

DECEMBER 1981 \$1.25

Popular Mechanics



5 dream cars that owners built from the ground up

1,000,000-MILE DRIVE REPORT

FORD'S SPORTY EXP:
Owners rave about handling and styling

STEREO: Exciting new shapes and portability in high-quality sets

A MASTER CRAFTSMAN'S WOOD-JOINERY SECRETS

PIPER CUB: The plane that taught America to fly

12 COMPLETE PLANS

9 Yule decorations you can make

3 art deco furniture pieces to build

PULL UP!

What happens when air-traffic computers fail?



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On the cover

Earlier this year, a New York Air Traffic Control Center computer spotted an airliner that had dropped below minimum safe altitude—and was headed for Manhattan's World Trade Center towers! PM's story, beginning on page 96, tells how the air-traffic system relies on computers, and what happens when they fail.

—PM painting by Ed Valigursky

Popular Mechanics®

DECEMBER 1981

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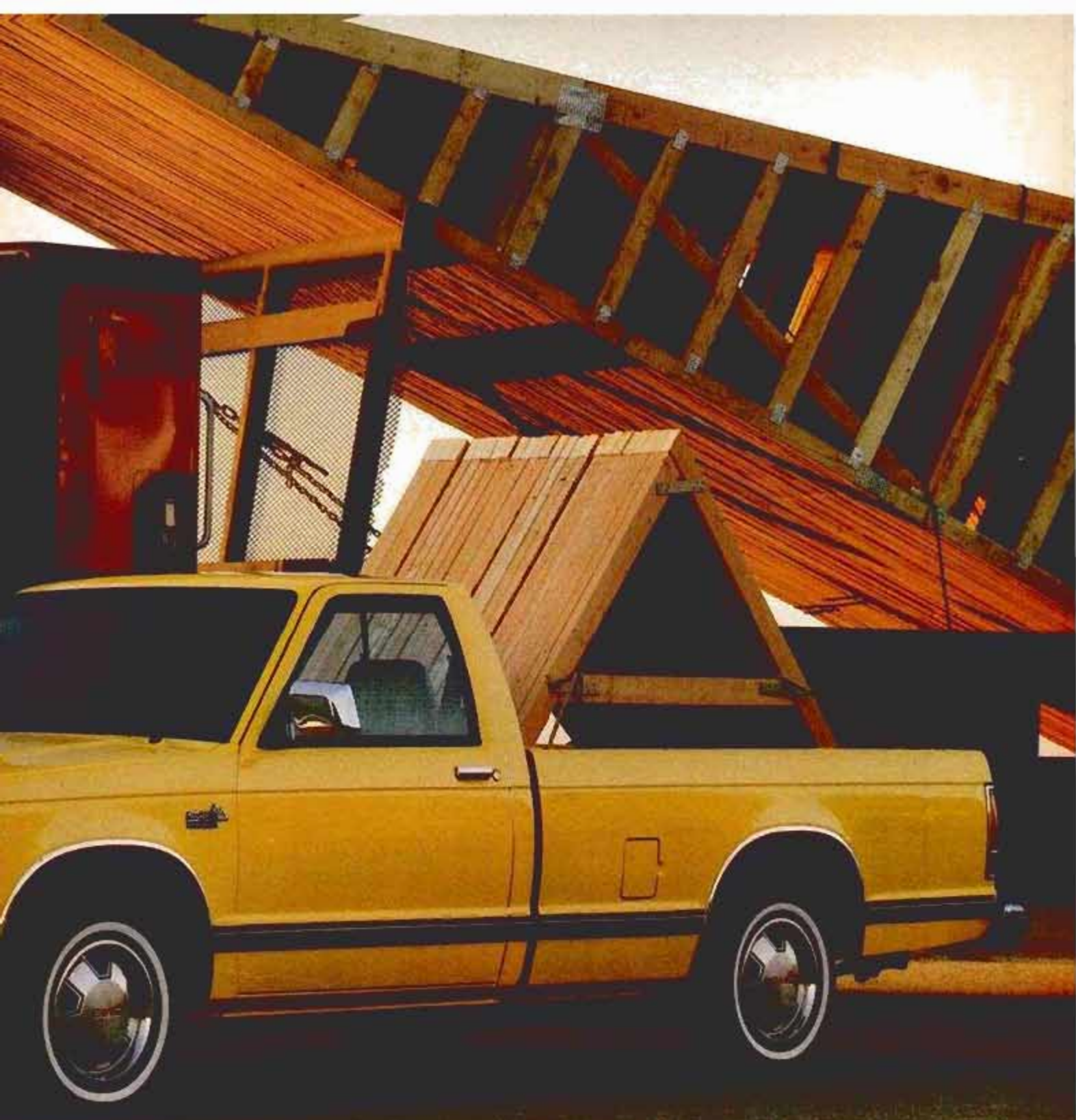
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LETTERS TO THE EDITOR

Inspired to build kit car

We greatly enjoyed Tony Assenza's article on building the Blakely Bernardi kit car (*The Real Fun of Building a Kit Car Is Driving It When It's Finished!*, page 96, Oct. '81). As the owners of a mechanically sound, but badly rusting '74 Pinto, the idea of using it to build a beautiful new kit car is terrific. We plan to do it.

