintbrush, hammer, wood block, roller, rolling pin, mill file and block plane.



2 Most workshopers prefer to use a router with flush and bevel trimmers, a belt sander and a sabre saw with fine-tooth blade. Roller applies adhesive.



3 Special tools include (clockwise from bottom left): laminate edger, laminate trimmer, AR roller, heat gun, J-roller and squeeze roller.



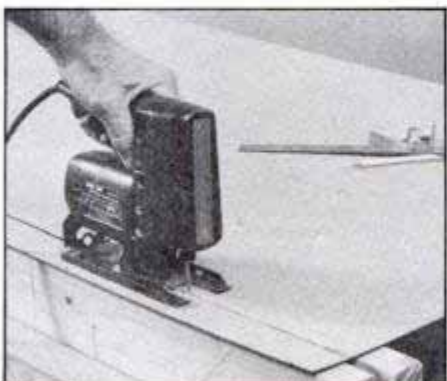
4 Core preparation is step No. 1. For self-edge treatments, where the same material is used on the edge as on the surface, core edge is usually built up with $\frac{3}{4}$ -in. stock for attractive look. Outside corners are often rounded with a sabre saw because square corners are painful to bump into and easily damaged.



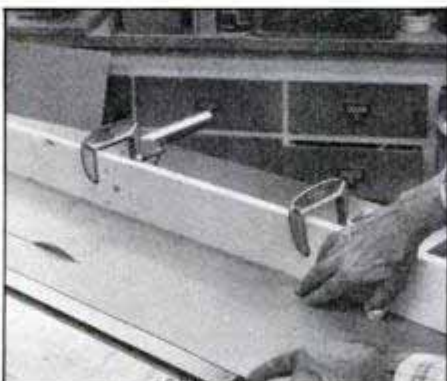
5 The core edge must be perfectly straight and at a 90° angle to the surface. Use a belt sander to smooth the curve and flatten the edge. Be careful not to sand too much and don't rock the sander side to side. A crooked, bellied edge will weaken the bond and also makes for a poor finished appearance.



6 Always cut laminate at least $\frac{1}{4}$ in. larger overall than needed. Lay out large pieces first, then edge bands. If you cut with a plastics scriber, keep the laminate face up and tape a metal straight-edge on the layout marks. Cut approximately halfway through, then bend toward the back surface to snap off.



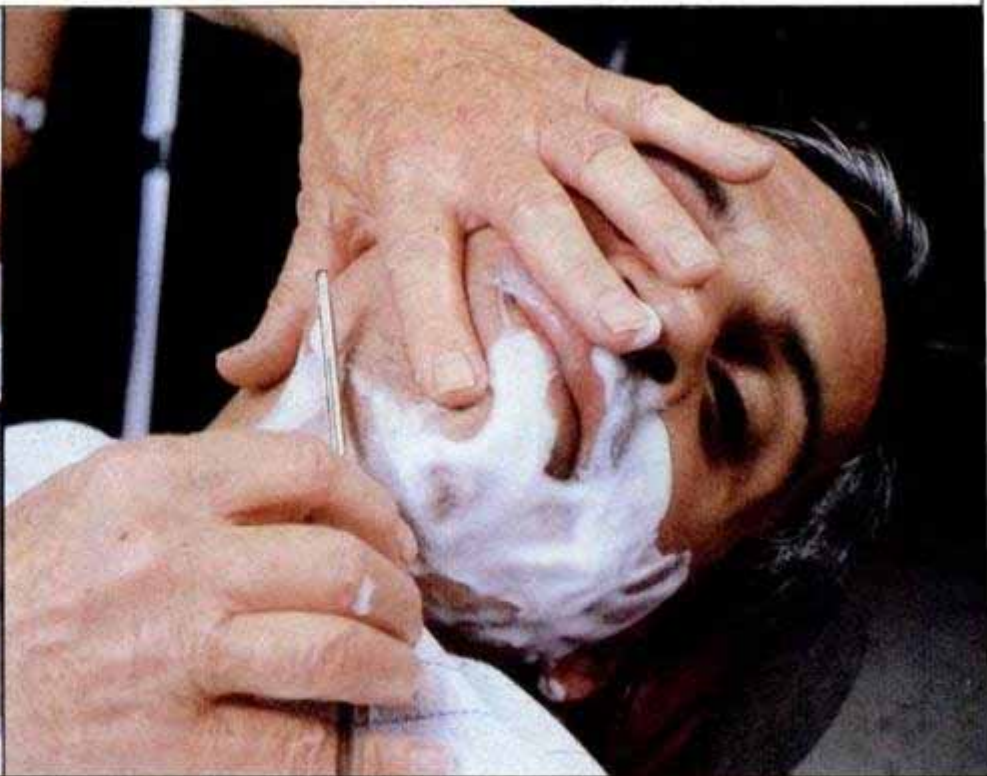
7 Cut sheets face down when using a sabre saw or portable circular saw. Support sheet close to the cutting line to prevent cracking. A white pencil makes layout marks easy to see, since the sheet back is usually gray or brown.



8 When cutting laminate on a table saw, the decorative side should be face up. A fine-tooth carbide blade is best, since chrome-steel blades dull quickly. Clamping a board to the fence keeps laminate from creeping underneath it.



9 When applying laminate to counter surfaces, always apply the edges before applying top. Prop core up about $\frac{1}{8}$ in. on work surface and dust well. Apply two coats of contact cement to the core edge and one to the laminate back.



7 Tips On Surviving A Really Close Shave!

Follow PM's advice, and you'll get the closest, safest shave you've ever had.

BY DENNIS ESKOW SCIENCE EDITOR

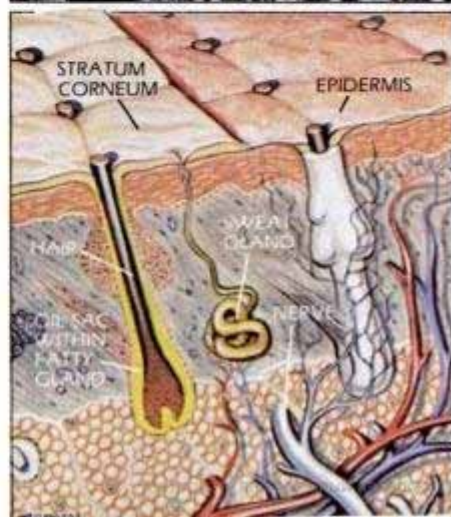
Ever thought of performing surgery on yourself? That's essentially what more than 70 million American men do every morning when they shave. Most use a blade to scrape away the upper shafts of about 12,000 hairs and the very thinnest and uppermost layer of skin—the *stratum corneum*. Roughly 20 million men do the job with an electric shaver system, which mows down the same number of hairs, but leaves the upper skin stratum just about unchanged.

Shaving has been around at least since the days when Joseph's brothers sold him into slavery in Egypt. The biblical Joseph may have singed the hair, or scraped it off with a blade

made of volcanic obsidian before entering Pharaoh's court. In the days since Joseph, shaving technology has evolved ever so slowly.

Only in the past two decades has research turned the art into a science, with the invention of coated metals and effective electric shavers, and with recent increases in dermatologi-

Electron micrograph of a hair shaft (upper right, magnified 100 times) shows hair shaft after being cut by a Bic disposable shaver. Most of the hair is actually beneath the skin surface (see drawing). The upper part of the hair shaft is cut by the blade and the stratum corneum is scraped. An electric cuts the hair to about the same length, but doesn't scrape stratum corneum.





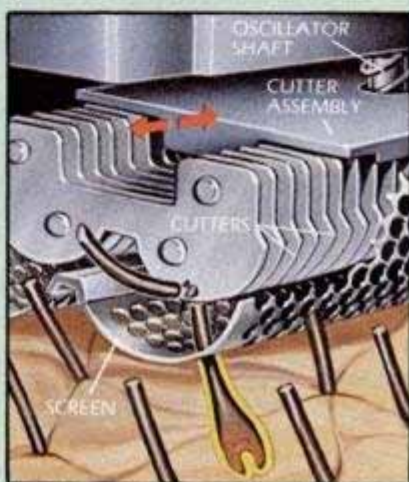
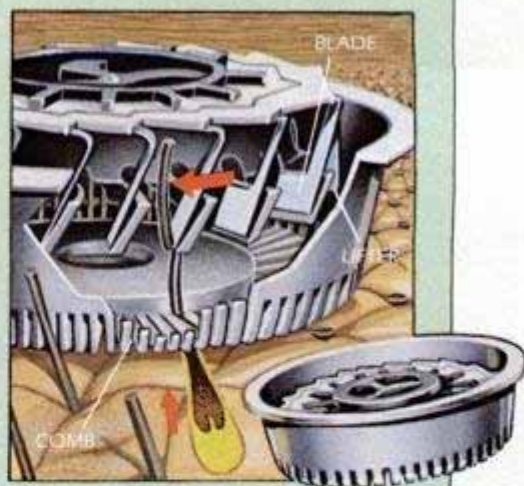
For wet shaving with straight or safety razor, lather beard using an against-the-grain circular motion; always run razor with grain of your whiskers (far left). Cutting is easier if you pull the skin taut (center). Always use smooth strokes, never choppy ones, even under your nose as shown above (top). Sharp edge of the blade always leads, never drags, when making cutting strokes (above). Same techniques apply whether you're shaving yourself or you're being shaved.

A MODEST PLUG FOR ELECTRICS

Before starting research for this story I was a confirmed safety-razor fan. But when a Norelco executive challenged me to try an electric for a couple of weeks, I did. I also tried a Remington shaver. All 15 dermatologists interviewed by PM said there is no significant difference between electric and nonelectric shaving—you'll get an equally close shave with both. These days, I'm using wet shaving in the morning, and I apply the electric if my beard needs an evening touch-up.

There are two basic kinds of electric: the rotary, produced by Norelco, and the oscillating type made by Remington and others. The rotary works best when you move it against the grain in a circular motion. With the rotary Norelco (above right), each hair pokes through a comb, is lifted up slightly and is quickly mowed by the spinning blade. With the Remington (below right), you should also use circular strokes, keeping the shaver flat against your beard and going against the grain so whiskers stick through the screen where the oscillating cutters can shear them.

Skeptics have declared electric shaving less effective than wet shaving largely because their faces don't feel taut after using an electric. But a 1979 Dutch study indicated that straight razors cut hair about 2/1000 inch shorter than electrics—which is really too small a difference to be detected by touch.—D.E.

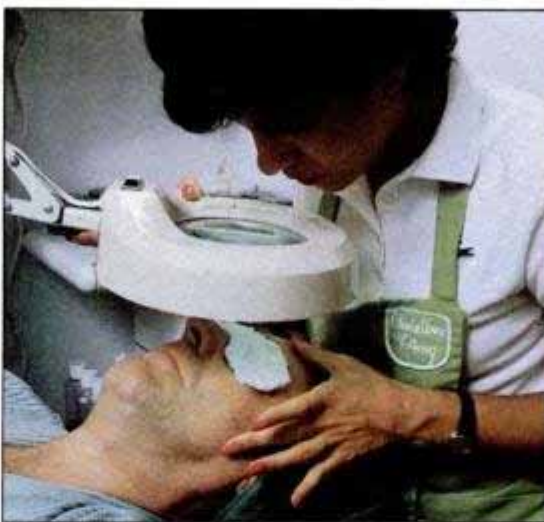


PM art: Jeff Mangiat

cal research. The 15 dermatologists, two barber college presidents, seven shaving company executives and others whom *Popular Mechanics* interviewed have revealed these hot tips:

1. Rise and shine your shoes, or do anything else but shave when you first get up. Schick research manager Anthony Booth says a delay of at least 10 minutes will give the body liquids that accumulate around the face overnight the time they need to redistribute themselves.

The face is a collection point for all kinds of bodily fluids—blood, sweat and tears. In fact, there's a complex system of microscopic blood, oil and sweat glands beneath every individual hair. When you rise from sleep, your face may be puffed up to nearly twice its standing volume. The puffiness keeps the blade from reaching some hairs, while raising high some skin bumps, thus increasing the chance you'll cut yourself. But after you've been on your feet a few minutes, it should return to normal. (Barbershop quartets seem to have grown popular at the turn of the century largely be-



Technician at Christine Valmy examines Harry Wicks' skin (left) before applying cleansing agent (above) for pores.

PM photos: Stephen Fay

cause patrons sat under a hot towel and then hot lather for long periods early in the morning. Apparently, they found the singing a pleasant way to pass the time.)

2. Hunt around your face for any potential injury points. This is especially important if you use a blade, but dermatologists say the procedure helps even with an electric razor. It

takes a little time to locate the sites of old cuts and nicks, but if you avoid such spots for a few days, you'll stop cutting yourself. You also should scrape your face with a dry towel and look carefully for blackheads. The procedure turns up and removes blockages at the base of the hair. Even if you have dry skin, oil from the sac that

(Please turn to page 124)



Two turn-of-the-century shaving aids—free-standing unit (above) and wall-hung version (top)—can be useful or decorative. Plans for both are on the following pages.

2 Victorian Shaving Stands You Can Make

Wall-hung Victorian Shaving Mirror



This wall-hung mirror has a ledge to hold grooming accessories. The water bowl is optional. You may prefer not to make the bowl cutout, but to use the drawer for storage instead. If you want to rest the stand on a dresser, simply eliminate the back of the case.

Begin work by cutting the pine case parts (A through E, see materials list and drawing, below). Note the curved edges on the bottom (A), top (B) and back (C). If you decide to incorporate a bowl into the top, make the center cutout slightly smaller than the bowl diameter. Use a pivot guide and a sabre saw with a set-tooth blade to make a clean, circular cut.

The mirror frame is composed of the top (F), sides (G) and bottom (H). Make

a cardboard template for the top by drawing a 1-in. grid and drawing the pattern on the grid. Cut out the template and trace around it on wood. Cut out the frame members. Use a doweling jig to bore holes for the attachment dowels. Join the frame parts with glue and dowels.

On pine draw a 1-in. grid for a stanchion (K); draw it inside the grid. Cut

out the stanchion with a sabre saw. Smooth the edges and use the stanchion as a template for making the second stanchion.

Use a 1/2-in. rounding-over bit in your router to round all edges marked with an asterisk (*) on the drawing. Don't round the stanchion edges that rest against the case top.

Use a router to cut a 1/4 x 1/4-in. rabbet

MATERIALS LIST—WALL-HUNG SHAVING MIRROR

Key	No.	Size and description (use)		No.	Size and description (use)
A	1	3/4 x 9 1/4 x 15 1/4" pine (case bottom)	N	2	3/4 x 3 7/8 x 7 1/2" pine (drawer sides)
B	1	3/4 x 9 3/8 x 14" pine (case top)	O	1	7 7/8 x 13" galvanized sheet steel (bottom)
C	1	3/4 x 9 1/2 x 12 1/2" pine (case back)	P	8	1/4"-dia. x 1 1/2" wood dowels (frame pins)
D	2	3/4 x 3 1/2 x 8 3/4" pine (case sides)	Q	4	7/8"-dia. ceramic knobs
E	2	5/8 x 3/4 x 3/4" pine (filler blocks)	R	1	3 x 6"-dia. bowl (max. dimensions)
F	1	3/4 x 2 3/4 x 12" pine (mirror frame top)	S	2	2 1/4" No. 6 rh screws (pass-through knobs)
G	2	3/4 x 1 1/2 x 12" pine (mirror frame sides)	T	2	1 1/4" No. 6 rh screw (pass-through knobs)
H	1	3/4 x 1 1/2 x 9" pine (mirror frame bottom)	U	13	1 3/4" No. 8 fh screws
I	1	1/8 x 9 3/8 x 12 1/8" mirror	V	*	2" 6d finishing nails
J	1	1/8 x 9 3/8 x 12 1/8" cardboard (backing)	W	*	1/2" brads
K	2	3/4 x 3 1/2 x 8" pine (stanchions)	X	12	Glazier points
L	1	3/4 x 3 7/8 x 14" pine (drawer front)	Y	2	Toggie bolts with flat washers
M	1	3/4 x 3 7/8 x 12 3/8" pine (drawer back)	Misc.:		Carpenter's glue, primer, enamel paint, wood filler.

*As required.

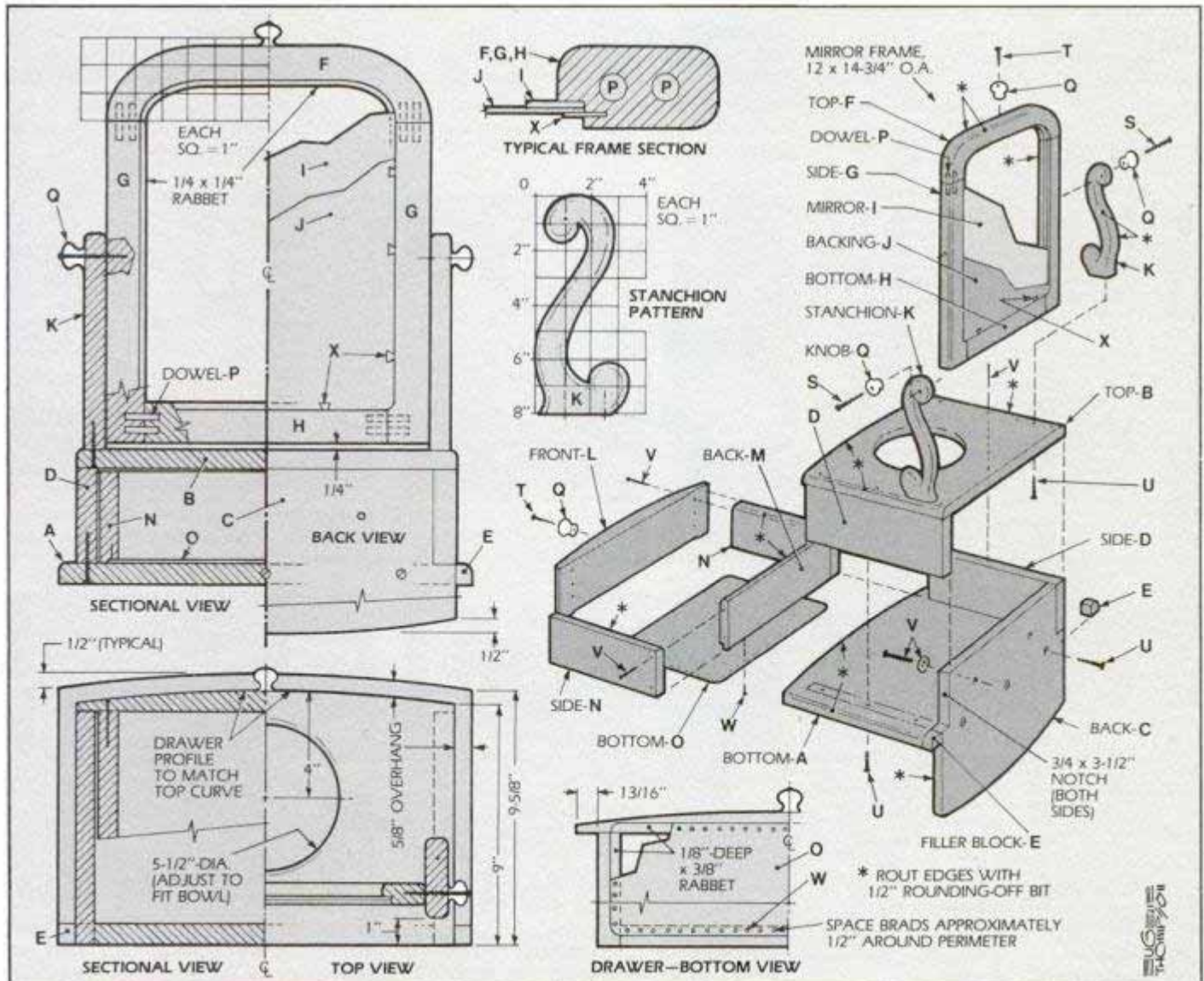
PM color photos: Harry Hartman

Styling: Gabe Herrick

Technical art: Eugene Thompson

Free-standing shaving stand—design, construction, black and white photos: Rosario Capotosto

Wall-hung shaving mirror—design and construction: Adam Peck, American Design



bet for the mirror in the back of the frame.

Sand all pieces with 80- then 120-grit abrasive, dusting and wiping with a tack cloth. Spend time smoothing the stanchions. Bore holes in the stanchions for the screws (S), which hold the mirror.

Fasten the stanchions to the case top with screws (U). Measure accurately to be sure the mirror can pivot between supports. Set the mirror frame in place on a 1/4-in.-high spacer while you bore holes through those in the stanchions into the mirror frame.

Assemble the case top and sides with glue and 6d finishing nails, setting the nails and filling the holes with wood filler. Fasten the case bottom to the sides and to the case back with screws (U). Fasten the back to the top and sides with 6d finishing nails, filling the holes.

Constructing the drawer

Cut the rough shape of the drawer front (L), the back (M), and the sides (N). The front surface of the drawer front follows the same curve as the case top. Shape the drawer front with a

plane followed by sandpaper, or shape it on a hand saw and sand smooth.

Rout the top inside edges of the drawer sides with a 1/2-in. rounding-over bit. Cut a 1/8 x 3/8-in.-wide rabbet in the bottom inside edges of the drawer front, back and sides for the bottom (O).

Use tin snips to cut the drawer bottom of galvanized sheet steel. Assemble the drawer, using glue and 6d finishing nails. Fasten the bottom in place with 1/2-in. brads. Bore a hole through the drawer front for the knob. Sand the

(Please turn to page 130)

Free-standing Victorian Shaving Stand

The design of this charming shaving stand was influenced by turn-of-the-century Victorian styling. Made of 4/4 oak, the piece has a clear finish to emphasize its wood grain.

The ceramic bowl we used is 3 in. deep and has a 13 3/8-in. outside diameter. After you select a bowl at a department or housewares store, alter the cut-out on the stand top (D, see materials list below) to suit.

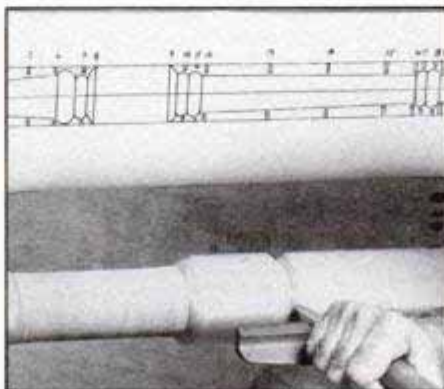
Begin work on the legs (J). Rip the legs from 12/4 stock, or you can glue

(Please turn to page 130)

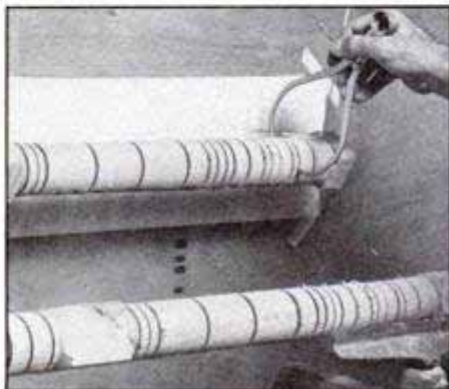
MATERIALS LIST—FREE-STANDING SHAVING STAND

Key	No.	Size and description (use)
A1	2	1 3/8 x 4 1/8 x 26 3/4" oak (yoke sides)
A2	1	1 3/8 x 6 1/2 x 12" oak (yoke base)
B	2	1 3/8 x 3 1/2 x 18" oak (side rails)
C1	1	1 3/8 x 6 3/4 x 9 1/2" oak (mirror frame top)
C2	1	1 3/8 x 3 1/4 x 9 1/2" oak (mirror frame bottom)
C3	2	1 3/8 x 1 1/4 x 17 1/2" oak (mirror frame sides)
D	1	1 3/8 x 20 1/4 x 24 1/4" oak; 3 boards doweled and edge-glued (top)
E	1	1 3/8 x 18 1/2 x 22 1/2" oak; 3 boards doweled and edge-glued (shelf)
F	2	1 3/8 x 3 x 18 1/4" oak (upper front F-1, back F-2 aprons)
G	2	1 3/8 x 2 1/4 x 18 1/4" oak (lower front G-1, back G-2 aprons)
H	2	1 3/8 x 3 x 14 1/4" oak (upper side aprons)
I	2	1 3/8 x 2 1/4 x 14 1/4" oak (lower side aprons)
J	4	2 3/8 x 2 3/8 x 33 1/4" oak (legs)
K	2	3/4 x 3/4 x 16" oak (glue blocks, front/back)
L	2	3/4 x 3/4 x 12" oak (glue blocks, sides)
M	1	1/8 x 10 3/8 x 12 3/4" mirror
N	1	1/8 x 10 3/4 x 12 3/4" plywood (mirror backing)
O	4	Plastic retaining clips for mirror
P1	4	3/8"-dia. x 2" spiral-groove dowels (yoke fasteners)
P2	52	3/8"-dia. x 1 1/2" spiral-groove dowels (fasteners)
Q	2	1/4-20 threaded insert
R	2	1/4-20 x 2 1/2" hanger bolts (for threaded inserts)
S	2	1 1/2 x 1 1/2"-dia. oak (knobs)
T	14	2" No. 10 fh screws
U	8	1/4"-dia. wood plugs
V	1	3 x 13 3/8"-dia. ceramic bowl or to suit

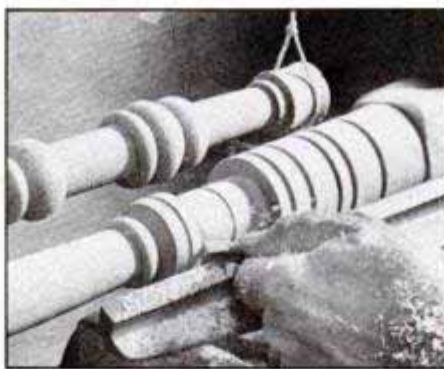
Misc.: Plastic resin glue (optional), carpenter's glue, wood paste filler, semigloss clear finish.



Begin turning a leg by marking, nicking and cutting shoulders; cut rough rounds. Then mark gauging groove cuts.



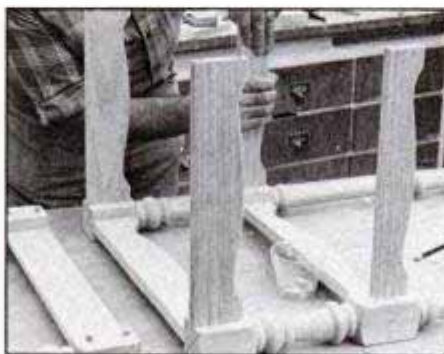
Set the caliper to size the groove cuts. After first leg is grooved, use it to set caliper for grooving other legs.



Make light final cuts by eye. Use a completed leg as a guide for the next leg.



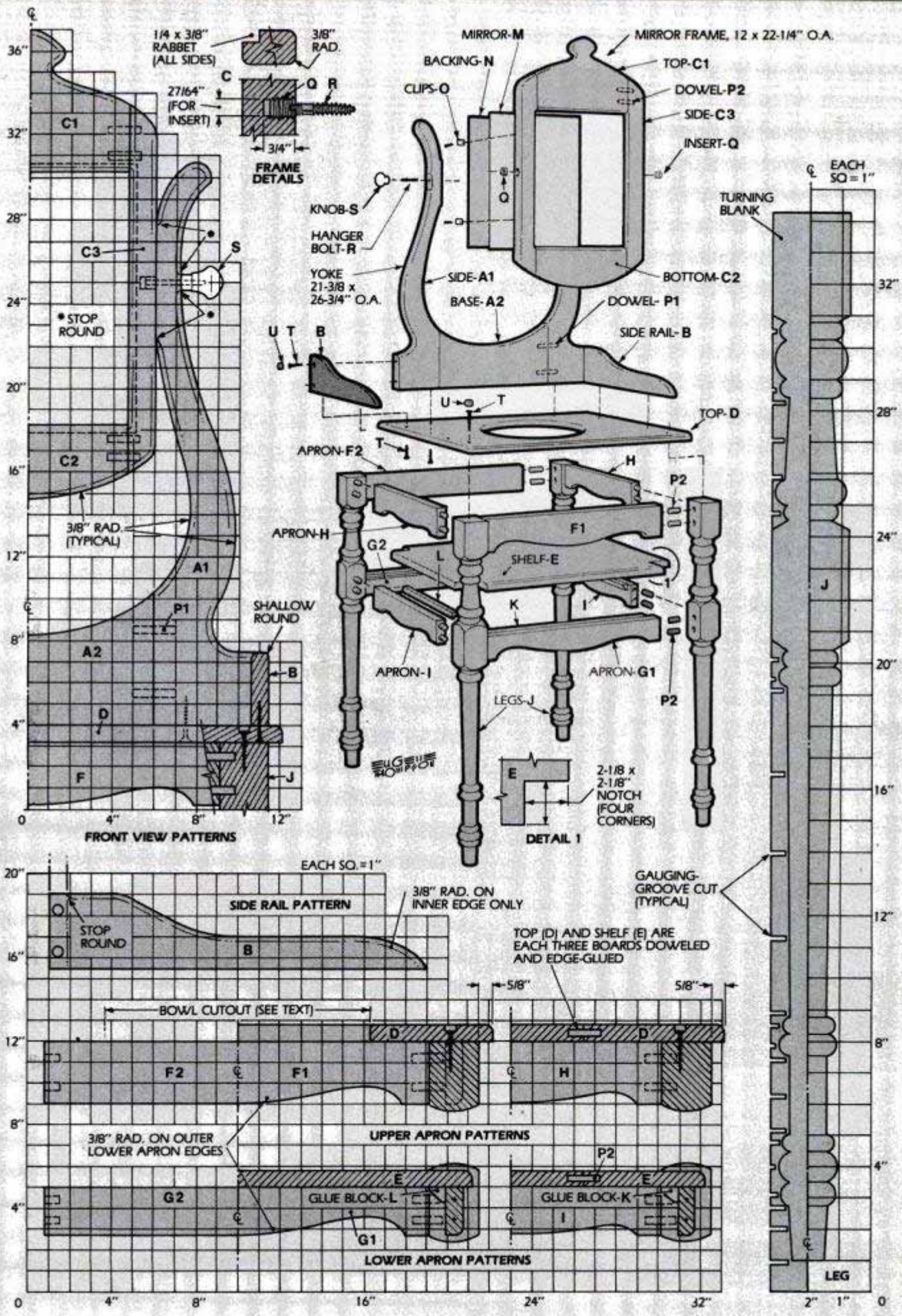
Cut a circle for the bowl with a scroll saw. Pivot the work on a nail driven into a board clamped to the table.