Thank you for sharing Assenza's honest experience with us.

MRS. RONALD J. BENDER SR.
McMURRAY, PA.

We're eager to know how the project turns out. We'd also like to hear from readers who have already built kit cars. An article on readers' kit-building experiences would be great for a future issue.

Anyone own a Publica?

I read with great interest your article *The Economy Cars America Never Bought* (page 63, July '81). It caught my eye because of its reference to the Toyota 800 Sports Coupe, known as the Publica.

I am the registrar for a group of Sports 800 owners called "The Publicans." At present, we know of 28 such cars in the United States. We'd like to hear from other Publica owners. There are no bylaws or dues—just an occasional newsletter. The purpose of the organization is to keep owners in touch with one another and keep these excellent little cars on the road.

R. E. HAMMEL
224 DEBBY DR.
PALM SPRINGS, CALIF. 92262

It's any man's ocean

I just caught up with your November '80 issue. In your *Letters* column (page 6), Ross Short stated that in World War II, the British warship *Hood* "really had no right being on the same piece of ocean with the heavily armed and armored *Bismarck*." Actually, the two ships were fairly even in size (41,000 tons for the *Hood*, 42,000 for the *Bismarck*), and they had identical main guns (eight 15-inchers). The *Hood* had slightly lighter armor (12 inches to the *Bismarck*'s 12½), but was faster (31 knots to 29).

Mr. Short might just as well have said that the British destroyer *Onslow* should not have been on the same piece of ocean as the German battleship *Lutzow*, or that the U.S.

destroyer *Johnston* should not have engaged the Japanese battleships *Yamato* and *Kongo*. Yet both these ships, though outclassed, gave a good account of themselves.

ANTHONY J. WALTON
LONDON

Reader Short was mainly pointing out that the Hood, despite her size, was not considered a true battleship, but was classed as a battle cruiser. We don't think he seriously meant that she should not have engaged the Bismarck—she had no other choice.

Oh, how times change!

Your readers may get a kick out of an item I found in your January 1909 issue. On page 40, it reads:

"The fumes of gasoline from automobiles, according to a London authority, are accountable for the decrease in the death rate of that city. Partially burned carbonized matter is claimed to be a splendid antiseptic and the creosote vapors from the motor are in reality a health tonic and bracer."

ERVIN KOELLING
REDWOOD CITY, CALIF.

And in 1909 the price of a full year's subscription to PM was \$1!

Improving stereo sound

I very much enjoyed your article on devices for improving stereo sound (*Six New Ways to Get Better Sound from Your Stereo*, page 106, May '81). But there's a question that's bothering me: Would you use a Koss K/4DS digital delay and a Carver Holograph Generator together?

JIM NAGY
PITTSBURGH

Electronics editor Neil Shapiro replies: Yes, the two can simply be hooked together, one after the other. The Koss unit would first delay the sound, then the Carver Holograph would process it further. The only units mentioned in the article that would not be used together are the Carver Holograph and the Omnisonic Imager, since they provide similar enhancements.

He who laughs last . . .

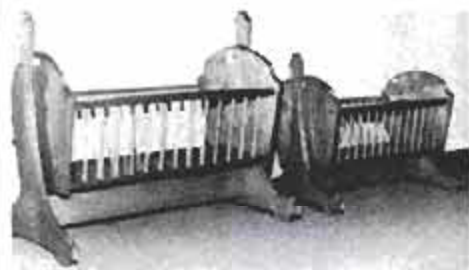
In your *Letters* column for August '81 (page 8), a reader said he had to laugh at the Army's use of a spotting scope on a .50-caliber machine gun. He shouldn't laugh.

The M2 heavy-barrel machine gun has bench-rest accuracy to 1,800 meters (almost 2,000 yards). First-round kills at such distances at night were not uncommon in Vietnam using early-model image-intensification scopes. This weapon/sight combination was found to be a devastatingly effective system for night combat.

DAVID M. DACUS
LAS CRUCES, N.M.

PM's versatile cradle

When my mother expressed an interest in a doll cradle and my wife announced that she was expecting, I remembered your article *Build a Cradle with Old-Time Charm* (page 128, May '80). After studying your plans, we worked out a way to get two cradles (photo below) from one sheet of ¾-inch plywood.



PM's colonial-style cradle (left) and a scaled-down, doll-size version to go with it, both the handiwork of reader Sterchy.

Results: a full-sized cradle for a mother-to-be, a scaled-down version for a doll-collecting grandmother-to-be, and a very satisfied PM reader. Thanks.

DICK STERCHY
SPRINGFIELD, MO.

Thanks for letting us know. For others interested in this project, photocopies of the article are available for \$1 from Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

About our Shakey-Jakey . . .

Some readers have reported problems in getting their Shakey-Jakeys to work properly (*Shakey-Jakey—Test for Steady Hands*, page 141, Feb. '81). Help is on the way. For information on circuit changes and alternate parts, write to Shakey-Jakey, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. **PM**



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PM ELECTRONICS MONITOR

Every holiday season, gifts are more expensive than last year—and electronic toys are no exception. There are so many choices in this field that retail for over \$50, it would take the entire magazine to list them. Instead, here are three special gifts we think you'll enjoy.

Touch and Talk

We've experimented with this toy on our own preschooler and can report that it's a marvel. A flat tablet, the Touch and Talk board accepts a number of colorful pictures of such children's favorites as dogs, cats, stars, horses and shiny cars.

The magic comes in when the overlay is installed on the tablet. The child presses down on one of the bright pictures. Then, a voice-synthesized computer names the picture that was touched in cheerful, electronic tones. If the child has not chosen an object for a few moments, the electronic voice asks such questions as, "Can you find the red star?" The Touch and Talk uses positive reinforcement to teach—the child is never made to feel he or she has made a blunder.

The unit we used had a pliable surface that was just a bit too stiff to be totally responsive to our 2-year-old's touch. But a little help from Dad made each session fun—and older children would have no trouble.

Manufactured by Texas Instruments, The Touch and Talk will sound off in your home for \$60.

Children's Discovery System

This first home computer for children will hit the market around Christmas. It's bound to delight and educate any kid in elementary school.

A real computer, with a liquid-crystal display, touch-sensitive keyboard and a library of available car-



Collect ham QSLs

"QSL" is shortwave slang for "confirmation." A QSL card is a postcard sent by a radio station to confirm a reception report. Many people collect QSL cards from big, national radio stations, but neglect the thousands of radio amateurs (hams) who broadcast internationally. Most hams are happy to QSL if you send them

a report. The report should include time and date heard, frequency and an "RS" report. R stands for readability, S for strength—rate R from 1 (poor) to 5; and S from 1 to 9. So, 59 is perfect. Ham addresses are listed in the foreign and American callbooks available at many electronic-supply stores.

tridges, this system is easy to use.

The liquid-crystal display makes large, easy-to-read letters in the type mode. The instruction manual details many games using the computer display to teach the alphabet, synonyms and much more.

Entering music is easy via the keyboard (A for an A note, and so on). Rests and notes of different lengths can also be entered.

But our favorite feature was the drawing mode. Plugging in the "Discoveries in Art" cartridge adds a number of pre-drawn shapes to the computer's memory and lets the child mix and match; drawings can even be animated in a kaleidoscopic way.

The Mattel Children's Discovery System lists for \$129.95; add-on cartridges are extra.

The Dark Tower

For a year, we've been saying how great the adventure-style games are on home computers—but if you don't have a home computer, you may have felt left out. Now, anyone can join in on the fun of computerized, fantasy role playing with this new board game.

In the middle of the board stands a 1½-foot-high, cylindrical computer. This "Dark Tower" controls various aspects of the game.

Just like on a home computer, there are many variables to add realistic complexity to the game. After a short time of playing, you enter into a world of fantasy, strategy and intrigue. Dark Tower is the first game of its kind: We think you'll agree it shouldn't be the last.

For ages 7 to adult, Dark Tower from Milton Bradley is \$50. **PM**



Children's Discovery System (far left) is first computer designed for kids. We liked its drawing mode and capability to act as music machine, word-game partner or referee. The Dark Tower (near left) uses cylindrical computer on a playing board. It's first computer adventure game that uses no home computer.