Assemble legs in pairs with adjoining aprons. Glue side aprons to one leg assembly; use sanded dowels in other.



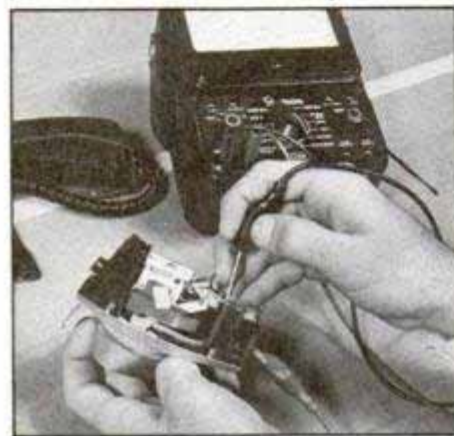
Hold the mirror yoke and side rails with clamps while boring pilot screw holes.



How To Repair



The two electric shavers chosen to demonstrate the basic maintenance and repair procedures are the Norelco rotary (left) and the Remington rechargeable razor.



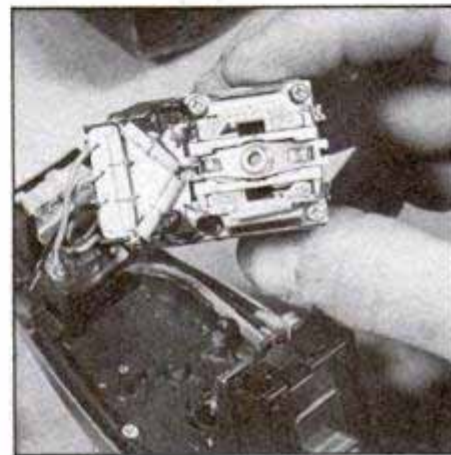
5 Test the main switch for a reading in the ON position, and for no reading when OFF. To do it, place one continuity probe on the line terminal, the other on the secondary side of the switch.



6 Place both continuity probes on the two brush contacts and use screwdriver to rotate armature. Large fluctuation of needle indicates a defective armature.



1 To test the line cord, place one probe of the continuity meter on the male prong, the other probe on the corresponding female end; test both wires.



7 To disconnect the field assembly, loosen the screws holding it to the body and pull the black, gray and red wires free from the terminal block.

Here's how to perform the basic maintenance and repair that will keep your shaver purring.

Electric shavers have become a popular way to shave. Wafer-thin shaving heads, portability, dual voltages and functional designs have caused many blade shavers to change over. However, though technology has greatly advanced electric shaver state of the art, it still has not made them immune to wear and occasional need for repair. Body oils, hair and preshave talcs can wreak havoc on shaving heads and blades. Daily after-use cleaning plus periodic servicing will ensure year-round, trouble-free use. The latter can be provided by an authorized service center or you can do it yourself. Basically, the tools you will need are

small slotted and Phillips screwdrivers, and a meter that reads both voltage and continuity. Check your warranty so you'll know if you are voiding it by opening the razor body.

We chose a Norelco rotary head and the Remington rechargeable razor for our service and repair study.

Before starting any repairs, inspect for external cracks, damaged heads, or worn cords. Also, make sure the voltage selector, if applicable, is on the correct setting. Test the shaver line cord by placing one probe of the continuity meter on the male prong of the cord, and the other probe on the corresponding female end. A meter reading should exist. Repeat this procedure with the remaining prong. If you don't get a reading, simply replace the cord.

Testing a Norelco rotary

Disconnect from power and check the internal parts of the Norelco shaver

by removing its head, and the three back cover screws. Remove the back cover and examine the shaver's interior for broken parts or loose electrical connections. Test the linkage to the ON-OFF switch by sliding it back and forth. Examine the motor brushes, which are held in place by small springs located on each side of the bearing block.

To test the main switch, remove the black wire from the terminal block. Place one end of the continuity probe on the line terminal, and the other probe on the secondary side of the switch. When the switch is slid to the ON position, a reading should exist; there should be no meter reading when the switch is slid OFF.

Test the armature by placing both continuity probes across the two brush contacts. With a small screwdriver, rotate the armature. Any full-scale needle fluctuation indicates a defective

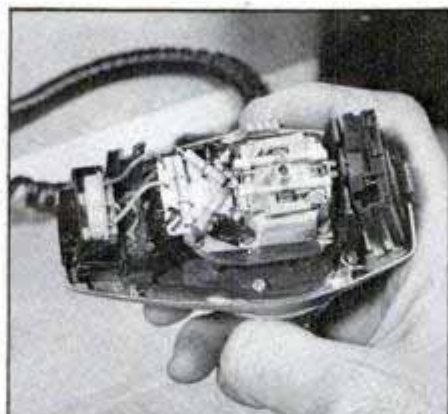
(Please turn to page 132)

An Electric Shaver

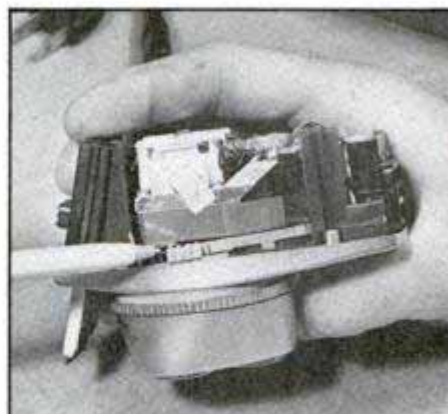
CUTTER SHAVER



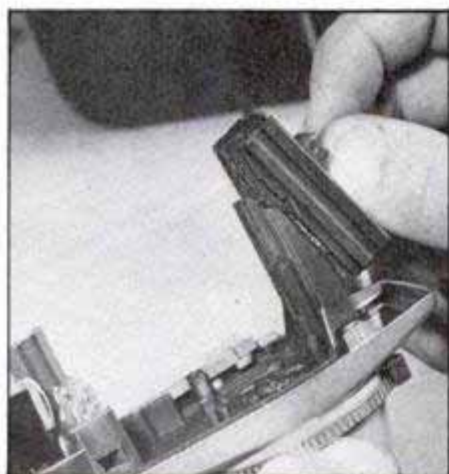
2 In order to check the internal parts on this model, you must take off the head and the three cover screws.



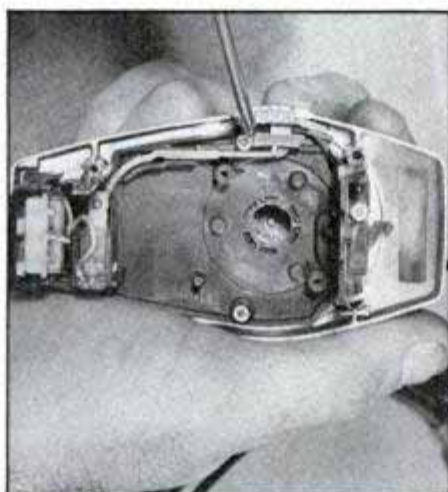
3 Examine the interior, checking for broken parts or loose electrical connections.



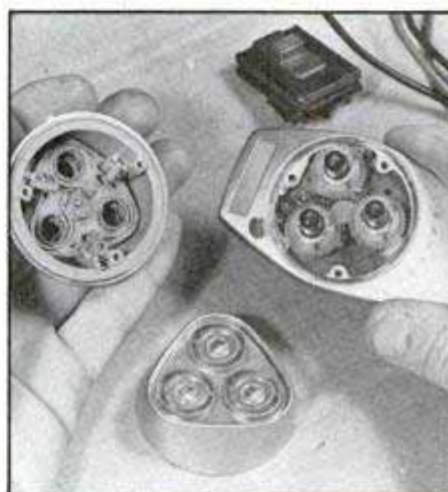
4 Test the mechanical linkage of the on-off switch by sliding it back and forth.



8 Unsnap and remove the sideburn trimmer to get at the gears and bushings so you can check for wear or damage.

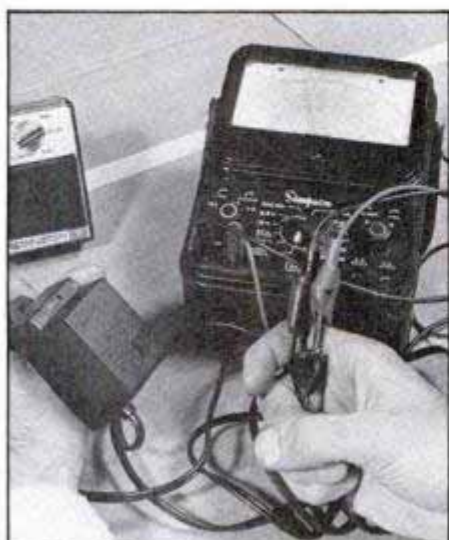


9 With the trimmer out, remove the three screws in the bottom of the shaver.



10 Inspect the gears for broken teeth, and the bushings for play (right hand).

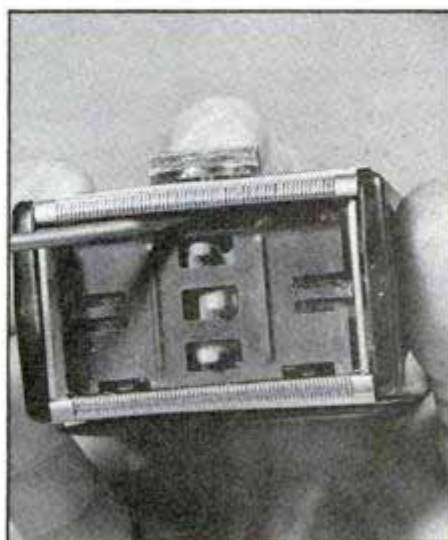
SERVICING A FLAT-CUTTER SHAVER



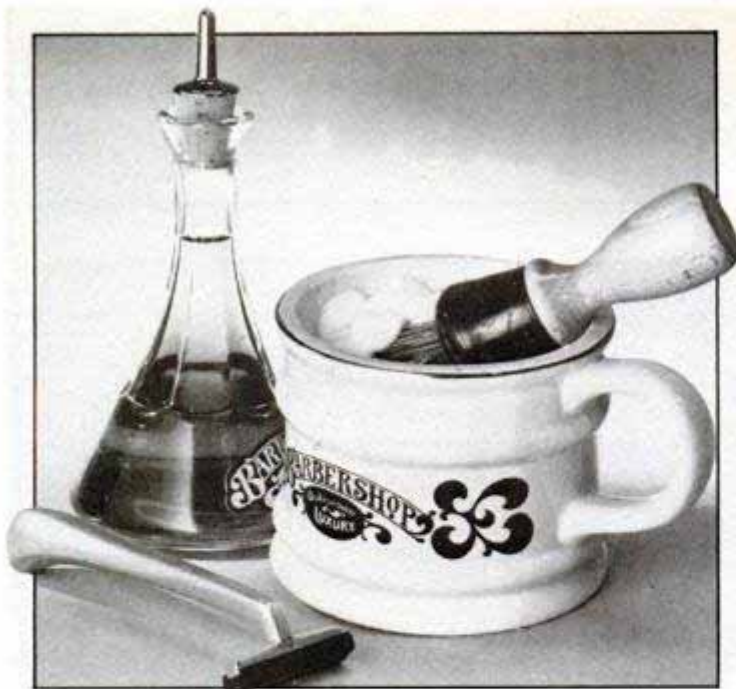
1 Test the recharger by plugging it into the wall and placing both probes of the voltmeter across charging terminals.



2 To get at the internal parts of this model, you must remove the razor head.



3 With a small screwdriver on the front side of the shaver behind the knob, pry the outer shell from the motor housing.

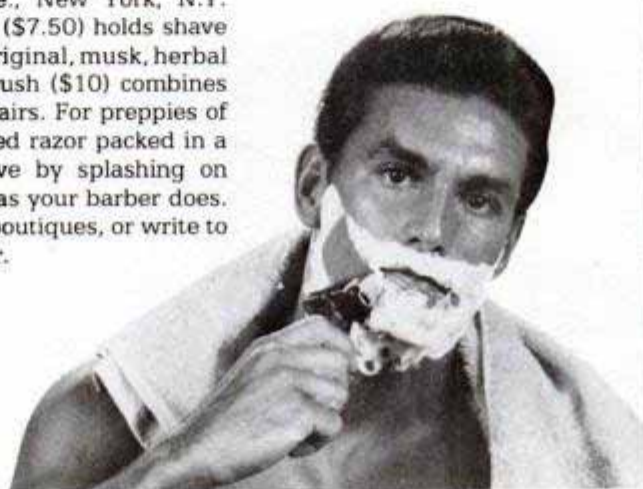


Get A Barbershop Shave At Home



Replica turn-of-the-century shaving gear is from Franklin Toiletry, PM 283, 76 Ninth Ave., New York, N.Y. 10011. The old-fashioned shaving mug (\$7.50) holds shave soap (available for an additional \$3) in original, musk, herbal and lemon-lime scents. The shaving brush (\$10) combines 2¼-in.-long boar bristles with badger hairs. For preppies of all ages, a touch of class—a brass-plated razor packed in a redwood case (\$20). Finish your shave by splashing on after-shave from a decanter (\$10), just as your barber does. All items are at department stores and boutiques, or write to the manufacturer for the nearest dealer.

You can combine the speed and convenience of an electric shave with the clean "feel" of a foam shave. This submersible wet/dry shaver is powered by a rechargeable battery which is claimed to deliver seven shaves on one eight-hour charge. Mr. Whisk features a recharger for converting 100-120 v. to 220-240 v. and a sideburn/moustache

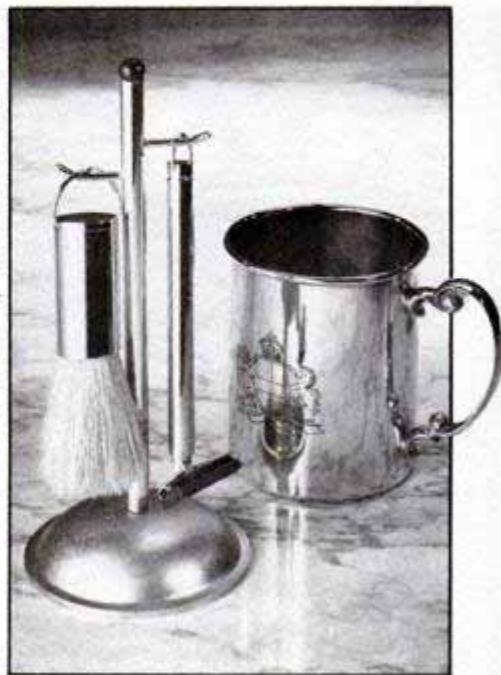


trimmer. It's \$65 from Panasonic Co., Dept. PM, 1 Panasonic Way, Secaucus, N.J. 07904.



Barbershop quartet, plus one, of shaving gear won't shorten the time you spend in front of your mirror each morning—but might make it more pleasant. Shown are a French straight razor (\$35), double-sided leather strop for keeping an edge on it (\$39), a hardwood bowl with 2 oz. of shave soap (\$9.75), and a brush with 2¼-in.-long bristles and badger hairs for working up a lather (\$16). The fifth entry is 1¾ oz. of shaving soap in a push-up tube (\$4). All are from Caswell-Massey Co. Ltd., Mail Order Div., Dept. PM, 111 Eighth Ave., New York, N.Y. 10011. Prices do not include postage. A catalog is available for \$1.

This three-piece shaving set consists of razor, shaving brush with 2¼-in.-long bristles and 8-in.-tall stand crowned with a jade stone. The Royal London coat of arms is etched on the 4-in.-tall shaving mug. Both these products are solid brass with 22-karat gold plate. The set is \$50, while the shaving mug costs \$20. For nearest dealer, contact Royal London Ltd., PM 283, 225 Fifth Ave., Suite 905, New York, N.Y. 10010. **PM**





**There's only one way
to play it.**

No other ultra brings you
a sensation this refreshing.
Even at 2 mg., Kool Ultra has
taste that outplays them all.



KOOL ULTRA

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

Kings, 2 mg. "tar", 0.3 mg. nicotine, 100's, 5 mg. "tar",
0.6 mg. nicotine av. per cigarette by FTC method.

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PM Reproductions

Make A Duplicate Of Lincoln's Shaving Mirror



Abraham Lincoln's shaving mirror (above) is a classic example of Victorian woodworking. PM's reproduction (left) is faithful in every elaborate detail.

Here's the step-by-step method for making a fine antique reproduction.

BY DAVID WARREN

When Abe Lincoln was a clean-shaven lawyer practicing in Springfield, Ill., people didn't bother much about keeping track of his home furnishings. But now that the Lincoln home is designated as a National Historic Site, there is much speculation about what really did and didn't belong to our 16th president.

The mirror on the bedroom wall is one thing the experts are sure about—it was there during the 1840s, and Lincoln probably used it every day.

The curators of the Lincoln National Home Site were extremely patient and cooperative in allowing us to examine and photograph the Lincoln mirror to authenticate each detail. We used some specialized shop tools to build the reproduction, though the original was made entirely with hand tools. Whether you decide to make it using the old ways or the new, the result will be a piece of lasting value.

Making the fretwork

First, prepare full-scale drawings of the fretwork pieces: the back panel, the box support, the two small shelves and the shelf supports. Make these drawings on heavy cardboard stock or 1/8-in. hardboard so that the patterns can be

PM color photo: Reproduction shaving mirror, Harry Hartman
Original mirror, in-process photos: Matt Doherty
Styling: Gabe Herrick
Craftsman: Ray Peterson
Original mirror on view at the National Park Service's Lincoln National Home Site, Springfield, Ill.

transferred accurately onto the stock.

Trace the pattern for the back panel onto a piece of mahogany plywood. Trace patterns for the two shelf supports and the box support onto a piece of solid mahogany $\frac{1}{4} \times 7\frac{1}{2} \times 13$ in. Lay out shelves on solid, $\frac{1}{4}$ -in. stock.

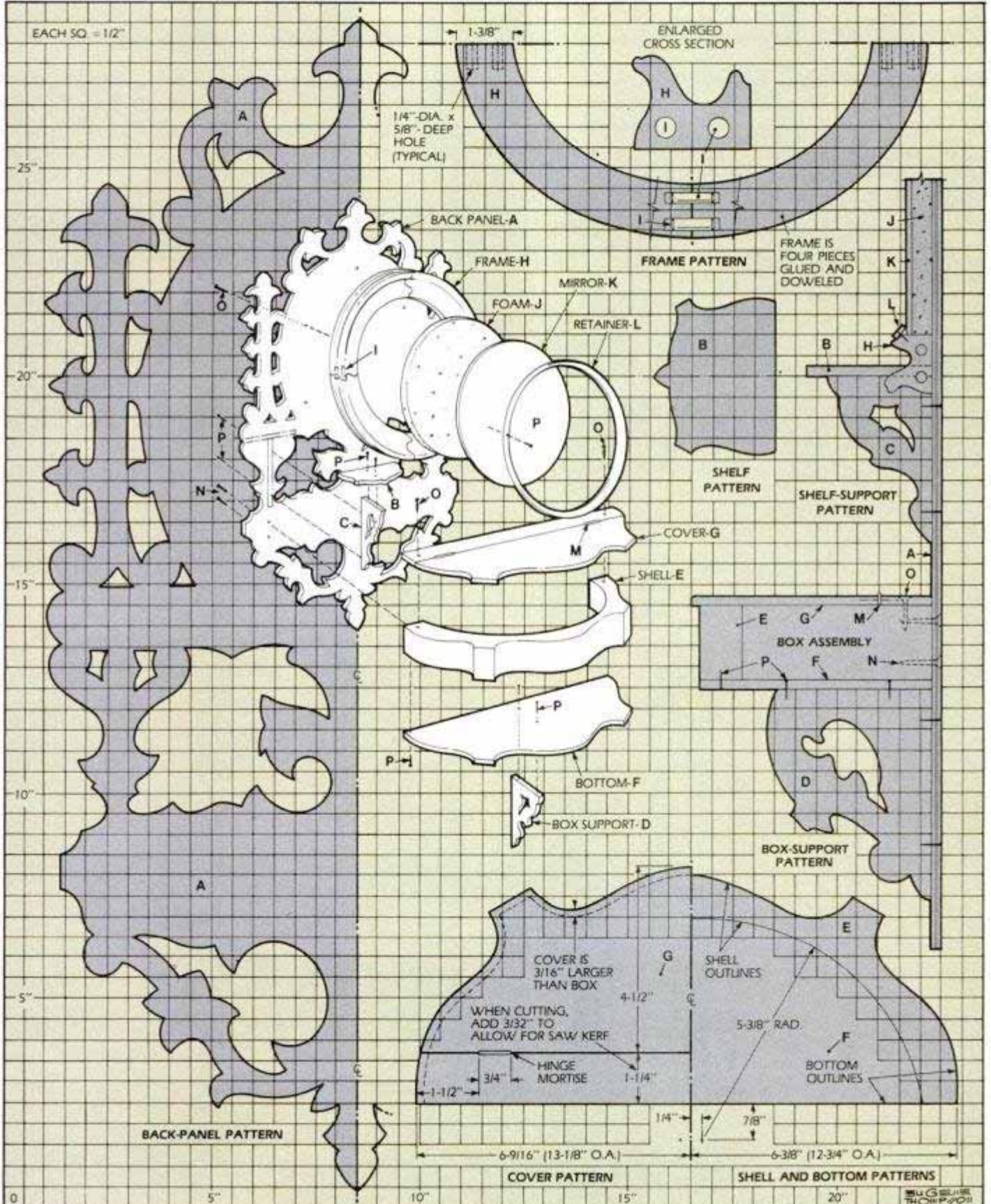
Cut out the fretwork pieces with a

(Please turn to page 120)

MATERIALS LIST—LINCOLN MIRROR

Key	No.	Size and description (use)
A	1	$\frac{1}{4} \times 18 \times 30'$ mahogany plywood (back panel)
B	2	$\frac{1}{4} \times 3\frac{1}{2} \times 4'$ mahogany (shelf)
C	2	$\frac{1}{4} \times 3 \times 4\frac{1}{2}'$ mahogany (shelf support)
D	1	$\frac{1}{4} \times 4\frac{1}{2} \times 5\frac{1}{2}'$ mahogany (box support)
E	1	$1\frac{3}{4} \times 6\frac{1}{2} \times 14'$ mahogany (box shell)
F	1	$\frac{1}{4} \times 6 \times 13'$ mahogany (box bottom)
G	1	$\frac{1}{4} \times 6\frac{1}{2} \times 13\frac{1}{2}'$ mahogany (box cover)
H	1	$1\frac{3}{4} \times 7\frac{3}{4} \times 18'$ mahogany (mirror frame)
I	8	$\frac{1}{4}$ "-dia. \times 1" hardwood dowels
J	1	$\frac{1}{2} \times 6\frac{1}{2} \times 8\frac{1}{2}'$ Styrofoam
K	1	$6\frac{1}{2} \times 8\frac{1}{2}'$ oval mirror
L	1	$\frac{1}{8} \times \frac{3}{16} \times 24'$ brass strip (retainer)
M	2	$\frac{1}{2}$ " (open) \times $\frac{3}{4}$ " brass butt hinges
N	2	1" No. 7 screw
O	8	$\frac{3}{4}$ " No. 7 fh screw
P		$\frac{1}{2}$ " brass brads

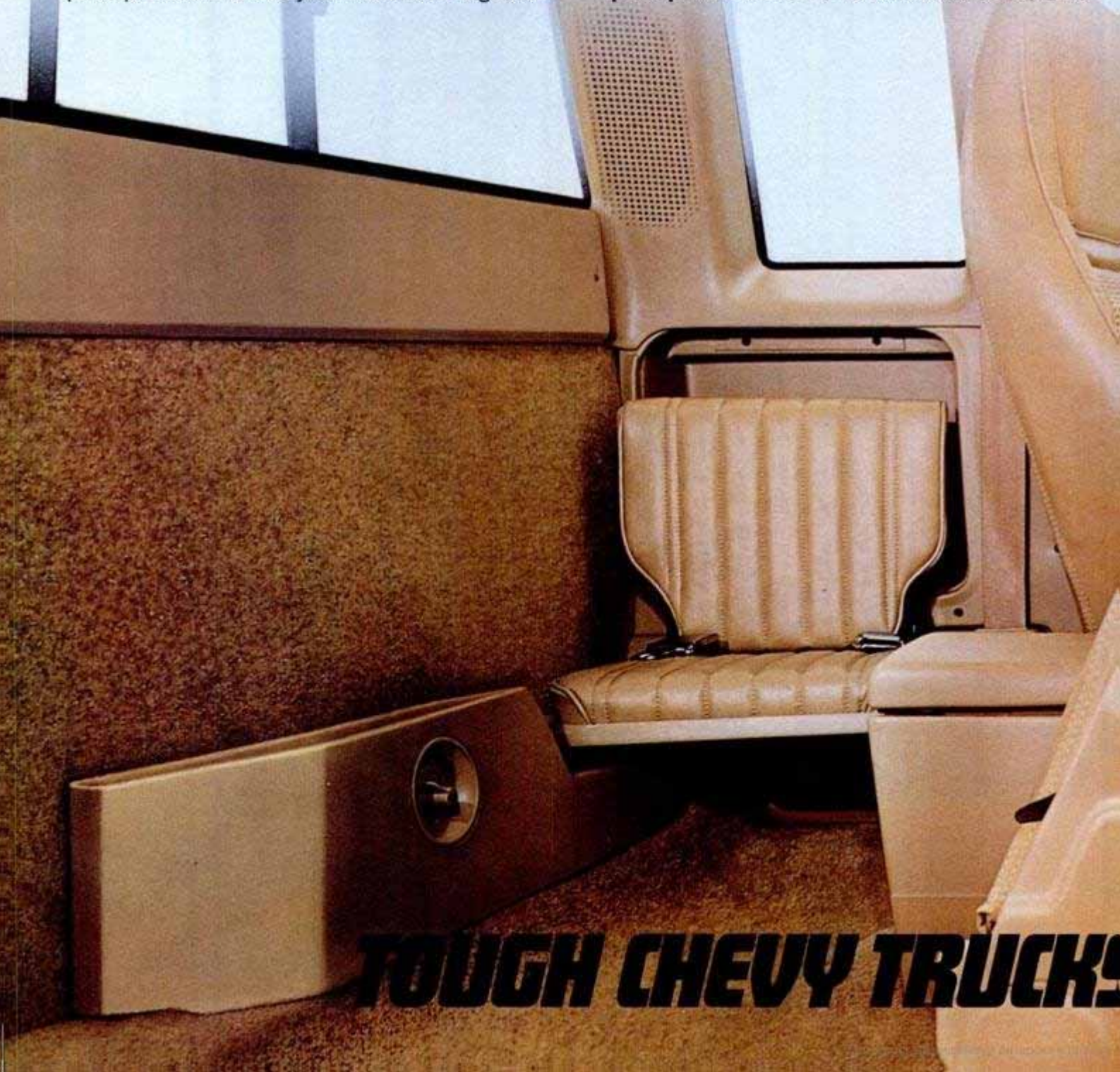
Note: All lumber given in rough dimensions.