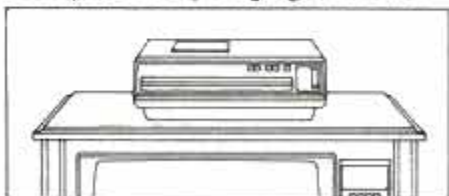


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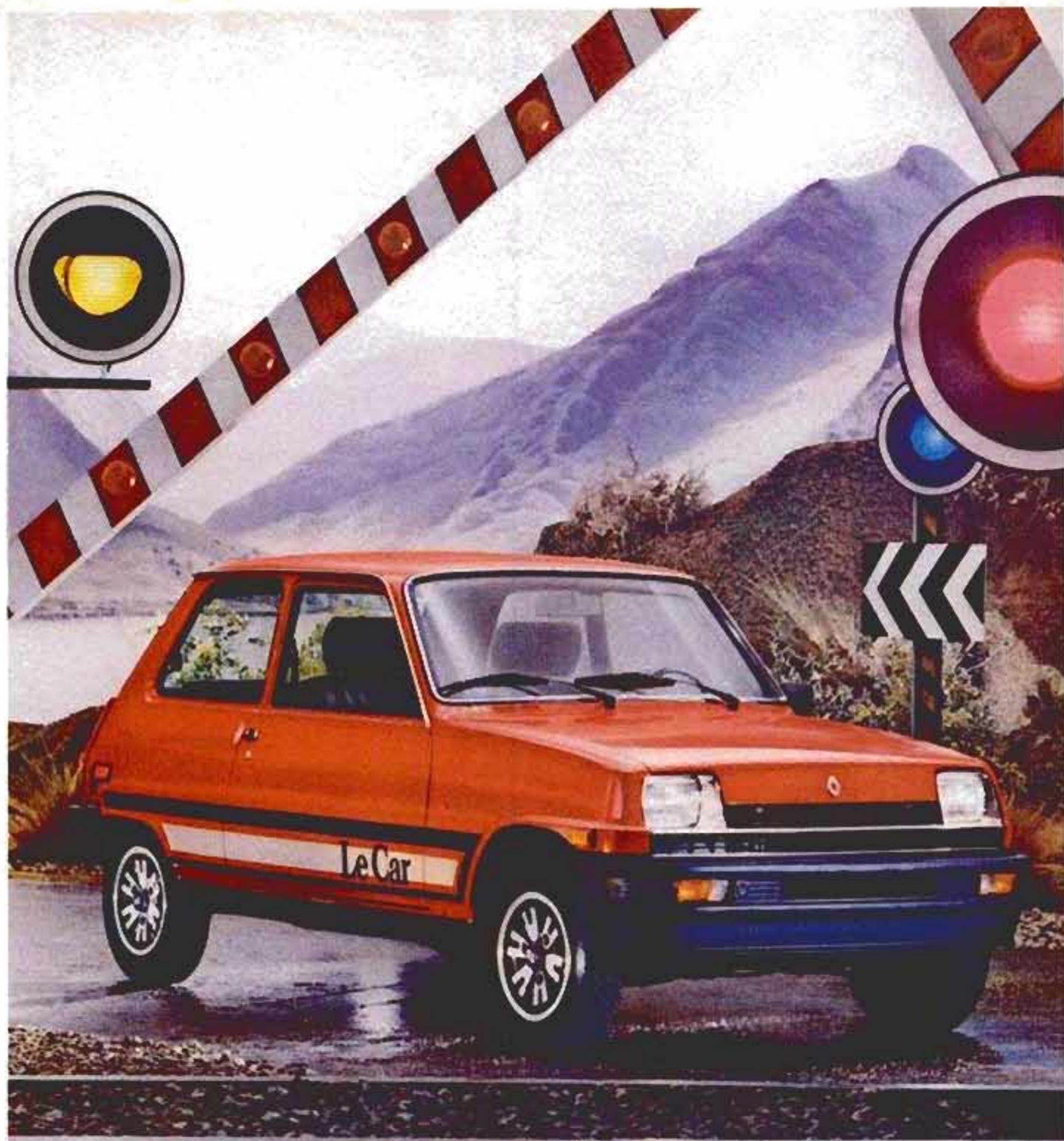
It's simple to hook up. As simple as a record player to operate. And built with all the technical know-how of the leader in consumer video electronics.

And best of all, the RCA VideoDisc Player lists at less than \$500*. A lot less than the list price of most video cassette recorders.*

So see your RCA VideoDisc dealer for a demonstration. And bring the magic home for Christmas.

RCA
VideoDisc System

*Prices optional with dealer; actual price may vary.
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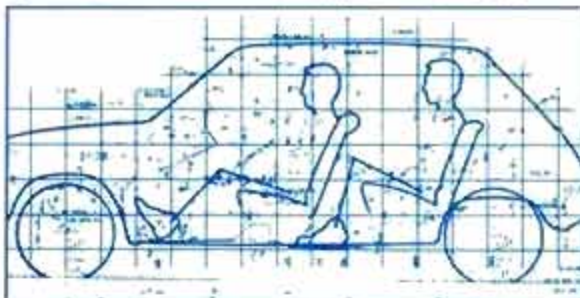


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40 HWY EST 32 EST MPG

**Compare the 1982 EPA estimates with estimated mpg for other cars. Your actual mileage depends on speed, trip length and weather. Actual highway mileage will probably be lower. Calif. figures lower.



SCIENCE WORLDWIDE

Beak softly . . .

Five-year-old Alex does more than parrot, even though he is a parrot. His trainer at Purdue University says Alex recognizes four colors and four shapes, uses 40 words correctly and speaks with something of a Boston Brahmin accent.

The reason for the accent is that Alex's teacher, Irene M. Pepperberg, has a bit of a northeastern accent herself. So when Alex says "shower," one of the words Pepper-



Smart Alex: parrot with a Brahmin accent.

berg has taught him over the past four years, it comes out sounding like "showah."

Pepperberg, a research associate in Purdue's biological sciences department, says hers is the only scientific attempt in the country to teach a bird to communicate verbally, not merely to mimic human sounds.

Elaborate training procedures involve several teachers. One asks questions of the African Grey parrot and offers praise and disapproval for responses. Another plays the role of parrot, acting as a model for desired behavior and stimulating the parrot's interest by pretending to be a rival for the trainer's attention.

Alex knows words such as *paper*, *key*, *wood*, *pasta* and *walnut*. He can identify triangles, squares and five-sided figures, and after eating or drinking, hollers "cork!" just like a discriminating diner checking the quality of the wine (although in Alex's case, pieces of cork are used to clean his beak).

Alex's performance is not proof that he speaks a language. Controversy continues about whether animals can actually use symbols to communicate, or whether they are simply doing tricks. Perhaps Alex will have something to say on the

subject in future decades; African Grey parrots sometimes live 50 years.

Mission to 'fossil islands'

U.S. researchers will sift the muddy, bleak soil of three Antarctic islands early next year for clues about the ancient supercontinent, Gondwanaland.

A ground party, led by Dr. William J. Zinsmeister of Ohio State University's Institute of Polar Studies, will be seeking fossils of 65-million-year-old marsupials, ratlike forerunners of kangaroos. The team, funded by the National Science Foundation, will look for the remains on three islands, James Ross, Snow Hill and Seymour. All are at the northern tip of the Antarctic Peninsula.

Marsupial fossils could provide evidence supporting a theory of how these mammals came to Australia, where they are common today. The theory holds that marsupials originated in North America (where their fossils have been found). Then they migrated over the giant land mass of Gondwanaland, through territories that would later divide into the separate continents of South America, Antarctica and Australia. (Gondwanaland may also have included Africa and peninsular India.) The missing link in this migration theory is marsupial fossil evidence from Antarctica.

Zinsmeister told PM that island terrain, comparable to the American southwest, is rich in fossils. Previous expeditions have discovered the remains of giant penguins, whales and sharks, as well as 3-foot-diameter fossilized tree trunks on Seymour Island, which is now barren of trees.

Crawling on air

A device used to simulate the movement of the space shuttle's manipulator arm in zero gravity is helping brain-injured children to crawl for the first time.

The crawling aid, created by Hubert Vykukal at the Ames Research Center in California, is a simple plywood platform. Air pumped from a compressor, normally used to spray paint, jets downward through aluminum discs under the plywood, lifting it slightly, like a hovercraft.

One brain-injured child named Andrew was virtually unable to crawl before being strapped to the device. After a month of continual

practice, he was able to crawl 16 feet in 25 minutes on his own.

Vykukal's invention works by providing positive feedback to children when their random arm-and-leg motions propel them over the floor. Principles behind the crawler were used by the National Aeronautics and Space Administration to build a two-dimensional simulator of weightlessness. Among other applications, the simulator was used to study the 50-foot-long manipulator arm of the space shuttle.

Coal-powered fish farm

The Brunner Island powerplant near Harrisburg, Pa., is capable of cranking out more than 1,400 megawatts of electricity, as well as a mess of catfish.

The coal-fired plant owned by the Pennsylvania Power & Light Co. produces heated water as a byproduct. And now, some of that water is being fed into large tanks. The 80° to 85° temperatures are perfect for raising catfish, according to William Frederick, the company's manager of engineering research. In long pools with gently flowing warm water, catfish grow to a full pound in about a year. These waters have produced up to 100,000 pounds of fish



Catfish thrive in the warm water that is a byproduct of Brunner Island powerplant.

annually, and the company is in the process of expanding its farm. Four new 200-foot-long, 2-foot-deep and 10-foot-wide concrete ponds would be capable of producing a yearly yield of half a million pounds of catfish, Frederick said, although actual output will be less. The company plans to devote some of the pool space to raising trout, tilapia, shad and eel.

PM



Premium
Canadian.

Happy Velvet!

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"I went my Popular Mechanics' projects to look professionally done. Irwin products help."

Mike Todd, School Principal and Do-It-Yourselfer



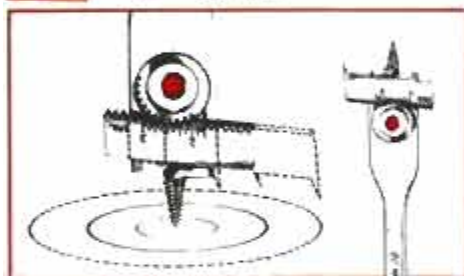
You can easily bore holes up to 1½" with the Irwin Speedbor "88." This is the wood bit that cuts clean, fast, accurately. Puts more boring power at the working end of your ¼" electric drill.

Irwin's exclusive hollow ground point starts holes fast. Sharp spade-type cutters power through any kind of wood. ¼" shank chucks perfectly.

Workshop special
Set of 8 Speedbor "88" bits with metal hang-up rack. Sizes ¼, ½, ¾, 1, 1½, 2, 2½, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100.



Strait-Line Chalk Line Reel Box—50 ft. & 100 ft. sizes. Popular-priced Irwin self-chalking aluminum alloy box. Easy action reel. Leak-proof. Practically damage proof. Fits pocket or hand.



Irwin Micro-Dial bores 35 hole sizes
Just dial the size hole you want up to 3 full inches. Taper square shank fits all hand braces. Machine-sharpened spur and cutters deliver clean, accurate boring action. No. 22 model (illustrated) combines 35 standard sizes in one precision-engineered wood bit, ¾" to 3". No. 21 lets you dial 19 standard sizes, ¼" to 1¾".