THERE'S NEVER EXTENDED CAB

New-size Chevy S-10 Maxi-Cab. Now there's a new-size American-made extended-cab pickup that's big enough to seat four people when you order the available front bucket seats and fold-up rear jump seats. The Chevy S-10 Maxi-Cab is a whole lot roomier than Datsun's extended-cab pickup. It even offers you more front leg room

than any *full-size* pickup. Maxi-Cab with standard front bench seat gives you up to 40% more load space behind the seat than Datsun. Or you can order the front bucket seats and rear jump seats shown below, and still enjoy more load space. **V6 power that Ford Ranger and the import pickups don't offer.** S-10 Maxi-Cab offers S-10



TOUGH CHEVY TRUCKS

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quality and cab room no other new-size truck can beat, plus an optional 2.8 Liter V6 engine that outmuscles any of these competitors.

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Let's get it together... buckle up.

Available in 2- and 4-wheel drive. S-10 Maxi-Cab 4X4 (shown right) with revolutionary new Insta-Trac 4-wheel-drive system, standard on all S-10 4X4 models. The first 4X4 system that lets you shift from free-wheeling 2-wheel drive to 4-wheel-drive High—and back—at any speed.



ARE TAKING CHARGE



LINCOLN'S SHAVING MIRROR

(Continued from page 117)

scroll saw. (The original was done either with a handheld coping saw or a pedal-operated jigsaw.)

When all of the pieces have been cut out, sand the edges with a fine jigsaw rasp. If you don't have the setup for this, you can glue a strip of 120-grit sandpaper to an ice cream stick in order to make a tool for hand-smoothing tight spots.

Draw centerlines from front to back on the undersides of the two small shelves. Center the shelf supports over the lines, and glue and nail each set

together with brads. Set the brad heads and cover them with wax filler.

Storage box

Lay out the box shell on solid mahogany. Cut just outside the layout marks with a band saw. Use a drum sander on concave areas and a disc sander on convex areas to sand down to the layout lines.

Trace the pattern for the box bottom on a piece of solid mahogany and cut it out with a band saw. Glue and nail the bottom to the shell. When the glue has dried, sand the edges of the bottom flush with the face of the shell, using disc and drum sanders.

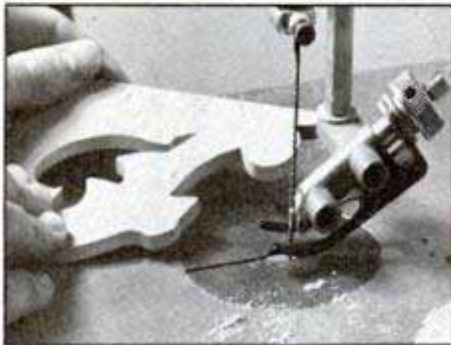
Next, lay out and cut the box cover from solid, 1/4-in. mahogany. Allow for a saw kerf at the back of the box where you will cut a strip to serve as the stationary mount for the hinges. Cut the 1 1/4-in. strip from the cover and mount it on the shell with brads and glue. Mount the lid with hinges.

The mirror frame

Make a full-size drawing of one segment of the mirror frame and transfer it four times to a piece of solid mahogany measuring 1 1/4 x 7 3/4 x 18 in. Cut out each segment of the frame with a band saw, staying just outside the layout lines. Again, use a combination of disc

(Please turn to page 122)

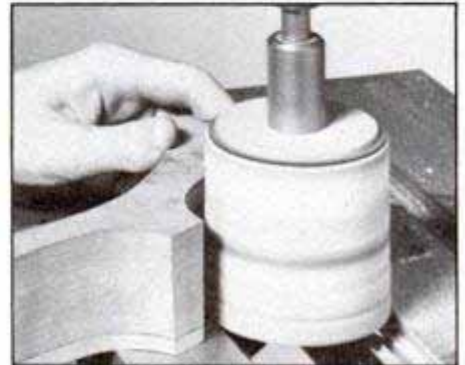
POWER TOOLS SHAPE PIECES ONCE CRAFTED BY HAND



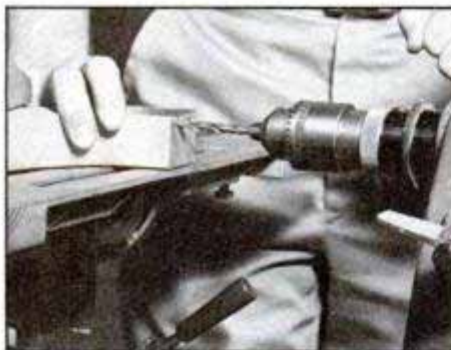
Trace the back panel, shelves and shelf supports from full-scale drawings and use a scroll saw to make the fine cuts.



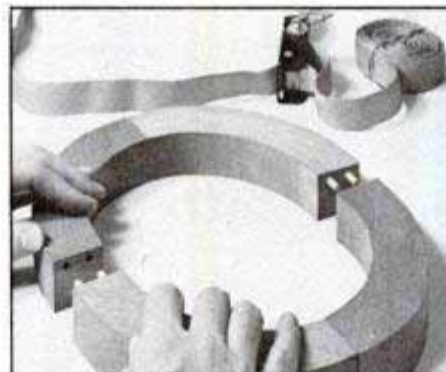
Use a fine jigsaw rasp to smooth the fretwork edges. For tight spots, use sandpaper glued to an ice cream stick.



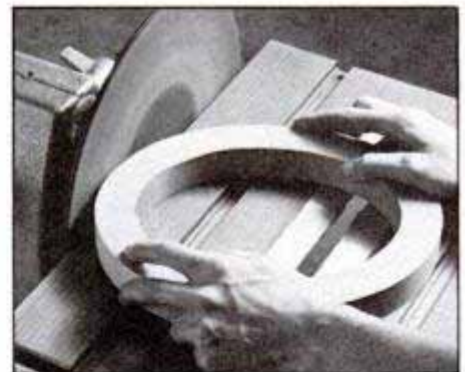
Use a 3-in. drum sander to smooth the outside and inside faces of the box shell.



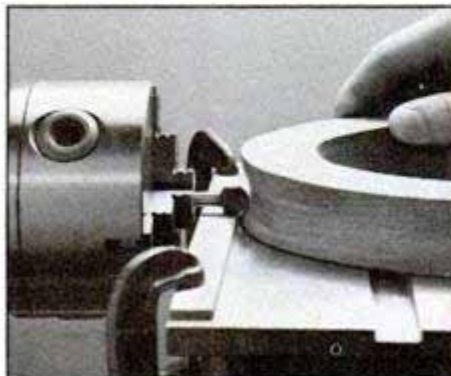
Make the mirror frame in four sections. Bore each section twice at either end for dowel pins. Center holes 3/8 in. from back face of frame and 3/8 in. from center.



Glue in 1-in. dowel pins and press frame parts together. Secure assembly in a belt clamp 24 hours, allowing glue to set.



Sand the edges of the frame on a disc sander to smooth joints and even frame width. Sand inside of frame with drum.



You can chuck a router bit into a lathe or horizontal drill press to shape the outside edge. Clamp a fence to the table to set cutting depth and adjust the table height. Carve, slowly rotating the frame.



To work with a pin router, prepare a jig and nail it to the frame through six evenly spaced, counterbored pilot holes.



With the frame attached to the jig, flip the piece over and set the groove over the pin in the table. The router bit should be centered over the pin. Rotate the work, guiding it carefully with the pin in the groove to shape the frame face.

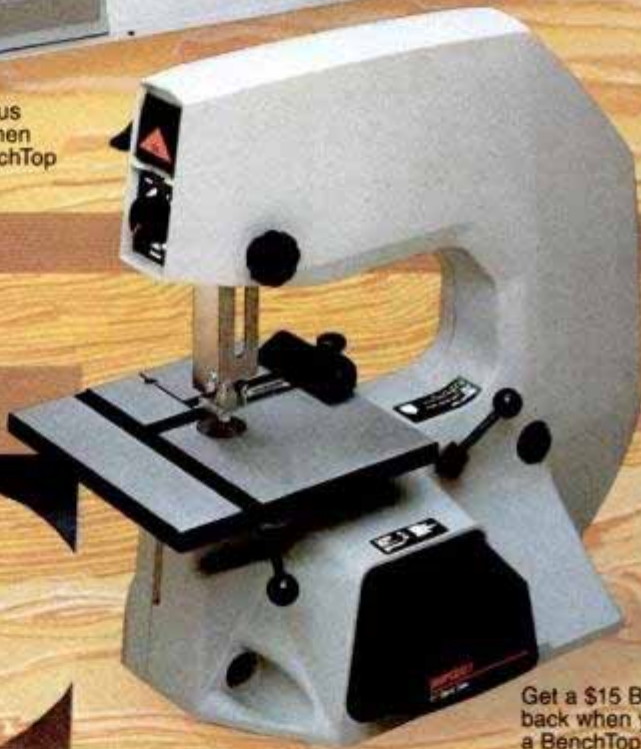
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LINCOLN'S SHAVING MIRROR

(Continued from page 120)

and drum sanding to bring the edges down to the layout lines. Form an oval with the pieces and make sure the ends meet perfectly.

Spot centers for two dowel holes in both ends of each piece. Bore the holes and cut eight 1-in. dowels. Glue them into place, assemble the frame parts and clamp overnight.

You can make a marking gauge to assure uniform molding width using an ice cream stick, dowel and pencil.

Bore a 1/4-in.-dia. hole in the ice cream stick and force-fit a 1-in.-long dowel. Measure from the edge of the



The lid of the storage box is mounted with brass hinges. It is cut to overhang the box front, following its contours.

dowel and make a mark on the stick equal to the desired frame face width. Bore another hole in the stick at the mark, just large enough for a pencil point. Position the marking gauge with the dowel against the inside edge of the frame. Run the dowel around the inside edge of the frame to scribe a mark for the outer edge. Sand the frame down to the mark with a disc sander.

We used a pin router to shape the frame molding. This requires preparation of a jig. Use the outer edge of the frame to trace an oval on a piece of scrap stock measuring approximately 1 x 10 x 11 in. Cut the oval out with a band saw, being careful to stay just outside the line. Use a disc sander to sand down to the line and smooth the jig edges uniformly.

Measure the width of the frame face and determine its exact centerpoint. Set up a portable router with a straight face bit 1/32 in. larger than the diameter of the guide pin, and a fence.

Guiding the fence on the outer edge of the jig, make a plunge cut in the back of the oval and cut a groove all around, equidistant from the edge. Bore and counterbore six evenly spaced pilot holes for nails in the back of the jig. Nail jig to the back of the mirror frame.

Cuts for shaping the frame were made with core box, rounding-over and cove bits. The series of cuts required were made with bits chucked into a

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lathe (for edge-shaping) and the pin router (for face-shaping).

Although they speed up the shaping process, expensive, sophisticated tools are not necessary for the mirror reproduction. The original frame was shaped by hand, probably with a device called a scratch stock (see *8 Homemade Tools You Can Make For Practically Nothing*, page 202, Apr. '76).

Finishing

After shaping the frame, sand it, once with 120-grit paper and again with 220-grit. Use a tack cloth to remove dust.

Make a mixture of one part lye to four parts water. Wear rubber gloves, goggles and a respirator for protection.

Test the solution on a piece of scrap mahogany to determine how long it takes to produce the desired rich color. If the duration is shorter than 15 minutes, dilute the solution with water to give yourself enough time to work.

Apply the solution sparingly to all wooden mirror parts with a brush or cloth. Repeat applications if necessary. To stop the darkening process, wipe off the treated surfaces with warm water.

Final assembly

After final sanding, glue and nail the box support to the underside of the box, then measure and mark the locations of the two shelves on the back panel. Mark positions for the brads for attaching the shelves on the face of the back panel. Bore pilot holes and glue and nail the shelves into place.

Lay out the position for the storage box on the face of the back panel and spot the locations of brads for attaching it.

Bore pilot holes for two 1-in., No. 7 screws through the rear of the back panel and into the ends of the box front. Apply screws through the back panel.

Position the frame on the back panel and clamp it. Drill pilot holes for nails through the rear of the back panel and into the frame. Apply glue to the back of the frame and nail it in position, using the pilot holes as location guides.

Cut a piece of 1/2-in.-thick Styrofoam to fit inside the mirror frame. Place it in the frame and lay the mirror on top.

Heat a flat brass strip with a propane torch and bend it to serve as a retaining ring for the glass. The ring will sit in the frame on an angle, so the ends that meet to form the seam must be angle-cut. Bore small, evenly spaced holes in the ring and attach it to the frame with brass brads.

When assembly is complete, apply two coats of orange shellac. When the second coat is dry, rub lightly with 4/0 steel wool. Tack off and apply a final coat of shellac. **PM**

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7 TIPS FOR A CLOSE SHAVE

(Continued from page 107)

protects the hair root beneath your *stratum corneum* tends to rise toward the surface overnight. If the oil dries, it forms a wax-like plug at the skin surface.

These plugs often turn into blackheads—merely unsightly in a teenager but absolute murder to a shaver. To remove a blackhead, all you need do most of the time is scrape with the towel.

When *Popular Mechanics* Home and Shop Editor Harry Wicks received a facial at New York's exclusive Christine Valmy salon, a skin expert spent 10 minutes hunting for bumps and shaving scars. With a rotating brush, she gently ground away facial wax. Unfortunately, some facial bumps won't come loose without the help of a blackhead remover. The devices are pencil-thin, silver-colored tubes with a sharp poking point concealed inside. Press the open end of the tube against the blackhead, and the tiny poker will gently dig out the wax.

3. **Get into hot water**—it's the very essence of surviving a really close shave. If you use a razor, hot tap water should be run over the blade, your fingers and your face. Even with an electric, heat will bring the cutting edge close to the skin with a minimum of destruction. (But dry vigorously before putting an electric shaver to your face.)

Shower before shaving

If you shower in the morning, do it before you shave. That will give you extra time on your feet and will warm up the pores on your face.

Facial hair is longer beneath the surface of the skin than it is above the surface. When you apply heat to the skin, the pores open, letting your razor—mechanical or electric—lift the hair partially from its socket. More of the hair shaft is cut and you get a closer shave. Even better, the heat makes the upward movement of the hair shaft smooth, preventing bleeding.

"If you're shaving yourself, I think the old-fashioned way of applying hard soap with a hot, wet brush is best for your skin," says Matthew Raguso, co-founder of the Atlas Barber College in New York. He and his partner, Leo Galletta, say the hot-towel method barbers use to prepare the face will make it almost impossible to cut yourself while getting the closest shave possible.

4. **Use the best soap** for your skin. That might involve using a special soap for washing before you apply the shaving lather. You can say your skin is oily if you frequently have blackheads. To treat such skin, lather your face with potash soap or green soap before apply-

ing shaving lather or using an electric. Don't let the soap remain on your face long. It leaches oil from your skin and prolonged application could cause roughness and make it too easy to cut yourself.

If your skin is dry (you frequently get whiteheads, also called milia or "facial dandruff"), wash before shaving with super-lanolin or super-fatted soap to soften the skin. (These soaps don't work with very hard water.)

For normal skin, all the dermatologists recommend pure soap, castile soap, or transparent soap. If you feel your skin is so rough or tender as to require medicated soap, see a dermatologist. Several skin diseases will go away simply by letting the face alone for a few days. Others may never go away, in which case the dermatologist may recommend you grow a beard.

Men of Mediterranean descent, as well as blacks, are subject to a shaving ailment known as *pseudofolliculitis*. In this disease the hairs become curved, turning back toward the skin. The end of each hair shaft pokes into a pore, which then shuts around the hair. Shaving causes a pulling and tearing at tissue beneath the skin's surface and the face can become extremely irritated. Several specialized electric razors are on the market, but most victims opt for growing a full beard or removing the hair with a depilatory, a cream or powder similar to the type that's very popular for removing hair from women's legs. (All the dermatologists we interviewed said depilatories are harmless to facial skin. Why don't more men use them? Most dermatologists think it's a question of macho: Who wants to put the same stuff on your beard that goes on a woman's legs? Others say there is a mild irritation of the skin. Then there are the sulfur depilatories which are used to break down the hair's keratin protein. Their gunpowder scent is hard to mask.)

Leave it on long

5. **Leave shaving cream on** for a long time. The experts say 15 minutes couldn't hurt. The longer the soap stays on your face, the softer the hair becomes. For this story, I tried shaving with the cream on my face for 30 seconds, two minutes and five minutes. Two minutes was about as long as I could go without feeling ridiculous. As it turns out, that's the ideal time for most shavers, according to industry research. I cut myself shaving at least once a week before doing this article, but when I followed the shaving cream tip, I didn't cut myself once in a month of shaves. Shaving cream should be applied with warm fingertips moving in a circular path *against* the grain of the hair. If you still cut yourself after trying

Tips 4 and 5, put a little skin cream on your face before applying shaving cream to help lubricate the blade. (Some shaving creams contain a lubricant.)

6. Use proper strokes with straight razor or safety razor (see story on page 107 for the best methods for electric shaving).

Barber school manuals stress that the sharp edge of the blade should always be leading in the swipe at the beard, never dragging. Even when your hand is pulling the blade, the edge should make first contact with the hair. Normal hair generally grows out of the face at a slight angle, and barbers suggest you go with the grain to get the best results. They also suggest that you use long strokes, as opposed to choppy motions.

7. If once isn't enough, and your beard is so tough that a second go-round might be required, touch up just the areas that are the heaviest. Continue shaving with the grain. Some patients of the dermatologists we interviewed thought they'd get a closer shave by going first with and then against the grain. But that method generally roughens the skin and spreads infection, if it exists in the first place.

To shave or not

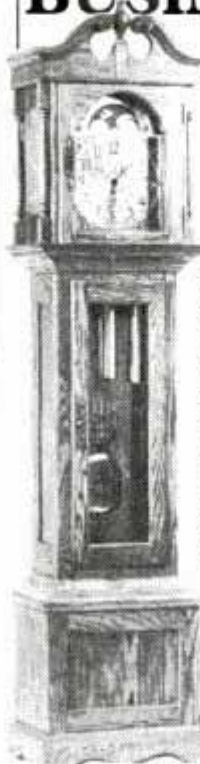
To my surprise, in several weeks of interviews with some of the nation's best dermatologists, I found that little knowledge exists about the effects of shaving or not shaving. For instance, although all doctors know that exposure of the skin to the sun may cause skin cancer in Caucasians, none could say with certainty that growing a beard would prevent skin cancer.

"If you grew a beard at the earliest possible point in your life and kept it permanently, there would be some protection for that skin—but how much is hard to say," says Dr. David Bickers, chairman of the dermatology department at Case Western Reserve University in Cleveland.

If growing a beard doesn't have a proven medical value, neither does shaving your whiskers. Says Bickers, "I shave daily basically because of convention." Perhaps that's why so little research has been done on shaving questions. Yet, many dermatologists say more research would benefit millions of men whose lives are made miserable by the daily struggle with their facial hair.

If you've got a shaving problem we haven't covered in this story, drop us a line. We can't answer your letter personally, but we'll do a follow-up to this story, answering the most popular questions. Address your letter: Close Shaves, Popular Mechanics, 224 West 57th St., New York, N.Y., 10019. **PM**

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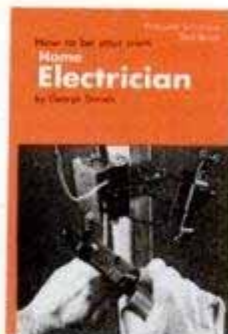
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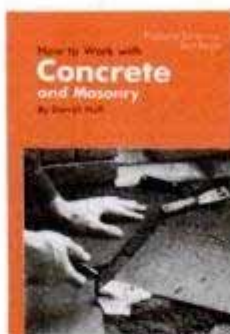
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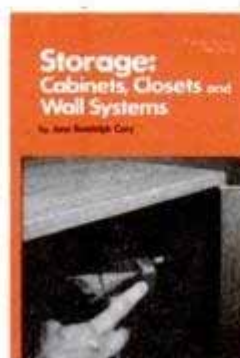
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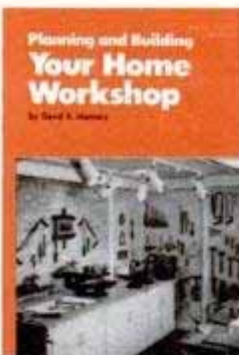
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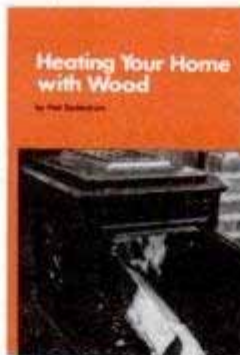
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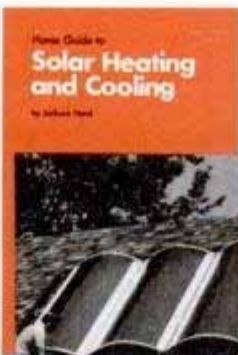
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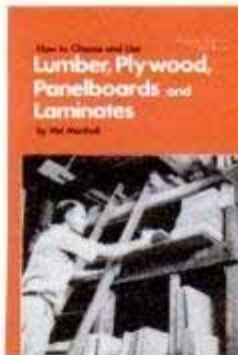
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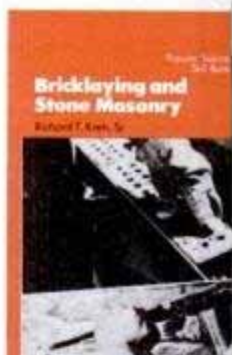
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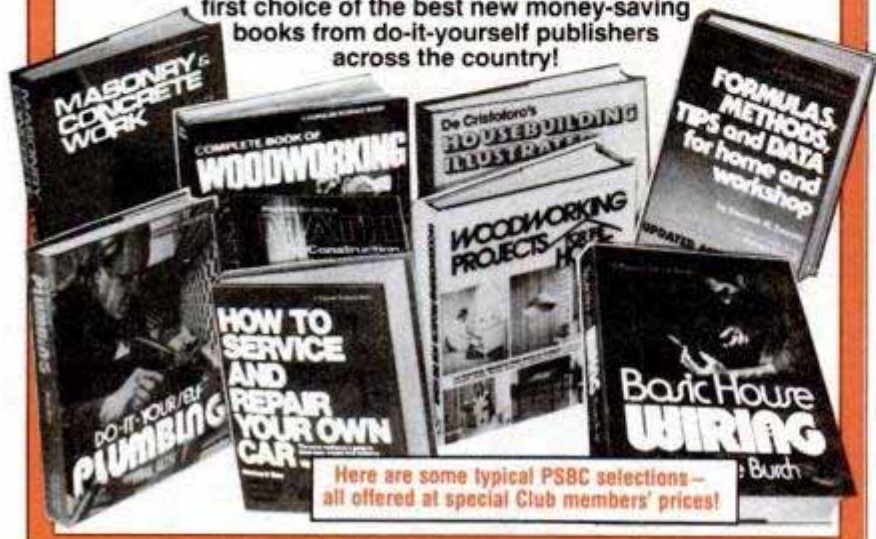


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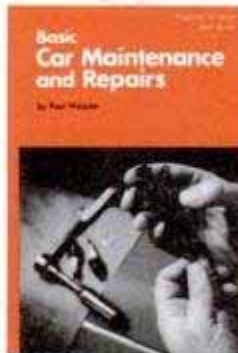


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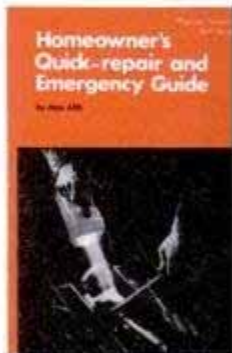
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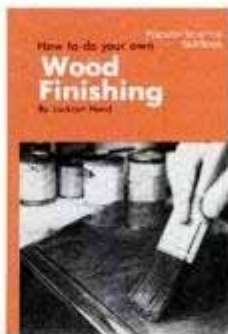
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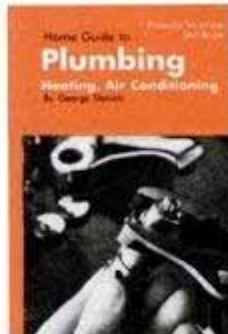
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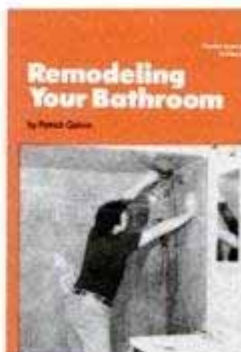
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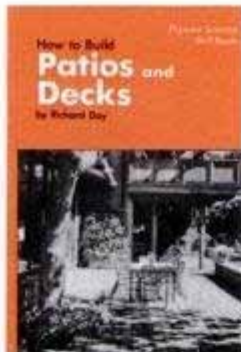
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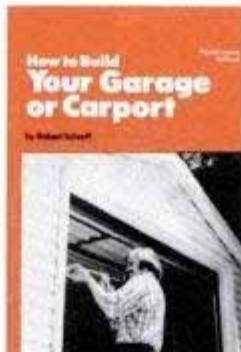
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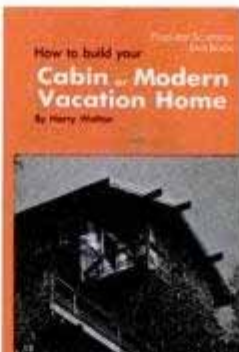
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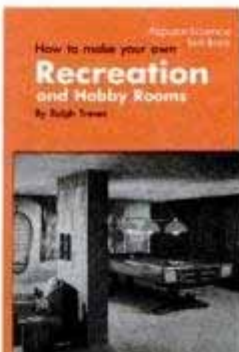
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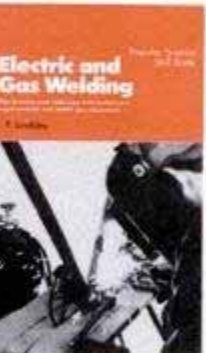
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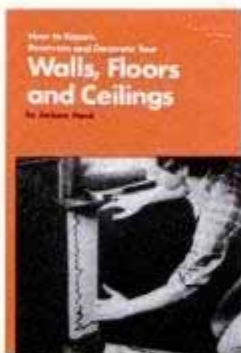
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FREE-STANDING

(Continued from page 110)

up three 4/4 × 10 × 36-in. boards.

Draw a full-size leg pattern, including the parting-tool, depth-gauging cut outlines. Mark the turning blanks to indicate the square shoulder sections. Mount the blank on the lathe and use a skew chisel on edge to nick the shoulders. Use the spear-point chisel to start the shoulder cut; alternate with a gouge to rough-round toward the shoulders.

For consistency, mark the gauge groove cuts on a length of straight stick and transfer the marks to each leg. Use the parting chisel and caliper to cut the grooves. When the first piece has been grooved, use it as a model to set the calipers for grooving the other three blanks. Guided by the sizing grooves, use the spear-point and skew chisels to shape the cylinders.

To shape the long tapered section, clamp the skew to a block of wood and ride the assembly against the tool rest. Angle the tool rest and the front edge of the chisel so both are parallel to the required taper. Cut a groove in the holding block to seat the chisel. Finish-sand the legs progressively with 80-, 100-, 120-, 180- and 220-grit abrasive paper.

Edge-joining boards

Make the slabs for the tabletop (D) and the shelf (E) by edge-joining three boards for each slab using glue and 3/8-in. dowels. Use a doweling jig carefully to bore the holes with accuracy.

If you plan to use the stand for its original purpose, or as a planter, assemble the top slab with plastic resin glue. (Assemble all other joints with faster-setting carpenter's glue.)

Close the joints with four bar clamps. However, don't tighten them fully until you've clamped four wax paper-lined cross supports with C-clamps to ensure

a true flat plane. Notch the shelf slab at the corners.

Make the cutout for the bowl with a sabre saw or scroll saw. An accessory pivot guide for the sabre saw will do a good job, provided you use a set-tooth blade. If you use a scroll saw, drive a pivot nail into a scrap board. Bore a hole in the work centered on the cutout so the work will slip-fit over the nail. Position the pivot at the radius dimension of the cutout and *in alignment with the front edge of the blade*; clamp the scrap board to the saw table. Bore a blade entry hole and insert the blade.

WALL-HUNG SHAVING MIRROR

(Continued from page 110)

drawer parts with 80- and 120-grit abrasive, dusting and wiping between sanding.

Completing the job

Prime all parts with a pigmented shellac such as Enamelac or Bin. After sanding with 220-grit abrasive and dusting, apply paint.

Cut the mirror to shape, or have a

glazier cut it from a pattern. Position the mirror, back it with cardboard (J) and secure the assembly with glazier's points (X). Fasten the mirror frame and ceramic knobs in place.

Bore holes through the case back behind the drawer. Mount the unit on the wall with toggle bolts (Y) and large flat washers, or other suitable fasteners.