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NOTES FROM THE EDITOR

John A. Linkletter

A very merry Christmas to all of our 6,311,000 readers from the editorial staff of Popular Mechanics!



The PM editorial staff (left to right, in four rather loosely arranged rows):

Seated: Melanie Roberts, Suzanne Pontecorvo and Helen Ullio.
Second row: Kathleen Corte, Joe Oldham, Penelope Spangler, Harry Wicks, Tony Assenza, John Linkletter, Sheldon Gallager and Ira Herrick.
Third row: Alan Andresen, Conrad Stowers, Don Mannes, Loretta Mossbarger, Bill McKeown, Robin Nelson, John Bostonian, Peter Easton, Neil Shapiro and Shannon Kelley.
Fourth row: Steven Fox, Bill Hartford and Steven Willson.
Not shown: Douglas Quinn, Josephine Caronia, Michael Lamm and Gary Witzenburg.

Thanks to all of you, 1981 has been another great year for Popular Mechanics. It's a real pleasure to create this magazine for you each month; we think you must enjoy the result because you keep on subscribing and buying it on newsstands. And, once in a while when you're displeased, we're grateful that you care enough to let us know about it.

Thanks, and happy holidays.

PM

New from NRI!

The first at-home training in videocassette recorder repair with exclusive videotaped lessons.

Learn Video/Audio Servicing... includes RCA state-of-the-art VCR, NRI Action Video lessons, plus full training in color TV and audio repair.

Now, you can learn the hottest, most wanted skill in home entertainment electronics...servicing and repairing videocassette recorders and video disc players. Well over 2 million units have already been sold and the demand is just starting! Already, qualified VCR technicians are in short supply...people are waiting up to a month for VCR repair. Good jobs at good pay are going begging. And NRI can get you in on the action with convenient and effective at-home training.

Choice of Specialized Training

NRI offers you three Master Courses in Video/Audio Servicing, each complete, each with equipment and training for the specialty you want. Each course thoroughly prepares you for color TV plus audio and video equipment. Then, you take the specialized hands-on training on the equipment you select.



Learn as you work with equipment you keep.

You can get specialized audio experience as you build your own AM/FM stereo system complete with speakers. Or gain real bench experience with hands-on TV training as you build a 25" (diagonal) fully-computerized, programmable color TV and professional test instruments. Or train with your own RCA video-cassette recorder and NRI's exclusive Action Video servicing lessons on videotape.



State-of-the-Art VCR

This modern VCR features high-technology design with electronic pushbutton tuning, remote control, three recording speeds with up to 6-hour capacity, high-speed visual search, built-in clock/timer, memory rewind and audio dubbing capability. Direct drive motors and azimuth recording give outstanding picture reproduction.

It's yours to keep, as part of your training. You'll not only use it to learn operation and servicing techniques, but to play the absorbing NRI Action Video lessons that come as part of your specialized training. In word and picture, you'll learn theory, construction, and service procedures, see them explained in graphic closeups. And you get this unique training only with NRI!

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No need to quit your job or tie up your evenings at night school. No time away from your family or expensive travel. NRI comes to you. You are a class of one, getting both theory and practical hands-on training backed up by our staff of experienced educators.

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More than 65 years and a million and a half students later, NRI is still the first choice in home-study schools. A national survey of successful TV repairmen

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Mail the postage-paid card today for your free copy of our 100-page look into tomorrow. It shows all the equipment you get, describes each lesson in detail. And it tells you about other important career opportunities in Microcomputers and Microprocessors, Digital and Communications Electronics, Electronic Design Technology, and more. Send today and get started on a big new future for yourself. If card has been removed, please write to us.



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DETROIT LISTENING POST

Ford Ranger sneak preview

"Wait for us," Ford's truck people seem to be saying as they roll out prototypes of their coming Ranger mini-pickup for small groups of writers—keenly aware that GM's small S-truck will beat them to market by at least five months.

First impression: Both Rangers we drove (two-liter, four-speed and 2.3-liter automatic) were low on performance (16 to 18 seconds, 0 to 60) but high on ride quality, sound and vibration isolation, creature comforts, features and styling. The only comfort problem for me was not enough stretch room for legs or arms in the cab, but that's common to most pickups, large and small.

Standard power train is the two-liter Four (imported from Brazil) coupled to a four-speed manual gearbox, while the 2.3-liter Four and automatic transmission are options. Coming attractions for next fall include a Toyo Kogyo-built 2.2-liter diesel engine, a five-speed manual transmission, a 4wd version, a chassis cab and a snowplow package. A bit over a year from now, there'll be a "Bronco II" 4wd sport truck and a long-wheelbase, heavy-duty chassis cab.

Primary emphasis was put on fuel economy, which Ford says will be very competitive with the import trucks, while everything else was tailored to look and feel much like today's conventional pickup. They want downsizing truck buyers to feel right at home.