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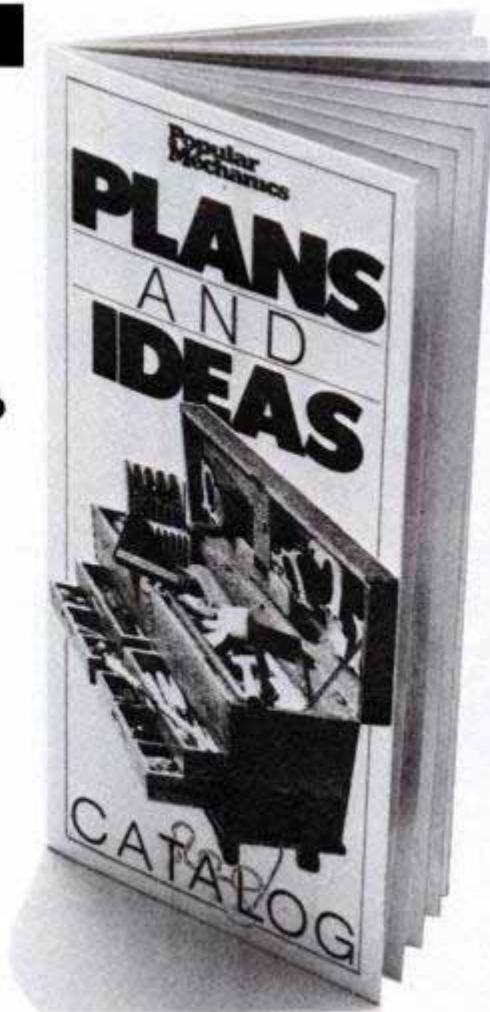
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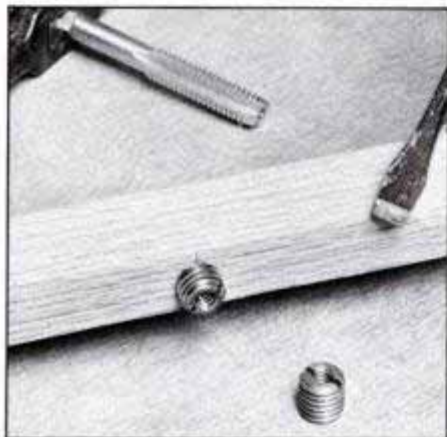
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Shaping the aprons

Cut the aprons (F-1 and F-2) to size. Bore their dowel holes and bore matching holes in the legs. Cut apron curves on a band saw; sand, then round the lower outside corners with a $\frac{3}{8}$ -in.-radius corner rounding-over bit in a router.

Join a pair of legs to the front aprons and a pair of legs to the back aprons; allow the glue to set overnight. Temporarily use eight smooth dowels sanded so they slip-fit the holes in one set of legs. Apply glue to one end of the side aprons and the mating surfaces of the remaining set of legs, and assemble with grooved dowels. Position the pair of legs with the removable dowels (and without glue) to the free ends of the side aprons. Apply clamps. When the glue has set, remove the free leg unit and discard the dowels.



Threaded inserts lock the mirror in an adjusted position. A tap with matching threads cuts threads into the wood.

Now tie the shelf into place with twine and glue the second pair of legs into place with regular dowels. Next, glue and clamp the shelf in place. Later, glue in the glue blocks (K, L).

Shaping the mirror yoke

Edge-join the mirror yoke sides (A1) and base (A2) to form a U shape; reinforce the joints with dowels. Cut the flat surfaces that adjoin the mirror frame and the lower straight cuts on a table saw; then cut contours on a band saw.

Smooth the outside curves with a disc sander, the inside curves with a drum sander. Use a router with a rounding-over bit to shape the corners; note that the rounds are stopped in the area opposite the knobs. Cut the side rails (B) and clamp them to the yoke. Bore screw pilot holes, counterbore for wood plugs (U) and bore for the screw shank. Temporarily join the rails to the yoke with screws; then position the assembly onto the unattached top.

Mark the top for gluing and for screw holes. Bore the screw pilot holes into the top. Clamp the yoke assembly to the top and use a portable drill to continue boring holes into the edges of the yoke assembly. Then glue the top to the legs and plug the holes. On a drill press bore holes in the yoke for the knob hanger bolts (R).

Glue up the rectangle for the mirror frame (C) and cut it to shape. Before rabbeting the recess for the mirror and

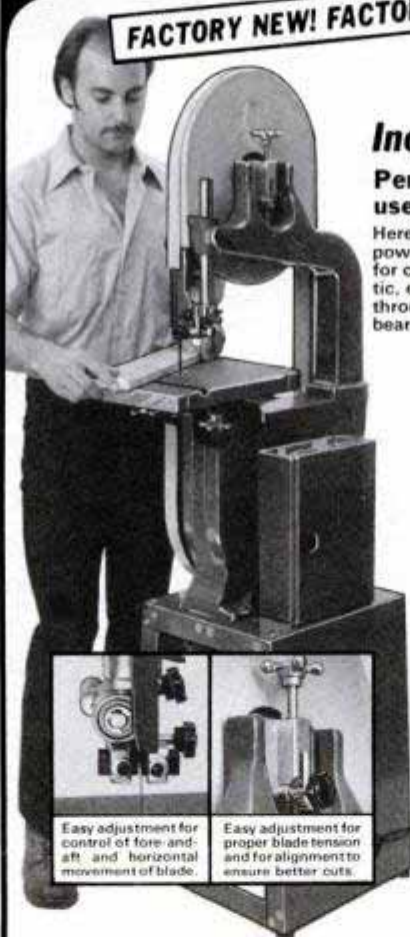
rounding the front, bore holes for the threaded inserts (Q). Use a $\frac{27}{64}$ -in. drill bit. Then use a $\frac{1}{2}$ -12 tap to match the outer insert threads to cut threads in the wood so it won't split.

Applying the finish

Apply natural paste wood filler to the open-grained oak following the manufacturer's instructions on the label. This is followed by two coats of Deft Semi-Gloss Clear Finish. **PM**

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REPAIR AN ELECTRIC SHAVER

(Continued from page 112)

armature. If all of the above check okay, the problem is probably in the field assembly. Remove it by loosening the two diagonal screws securing it to the body. Carefully pull the black, gray and red wires from the terminal block and lift out the assembly. At this point, check the gears and bushings for wear. Unsnap the sideburn trimmer and



4 Pull down to take off motor assembly.



5 Use a screwdriver to remove the plate.



6 Remove motor cover for inspection.

remove the three screws in the bottom of the shaver. Examine all the gear teeth and look for play in the bushings. Replace any worn or defective parts, and clean the shaver of all hair and dust. Then, lightly lubricate the gears with an all-purpose grease and reassemble and test the shaver.

Servicing the Remington

The Remington shaver is a little easier to test, but it is necessary to have a voltmeter handy. First test the charger by plugging it into the wall, and placing



7 Remove the battery and test it with the voltmeter probes across its terminals.



8 Test motor for continuity by placing probes across the two motor leads.

both probes of the voltmeter across the charging terminals (female sockets). The voltage reading should correspond to the nameplate rating on the charger; if not, replace it. Remove the head assembly, and place a small, flat-blade screwdriver between the outer shell and the motor housing. Make sure the screwdriver is on the front side of the shaver, behind the knob. Carefully pry the outer shell away, while pushing the motor assembly down. Next, remove the plate and motor cover. Inspect all electrical connections.

Remove the battery and place the voltmeter probes across its terminals. A reading of approximately three volts should exist. If not, or if the shaver runs slow, replace the battery.

Test the motor for continuity by placing the two voltmeter probes across the two motor leads. Make sure the selection switch is turned to the ON WITHOUT CORD position. A defective motor won't register a reading, and the entire housing would have to be replaced. If the battery, motor and all electrical connections check out okay, and the shaver still does not work, then the problem is in the main switch. If the switch is faulty, the entire motor assembly must be replaced. Finally, clean the entire shaver and reassemble.

A good source for factory-authorized parts and service on electric shavers, as well as other small appliances, is Boulevard Brunswick Appliance Service Inc., Rte. 18 and Milltown Rd., East Brunswick, N.J. 08816. When writing or calling for parts or service, give the brand name, model and serial number for each product.—Ed Franzese

THE FIVE FRIENDLIEST COMPUTERS

(Continued from page 97)

for children generate video displays that are works of art.

The TI computer also provides a unique feature: In many areas of the country, TI runs a computer school which it calls a club. For more information on the computer course, phone 1-800-858-4069.

Atari 400

The Atari 400 is a color computer with 16K of RAM that can be expanded to 32K. It does not come with a built-in version of BASIC. Instead, the computer has a compartment into which a ROM module, that Atari calls a "cartridge," can be installed.

There is an enormous selection of programs available in cartridge form—selections ranging from superb arcade game simulations to foreign language training and musical composition. BASIC, which is available in a ROM cartridge, provides access to color graphics and a music synthesizer.

Atari's optional cassette recorder is also available as part of an "Educator package" that includes the Atari BASIC cartridge. The cost of the minimal entry-level computer package includes the computer and the BASIC cartridge.

The Atari 400 has connectors for four joysticks or game controllers (other computers handle only two). There is a direct output for a 40-column printer. An 80-column (standard) printer and a communications modem require a special interface module.

A major difficulty with the 400 is its keyboard. Though it's styled like a conventional typewriter, it's actually a membrane keyboard on which the keys have been printed and indented to provide the feel of standard typewriter keys.

Considering the cost of the 400, you should try it before you buy it. The higher priced 800 might turn out a better investment if you plan to expand your system—particularly if you'll be using it for business applications.

Radio Shack Color Computer

The Radio Shack Color Computer was initially released in three versions to cover everything from the entry-level user to what Radio Shack called the "serious user." Currently, only two versions are available, a model with something called "Color BASIC" and a model with "Extended Color BASIC." Both models have 16K RAM, but can be expanded to 32K or purchased initially with 32K.

"Color BASIC" is BASIC with color commands. It is quite extensive and serves as an excellent training aid for

someone interested in computer-aided graphic art. Extended Color BASIC provides sound and high-resolution displays.

Otherwise, the Color Computers are identical. They have a typewriter-style keyboard, but without typewriter keys. The keys resemble the large button-keys used on large calculators.

The Color Computers can be used with any inexpensive cassette recorder, and there is a connector on the side for ROM modules. Radio Shack has a moderate selection of modules available, ranging from games (an excellent computer chess) to a difficult-to-learn word processor. In between are a touch-typing course, children's games and others.

Much better software is available on tape because there's a large selection of excellent software both from Radio Shack and from aftermarket software houses.

The Color Computer has connections for joysticks, a printer (several models are available) and professional-type accessories.

When it comes to computer manuals provided by the manufacturer, Radio Shack has an outstanding reputation. The Color Computer instruction book is no exception. The problem with the Color Computer is that it's more than you need for entry level—as is the price. It's really just short of something that could serve as the foundation for a small business computer.

Truth about ROM

Most computers are specified as having a certain amount of ROM (read only memory) in addition to RAM. Often, the ROM (number of bytes) exceeds the RAM. ROM is a "factory programmed" (fixed) memory that contains the BASIC language and any operating systems required by the computer. *The size has no real bearing on the computer.* As long as what you want and need is in ROM, you're okay.

With the exception of the Color Computer, the entry-level computers are expensive to expand and you don't really wind up with something as easy to use as a "standard" personal computer. If you want to *learn about computers* the entry-level models are all excellent for their price. If you decide you then want a full-blown personal computer, start anew with a "standard" personal computer, such as the Apple, Heath/Zenith, IBM, TRS-80 Model III or Osborn.

In the long run, it will be a lot less expensive to start over, and you'll end up with the exact computer system you want and need. **PM**

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PM'S FOUR-CAR TEST

(Continued from page 85)

next payment is due, and an excellent four-speaker electronic stereo with cassette tape player and built-in graphic equalizer finishes off the appointments.

Also standard are power mirrors, windows and door locks, the latter with a unique-to-the-American-industry feature: unlocking the driver's door with the key automatically unlocks the other three. But the STE's most unusual features are a valve in the trunk that lets you use the electronic ride control's on-board air compressor to inflate a tire, beachball, rubber boat or whatever, and an accessory kit that includes everything you need to do it. There are flares, a first-aid kit, even a rain parka to keep you dry, and moist towellettes to clean your hands.

All of GM's A-cars give outstanding ride and handling and are quiet, comfortable and nicely designed throughout. This very special A-car is all that, in addition to being fast and exceedingly fun to drive. All it needs is a tachometer and a five-speed manual transmission (not yet available) to be a real four-door sports car.

Its manners on both road and track are impeccable. The car is stable and neutral on or off the power, except for a disconcerting tendency to lock up one or both rear tires under hard braking from high speed. Pontiac offers a stiffer Y99 suspension as a 6000 option, but the STE's slightly softer riding setup does fine.

Our only major gripes are with the interior design. Though the STE has the most complete set of auxiliary instruments in this group, they're rectangular in shape—serious driver's car dials should be circu-

lar, with finer gradations—and they're lined up way over to the right out of the driver's line of sight.

There's a small console bin sectioned off for cassette tapes, a coin holder and a deep box under the center armrest. But the mail slot that passes for a glovebox won't even hold your radar detector, and the pockets on the lower front door panels aren't good for much but maps.

Still, Pontiac's STE is a noble first effort and a very close second in performance and handling to the lofty Audi—for \$7,000 less.

Buick Century T-Type

This is but one of five T-Type Buicks, ranging from the fwd Skyhawk J-car to the turbo V6 Riviera, all aimed at the Euro-sport buyer. But in our book, the Century is the best in terms of value for money. It lacks most of the Pontiac's gewgaws and gimmicks, but costs some \$3,000 less in base form.

The Century T-Type has superclean styling, inside and out. For one thing, it's completely devoid of chrome on its flanks and tail, out-Europeanizing even the Europeans, yet not at all plain-looking or underdecorated. It also has no protective body side molding, a negative to us. You can have it in two- or four-door form in any color combo as long as it's silver over charcoal.

Standard front seating is a 45/45 split bench. Our test car was equipped with the same optional, multiadjustable Lear-Siegler buckets found in Camaros and Firebirds. These are a bit overpadded in the center seat and back areas, but otherwise excellent for cornering.

A terrific leather-wrapped, three-

PM'S FOUR-CAR TEST—SPECIFICATIONS

	AUDI 5000 TURBO	BUICK CENTURY T-TYPE	DODGE 600 ES	PONTIAC 6000 STE
Price—Base As tested	\$19,045 \$20,905	\$10,178 \$13,972	\$9,372 \$13,025	\$13,572 \$13,867
Engine	SOHC 2.2-liter in-line-5, turbocharged, 130 hp	OHV 3.0-liter V-6, carbureted, 110 hp	OHV 2.2-liter in-line-4, carbureted, 94 hp	OHV 2.8-liter V-6, carbureted, 135 hp
Transmission	3-speed automatic/lockup	3-speed automatic	5-speed manual (overdrive in 4th and 5th)	3-speed automatic/lockup
Suspension (front/rear)	Independent/beam axle	Independent/beam axle	Independent/independent	Independent/beam axle
Brakes (f/r)	Disc/disc	Disc/drum	Disc/drum	Disc/drum
Wheelbase	105.5 in.	104.9 in.	103.1 in.	104.9 in.
Length	188.9 in.	189.1 in.	185.6 in.	188.8 in.
Width	69.6 in.	67.2 in.	68.3 in.	67.2 in.
Height	54.7 in.	53.6 in.	52.9 in.	53.7 in.
Track (f/r)	58.1/57.2 in.	58.7/57.0 in.	57.6/57.0 in.	58.7/57.0 in.
Weight	3,040 lbs.	2,875 lbs.	2,564 lbs.	3,000 lbs.
EPA mpg (city)	18	20	23	22
Note: All four cars are front-engine, front-drive types with transverse engines, except for the Audi, which has a longitudinal engine. All are four-door sedans.				

spoke steering wheel is standard but auxiliary instruments—voltmeter and water temperature—are optional. As in the Pontiac, these are rectangular in shape and more family car than sports car in character. But at least they're neatly grouped in front of the driver.

Easily the Century T-Type's worst interior feature is its very unспорty automatic transmission column shifter. The shift quadrant is cleverly disguised as a gauge, up high and offcenter to the right. We couldn't find it at first.

Other standard equipment includes a very good Gran Touring suspension, quicker-than-stock steering, heavy-duty brakes and styled aluminum wheels. Unfortunately, those wheels wore a set of very ordinary, nonaggressive 195/75 R14 radial tires. Also unfortunately, the whole lovely package is motivated by Buick's lackadaisical 110-hp, 3.0-liter V6.

The Buick was easiest of the group to drive at its limit, turning into corners on demand, generally going where it was pointed and remaining stable and highly controllable at all times. One reason, though, was because it was going much slower at any given point than the rest.

Sadly, the Century's power train can't live up to its snappy looks and happy handling feel. Even with a specific-to-the-T-Type 2.97:1 final drive, the engine feels lazy on the road and sluggish on the track. Worse, its three-speed automatic transmission is hampered by fuel-mileage-oriented ratios and low shift points. In the sharper turns, and especially uphill, the thing downshifts momentarily, then jumps right back up to a more leisurely gear. Its road course times were more than eight seconds slower than Pontiac's and nearly 10 seconds slower than Audi's.

This car is a handsome piece and a good value at about \$10,000, possessed of all the GM A-cars' fine traits and then some. But most of its better equipment is optional, and it cries out for the STE's HO engine, modified transaxle and fat, aggressive tires.

Dodge 600 ES

You've seen the Dodge ads with the 600 ES in front of Mercedes, BMW and Audi sedans, with "38 out of 50" automotive engineers picking the Dodge as the better car. Well, they must have been factoring price into the equation and giving it double points. A 600 ES is less car than an Audi, and not even in the same league with a Mercedes.

On the other hand, the 600 ES isn't a bad car at all. It handles with lovely neutrality, gets excellent fuel economy for a car of this type and seems very well put together. It's like Chryslers from 20 years ago—well-engineered, sturdy, good-handling cars with conser-

(Please turn to page 136)

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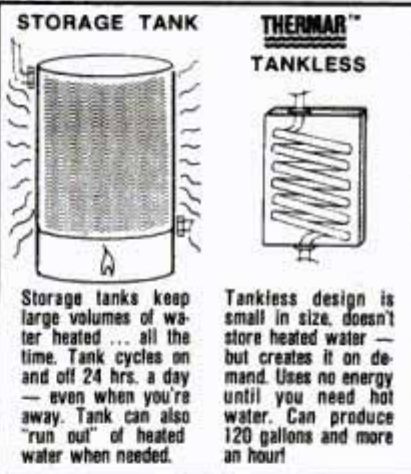
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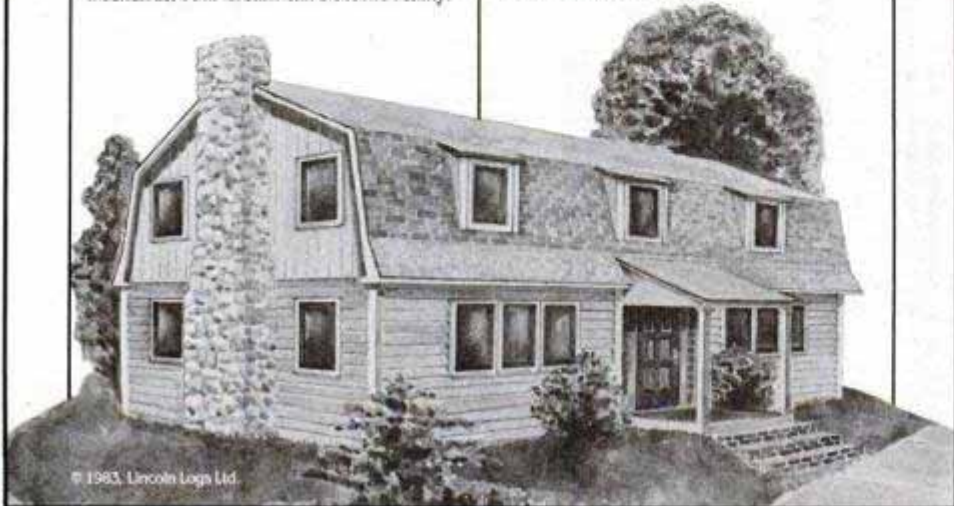
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PM'S FOUR-CAR TEST

(Continued from page 135)

vative styling and ho-hum interiors.

Dodge offers two powerplants in the 600 ES front-driver—a 2.2-liter Four coupled with either a five-speed manual or an automatic, and the 2.6-liter, Mitsubishi-built Four available only with the automatic. Our test car had the 2.2-liter motor with the manual five-speed. This motor makes 94 eager hp and feels quite lively.

Chrysler is the only domestic maker manufacturing its own five-speeds, and the 600 ES was the only car in this test offering any manual transmission at all. If you like shifting your own gears, the 600 ES is your only domestic choice.

The lone sporty member of Chrysler's new E Class sedan family, the 600 ES offers the obligatory blackout trim, handling package, fat Goodyear Eagle NCT tires on aluminum wheels, a tastefully trimmed interior with reclining front bucket seats, sport steering wheel and a console with two storage bins.

Also standard is a neat 11-function voice alert warning system that reminds you of everything you should know in a very courteous and human-sounding computer voice. It even says thank you.

The car's road course performance was surprising: only 2.5 seconds slower than the much more powerful Pontiac. This is due to the K-car-based chassis's excellent balance and the glue-like grip of the beefy Goodyears. The manual five-speed also makes it extra fun to toss around the track. It lets you select the right gear for every situation, though its cable-type linkage could be more precise.

Things are not so happy in the interior ergonomics department, though. The rear seat area is quite roomy even for tall, long-legged passengers. But this second cabin room comes partly at the expense of front-seat adjustment travel. A six-foot driver will find his legs a little cramped and the steering wheel too close for serious driving.

The K-based instrument panel is hopelessly outclassed in both appearance and function. It's basically a wood, wallpapered slab with a speedometer and fuel gauge in front of the driver, radio and heater in the middle and two little pull-out bins masquerading as ash tray and glovebox.

The 600 ES, though not unattractive, is no match for the Audi or the handsome, wedgy GM A-cars in exterior styling. But it's definitely fun to drive, a veritable scrooge in fuel economy, even during lead-footed track testing, and a relative bargain at under \$10,000. If lower price and fuel economy are priorities on your sporty sedan shopping list, this may be your best bet. **PM**

THROWAWAY CAR

(Continued from page 95)

welders. The assembled stampings must then be rustproofed and painted; the suspensions are bolted on; drive line goes in; then there's insulation, soundproofing, wiring, trim and upholstery; finally, inspection and release of the finished car.

A Camaro or Thunderbird takes about 36 man-hours of labor to build, from the time the stampings are assembled to the moment the finished car rolls out the door. This doesn't include the time required to build the motor, transmission and all the various sub-assemblies like the suspensions, seats, wiper motors and so on. These sub-assemblies come to the final assembly plant complete and ready for installation.

Those 36 hours of assembly time are what the world's automakers are focusing on to reduce the cost of producing a car, and ultimately the cost of buying one. Their goal is to build a car in an incredible 10-hour period. But for that to happen, fundamental changes must be made, beginning with the very concept and nature of what makes up a car to a change in materials and how those materials are crafted and assembled.

Time Frame Construction

The process of reducing assembly time, simplifying the components of a car and streamlining the entire process is called Time Frame Construction (TFC). The process will allow a carmaker to build smaller assembly plants, use fewer individual components, ease the cost and time of transporting sub-assemblies and, naturally, reduce the amount of manual labor.

This process has already begun. A few Japanese carmakers have reduced assembly time to around 20 hours. These cars, however, don't meet the strict U.S. safety standards for collision protection, and therefore aren't available for sale in this country.

Cost reduction, however, has to be accomplished without a sacrifice in the qualities customers have come to expect in their cars. Look carefully at the illustration on page 94. The 10-hour car is a collection of old and new ideas combined in a unique way with a unique objective. Time Frame Construction is used to produce a finite automobile, one with a preset, known service life beyond which ownership becomes prohibitively expensive. Replacement of components, rather than repair, is a process already underway. It will become more common as assemblies become more complicated and labor costs accelerate.

These are some of the proposed details of the 10-hour car.

The wheel-tire-hub-brake rotor will be one piece. Goodyear sees no reason why these can't be manufactured. A one-piece tire/wheel already exists. Combining of components results in lighter unsprung weight, contributing to better handling. Tires can be coated internally with sealant before bonding to the wheel-hub assembly, removing the necessity for a spare and further saving weight and space. Light weight, moderate power and modern radial tire technology will combine to keep the same tires in service for the 75,000-mile expected life of the car.

Suspension units will be similar to those used on some Fiats dating as far back as the mid-30s. A tubular alloy housing will enclose coil spring, shock absorber valving and a nitrogen chamber. The lower control arm will pivot from the bottom of the assembly, while the upper control arm will have a rocker arrangement. The inner end of the rocker will compress the internal spring/shock assembly.

The units are essentially identical at all four corners, saving production cost, and can be hydraulically linked to provide rising rate compliance, load leveling or rate balancing.

The engine shown uses a die-cast block of Reynolds 390 aluminum alloy (like the Vega and Porsche 928). It will have a flat Four configuration, and use a hollow crank and camshaft (like the Toyota Corolla 1500). The distributor is mounted on the end of the camshaft, and a short cog belt drives the cam and water pump. The alternator is driven directly off the back of the cam. It will probably have a flathead valve-in-block design which will mean low levels of NOx emissions. A turbocharger will restore power lost due to the small engine displacement.

Turbo savings

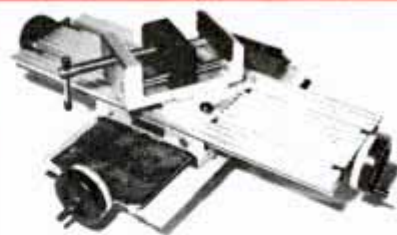
The turbocharger will use ceramic turbine and compressor shells encased inside a stamped steel, rather than forged steel, housing. This process will save weight and drastically reduce the cost of making a turbo, while increasing the efficiency and durability of the turbo. Fuel injection will be used, controlled by a microprocessor.

The chassis and body unit are glued together, allowing the use of composites of light alloy, plastics, zinc-coated and plain steels. Engine and transaxle unit will hang from stressed floor under the rear seat bench. The fuel cell is a stressed box, forward of the engine. The target weight for engine/transaxle unit is 250 pounds total. The radiator is located in the center, alongside the motor.

Door windows are friction-mounted and slide vertically like the Austin Fari-

(Please turn to page 138)

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THROWAWAY CAR

(Continued from page 137)

na A-40 and Lotus Elan S-1. Exterior door hinges will keep door thickness to a minimum. Side crash reinforcements are exposed, but padded, and will double as armrests. Seats are tubular-frame with snap-on, foamed fabric covers similar to Citroen 2CV or lawn furniture. Dash padding might be semi-pneumatic with additional semi-pneumatic pads to combine with a passive belt assembly (English Ford patent) to provide a remarkably safe interior in a light, impact-absorbing, deformable structure. Gluing body panels together is already in production and used on some body panels in a few Ford cars.

Integrated soft fascias front and rear can absorb nearly all of 2.5 mph impact without resorting to Menasco-style telescoping struts, which "take over" at higher impact levels. Left and right doors have interchangeable skins and frames. Front and rear fascia assemblies also interchange.

LED instruments

Rear lights and front parking lamps are body color when off (a Carello development), and glow red, amber or clear when on. All instruments are LED, more compact and lighter by far than possible with electromechanical units. A single windshield wiper (Lotus Esprit, VW Scirocco) clears the windshield, which is glued in place to very slim A-pillars. The windshield doesn't have as much rake as is sometimes fashionable, but does act as a careful aerodynamic transition from the short sloped nose. The windshield also has considerable wrap ('48-'54 Hudson, Saab 99, 900) to ease airflow around pillars instead of over roof. The drag coefficient is not extraordinarily low (.37-.40 range), but combines with low frontal area to give low total drag at cruising speed.

GM is working with a Japanese maker to develop a 10-hour automobile. TFC techniques are now being studied in Japan, and being developed here.

Will a manufacturer ever actually admit to producing a car with a "finite" life and hope to sell any? That's tough to say. You can be sure considerable market research money will be spent before a final building decision is made. Certainly, other parts of the world are ready, and the vanguard of this new breed of cars is already on the road. The Fiat Panda and Honda City are good examples of the trend. While they might not have been conceived as having a finite life, they're certainly cast in the mold of TFC process. And who knows? If the price is low enough, a car with a predetermined expiration date might not be such a bad bargain. **FM**

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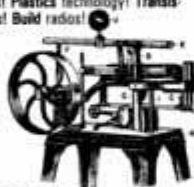
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SCROLL SAW

(Continued from page 100)

fore, a shim is required below each screw to ensure that the top of the angle iron lies on a plane flush with the tabletop. Secure the angle iron, and scratch a centerline across its face in line with the blade. This will serve as a guide for setting the fence to the desired width of cut.

The crosscut guide is designed to ride over the rip fence with a snug fit. Apply a sealer coat of shellac to the wood, then sand and apply candle wax to all contact surfaces. Note that with the workpiece riding on the table, the amount of cutoff is limited to 3½ in. To increase the cutoff to 23½ in., simply rest the workpiece on the ledge of the crosscut guide and place a scrap of wood under the free end for support, as shown in the photo. To accommodate cutoffs of unlimited length, just rotate the table and the chuck 90° to avoid interference with the overarm.

Auxiliary table

While the scroll saw will support work of average size, oversize work can be handled easier and with greater precision once you install a large auxiliary table. The one shown also features a novel circle-cutting device which enables you to cut perfect circles up to 48

in. in diameter. Both the pivot and table incorporate sliding components. This combination is far superior to the typical pivot arrangement for two reasons. First, you don't have to begin the circle from the outside edge, which usually starts the blade off erratically. Second, this pivot does not require a blade insertion hole for starting the cut, which produces a circular depression in the edge.

When using the sliding table, the workpiece is placed on the prepositioned pivot with the table pulled forward. To start the cut, the table is pushed back to the predetermined starting point, resulting in a tangent lead-in cut. When the table comes to a stop, rotate the work to obtain a perfectly circular cut.

Accurate pivoting cuts are achieved only when the pivot is in exact alignment with the front of the blade. This means the pivot must have the capability of being shifted forward or back to match different-width blades. You can accomplish this by installing a simple eccentric stop below the table.

To make this table, start with two pieces of ½-in. plywood 36 in. square. Make the cuts indicated with the exception of the circular cuts, which are made after the two panels have been glued and screwed. Cut the pivot clearance slot after routing the recess for the

pivot bar, but don't cut the blade clearance slot until the two table panels have been assembled.

Two pieces of ½ × ¾ × ¾ × 15¼-in. aluminum angle are used as tracks. Attach these to the left and right edges of the saw table with two 10-32 × ¾-in. screws in tapped holes. The pivot is made by cutting the head off a ¼-20 bolt and grinding one end to a narrow, sharp point. When cutting large circles that position the pivot beyond the table, it's advisable to place a few washers over the pivot so the work rests on the same plane as the tabletop.

Circular segment jig

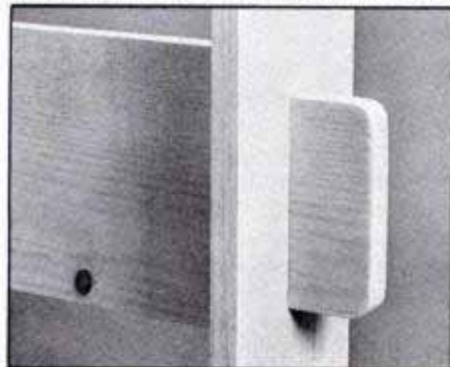
This jig enables you to cut perfectly parallel circular segments. The Y-shaped arm is temporarily tack-nailed onto the workpiece while making the cuts. A longer, nonpointed ¼-20 bolt is substituted for the pointed pivot in this operation. A sufficient number of washers must be inserted over the pivot to keep the arm level with the work surface.

Through mortise/tenon

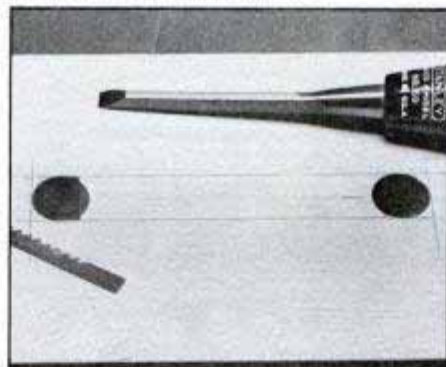
This is usually a tricky and time-consuming joint to produce with the conventional saw and chisel method. But with a simple scroll saw technique, you can obtain precise, clean-cut through

(Please turn to page 140)

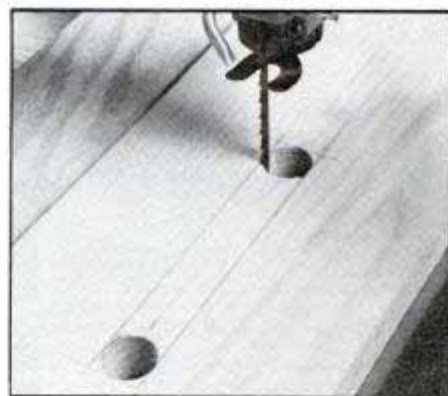
CUTTING MORTISE/TENON JOINTS LIKE A PRO



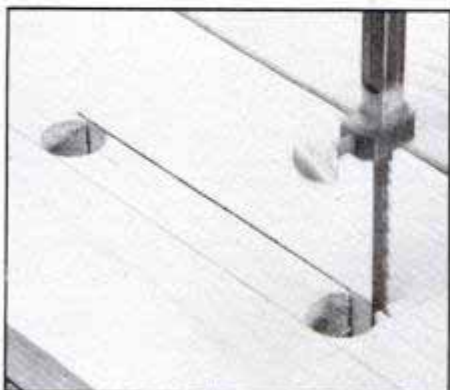
Produce this neat through mortise/tenon joint easily and quickly by employing the scroll saw's reverse blade technique.



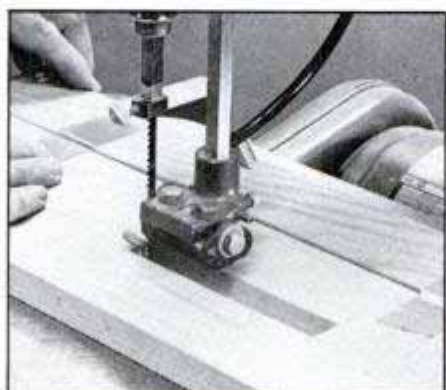
Bore full-diameter holes at the ends of the rectangle. Use a small chisel to cut flats tangent to the cutting lines.



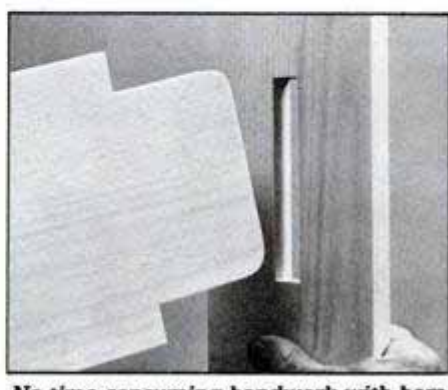
Flats allow the blade to start tangent to the line; cut to the lower cross line.



Blade guide is removed, and a short pass continues the cut to the upper cross line.



Tape the workpiece to the rip fence, and carefully scrape-saw out the fillets.



No time-consuming handwork with hammer and chisel was needed for this top-quality through mortise/tenon joint.

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SCROLL SAW (Continued from page 139)

mortise/tenon joints. Here's how: Mark the outline for the through mortise and bore two holes, one at each end of the proposed rectangular cutout. The diameter of the holes should be equal to the width of the cutout. A coarse, 7-tooth, .250-in.-wide blade is recommended for this operation. A wide, flat blade cannot start tangent to a round hole, so you'll need a small chisel to cut two flats in one of the holes tangent to the cutting lines. The flats allow the blade to start cutting exactly on the line.

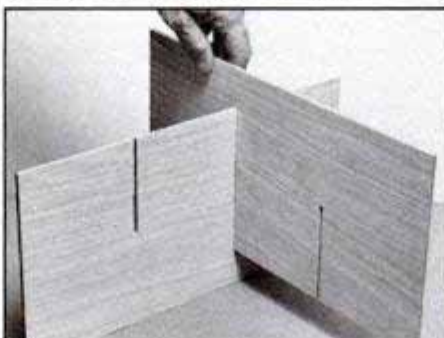
Set up the rip fence and make the first cut the length of the mortise to the bottom cross line. Now, without disturbing the rip fence, remove the blade guide assembly. Withdraw the blade

and insert it backward so the teeth face the "wrong" direction. With the blade guide out of the way, pull the workpiece backward to continue the cut to the upper cross line. Now readjust the fence for the second long cut. Make the small cut up to the corner of the hole, then return the blade to its normal or "right" position. Reattach the blade guide and complete the second long cut. Remove the waste wood and you'll notice two parallel cuts with fillets in the corners.

To clean out the fillets, adjust the rip fence so the blade teeth abut the end cross line of the mortise. Tape the workpiece to the fence, turn on the power and slide the entire assembly back and forth so the blade will scrape away the fillets. During this procedure, keep the rip fence against the angle-iron edge to produce a true and square scraping movement. (The reason for using the reverse blade technique is to avoid the possibility of a misaligned fence when making those opposite corner cuts.)

The tenon can be cut with equal accuracy by utilizing the rip and cross-cut fence combination.

INTERLOCKING JOINTS



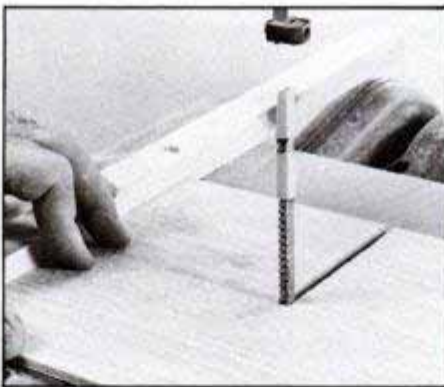
Edge half-lap joint: Cut the notches with ganged blades for interlocking pieces.

Edge half lap

The scroll saw can cut half-lap joints in stock up to 1/4 in. thick quickly and accurately. The trick is to gang up several blades, so the kerf is equal to the stock thickness. The notches, cut half-way through to the center of the mating pieces, slide together and interlock.

Only the lower chuck is used, since the upper chuck lacks the capacity to hold several blades. Insert the required number of blades into the lower chuck, then use electrical tape on the upper ends of the blades to prevent whipping. No blade guide can be used with this procedure, nor is one necessary.

If the workpiece is small enough, a guide strip clamped to the table will suffice to guide the crosscut. If the work extends beyond the table, clamp a guide block to the work so that it rides the edge of the auxiliary angle-iron fence. **PM**



Ganged blades are held in lower chuck only; tape blades to prevent whipping. Clamp down a wood strip to guide work.



When workpieces extend beyond the table, clamp the guide block to the work so it rides against the angle-iron rail.

MANUFACTURERS LIST

AMI Ltd., 2735 Tanager Dr., Wilmington, Del. 19808 (Hegner scroll saws; two models available: \$1,799 and \$829).

Dremel Div., Emerson Electric Co., 4915 21st St., Racine, Wis. 53406 (two smaller handicraft models available: \$95.95 and \$122.95).

Powermatic Div., Houdaille Industries Inc., Morrison Rd., McMinnville, Tenn. 37110 (\$1,300).

RBI Industries Inc., 201 First St., Pleasant Hill, Mo. 64080 (Eagle scroll saw, \$800).

Rockwell International, Power Tool Div., 400 North Lexington Ave., Pittsburgh, Pa. 15208 (variable-speed model, \$1,250).

Sears, Roebuck and Co., Dept. 703-4015 PM, Sears Tower, Chicago, Ill. 60684 (one smaller handicraft model available: \$85).

an integrated audio amplifier, AM/FM tuner, cassette deck and linear-tracking turntable. Flanking these cabinets are a pair of two-way speaker systems mounted on pedestals. Suggested price is about \$2,400. If you have appropriate installation space, you could save the price of the cabinets—about \$350. The ensemble's tuner/video control system has inputs for integrating signals from VCRs, videodisc players, video games, personal computers and cable TV—for a *ne plus ultra* system guaranteed to bring you lots of pleasure.

Pioneer Video gives you two system choices. One is the Foresight 5000, the other, the Foresight 7000. These systems are comprised of a 19- or 25-in. color monitor (5000 and 7000, respectively), a 127-channel cable-ready video tuner with remote control, a 50-watt-per-channel audio amplifier, two three-way speaker systems and two castered cabinets. One cabinet holds the monitor and one houses the amplifier, video tuner, optional videodisc player or VCR. Both units also have room for records and tapes. The vertical-model speakers fit snugly into the cabinets for a neat, console look. The amplifier has inputs for an audio tuner, as well as audio tape and disc equipment.

Switching capability

You can buy the Foresight system elements separately or as a package. The 5000 system is \$2,350. The 7000 costs \$3,000.

Jensen's new Audio+ Video products are designed to be used as an entire home-entertainment system. However, each component may be used with units not made by Jensen. The product line includes 25-in. (\$885) and 19-in. (\$595) color monitors, minus audio or tuner circuitry. The latter is provided in an audio/video receiver—the 50-watt-per-channel AVS-1500 (\$990) that contains a 133-channel video tuner with microprocessor-controlled input/output switcher. A second receiver, the AVS-1400 (\$595) with a 50-watt-per-channel amplifier, has similar switching capabilities. This unit, however, requires use of the TV tuner portion of Jensen's new AVS-4400 VHS videorecorder (\$1,595), or some other brand/model. The audio/video receivers feed into a choice of two-way, three-driver Jensen speaker systems (\$250 per pair), which feature magnet structures specially designed and shielded to prevent interference with monitors. Their height matches that of the monitors.

Kenwood offers a wide variety of options for the system builder. First, there's an audio/video amplifier (KVA-502, \$400), which permits connection

of an existing TV set or monitor/tuner into an audio system. A 30-watt-per-channel audio/video receiver (KVR-510 at \$419) serves as the heart of a comprehensive A/V ensemble. And there are five packaged A/V systems incorporating either the A/V amp or receiver with the firm's KV-901 four-head VHS format VCR, horizontal cabinets and various choices of audio tuners, cassette decks, turntables and speakers. The outfits range from \$2,562 to nearly \$3,000, not including the cost of a monitor or TV set (in other than the Kenwood brand).

Teknika offers three A/V systems—one with 25-in. and two with 19-in. monitors—all for use with a 10-watt-per-channel, full-feature remote control TV/FM receiver with 105-channel capability. A pair of matching, magnetically shielded speakers, plus three stands—one for monitor, two for speakers—is available. A matching VCR is coming.

Zenith's Hi-Tech component audio/video system is made up of a 19-in. color monitor, a quartz-controlled electronic TV tuner with remote control, a multiple program source selector, a 20-watt-per-channel stereo amplifier and a pair of two-way speakers, all for about \$1,170. It has inputs for a video game, VCR, videodisc player and home computer. Zenith offers a matching Beta format VCR for use with the above rig.

Separate monitors

JVC calls its 19-inch Network AV-2000 a "system television." The unit can function as a high-quality, self-contained TV set with built-in 4-in. round speakers, operating at 3 watts per channel, or through optional speakers with its 5-watt-per-channel amplifiers. Its line output jacks permit connection to a stereo audio system. It also has inputs for standard and portable VCRs and videodisc players.

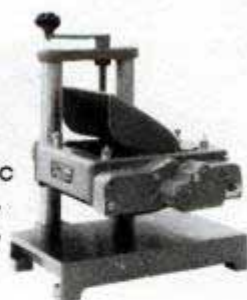
Mitsubishi has a 25-in. color monitor, the CM-2501, for \$1,250. It's housed in a large cabinet with bottom storage area that can hold an optional 105-channel tuner/control center, the TX-101 (\$550), to which one can attach assorted audio and video equipment, as well as personal computers. Five-watt-per-channel audio amplifiers and 4 x 7-in. oval speakers, as well as external speaker connectors, are built into the monitor. The control center provides additional audio line outputs.

NEC's Model C-25-900A color video monitor has dual 7-watt-per-channel outputs to drive external speakers, as well as line outputs to interface the set with an existing audio system. Further, it has a built-in 4-in. monitor speaker. The set can be linked to various NEC

(Please turn to page 142)

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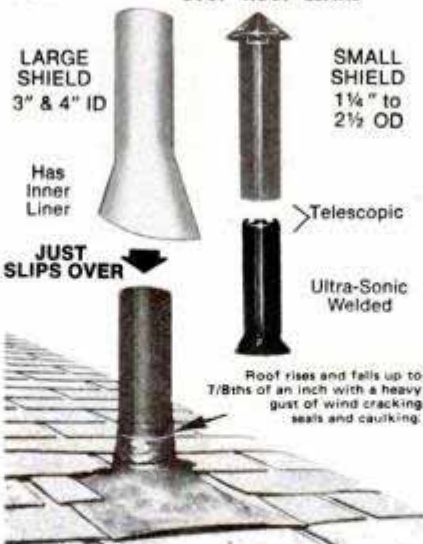
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VIDEO COMPONENTS

(Continued from page 141)

units to form an A/V system. Those units consist of the TU-820EN or TU-831EN tuner/timer, VC-731 Beta VCR and NS-2600 speaker systems.

Panasonic's Omni Series includes a separate 19-in. color monitor, separate control and selector unit (CT-9072M, \$650), tuner (TU-1012, \$450), separate speaker systems and lowboy cabinet. Also available are 10- and 19-in. portable self-contained monitors with one set of video/audio input jacks and two sets of video/audio output jacks.

Proton is selling a 19-in. color monitor, the 600M, for \$750, and a separate 105-channel audio/video tuner/pre-amplifier, the 600T, for \$550. There are inputs for four program sources and outputs for various audio components. The tuner is remote control operable and the monitor provides 350 lines of horizontal resolution.

Modular cabinets

RCA has five SelectaVision video monitors (one 19-in. and four 25-in. models) with infrared remote controls. These can be connected to a variety of audio products for full stereo sound with stereo videodiscs or stereo VCR programming. Three of the monitors sport a component look. Two are consoles with space for a VCR or videodisc player. They sell for \$730 to \$1,900. RCA also has a series of modular cabinets to house A/V ensembles for a unified furniture appearance.

Sony's Profeel line includes 19-in. and 25-in. color monitors, access tuner, wireless remote control, two choices of magnetically shielded component speaker systems, video rack and accessories. The Profeel's access tuner is notable. It connects you to various program/function sources, namely VCRs, videodisc players, cablecasts and UHF/VHF, as well as video games, home computers and home-security systems. Prices are \$1,500 for the KX-2501 25-in. monitor; \$850 for the KX-1901 19-in. monitor; and \$520 for the VTX-1000R access tuner.

Toshiba offers the 19-in. CZ-9700 color monitor (\$770 to \$800) with built-in tuner and other controls. The circuitry includes a dual-channel amplifier with enough power to drive a pair of two-way detachable wing speaker systems and audio line outputs. Once stereo TV broadcasting begins, a simple adapter will convert the CZ-9700 to receive it.

All this adds up to a wide range of choices. There's no longer any need to wait to create your own, personalized A/V entertainment system—provided you can afford the equipment. So go to it!

PM

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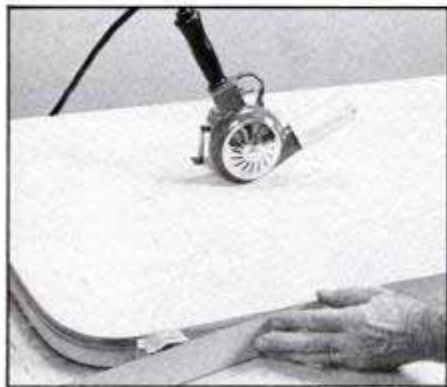
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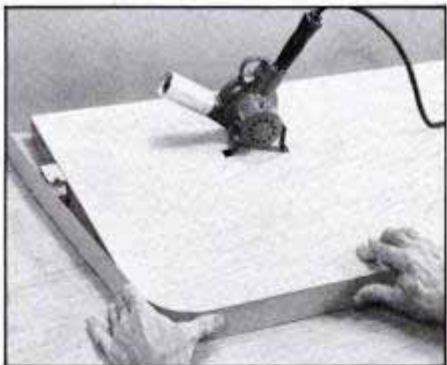
(Continued from page 105)

over old laminate. Exterior-grade plywood or particleboard are ideal for new work, but whatever the surface to be covered, it must be whole and solid, clean, flat and dry.

Fill all voids in the core material, no matter how small or shallow. This is particularly important if you use a piloted router bit for trimming, because



10 Once contact cement is dry to the touch, apply the edge strip. Start at one end and use the work surface as a positioning guide. For better control, you can set an object between the adhesive-coated surfaces to keep them apart.



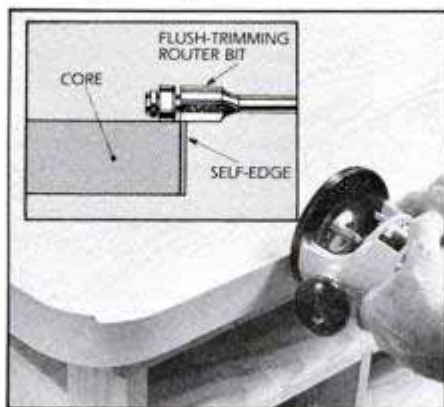
11 To make laminate pliable enough to bend around a relatively tight radius, you can heat it with a heat gun, heat lamp or hair dryer. If the corner above were a square one, we would have put the end piece on before the front edge.



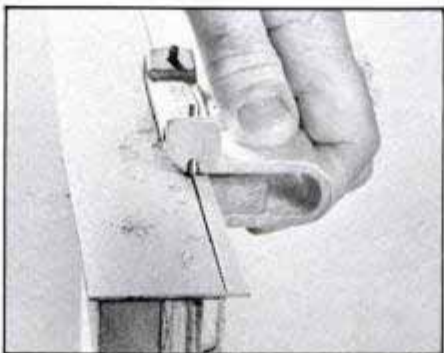
12 Apply pressure over the entire bonded surface. Tap the surface with a hammer using a wood block to protect the finish or burnish it with a roller or a wood block. Never apply pressure to laminate that extends past the core.

the pilot will follow any irregularity causing matching deviations in the laminate edge.

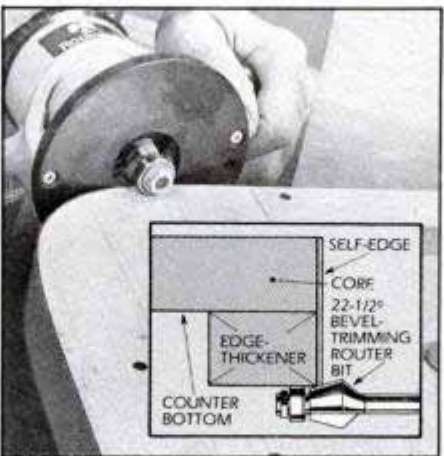
There are two types of contact cement, the adhesive used for bonding the laminate: flammable and nonflammable. It is safest to use the nonflammable type, though it dries a little more



13 Each piece must be flush-trimmed before adding an adjoining piece. A flush-trimmer router bit has a pilot to guide the carbide cutters. It might leave the edge slightly proud. If so, you should level it with a belt sander.



14 If you don't have a router, flush-trim with a scoring tool. Exert downward pressure to guide tool on the adjacent surface. It takes several passes to score laminate halfway through. Then, press back on waste to snap it off.



15 Edges that don't adjoin a piece of laminate—like the counter bottom—are bevel-trimmed to eliminate sharpness. When bevel-trimming with a router, set depth so bit cuts only laminate's thickness, not into adjacent face.

slowly than the laquer-based flammable adhesive. With either type, work in a well-ventilated area. Lacquer thinner should be used to clean off excess contact cement that builds up on edges.

Laminate will bond properly only to a true plane surface. A belt or finishing sander will prove useful for smoothing and leveling large surfaces. However, you must exercise great care to avoid tipping the sander downhill as it moves past the ends, or you will create a slop-

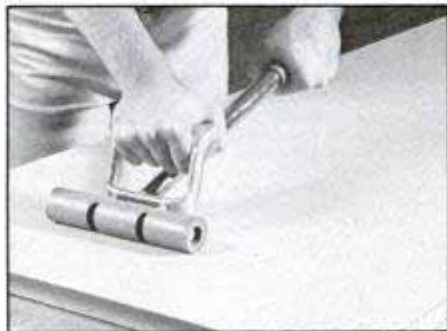
(Please turn to page 144)



16 Rollers used to apply contact cement should have a phenolic core and short nap. Line roller tray with aluminum foil to ease clean-up. Make adhesive coats ample, but be careful; drips on edges make trimming and cleanup hard.



17 Contact cement bonds instantly. Use slip sticks to separate glued surfaces until laminate is positioned to cover whole core. Work from one end, removing sticks in succession, allowing glued surfaces to bond a bit at a time.



18 Apply pressure once the laminate is in place to assure a good bond. Pay special attention to the edges. A roller like the one shown is perfect for broad surfaces, but a hammer and block of wood or a rolling pin would also work.

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WORKING WITH LAMINATE

(Continued from page 143)

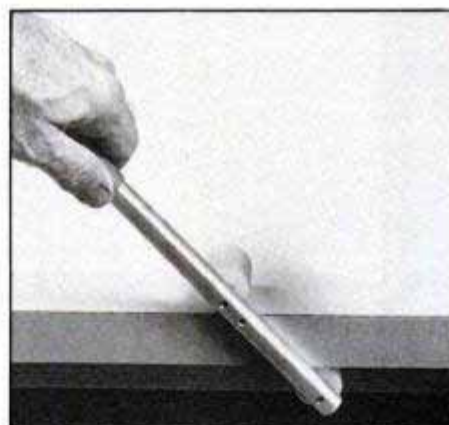
ing surface. If old laminate is to be resurfaced, it should be sanded thoroughly to provide "tooth" for a good adhesive bond.

The basic steps in applying laminate are cutting, applying adhesive, bonding and trimming. The tools required for these operations are relatively few. If need be, you can do the job entirely with hand tools.

Various tools that can be used to work with plastic laminate are shown in



19 If you're using a router, trim off excess with a flush bit. Then, finish the edge with a bevel trimmer.



20 After trimming, go over edges again, either with a J-roller, as above, or with another burnishing tool.

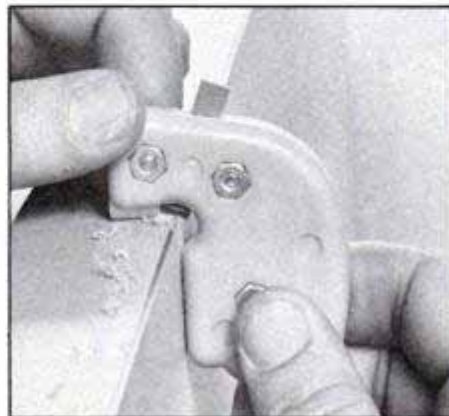


21 Trimming and beveling bits leave slight ridges. Smooth with medium-grit sandpaper or a fine mill file.

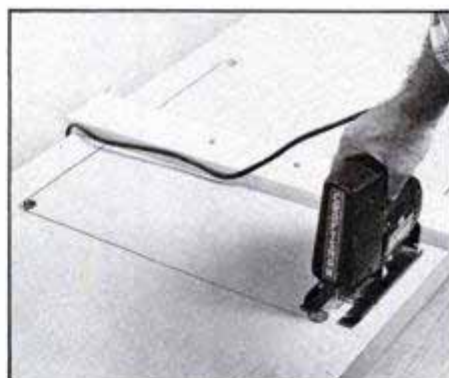
the how-to photos beginning on page 105.

Note that there are many options for achieving the same end result. For example, you can cut the laminate with a saw or tin snips, or by scoring and breaking with a plastics scribe. Bonding pressure can be applied with a hammer and wood block, rolling pin or a photo print roller. Trimming can be done with a block plane or file.

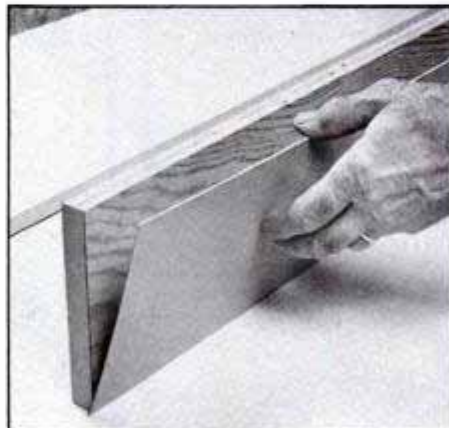
Power tools enable you to do the job quicker and with less effort. Some of the special laminate tools (like the heat gun and special rollers) are not essen-



22 If you don't have a router with a bevel trimmer, you can use a laminate edger to shave a controlled bevel.



23 Lay out and cut opening for sink. Cut two parallel sides. Attach a cleat to support cutout before making final cuts.



24 Laminate the backsplash in three steps. Apply the end pieces first, the front next and the top strip last.

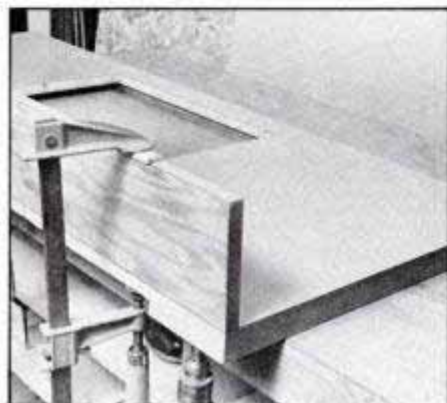
tials. But they're relatively inexpensive and you might find them handy. **PM**

INFORMATION— LAMINATING TOOLS

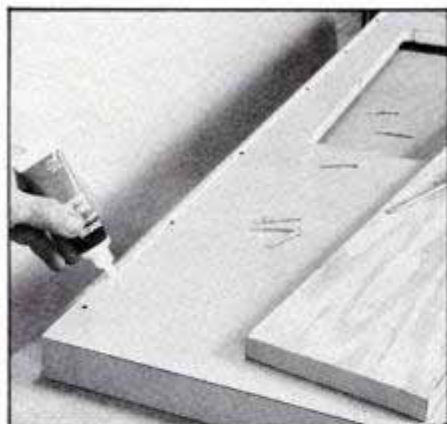
The special laminating tools listed here are available from Beno J. Gundlach Co., Box 544, Belleville, Ill. 62222. All prices are postpaid:
S202 squeeze roller, \$14.80; 333 AR roller, \$24.30; J200B "J" roller, \$8.85; 688 Mica Nife laminating edger, \$12.05; 750-X heat gun, \$72.80; PLT laminate trimmer, \$21.50; 7-F roller frame, \$4.83; 77-C roller cover, \$4.53.