A mystery wagon



X-car wagon? Probably not, but the running prototype of what looks like a Chevy Citation station wagon, caught by one of our ever-vigilant photographers near GM's Warren, Mich., wind tunnel, is most likely a disguised early version of a front-wheel-drive A-car wagon. As you may know, the new GM A-cars that are set to debut in mid-January are based on the popular X-cars; in fact, they share the same wheelbase, floor pan and power trains. We know of no station wagons in the '82 A-car lineup, but it's logical that they are being evaluated for possible future introduction.



Ford's new Ranger mini-pickup is set to do battle with GM's new S-truck and the horde of Japanese minis. It will have a two-liter Four and manual gearbox as standard.

GM/Suzuki minis?

Speculation around Detroit is that GM's complicated deal with Japanese minicar and motorcycle maker Suzuki gives it the inside track for future importation of supereconomy minis with engines of one liter and less. It's known that GM has been having second thoughts about the profitability of building its own high-tech, front-wheel-drive minis in the United States. Thus, the Suzuki tie-in, in conjunction with existing partner Isuzu, could be just the ticket for both companies to penetrate this country's future minicar market with a minimum of investment and risk.

On the occasion of the announcement, GM chairman Roger B. Smith said: "As a leading producer of vehicles smaller than any GM manufactures, Suzuki offers products and production capacity that can be of interest in many parts of GM's worldwide marketing network, and GM has technology in many fields that is of interest to Suzuki."

It's too early to tell, but some observers believe the arrangement could shake up the No. 1 automaker's future product plans, including the Chevette-replacement S-car and possibly the much-talked-about GM electric car, both tentatively due for mid-decade.

More convertible talk

Long before its highly anticipated LeBaron convertible hits the market, Chrysler is already talking about ragtop versions of its less expensive Plymouth and Dodge K-cars. Obviously, there's more per-unit profit in the top-of-the-line LeBaron "Super K," and Chrysler needs all the profit it can earn, but

there should be significantly more volume in the more affordable Aries and Reliant.

We've believed all along that the U.S. convertible's demise in the early '70s was largely due to the fact that the last few available American soft-tops were either too big or too expensive (or both) to appeal to young convertible fanciers. If that's true, then any serious ragtop revival will be led by small, fun, youthful, economical and affordable convertibles, not de-roofed luxury cars.

Along those lines comes word that at least one GM division (probably the new-image Pontiac) is working hard on a convertible J-car for early '83 introduction; Buick, at the other end of the scale, is rumored to be preparing a Riviera convertible. Guess which will have more youth appeal?

Of course, what the youth market is really waiting for is Ford's '83 Mustang convertible—now there's a company with the right idea! If it's affordable, it should sell like nickel popcorn. All of these, incidentally, are not assembly-line soft-tops, but conversions by outside firms. Only

(Please turn to page 22)



SHOW OFF WITH STANLEY. BUILD THE COLLECTOR'S TABLE.

You get a lot of personal satisfaction in building something yourself with tools and wood. In this case, it's even more satisfying, because the Stanley Collector's Table also provides a beautiful, lasting showcase for your special hobby. (What's *your* specialty? Is it shells, blue ribbons, antique jewelry, campaign buttons?)

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You will have to buy the stock lumber and glass. You'll also need such Stanley fasteners as screws, brass hooks and eyes, hinges and T-nuts. Most of these Stanley hardware items are sold, by the way, in convenient drawers which, in turn, store in Stanley's unique Workshop Organizer Cabinet.

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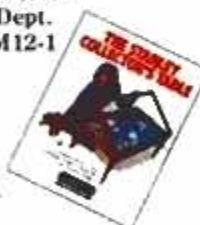
So go ahead. Here's your chance to show off your skills as you show off your collection. And enjoy doing it yourself every step of the way.



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DETROIT LISTENING POST

(Continued from page 20)

when and if the revival really gains momentum will any manufacturer lay out the heavy investment necessary to build its own ragtop versions of existing sedans.

Tire trends

Even as American cars, at long last, are beginning to be more tasteful in exterior and interior decorations, phasing out some of the half-vinyl roofs and opera lamps and fake wire wheels that most auto designers

agree are tired, old clichés of the over-chromed '70s, comes word from one tire expert that people are balking at buying cars with black-wall tires. Although the designers and marketers of prestigious European cars, who have been setting style trends for *everyone* in recent years, wouldn't think of putting a white-wall tire on a Mercedes, a BMW, Audi, Jaguar, Volvo, Saab, Peugeot—you name it—apparently middle-American tastes are slower to change than some people had expected.

The source of this sad news, a GM

chassis engineer, also says that efforts to eliminate the traditional spare tire to save both space and weight will concentrate more on the self-sealing tire than on the runflat type. The reasons are that runflats weigh more, which only transfers weight from the spare tire to the four on the road, and that they require some sort of low-pressure warning to alert the driver.

While tire technology advancements will continue, especially in the areas of better rubber compounds and lower rolling resistance, he adds, these future developments will have little visibility to consumers.