SOURCES—LAMINATES

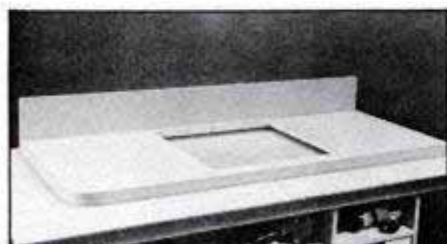
Formica Corp., American Cyanamid Co., Wayne, N.J. 07470.
Lamin Art, 6430 East Slauson Ave., Los Angeles, Calif. 90040.
Micarta, Decorative Div. of Westinghouse Electric Corp., Hampton, S.C. 29924.
Nevamar Corp., 8339 Telegraph Rd., Odenton, Md. 21113.
Ralph Wilson Plastics Co. (WilsonArt), 600 General Bruce Dr., Temple, Tex. 76501.



25 Align backslash with back edge of counter and clamp it. Bore pilot holes for No. 8 x 1½-in. wood screws.



26 A bed of caulking seals backslash seam. This prevents water seepage that could make the laminate bubble.



27 Install backslash and countertop on base cabinets as a single unit. Protect corners when moving the piece.

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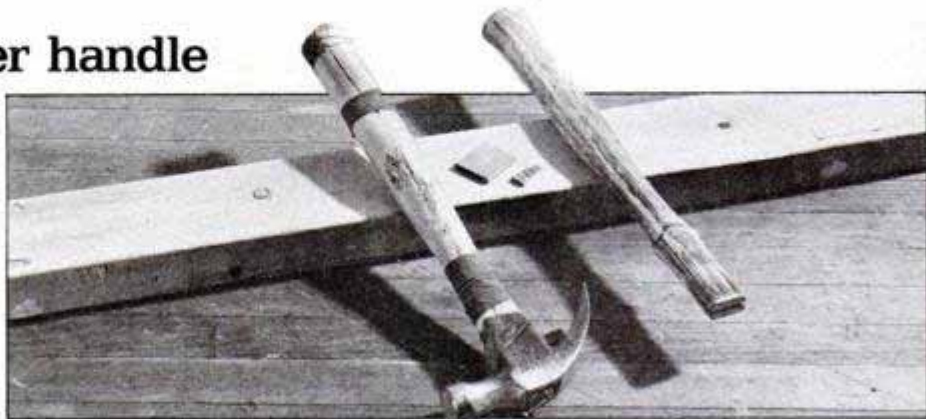


WORKSHOP MINICOURSE

Replacing a hammer handle

The ordinary hammer is the one tool that must be in everyone's toolbox, whether you're a fledgling do-it-yourselfer or experienced carpenter. Many people believe that once a hammer handle is battered or the head comes loose, the hammer should be tossed out automatically. But that isn't always the case.

You should *never* work with a hammer that has a loose head because there is too great a risk of its head flying off and injuring a bystander. However, it is most often the handle that



1 Abused hammer (left) can be salvaged because its head is still usable; only handle needs retiring. Replacement (right) sells for about \$3 at hardware stores.



2 First step is to clamp hammer in a vise so its head can be sawed off, using a crosscut or dovetail saw. Make cut as close as possible to head.



3 If portion of handle left in head's eye is difficult to remove, bore a series of 1/4-in.-dia. holes. Punch scrap out with sharp, narrow chisel and hammer.



4 Replacement handle must be customized to fit hammerhead (handle is more or less universal size). Here, neck is planed both sides with a Surform rasp.



5 Tap in the replacement handle by putting old head upside down on a solid surface (workbench). Tap handle in until it is flush with hammerhead top.



6 This type of replacement handle comes with two wedges. The wooden wedge is sliced to correct width, then tapped into the slit at handle's neck.

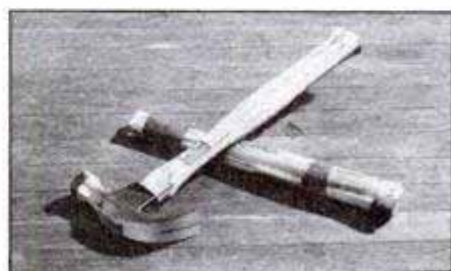


7 To ensure a completely tight fit, the metal wedge is then hammered fully home. Take care not to drive in the wedge until it is properly positioned.

goes, while the head remains perfectly usable. (If you made the mistake of buying a cheap, unknown brand of tool to begin with, chances are the hammer *should* be tossed.) But, if the head is in good shape, replacing just the handle can save you about \$10. A quality hammer costs around \$13, while a replacement handle is \$3 or so.

There are two types of replacement handles available. The one shown in the photos is installed exactly as

shown. The second type comes with the handle solid at the end and you must cut the kerf for driving in the wedge. No matter which particular replacement handle your hardware store stocks, make certain the head is on securely before driving home the wedges. Once these are correctly in place, your hammer will be good as new. Don't bother to replace a handle if the hammer's striking face is worn or nicked.



8 Old hammer is now as good as new. Replaced handle can be discarded.

PM

TECHNOLOGY UPDATE

Zippering along, flat out

Recreation

Fixing flats has always been a prime concern of the recreational cyclist. In the more exotic bikes, in particular, this task takes on the aspect of major surgery. In some cases, the tires have to be *sewn* back together. At the recent International Bicycle and Motorcycle Show in Cologne, West Germany, one innovation caught the eye of flat-fixers: a zip-open tire, with tube. You can patch the tube, zip it up again and put the whole assembly back on the rim. Conti Co. manufactures the zippered tire which will be distributed through many specialty shops.

Taking a fall

Do "jumpers" always pass out, as folk wisdom used to maintain, before they hit the ground? You may be in a position to find out for yourself, before long, if the latest rage in amusement franchising catches on in your area. The idea is called Flyaway, and it's based on an original installation opened near Montreal. The first U.S. outlet opened recently in Las Vegas, Nev.

Essentially, a Flyaway is a vertical wind tunnel; since the terminal velocity of the average human form in an airstream is about 125 mph, velocities greater than that will provide levitation—flying, if you will. An aircraft propeller generates upward velocities of 130 mph.

A rider can jump into the Flyaway's



The solution for high-pressure, tubed bicycle tire problems: a built-in zipper.

vertical airstream, wearing a specially vented and configured coverall, and find all the thrills of free fall with none of its potentially fatal drawbacks.

In the event of a possible power failure, the windmilling 13-foot prop would make for a slow settling onto the bottom grid. Even so, participants are required to sign releases absolving the ride owners of responsibility for injury. In addition, the participants must take a 10-minute instruction session before they can embark on their own (at \$15 per hour).

Marvin Kratter, originator of the franchise, estimates that free-fall parachutists pay up to \$125 for 12 seconds of the same experience.




Flyaway rider gets his money's worth.




Kevlar bobsled, the first one to incorporate a roll bar, carries two in competition.

Hitting the skids


At the mid-January North American bobsled championships in Lake Placid, N.Y., the eye-catching new shape belonged to the Gold Medal Team sled. It was built by Gold Medal Bobsleds Inc., of Douglaston, N.Y., and backed as a (hopefully) international promotional venture by Lederle Laboratories on behalf of its vitamin products. The "inverted" wings are designed to keep the sled's nose pressed to the track; in addition to full aerodynamic fairing, the extensive use of Kevlar in its construction makes it the lightest competitor in the field.




P-3C Orion antisubmarine aircraft uses radar, sonar, infrared and magnetic anomaly detector (in tail extension) to locate enemy. On-board Univac computer processes sensor data.




Military satellite relays ASW data that's been collected by ships, aircraft, submarines and listening networks.




Lamps Mk. 111 helicopter tows sonobuoy for passive listening; also carries Mk. 46 ASW torpedoes and magnetic anomaly detection gear.



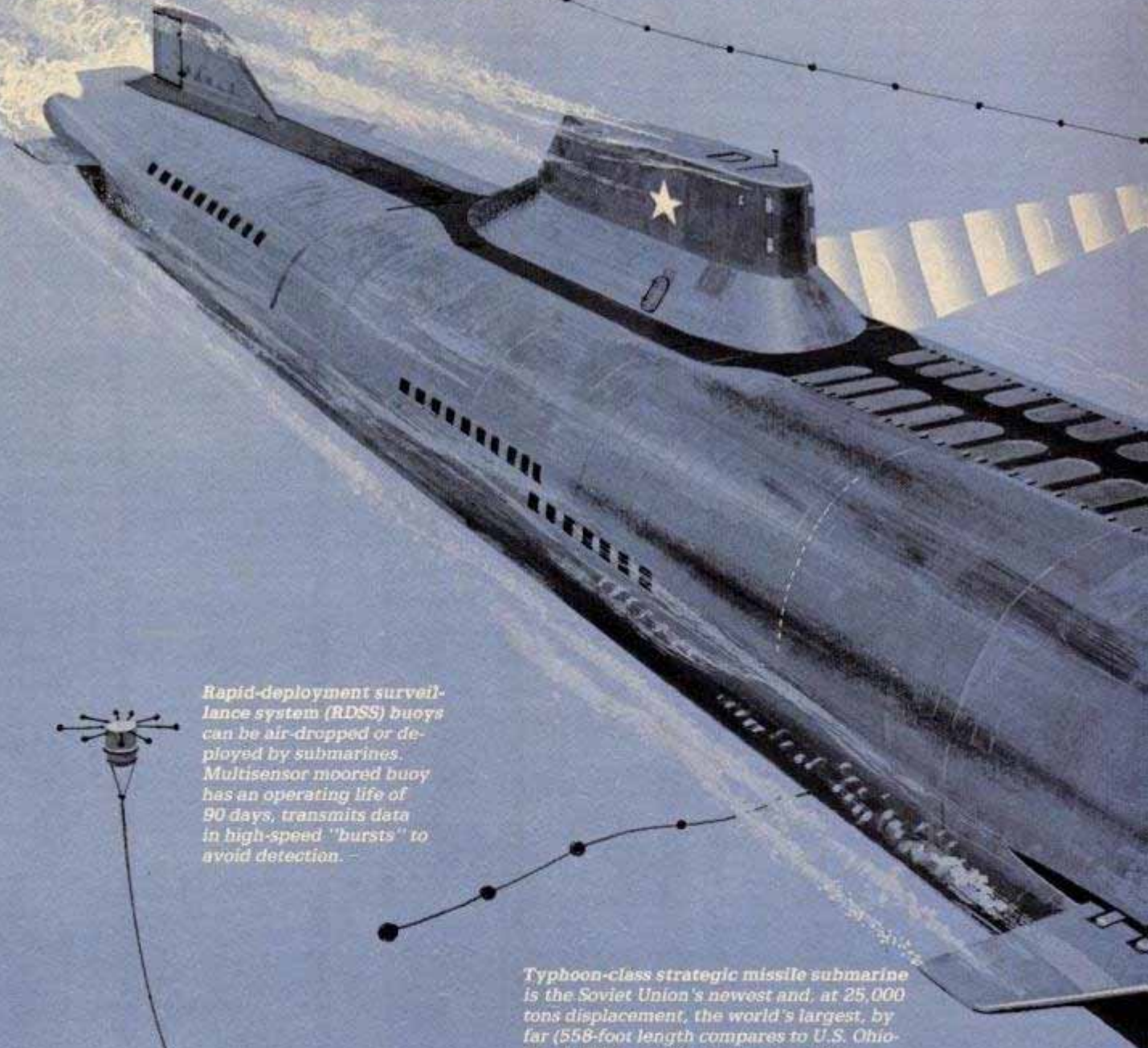
Surveillance Towed Array System, consisting of sensitive hydrophone string, will go to sea behind civilian-manned Navy ships this year.



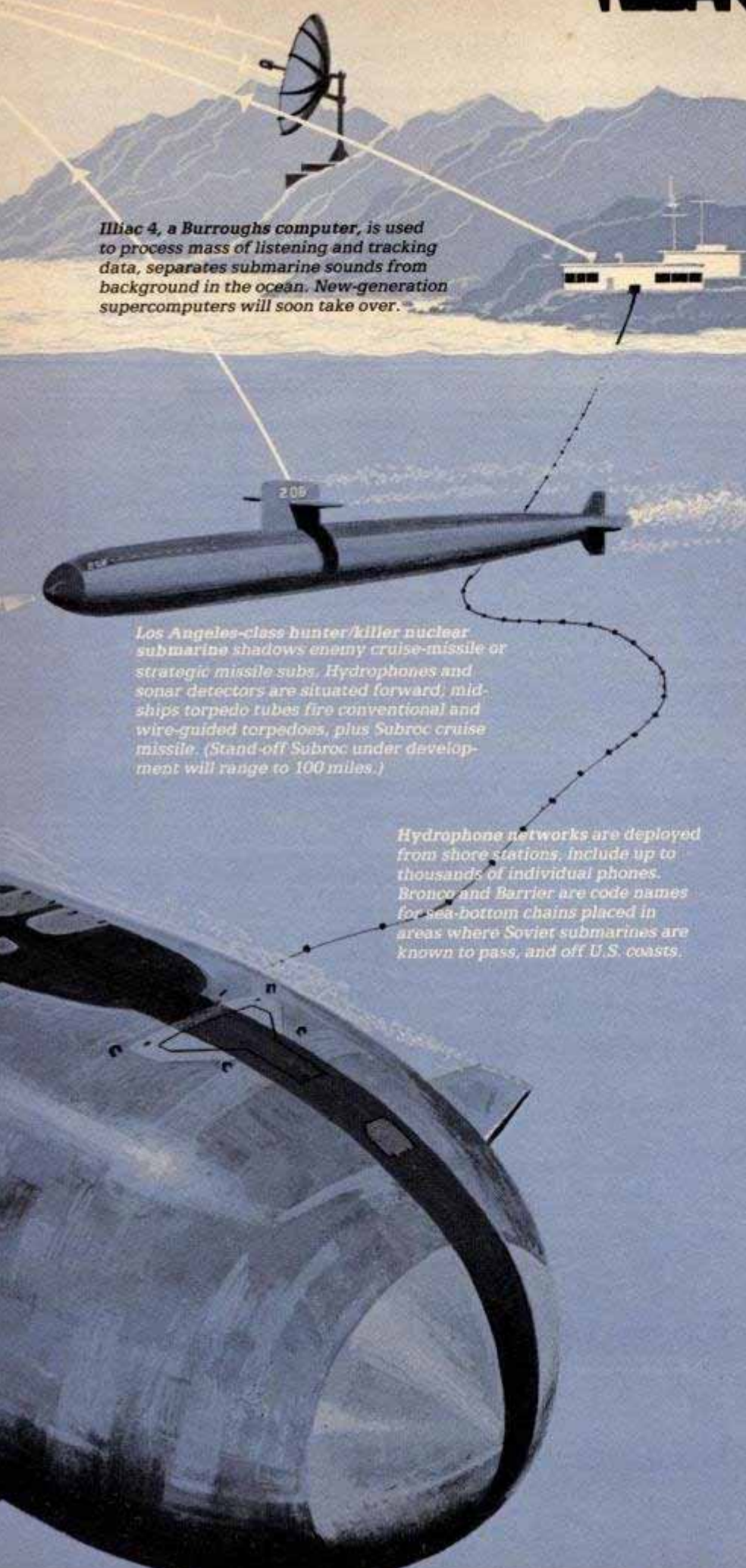
Perry-class frigate is equipped with anti-sub missiles and torpedoes, can launch ASW helicopter.



Rapid-deployment surveillance system (RDSS) buoys can be air-dropped or deployed by submarines. Multisensor moored buoy has an operating life of 90 days, transmits data in high-speed "bursts" to avoid detection.



Typhoon-class strategic missile submarine is the Soviet Union's newest and, at 25,000 tons displacement, the world's largest, by far (558-foot length compares to U.S. Ohio-class). With missile range suggesting possible deployment in Pacific, Typhoon poses new threat to our ASW forces.



Illiac 4, a Burroughs computer, is used to process mass of listening and tracking data, separates submarine sounds from background in the ocean. New-generation supercomputers will soon take over.

Los Angeles-class hunter/killer nuclear submarine shadows enemy cruise-missile or strategic missile subs. Hydrophones and sonar detectors are situated forward, midships torpedo tubes fire conventional and wire-guided torpedoes, plus Subroc cruise missile. (Stand-off Subroc under development will range to 100 miles.)

Hydrophone networks are deployed from shore stations, include up to thousands of individual phones. Bronco and Barrier are code names for sea-bottom chains placed in areas where Soviet submarines are known to pass, and off U.S. coasts.

Military

A deadly game of hide-and-seek

Recent developments, both in the news and behind the scenes, have focused attention on antisubmarine warfare as one of the key military and political arenas for international relations in the near future. On the one hand, Soviet submarines seem to be penetrating the territorial waters of Baltic neighbor Sweden, a neutral country, at will, and escaping undetected. On the other, U.S. advances and planned deployment this year of new antisubmarine warfare (ASW) systems are seen as such a threat to the integrity of Soviet undersea operations that the Russians have brought them up at Strategic Arms Limitation talks.

A Soviet submarine (a nonnuclear, obsolescent Whiskey-class vessel) ran aground in Swedish waters in October 1981 and had to be towed off by the Swedes. A year later, the Swedish coastal defense forces believed one, or possibly two, submarines to be trapped in a small estuary.

Thus began a deadly game. The Whiskey sub, scanned during the 1981 refloating, was determined to have been carrying nuclear-tipped torpedoes. The Swedish forces began by dropping depth charges into the bay after sealing the exit with nets and patrol vessels. Because of Soviet activities, the Swedes had developed a whole range of weapons designed to disable modern U-boats without necessarily endangering the lives of their crews. Shaped-charge depth bombs punch small holes in the pressure hull, forcing the sub to surface without destroying it; torpedoes with small explosive charges home in on a fleeing sub's propellers, also forcing it to surface.

Last October, there was no final determination; either the Soviet sub escaped, was destroyed (unlikely) or, as the U.S.S.R. maintained, was not there to begin with. With its rugged, rocky bottom and constant intermingling of waters of differing temperatures and salinities, the Baltic

coast of Sweden is one small area where a submarine could probably hide from a concentrated search. False sonar echoes from the bottom and various water layers are used as cover by modern subs as a matter of routine.

However, the ASW systems that the United States (unlike Sweden, which doesn't employ highly advanced detection gear) is putting into operation will soon render the escape of a submarine from similar circumstances unlikely. Among the elements (see illustration) of a complete, global ASW network, one of the least known is a central computer that can receive listening data from land, sea, air and undersea stations. The computer can process this input to virtually separate background echoes and natural feedback (even whale songs!) from operational noises and sonar "hits" on live submarines. Data are relayed by satellite to the computer.

Sound is still the medium by which a submarine is most likely to give itself away. But the stress has shifted from active sonar ("pinging") to passive listening with sensitive hydrophone arrays. For one thing, sonar betrays the seeker; unlike the WWII

scenarios, where convoy escorts would steam in hot pursuit of any suspected submarine, today's sub search is more likely to involve aircraft. With vertical torpedo tubes and torpedoes that can home on active sonar signals, a submerged enemy can sink its pursuers as they steam over it. And the most modern subs, like the Soviet Alfa Class, can run faster submerged—nearly 50 mph—than escort vessels on the surface.

Hydrophone arrays have already been deployed on the sea bottom near the "chokepoints"—channels through which all U.S.S.R. naval vessels must pass to get from their home ports to the open seas. In addition, cable-linked hydrophone arrays in the Navy's Sound Surveillance System (SOSUS) are off U.S. coasts, monitored by land stations.

Units of the Surveillance Towed Array Sound System (SURTASS)—hydrophones towed behind civilian-manned ships—will go to sea this year. Rapid Deployment Sound System (RDSS) buoys are being developed that can be put into place temporarily, by airdrop or submarine launch, to monitor areas that have become sensitive or where other hydrophones are inoperative. The

RDSS buoy has an operational life of about 90 days and will broadcast its data in short, high-speed bursts to avoid giving its location away.

Any submarine running at speed, even miles away, can be sensed by hydrophones. But pinpointing exact location is very difficult. Aircraft, like the land-based Orion, the carrier-launchable Nimrod and the Sea King and Lamps III helicopters, are required for this phase of the operation. Airborne computers on the fixedwing planes process radar, infrared and magnetic anomaly information. The helicopters can lower sonobuoys into the ocean and tow them like ships, to listen passively and/or "ping" for the suspected sub.

And perhaps most formidable, the Los Angeles-class attack submarine also tracks the Soviet sub with its bow-mounted sound gear. Against its counterpart's greater speed and deeper diving capabilities (some U.S.S.R. classes), the American submarine pits the Mark 48 torpedo, with speeds of over 60 mph, range of 25-plus miles and multiple search/homing modes. Currently, the Russians seem to be trying to develop quieter submarines.

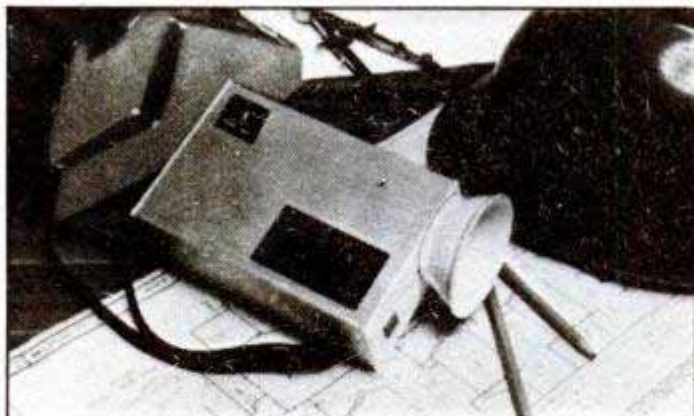
Meanwhile, the game goes on.

Electronics

Acoustic tape

Bats used sonar to navigate through the air long before it was used to detect submarines. And now, high-frequency sound is being used in everyday devices. Cameras use sound pulses for setting accurate focus, and an instrument, known as the Kwik Tape, operates on the same principle.

The unit is about the size of a small home movie camera; operating from rechargeable batteries, it emits ultrasound pulses to measure distances from 2.5 to 90 feet on a digital readout. The manufacturer claims the device is accurate to plus or minus one



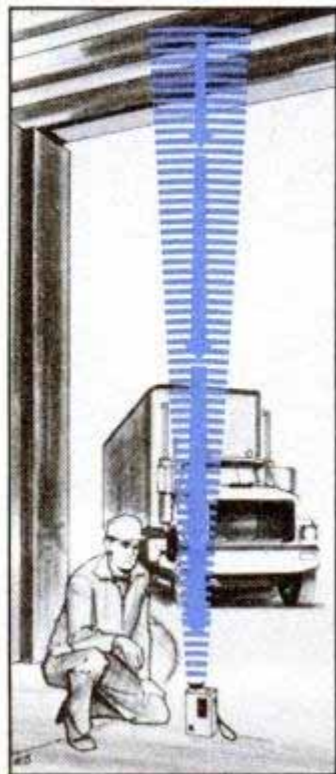
Kwik Tape weighs about 32 oz.; many applications are possible.

inch through the entire range.

The Kwik Tape updates a measurement every second, if left in the ON position; a narrow beam angle permits measurements to be made in confined areas, such as through doorways. The 40-megaHertz sound is

imperceptible to humans and doesn't harm animals.

E.M.U. Electronics, 8260 Blaine Pl., Crown Point, Ind., maker of the Kwik Tape, has established the retail list price of \$250 for this versatile instrument.



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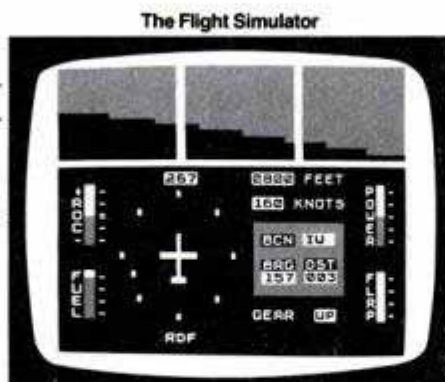
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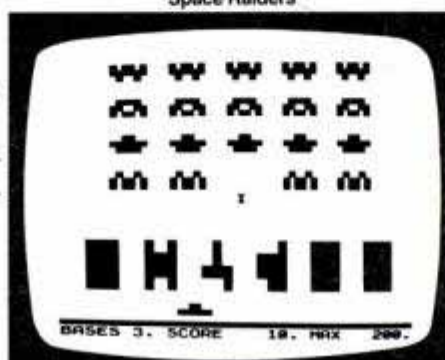
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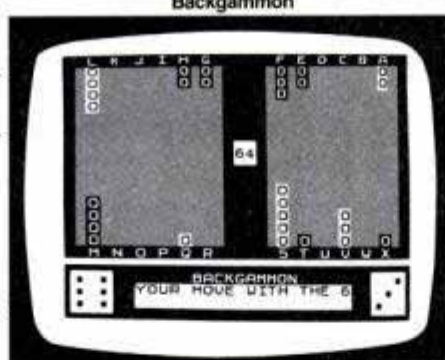
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| Includes Statistics, Regression and Trend, CHI Squared Text and Graphics Plot | Rings Around Saturn, Secret Code, Mind Boggling, Silhouette, Memory Test, Metric Conversion |
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A full-featured Pascal for \$29.95!

If you know what Pascal is, then you're already pretty excited and you have permission to skip this paragraph. For those who don't—let's first say that the exclamation point in the title above is well-deserved. Pascal is a very powerful computer language that often sells for \$300 to \$600 from various suppliers.

This new version of the language, from JRT Systems (1891 23rd Ave., San Francisco, Calif. 94122), offers an incredible amount of value.

People who have used other versions of Pascal will recognize several top-notch features that include a one-step compiler, graphing procedures and

random files that can go to 8 megabytes. And this package also shines for the Pascal beginner. It includes a 125-page manual that, in our opinion, is worth the \$29.95 by itself. While the manual alone won't teach you Pascal, it's an excellent reference to use with any of the many available Pascal textbooks.

The one thing that people familiar with other Pascal versions might miss is a text editor: This version doesn't have one of its own. Program lines must be entered using a word-processing or screen-editing program, but most computerists already own such programs.

The truly amazing price seems more eye-catching when you consider that the program is *not* copy-protected. JRT feels that lowering the price of such software and offering it in a user-accessible manner will widen the marketplace to new levels of profitability. In these days of programs that cannot be copied by the user, JRT's approach is refreshing—and surprising. The company's ads specify that if a user wants to copy the disc or manual to pass onto a friend, that's okay—as long as such copies are not resold.

The Pascal language JRT offers will run on any CP/M computer. If you have one, this is an absolute must.—N.S.

New Apple/IBM database

The *Data Reporter*, a database management package for the Apple or IBM-PC, can be used for a vast range of applications. Records may be added, changed, stored, sorted and printed. For instance, you can balance a checkbook, keep all expenses from several accounts sorted into categories, and have it printed in a concise report at tax time, or for budgetary analysis. The *Data Reporter* is fast, and easy to learn and use.

The programs are written mainly in BASIC, which makes custom modifications simple. The data-handling routines are written in machine language

for top-speed operation. All data are kept in memory, speeding operation of sorts and searches. The data can also be displayed graphically with statistical analysis performed.

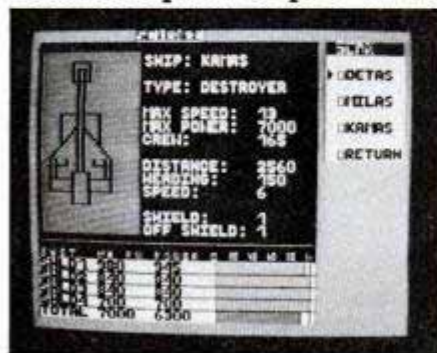
And once you've set up your database, you can reformat the fields. If you want to add phone numbers to a client list, for example, you don't have to re-enter all the other data.

An on-board text editor allows printing of very flexible formatted reports. The editor can also be utilized for notes, memos or even form letters that include data. *Data Reporter* lists for \$225 and is available from Synergistic Software, Renton, Wash.—Allan Turoff

TRS-80 disc utility

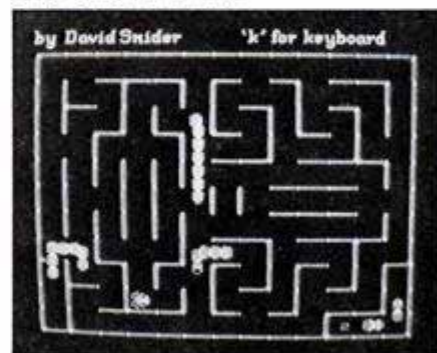
Super-Utility Plus is a first-aid kit for TRS-80 Models I and III. It lets you make backup copies (even of protected or slightly damaged discs) faster than TRSDOS, modify disc files, find any string of ASCII or hex bytes on the disc, kill files by category and change a formatted disc's name. It also allows you to create custom disc formats, repair damaged directories (the part of the disc that usually goes first), modify and copy tape files, and compare, copy and find the memory address of any file. This amazing kit is from Breeze/QSD, 11500 Stemmons Expwy., Dallas, Tex. 75229.—Charles Bennett

Become captain of your own starship



Starship Commander from Voyager Software features screens that simulate action at various battle stations. Above are the science station (left) and weapons station (right). The game turns any Apple II into a complex starship command center.

The snake turns



Serpentine from Broderbund lets those with the Apple II or Atari 800 enter a maze of fun and animated snakes.

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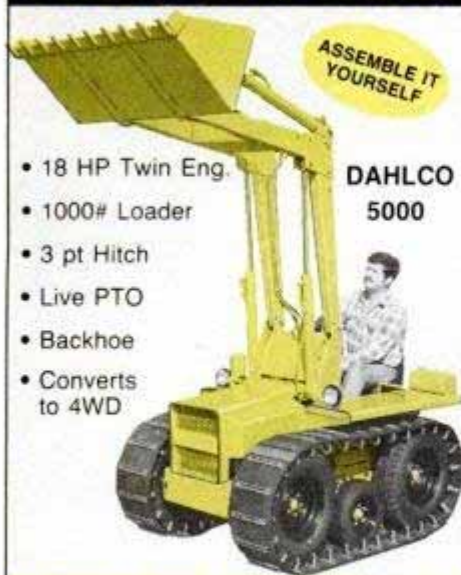
"Hands-on" training covers what you need to know from bumper to bumper. Includes professional tools like inductive timing light, ignition analysis and tune-up instrument, vacuum test pump, and precision oscilloscope for diagnostic work. Approved by Richard Petty, America's winningest stock car driver and NRI automotive consultant.



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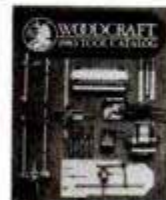
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'HAWKEYE'

(Continued from page 81)

silent, and that was enough for Bill Perry. It was time to chase the smuggler into a corner and trap him.

"We called ahead to Jacksonville and asked U.S. Customs there to ready their Cobra (Army helicopter)," Perry explains. Then he radioed the Hawkeye crew to "tag along in case this guy (the smuggler) ducks in the clouds."

At that point, the smugglers were part of a convoy, unbeknownst to them: Their Beachcraft Bonanza led the way, followed by the Customs King Air, with the Hawkeye trailing close behind, about 20,000 feet above the other traffic. Slightly ahead of the convoy, the Cobra chopper skimmed the treetops in woods just off the coast, where many small, often abandoned, airfields are havens for illegal traffic.

Captured without a shot

At first, the hunted didn't know the King Air was behind him. Nor could he see the Hawkeye circling above. But, as the smuggler's plane turned landward, the pilot saw the Customs craft.

"We had some nice puffy white clouds," Perry remembers. For a moment, the smuggler used the clouds as cover, but the Hawkeye didn't lose him for a second. The chase plane followed the Navy crew's instructions and stayed right on the smuggler's tail as he dipped through the clouds and put down quickly on an abandoned air strip.

Apparently, the smuggler intended to flee into the nearby woods before the King Air could land. But he had a surprise coming. The Cobra chopper skimmed the surrounding woods and put down right in front of the smuggler's craft.

As the suspect started fleeing toward the woods, the King Air touched down and the copilot leaped onto the field, drawing a bead on the fleeing smuggler with his 9-mm automatic. No shots had to be fired. The arrest was easy, and the catch netted 375 pounds of marijuana.

The Hawkeye, manufactured by Grumman for land- or carrier-based duty, has revolutionized drug enforcement.

In roughly a year of service in southern Florida, the snub-nosed, turbo-prop-driven craft has been credited with nailing scores of smugglers on land and sea with catches of up to 20 tons. Critics have called the southern Florida experiment too expensive. But there was hardly a whisper of opposition in October, when President Reagan announced the Hawkeye program would be instituted along all U.S. coasts by early 1983.

Operation Thunderbolt

When the program started as Operation Thunderbolt in October 1981, the flying radar station's presence was top secret.

Two E-2Cs flying out of Patrick Air Force Base south of Cocoa Beach spent 10 weeks escorting federal, state and even county aircraft in their searches. The craft gave the antidrug officials thousands of additional eyes with its General Electric AN/APS-125 radar. (According to a Navy source, the Hawkeye radar, communications and data-processing equipment make it capable of taking over for all the air traffic control towers from Boston to Washington, D.C., and probably more.) During Thunderbolt, the Navy recorded confiscation of 13 tons of marijuana, 1,113 pounds of cocaine, 50 pounds of hashish and 45 aircraft. Some smuggling pilots got away, but 29 were arrested. Officials credited the Hawkeye with catching 50 percent of the smugglers arrested in that period. And the cost for the eyes-in-the-sky was a reasonable \$800,000.

At times, state officials have felt the Florida peninsula was acting as one huge runway for planes from South America and the Caribbean, smuggling all sorts of illegal cargo: drugs, aliens, even exotic birds. Between 70 and 90 percent of the cocaine, marijuana and Quaaludes brought into the United States passes through the state, according to Brent Eaton, a spokesman for the Federal Drug Enforcement Administration in Miami. In fact, drug traffic has grown so heavy that the Miami press seldom even mentions marijuana busts involving amounts under one ton.

If you're tempted to criticize the expense of the Hawkeye missions, consider this: For two months after the administration went public with the program in southern Florida in 1982, drug traffic appeared to come to a near standstill.

Increased risks

Airplane pilots around Miami told *Popular Mechanics* that some smugglers had to take huge chances to avoid detection by the Hawkeye. Some flew their craft right into the Miami airline approach pattern, hoping to get lost in the traffic. Navy sources say such a maneuver might allow a few planes to slip past the Hawkeye, but the craft has picked off more than a half dozen smugglers trying to fly in with commercial traffic.

Those who risk the net, PM has learned, are attracted by the big income. "The pilot's price (for bringing in a load) went from the \$50,000 to

\$80,000 range to \$150,000" in the months after word got out about the Hawkeye, according to Eaton. Meanwhile, he says, "the price of a kilogram (2.2 pounds) of cocaine fell in Bogota, Colombia, from \$20,000 to \$15,000. When the kilo reaches the United States, it can sell for as much as \$60,000."

In addition to the Hawkeye and the Cobra choppers, the Reagan administration has brought other military hardware into the drug war.

Navy vessels routinely assist the Coast Guard patrolling waters where smugglers are found. Sometimes a Navy vessel, following the lead of an airborne Hawkeye, follows a plane to a dropoff point at sea. The vessel then steams to the pickup boat's location and holds the smugglers as the Coast Guard moves in for the arrest.

For a while, the Hawkeye's presence was a source of concern to many law-enforcement officials outside southern Florida.

They worried that traffic which was chased out of southern Florida would merely find new borders to cross. Canadian drug-enforcement officials were particularly disturbed, and the announcement of the spread of the Hawkeye program to all U.S. coasts hasn't calmed their nerves much.

Good timing

But Southern governors, who had planned to hold an emergency winter meeting this year to discuss the turning of smuggler traffic from Florida to their state borders had second thoughts after the October announcement. And they were further reassured in early November when federal officials made a \$20 million cocaine bust in southern Georgia.

The timing couldn't have been better: a few weeks before the governors' meeting was to have been held, but after election day. No one accused the feds of playing politics, and many drug-enforcement officials from New Orleans to Nashville breathed sighs of relief.

While the Hawkeye probably won't bring drug trafficking to a screeching halt, the program has already been credited with causing a panic among marijuana distributors. Probably, the experts say, the drug business will be homegrown for now, with farmers growing marijuana plants that can yield thousands of dollars in profits each. But the hard-drug traffic—heroin and cocaine—is expected to maintain a very low profile for a long time to come as the Hawkeyes start their sweeps of coastal waters nationwide. **PM**



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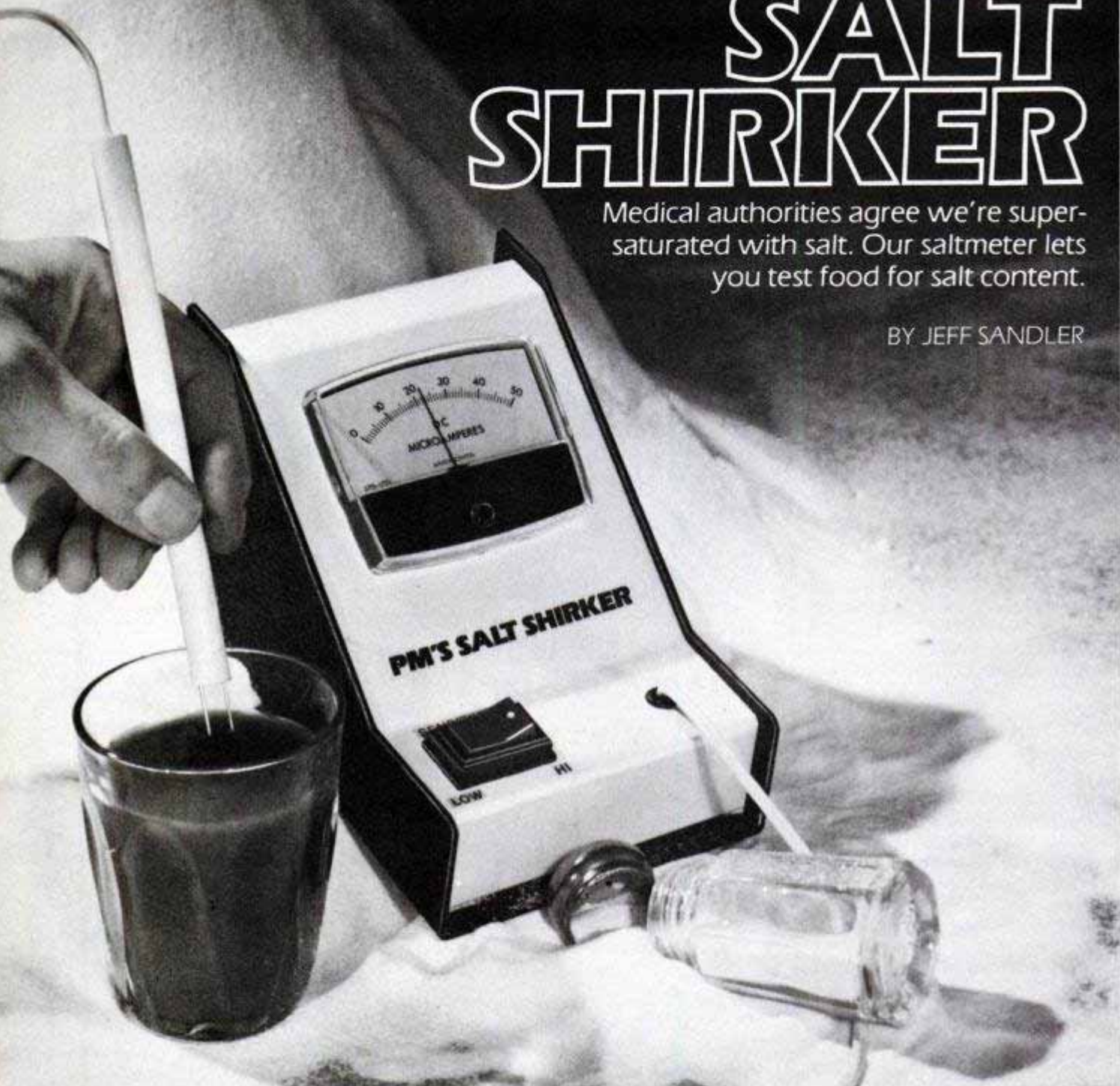
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Build PM's SALT SHIRKER

Medical authorities agree we're super-saturated with salt. Our saltmeter lets you test food for salt content.

BY JEFF SANDLER



Not all foods with salt in them taste salty; many can fool you. Our saltmeter project will let you measure salt content accurately.

Our PM Salt Shirker comes to the rescue of people worried about their daily salt intake. It tells you which foods have no salt, which have a little bit, and which are simply loaded with salt.

You might think that your tongue alone could tell you what foods were salty. With something like potato chips or anchovies, this is true. It isn't hard to tell. Yet, some foods you might never suspect, like ketchup, are loaded with

salt. Likewise, some unsalty-tasting cheeses are quite salty.

Salty circuits

Those sophisticated chemical sensors—your taste buds—can't measure salt content reliably. But the Salt Shirker can. It operates electrically, rather than chemically, and tests for conductivity in your food. This is closely proportional to the amount of dissolved salt present. If the Shirker doesn't

detect any conductivity, then there isn't any salt to worry about.

Things other than salt affect the conductivity of food, but generally salt (sodium chloride) is by far the largest contributor. Examples of other conductive water solutions are acids (like vinegar), bases and other salts (like potassium chloride). However, these only *add* to the Salt Shirker's readings. They never subtract. While it's possible to get a

(Please turn to page 160)

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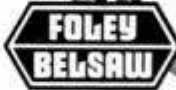
A Good Investment • Robert Sawyer, Roseburg, Oregon: "I believe that the Foley-Belsaw is the best investment I ever made. I've been a planer man for years and am now retired. The Foley-Belsaw has earned me \$60,000 extra income in the past eleven years."

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More Than Expected • Stephen Schultz, Orangeville, Penna.: "This machine pays for itself by making money out of scrap boards. It is a very well built machine and I confess it is more than I really expected for the price. It does everything you say it will!"

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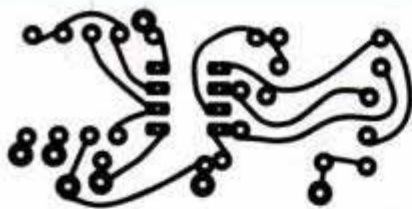
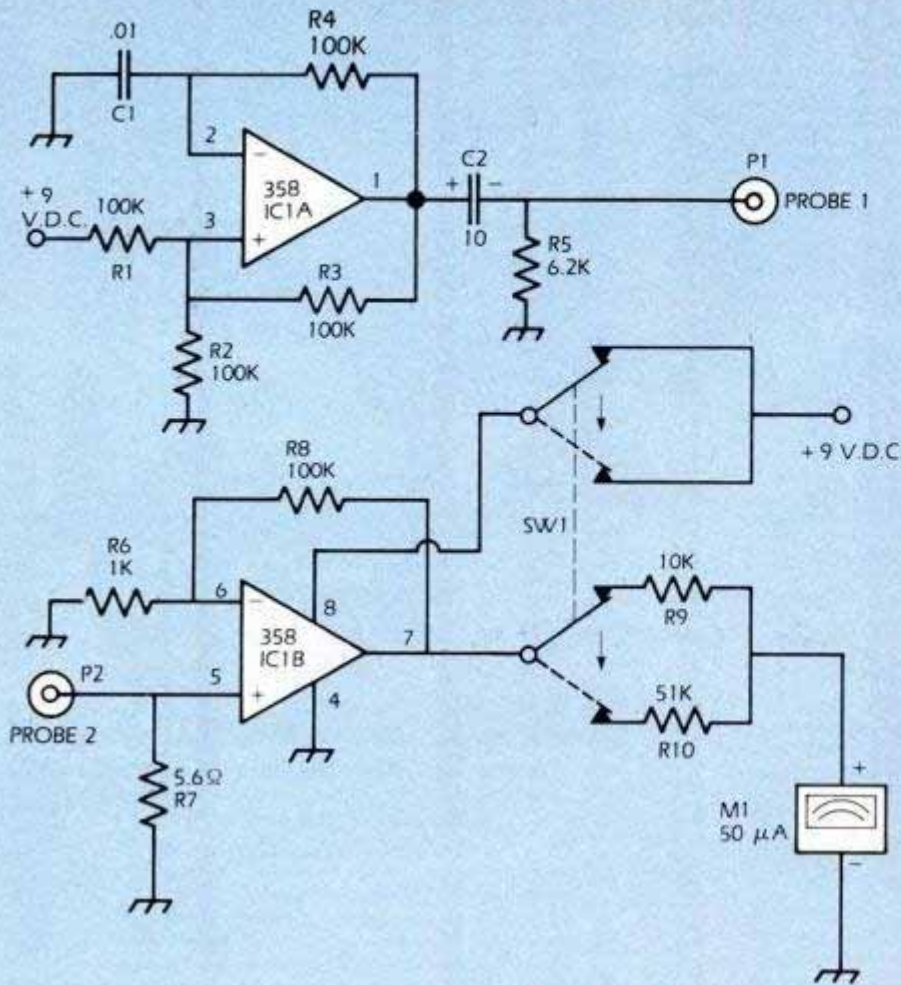


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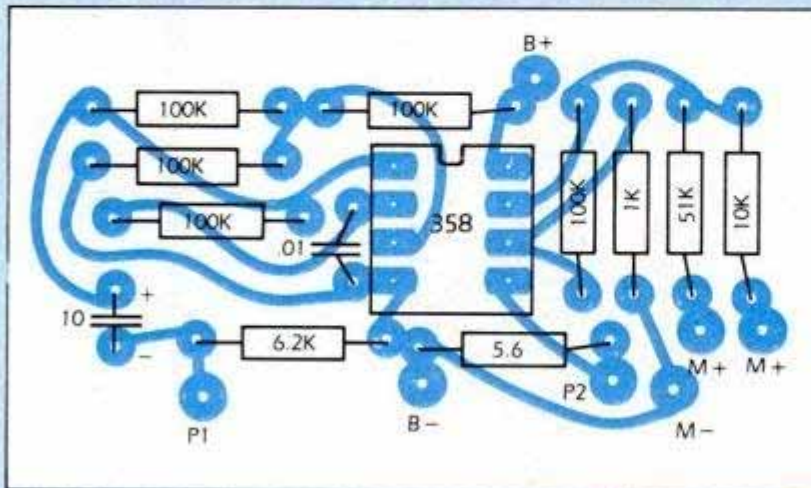
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PM'S SALT SHIRKER—SCHEMATIC DIAGRAM



Saltmeter uses a.c. circuitry from a d.c. supply to measure conductivity in food. Layout isn't critical, but you may use our PC-board layout (left); view shown is foil side of board. Attach a 9-v. supply (battery or other), plus going to where marked, negative to ground.



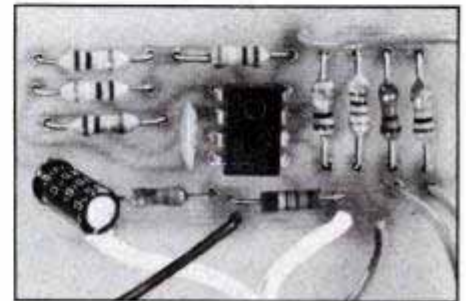
The component side of the PC board (above) shows where all of the parts go.

BUILD PM'S SALT SHIRKER

(Continued from page 158)

positive reading for an unsalty food, you'll never get a zero reading for a salty one. And since one dose of a salty food can fill a day's quota, it's better to be safe than sorry.

To make a simple conductivity measurement, you would need only a meter and a battery (essentially an ohmmeter). But a quick look at the schematic will tell you that our circuit is more complicated. This is because when you apply d.c. test voltages to a salt solution, an electrolytic reaction occurs that coats the electrodes. This changes the conductivity and results in drifting, inaccurate readings. The Salt Shirker overcomes this problem by applying a.c. voltage to the electrodes. Then, with the current rapidly reversing



You can use the photo of component side (above) with the drawing at left to build our PC board or to design your own.

itself, the electrolytic reactions cancel out, giving you steady, accurate readings.

A square wave is generated by one-half of the LM358 (IC1A), the four 100K resistors and the .01-mfd. capacitor. As the square wave passes through the 10-mfd. capacitor (capacitors can't pass d.c.), the d.c. components are removed and you're left with the a.c. voltage you need for testing foods. The portion of the a.c. square wave that conducts through the food passes into the remaining section of the LM358 (IC1B). There, it is amplified and displayed on

(Please turn to page 162)

PARTS LIST—SALT SHIRKER

- C1—.01-mfd. disc capacitor
- C2—10-mfd. electrolytic capacitor, 150 v.d.c.
- IC1—LM358 integrated circuit
- M1—50- μ A meter (Radio Shack 270-1751 or equiv.)
- All resistors are $\frac{1}{4}$ w. carbon, 10% tolerance
- R1-R4, R8—100,000- Ω (100K) resistor
- R5—6,200- Ω (6.2K) resistor
- R6—1,000- Ω (1K) resistor
- R7—5.6- Ω resistor
- R9—10,000- Ω (10K) resistor
- R10—51,000- Ω (51K) resistor
- S1—Switch, d.p.t.t. (double-pole, triple-throw)
- Misc.—Cabinet, circuit-board materials, 9-v. battery or other 9-v.d.c. supply.

Note: A kit, with all parts included, is available for \$29.95, or completely assembled for \$34.95. A special budget version with a smaller meter and case than the one pictured comes in kit form for \$14.95 from Circuit Craft Inc., 10 Idell Rd., Valley Stream, N.Y. 11580. Postage and handling included.

CLEAN AIR ON DEMAND!

At last, you can clean smoke, dust, pollen, bacteria, and odors from your home or office air. The Zestron Ion-Generator cleans your air of harmful pollutants as it fills the air with 30 trillion Negative-Ions per second.

If you've been in the mountains lately, you know how air is **supposed** to smell.

And perhaps you've captured that clean, fresh, invigorating atmosphere after a thunderstorm, or while standing near a waterfall.

That clean fresh air you enjoyed was **rich in negative ions**. Nature's own air purifiers.

THE ZESTRON IG-700

Pollution and civilization destroy natural air ions. A ZESTRON ionizer recreates 30 trillion of these ions every second. They clean the air of smoke, dust, solid pollutants, odors, bacteria viruses, and furnace fumes.

A new solid-state pulse circuit breakthrough is used in the Zestron ionizer. This gives the greatest ion output (with no detectable ozone) at an extremely low price! Compare the performance and prices shown in the chart. The IG-700 clearly has the greatest ion output — yet sells at a remarkably low price.

ION GENERATOR COMPARISONS

IONIZER	OUTPUT Ions/cc/sec. (at 1 meter)	PRICE
ZESTRON IG-700	1,904,000	\$ 99.95
Ion Cloud 9000	700,000	300.00
Energen 402B	550,000	149.70
Dial-An-Ion	540,000	189.95
Ion Breeze	500,000	399.00
Ion Fountain	360,000	129.95
Ionshpere	350,000	99.95
Ion Cloud 7000	350,000	119.95
Modulian	75,000	85.00
AirCare	72,000	149.95
Omega 700	63,000	245.00
JS&A Air Bubble	???	89.95
Orbit	???	99.95

WHAT IT DOES

The high-powered output of the IG-700 provides more negative ion benefit for you. It cleans a larger room faster and more thoroughly than lower-powered units. Under ideal conditions, a 40 by 40 foot area can be cleaned by a single IG-700.

Scientists claim that these amazing negative ions are of great benefit to you and can actually make you feel alive,

revitalized and alert while relieving depression and allergies. In addition, hospitals use ionizers in burn units to destroy bacteria and reduce pain. The Zestron IG-700 is clearly the **world's most powerful** room ionizer.

HOW THEY'RE BUILT

Don't let the IG-700's low price mislead you. The unit is of the highest quality, designed by engineers with many year's experience in zero-defect spacecraft design. The Zestron unit is totally electronic and very quiet. This unit is actually a home and office version of a large commercial air cleaning device costing over a thousand dollars.

FREE TEST DEVICE

A free passive remote ion detector is included with each ionizer. This handy little device gives you independent proof of operation, and permits comparison with other manufacturers' ionizers.

Place the detector first close to a Zestron ionizer, then close to a competitive unit. You will see far less ion output from the competitive ionizer — in some cases no activity at all!

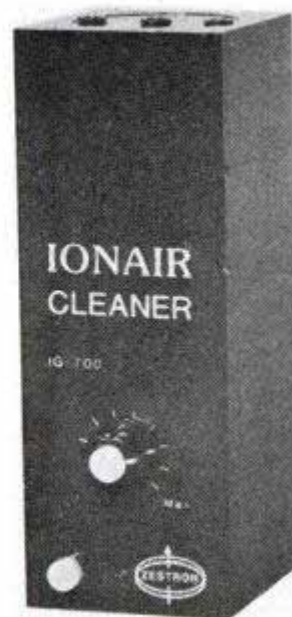
IG-700 SUPERIORITY

The IG-700 features adjustable output, which lets you set the output to your own preference. Some people prefer fewer ions at night, while a large smoke-filled room needs more ions than a small room with no smokers present.

The IG-700 has no moving parts and nothing to wear out or replace, unlike "perfume" filter-type air cleaners which require frequent replacement of expensive filters, and which emit no beneficial negative ions.

Scientific tests show that these noisy inefficient filter-fan units which emit chemical "citrus" odors are more like toys, and are no match for high-powered ionizers in thoroughly cleaning the air we breathe.

The IG-700 is a compact 2¼ by 2¼ by 6¼ inches. At 1.5 watts, it costs about 7 cents a month to run from standard house current and carries a full 1-year guarantee.



ZESTRON ION-GENERATOR

Please study the facts and figures on this page, and then order your Zestron IG-700. Try it for 15 days in your home or office. We predict that you will be delighted with the fresher air and more stimulating atmosphere it provides.

If you are displeased for any reason, however, you may return your unit within 15 days, and we will promptly refund your purchase price.

HOW TO ORDER

Mail your name, address and phone number with your check or money order. Credit card holders may speed delivery by calling our Toll-Free number. The Zestron IG-700 Ion Generator is \$99.95 plus \$4.00 postage and handling. The price includes a FREE remote Ion Detector and Owners Manual.

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(2 Units, \$94.95 each
plus \$3.00 postage and handling)

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**CLEAN AIR
ENGINEERING**

Department PM2
110 Towergate Place
Atlanta, Georgia 30338

BUILD PM'S SALT SHIRKER

(Continued from page 160)

the meter. If you switch in the 10K resistor, the Shirker will have high sensitivity to salt. When the 51K resistor is in, the meter will have low sensitivity.

Placement of the parts isn't critical. Once you have the parts soldered to a circuit board or wired on a perfboard, wire the connections to the meter, probe and switch. Solder the battery clip onto the circuit board, mount the components in the case and connect the 9-volt battery to the clip.

The best way to check out and cali-

brate the Salt Shirker is to make some test solutions of saltwater.

Make a saturated salt solution by dumping enough ordinary table salt into a jar of water so that even after shaking the jar, no more salt dissolves. Take exactly one teaspoon of the clear salt solution from the area above the undissolved salt and add it to one quart of fresh water. This calibrated quart solution has 24 milligrams (mg) of sodium per ounce. By adding other amounts of the saturated salt solution to a quart of water, you can get other accurate salt concentrations as outlined in the charts.

INTERPRETING THE SHIRKER

High-sensitivity scale		
Reading	Salt (mg/oz.)	Sodium content
0	0	None
10	2	Low
20	3	Low
30	4	Low
40	5	Low
50	6	Low
Low-sensitivity scale		
0	0 or trace	Low
10	6	Medium low
20	12	Medium low
30	24	Medium
40	40	High
50	70	High
Pinned		Very high

CALIBRATING THE SHIRKER

Saturated salt solution added to 1 qt. fresh water (teaspoons)	Sodium concentration (mg/oz.)
1/4	6
1/2	12
1	24
2	48
3	72
5	120
10	240

SONIC-SCAT! T.M. ULTRASOUND GENERATOR

Rids Your Home or Business of
**RATS, MICE, ROACHES, SPIDERS, FLEAS, FLIES,
MOTHS, CARPENTER ANTS, BATS, BEES, CRICKETS,
SQUIRRELS, WEASELS, SKUNKS...**

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No Poisons! No Traps! 100% ELECTRONIC DEVICE
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and flying and crawling intruders disappear



(Super Model illustrated. Standard model varies slightly in appearance.)

The clean, safe, odor-free, mess-free PEST-REPELLING method used by restaurants, food packers, kennels, racing stables and veterinarians... NOW AVAILABLE FOR YOUR HOME OR BUSINESS!

ONLY
\$49.95
(Standard Model)

ULTRASOUND (Sonic signals well beyond the range of human hearing) has proven amazingly successful in pest control. Devastating to the sensory and nervous systems of rodents and many insects, they seek escape and don't return! Forget hazardous poisons, dangerous traps, smelly chemicals and costly exterminating services — let advanced technology protect your home or business. Just plug neat, unobtrusive unit into any 110-120 volt AC outlet. Operates for only pennies a week. Standard unit safeguards up to 1500 square feet (12,000 to 15,000 cubic feet)... Newest Super model can provide protection for up to 2000 square feet (16,000 to 20,000 cubic feet!)

HARMLESS TO CHILDREN, DOMESTIC PETS!

Restaurateurs, food packing plant operators, bakeries, grocery warehouses, schools and hospitals are among the most enthusiastic users of ultrasound generators. Kennels, catteries and veterinary institutions use them for flea control, racing stables to eliminate rats, mice and flies. Completely harmless to dogs, cats, birds, fish and other domestic pets, livestock and house plants. (Hamsters, white mice, gerbils, guinea pigs and similar rodent pets must be kept from protected areas.) Poses no hazards to humans, even youngest children.

PESTS TOTALLY ELIMINATED

Results can usually be observed shortly after plugging-in as rodents and insects seek escape routes. Within 2 to 4 weeks, protected area is totally cleared and pests stay away! Humane and mess-free, it requires no cleaning, care or maintenance of any kind. Cannot interfere with TV or radio reception, pacesetters, hearing aids or other electronic equipment.

IMPORTANT! DON'T SPEND MORE TO GET LESS

Ultrasonic Generators with lower output (and notably poorer effectiveness) than the \$49.95 SONIC-SCAT are currently being widely sold at prices as high as \$100. Units approaching the efficiency and covering power of our \$69.95 Super model are selling at up to \$150.

We believe that the specifications of our instruments... their precision engineering and the standard of construction represent the highest level offered in equipment designed for home and office use. Each incorporates the latest advances in technology, ruggedized components and quality control techniques.

The frequency spectrum and sound intensity have been carefully determined to assure the maximum impact on the widest possible range of vermin. (The Super model extends the frequency sweep 7 KHz. above most other units and provides a force of 130 db. if you're technically minded. This means you'll be rid of more different pests CLEARED FROM A BROADER AREA.)

Multiple-story homes and buildings or rooms separated by brick or masonry walls may require 2 or more units. A special 220 Volt EXPORT version of the Super model is available for overseas use.

DESIGNED AND BUILT IN THE U.S.A.

While so ruggedly constructed (using advanced solid state components) that service will probably never be required, prompt and efficient attention is assured directly from the American factory. The manufacturer provides a guarantee for ONE FULL YEAR. Both standard and super models are handsomely finished in jet black with grained face plates. A red diode lights to indicate unit

is operating. Overall dimensions: Only 6 1/2" x 5" x 1 3/4"; Super model: 6 3/4" x 5 1/4" x 2 1/4". Full instructions included.

TEST IT FOR 45 DAYS AT OUR RISK!

Order with full confidence. When unit arrives, plug it in and use it for 45 days. If dissatisfied for any reason, return it for a cheerful and prompt refund of the full purchase price. Order TODAY and enjoy freedom from uninvited guests!

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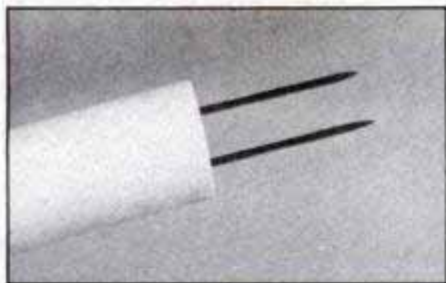
Set the Salt Shirker on its low-sensitivity scale and dip the probes into the 24-mg/oz. calibrated solution until the meter reads 30. The probes should extend in the water about 1/2 inch. Make a tiny nick on them with a file at about 1/2 inch from the tip so you know how deep to probe the food.

If you're trying to reduce your salt intake because you've heard that the average American eats about 20 times the salt his body requires in a day, then it's simple. Just avoid the foods that make the meter read high on the low-sensitivity scale. See the list on page 163 for the average amount of salt found in various foods.

A typical Salt Shirker measurement might go like this: You ate 4 ounces of cottage cheese and measured the sodium content to be 64 mg/oz. Multiply this by four since you had four ounces for a total of 256 mg. Add this to whatever other sodium you had during the day to arrive at your sodium intake.

Remember that it's the total sodium you eat in a day that counts. If all you had in one day was one salty potato chip (20 mg sodium), and all the rest of your food was salt-free, then your sodium intake for the day would be low. On the other hand, if you dissolved a teaspoonful of salt in a gallon of water, it might not even taste salty. But if you drank that gallon of water in the course of a very hot day, you would get 100 times as much salt (2,000 mg sodium).

You might be surprised at the things that have too much salt for



Design the probe so you'll always have the same length of electrode in the food you're testing. We used a plastic dowel.

severely restricted diets—some tap water, for instance. If your Salt Shirker gets a reading from your water, call the company to find how much of the impurity is due to sodium.

Ever take a dose of sodium bicarbonate for an acid stomach? It may put the fire out, but it also wallops you with a dose of sodium about equal to straight salt (NaCl) in sodium content. Generally, you have to be careful of processed foods because that's where the high sodium contents are.

Keep in mind that the Salt Shirker only works in water solutions. You could push the probes directly into a pile of dry salt and nothing would happen. But wet the salt and the meter would slam on the salty side.

Foods that are dry or fat based—for instance, bread and butter—don't have water. So you might not get a reading even if salt were present. So if you suspect that a given food doesn't have enough water to use the tester, mash it up in a dish with a little water. This will leach out the salt. Then you can test in the normal way. **PM**

TYPICAL SODIUM CONTENT—ONE SERVING, COMMON FOODS Mg

Antacid	53
Apple (medium)	1
Apple pie (1/2 slice)	482
Bacon (4 slices, broiled)	304
Bread (slice)	117
Butter (tablespoon, salted)	138
Butter (unsalted)	1
Chicken (1/2 breast, baked)	103
Chicken pie (8 oz., frozen)	863
Club soda (1 cup)	39
Corn (1/2 cup, canned)	196
Corn flakes (1 cup)	165
Cottage cheese (4 oz.)	256
Cucumber (1/2, medium)	3
Dill pickle (large)	1,428
Dry milk (1/2 cup)	224
Grape jelly (1 tablespoon)	3
Green grapes (1/2 cup)	3
Ham (3 oz.)	610
Instant mashed potatoes (1 cup)	494
Lemon (medium)	2
Margarine (tablespoon)	138
Meat loaf TV dinner	1,226
Milk (1 cup)	122
Pork (3 oz., roasted)	68
Potato (medium, baked)	3
Potato chips (10)	200
Pound cake (1 oz.)	33
Salt (1 tablespoon)	2,132
Soy sauce (1 tablespoon)	1,319
Steak (3 oz., broiled)	39
Tomato (medium)	4
Tomato sauce (1/4 cup, canned)	364
Tomato soup (1 cup, canned)	1,000
Tuna (3 oz.)	32
Tuna (canned in oil)	460
White wine (4 oz.)	5

NEXT MONTH IN PM

- All-new '83 Corvette—what it's like to drive.
- A beauty of a barn that you can build.
- Special RV section.
- PM shows you how to be your own weatherman.
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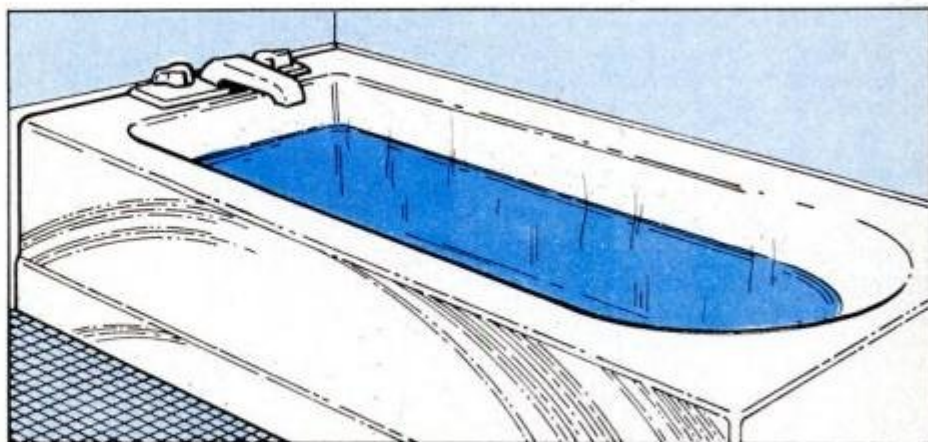
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5 Energy-Saving Tips That Work For Readers

1 Synchronized bathing

Our two daughters, my wife and I used to drain the hot water from our baths immediately after we bathed. Now, we leave the water in the tub. The heat from the water is released into the air. We can lower our thermostat and still be comfortable. We also stagger our bathing to let the heat from each bath warm the air. The last bather at night leaves the tub full. This restores the humidity upstairs and helps us sleep well.—*Bob Holton, Toledo, Ohio*



2 Tempering tank for a water heater

I removed the outer shell and insulation from an old water heater that had a sound water tank, and placed the bare tank next to my heater. Now, the incoming cold water first enters this tempering tank and is warmed by the

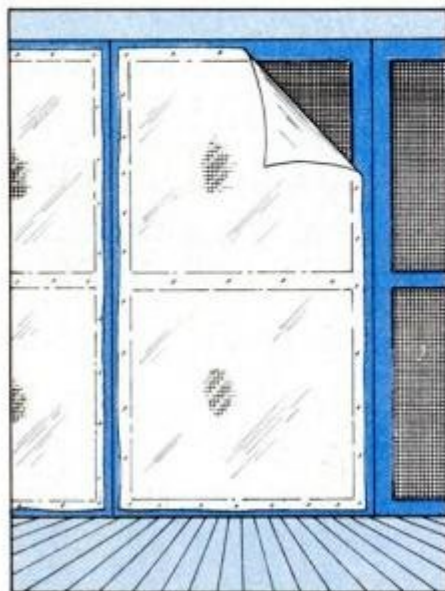
surrounding air in the room before passing to the water heater. *Note:* Since the tempering tank sweats in humid weather, it's a good idea to stand it in a large pan to collect the condensation.

—*Fred Devens, Toms River, N.J.*

3 Outside air for your wood stove

We built an outside air source for the wood stove in our fireplace, to prevent it from burning up heated air for combustion and thereby creating drafts along the floor. From behind the stove's air intake we extended a 4-in.-dia., flexible aluminum pipe through the ash pit on the fireplace floor, sealing the hole with fiberglass. In the basement we cut

a 4-in.-dia. hole directly above the ash pit's clean-out door, and ran sewer pipe from it to the outdoors through the nearest basement wall. We used elbow sections to route the pipe upward to grade level, the opening facing down. Fine mesh screen in the pipe end keeps out bugs and leaves.—*E. Barrett and G. Burns, Harrisburg, Pa.*



4 Plastic keeps heat in

Several winters ago we began stapling heavy, 4-mil. polyethylene plastic on the screens of our back porch to keep out the snow. We carefully stapled the plastic around each screen. This was easier than transporting the porch furniture to our crowded basement.

Little did we realize how much heat that would build up in the enclosed porch. From noon on, the sun shines into the porch. As soon as the temperature there reaches 70° F., I open the kitchen door and dining room windows onto the porch. The heat pours into these rooms. In May we remove the plastic so we can use it again.—*Greta Emerson, Lynnfield, Mass.*



5 Keeping coffee warm and fresh

We used to leave our coffee maker on its warmer from 6 a.m. until after midnight every day. Then I purchased a vacuum bottle to hold the coffee. Now that I use the bottle we not only save energy, but the coffee stays warm and doesn't get strong and bitter.—*Louise Schleissing, Niagara Falls, N.Y.*

Share your original home energy-saving ideas. PM will pay \$50 for each published idea. Include sketch or photo, if necessary, as well as your social security number (needed if payment is made). Submissions will not be returned unless accompanied by a self-addressed, stamped envelope. Send to: Energy-Saving, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.

It's like having X-ray ears...

Tiny, powerful electronic "ears" let you hear whispers through walls, conversations 2 miles away.

The Dyna-Mike Transmitter

It's smaller than a quarter. But DYNA-MIKE will transmit every sound in a room to an FM radio tuned to the proper unused frequency, from 1/2 mile to 2 miles away.

If you're at a neighbor's home a block from your own, you can hear your baby's cry, or you can tell the instant your



spouse comes home. If two of you are driving tandem in two cars, one or both of you can communicate with the other even if other cars drive between you.

DYNA-MIKE has as many uses as your imagination can think of. For a business conference, let the tiny microphone sit unobtrusively on the table or concealed on a shelf, and you'll be able to record every word. For businesses, you can put an FM receiver in a warehouse or remote office and "broadcast" instructions or orders to be filled.

Public speakers never had a better friend than the DYNA-MIKE. No wires or setup — just turn on one or more radios and your speech will come through with perfect fidelity. Put one on the front porch. If you hear a suspicious sound, turn on the radio and you'll hear the doorbell or the ring of the telephone.

Choose Your Model

New Horizons is introducing three models of the DYNA-MIKE supersensitive broadcast microphone. Model IC-18 is the world's smallest microphone — it's a miracle of electronic miniature power, with a high-fidelity range of 1800 feet. Introductory price is \$129.95 (two for only \$119.95 each).

Model X-18 is the longest-range microphone, with an unbelievable two-mile range. Introductory price is \$149.95 (two for only \$139.95 each).

Model X-3 is the most sensitive microphone. It broadcasts perfect-quality sound even from low-levels or whispers, up to 1,500 feet. Introductory price is \$99.95 (two for only \$89.95 each).

Each microphone is fully wired, complete with standard HC-1.35v. battery, good for 100 hours of continuous use and easily and inexpensively replaceable.

Of course you're protected by the New Horizon guarantee: use any DYNA-MIKE transmitter microphone for 30 days, with the right to return it for a full refund if you're not delighted.

— Phone or use this coupon —

The Super-Ear

You'll hear it all.

Effortlessly, you can hear not just a baby's cries, but quiet breathing, through a concrete wall a foot thick. Put the SUPER-EAR earphone in your ear and place the speaker on the wall. That's all there is to it.

SUPER-EAR hears everything, and even more astounding, hears it clearly. It's as though the wall weren't there. If you're coming home late at night and think intruders are in your residence, let SUPER-EAR find out for you. Want to know if the meeting is over in the room with the closed door? SUPER-EAR will tell you in a second.

SUPER-EAR is undetectable from the other side of the wall. The quality of sound has amazing fidelity—good enough to record, and SUPER-EAR has its own built-in recorder jack.

Because SUPER-EAR is the ultimate listening device, you can use it to pinpoint hidden squeaks in your car or the source of mysterious engine noises.

Construction experts use it to check for flaws or cracks in buildings.

It Works Anywhere!



Ever put your ear to a railroad track to try to hear the train? Try it with SUPER-EAR. You'll hear that train many miles away. Use it as a powerful stethoscope on yourself, a friend, or a pet. You can even hear a bird's breathing.

The only source for SUPER-EAR is New Horizons. Choose from two models — Model SB-5, with ultrasensitive microphone, \$139.95 (two for only \$129.95 each); or Model SB-1, with suction-type microphone, \$99.95 (two for only \$89.95 each).

Use your SUPER-EAR for 30 days. If for any reason you're not delighted, the absolute New Horizons guarantee means you can return it for a prompt refund.

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The PHONE ANSWERER/RECORDER connects in seconds between any tape recorder and your telephone. When you're away it automatically delivers a message up to 20 seconds to anyone who calls; when you'll return, when to call back, where you are.

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New Pulse Meter makes your exercise safe & effective!

The Pulse Tach™ Heart Computer was developed for use in hospitals and doctors' offices by a select team of physicians and engineers. Read what it can do for you.

How fast does your heart beat when you exercise? How quickly does your pulse return to normal? Does this "recovery time" improve as you get into better shape?

Well, guess no more. The Pulse Tach Fingertip Heart Computer accurately reports your pulse to insure maximum benefit from your exercise without dangerous over-exertion.

Pulse Tach is actually a micro-computer that fits over your finger. It weighs one ounce and can be worn easily during most exercise programs. It measures, calculates and displays what your pulse is doing.

Its custom-made, powerful micro-chip circuit replaces 5600 transistors and makes Pulse Tach the most advanced pulse instrument ever developed for consumer use.

Reading your pulse isn't as simple as it might seem. Your heart beat constantly changes — perhaps three fast beats followed by two slow ones, one fast one, four slow ones and so forth.

Pulse Tach has two ways to overcome the problem. First, in general or light exercise use, it "averages" your pulse every four beats. But after heavy exercise (or if you have an irregular rhythm) Pulse Tach can also compute heartbeats over a longer span of time. In fact, Pulse Tach is accurate to .4%.



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After Pulse Tach evaluates and processes your heartbeat, it shows your pulse rate on an extra large Liquid Crystal Display for easy reading indoors or out.

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There's more. Press a button and an audio "beeper" lets you "listen" to your heartbeat. It's like having a direct line to your heart.

ALSO A CHRONOGRAPH

Pulse Tach is more than just a way to count heartbeats. It also has an independent quartz stop watch. Now you can time your exercise period, laps or anything else up to one hour.

With Pulse Tach you know when you reach the heart rate at which exercise does the most good. The stop watch feature tells you precisely how long you're at this optimum level. Then combine both functions and compute cardiac recovery time — the most important measure of cardiovascular fitness. The better your shape, the shorter your recovery time.

Pulse Tach should be used by everyone. The fitness buff knows the value of pulse monitoring and a Pulse Tach is essential for the beginner to avoid dangerous over-exertion.

Additionally, Pulse Tach will show you how your heart is affected by coffee, a cigarette or a stressful day at the office.

It makes a great gift for a wife in aerobics or your tennis partner. In fact, anyone who exercises will appreciate this little heart computer.

THE PRICE MAY BE THE BIGGEST NEWS

Original cost of the Pulse Tach was quite high because quantities were limited to professional use. But just as pocket calculators and computers have dropped in price when made available to consumers, so, too, it is with Pulse Tach.

The Pulse Tach Fingertip Heart Computer is only \$49.95 yet its solid-state micro-chip components give better accuracy and more features than bulky, old-fashioned pulse meters costing \$100-\$200.

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Prove to yourself that the Pulse Tach Heart Computer is the smallest, most advanced pulse monitor



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

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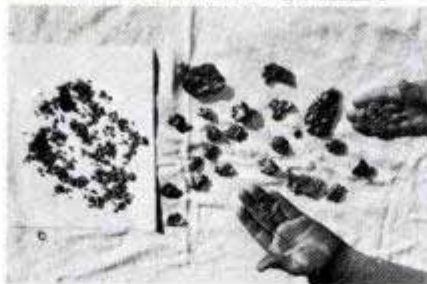
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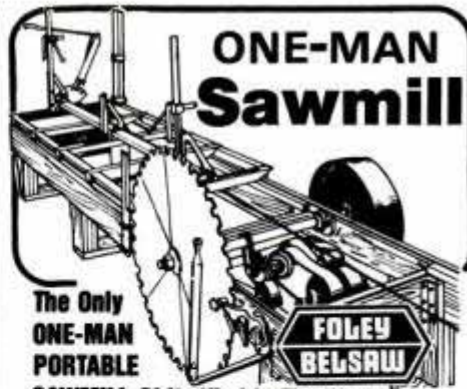
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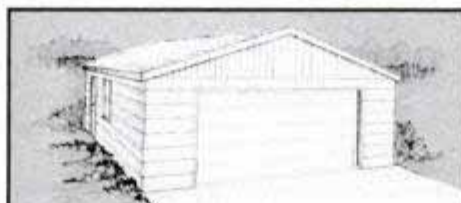


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OUR 26TH YEAR



24" OAK

PROVIDENCE

I first saw your Monster Maul advertised in *Mechanix Illustrated*. . . I was truly amazed when I discovered that it actually performed EXACTLY the way you said it would. Not one single testimonial that accompanied the maul was overstated in even the smallest detail. . . I quartered 3½ ft. long green fir log sections, 18" to 30" dia., with four swings. . . I only weigh 160 lbs. . . and it was in no way exhausting. When I see others weighted down with two mauls and two wedges to do the same job I do but take twice as long, I count it as Providence that I responded to your ad before I threw my money away.

Dave MacGregor, Washougal, Wa.

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I have split over 5 cords with the Monster Maul and it has performed up to my high expectations. Before I bought the Monster Maul, I broke 3 wooden handles in one week! My Monster has not been caught once. It has split logs 35" in diameter (elm) with an ease that makes observers ask to try it. Keep up the good work.

R. Crocker, Lincoln, R.I.

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Over a year ago, I purchased your Sotz Monster Maul and have never been happier. My husband and I have in just one winter season split over 150 cords of oak and assorted hard woods with your maul. We recently received your latest edition of the *Sotz News* and I really was impressed with your Lift N Saw. . . There

have been too many occasions where our saw has been jammed or we take our chances and hope we don't hit a rock, but we're never that lucky. Again, thank you for a really fantastic product. I can see why you guarantee your products for so long. They're really worth it.

Dawna Beckmann, Lenox, Mass.

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L.D. Hubbard, Upper Marlboro, Md.

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Last fall I ordered one of your Monster Mauls. Before winter set in I had split 8 cords of firewood with it - it works! Consider that I have been cutting and splitting firewood for over 40 years and this is the best device I have ever used.

Chester Evans, Coeburn, Va.

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Last year was my first with a woodstove and the first that I cut my own firewood. I had been using a 8# splitting maul and a 6# sledge with wedges. For kindling I had a large supply of broken handles! As a joke somebody left an ad for the Monster Maul on my desk at work. It

sounded great to me, so I ordered it. I couldn't believe your prompt response for I had the Monster in about a week. It was great! I couldn't believe how easy splitting even 20" oak was. To this part of the country a common hardwood is sweet gum which burns well but splits awful. Even the Monster can't always split gum in one shot, but it has never gotten stuck and it is the best way I know how to split this tough wood. (Many people who rent out log splitters will not allow them to be used on gum!) Two of my friends have been so impressed with the Monster that they've ordered their own. . .

Robert Prince, Virginia Beach, Va.

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Jack Shuller, DDS, Londonderry, N.H.

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A friend of mine used my Monster Maul on some apple wood and as you know it is very hard to split. The maul just went through it, like kindling wood. So I want another one to give to him, I wouldn't take any amount for mine, I never saw anything so easy to use. When anyone comes to the house and tells us how lucky we are to have large piles of wood for the stove and fireplace, we always show and tell them how we do it. We really bless the day we saw your advertisement in the magazine.

James Ruyf, Holden, Utah

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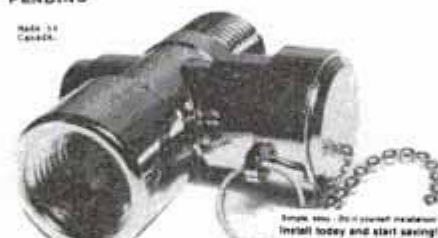
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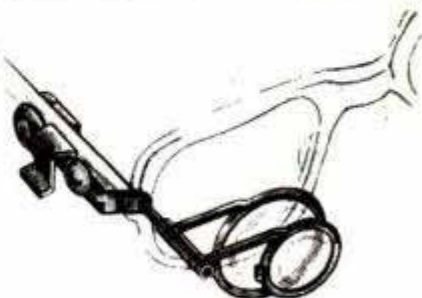
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* ALL MODELS SAFETY TESTED TO UNDERWRITERS LAB. SPEC., BY GEISSER ENGRS.

\$34.96

55-Gal. bottom kit factory pick-up

\$28.95

30 Gal. bottom kit factory pick-up

Kit converts 55 gal., or 30 to 15 gal., drum (not supplied) into high capacity stoves.



• Burns over 24 hours.

PRICE

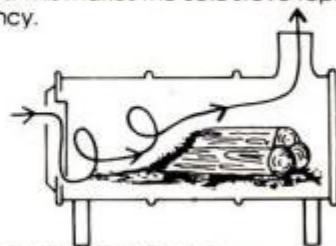
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30-Gal.-Bottom	\$32.95	\$28.95
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SPECIFICATIONS: Door, door frame, flue collar, draft control, internal draft channel of 13 ga. steel legs, 1/8 in. steel, hinges, latch, catch of 3/16 in. steel, nuts and bolts. Top Drum: Connector flanges, pipe assembly, 4 nesting brackets, nuts and bolts.
55 Gal. stove has KING SIZE 15 1/2" diagonal door opening
30 Gal. stove has 9 1/4" round door.

Sotz Corporation, 13643 Station Rd., Columbia Station, OH 44028

Patented INTERNAL DRAFT CHANNEL—Air entering top draft control is preheated as it is drawn down inside of door and is sucked into bottom of heater with a turbulent action, mixing with the wood gases. This makes the Sotz stove tops in efficiency.



SPARK-PROOF DESIGN Because of our internal draft channel, hot sparks cannot jump out of heater as in others with draft straight open to fire.

GUARANTEE. Try the Sotz Heater Kit at our risk. If (within one year) you don't agree it outperforms any wood heater money can buy, or (within 10 years) if the kit cracks, warps, or burns up, your money will be refunded, including shipping charges. We have been in business 26 years to back it up. Write for free information.

BARREL STOVE'S UGLY

People have told me this when they walk in my door. As far as I'm concerned, they can keep on walking, unless they've got five minutes and want to hear and witness just how beautiful that barrel stove is. Last year '78 (where the barrel stove is now located) there was a \$265 Wood Master Stove. In the beginning the W.M.S. burned 12-14 hours and gave nice heat. Three months from installation of the W.M.S. and some hard burning, the W.M.S. defaulted. Melted metal, air leaks and warpage caused the W.M.S. to lose its lasting and heating qualities. By now 7 to 8 hours burn time was tops and it smoked occasionally inside the house. This year we have your barrel stove. 22-24 hours burn time, even heat, hasn't warped, does not smoke (even after some hard burning). Last year our electric bill was \$40 to \$50 per month. This year \$20-\$25 per month. Why so cheap? Simply by placing an H2O tank . . . to heat domestic water, we've bypassed our electric hot water heater. A savings of approximately \$175 per winter. Prior to installing the barrel stove, I installed a \$600 Frontier Stove in front of my fireplace. This is at the opposite end of the house from my barrel stove. My basement is 30' x 60' x 9 1/2' ceiling. Although the Frontier Stove works good, I don't need it. The barrel stove alone, keeps my basement 72 degrees. Anyone interested in a \$600 Frontier Stove for \$550? (Used for 2 months.) **THAT BARREL STOVE IS BEAUTIFUL!** I've dropped it, kicked it, rolled it, burnt trash in it — she still works beautifully. I can even pick it up and carry it

myself. If I can sell my Frontier Stove, I will have saved \$982 this winter. Almost \$1,000 — NOW, ISN'T THAT BARREL STOVE BEAUTIFUL??

Dick Motter, Jersey Shore, Pa. HEATS LARGE GREENHOUSE

Last year we had 2 small greenhouses. During an extremely cold week with strong winds and very low chill factor, we lost hundreds of plants valued at over \$500. This year we built one large greenhouse 19'x54' and installed one of your double drum heaters. It holds the temperature safely and comfortably in cold weather. With a fan hanging over it, the temperature stays around fifty in sub-freezing weather. We also ordered a Monster Maul recently and it is well worth the money. My husband can split a cord of wood in very short time and with 1/3 the effort it took with an axe.

Mrs. Robert Gay, Cleveland, Tx. A DEFEATED PAIR

Your maul makes splitting wood pretty easy. First I bought a maul and wedge, not much good. Then I bought a patented chopper, a little bit better. Then I bought your maul. That did it! I never thought I would write a letter of thanks.

J. Linn, Terra Alta, W.V.

OIL BILL - \$76.00 FOR ENTIRE WINTER!

Four years ago, I bought your kit for the 30 gal. drum. It worked so good as a supplemental heat source in my fireplace that last year I ordered the double barrel kit. I used it all last winter. My oil bill was \$76.00 for the entire winter,

and I burned 3 cords of wood. As a chimney sweep, I have seen them all, and none can hold a candle to yours. It is the ugliest stove I have ever seen and therein lies the beauty of it. It is totally functional without a lot of fancy doo dads on it. Keep up the good work.

Arthur L. Hyson, Jr., Smithtown, N.Y.

WE LOVE IT

Last year my father and I ordered your 55H kit. We love it. Our stove performs beyond our expectations! Thank you for prompt delivery and an outstanding product. We are ordering two more kits.

Dave Wagner, Lake in the Hills, Ill.

USING IS BELIEVING

After seeing your advertisements in Organic Gardening and Farming magazine last fall, my father bought one and then a second of your \$35 oil drum stove door kits. They kept our two old farm buildings warmer than they have ever been when we tried to heat with oil/kerosene. Using is believing.

Bo Prichard, Farmville, Va.

AN OLD FASHION FRIEND

After having received your 55HDD kit, I find it necessary to write. What a refreshing experience to buy something and get what you pay for. Each part in perfect shape, instructions that anyone can follow. Just good, old fashioned American business. I get very even heat through out my house. (1500 sq. ft. living space and 1500 sq. ft. full basement). Thanks again, . . . I feel like I have a new friend.

Gene Gierisch, Henderson, N.C.

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