Olds V6 diesel

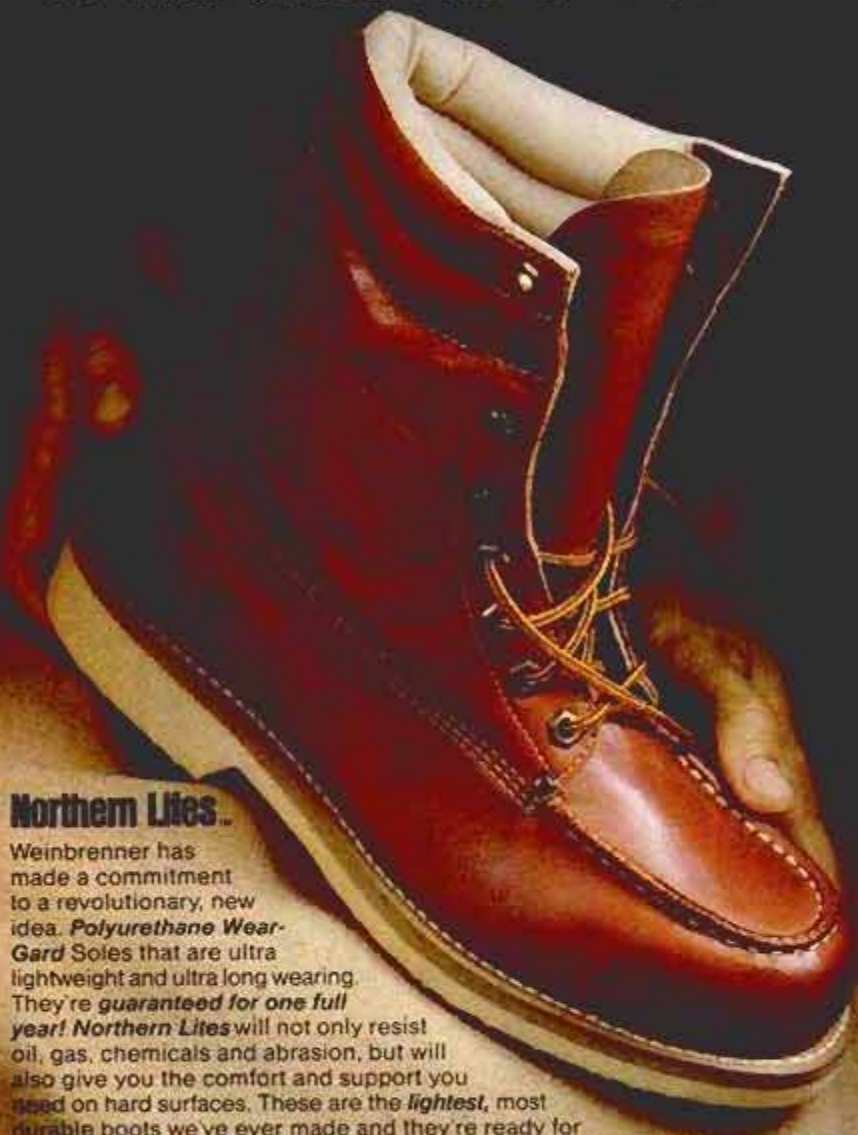
One of the prime features of GM's new fwd A-cars (Chevrolet Celebrity, Pontiac A6000, Olds Cutlass Ciera and Buick Century) will be the optional availability of a brand-new 85-hp, 4.3-liter, V6 diesel engine from domestic diesel king Oldsmobile Div. Early EPA tests indicate city/highway numbers around 28/42 mpg, along with adequate acceleration (about 16 seconds 0 to 60) and impressive (for a diesel) smoothness and quiet—and that's with a standard A-car automatic transmission. The transverse fwd unit boasts a weight-saving aluminum head, while a north-south version for rear-wheel-drive intermediate G-cars uses a conventional cast-iron piece.

Plastic up, steel down

A table published by the Automotive Information Council is testimony to the crash diet the American car has been on in recent years. Average steel content, for example, is down from over 2,400 pounds in 1975 to about 1,800 in 1980, and should fall to less than 1,400 by 1985. At the same time, plastics have risen from 168 pounds to 184 and are projected to reach 252 pounds in the next four years. Aluminum, the other widely used weight-saving material, should nearly double from 86 to 156 pounds between 1975 and 1985. And just take a look at the resulting drop in total weight!

POUNDS USED IN AN AVERAGE U.S.-MADE CAR			
Material	1975	1980	1985
Steel	2,420	1,834	1,356
Iron	626	458	216
Plastics	168	184	252
Rubber	160	124	180
Aluminum	86	124	156
Glass	94	80	72
All others	415	276	188
Total car weight	3,970	3,080	2,400

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Weinbrenner has made a commitment to a revolutionary, new idea. **Polyurethane Wear-Gard Soles** that are ultra lightweight and ultra long wearing. They're **guaranteed for one full year!** Northern Lites will not only resist oil, gas, chemicals and abrasion, but will also give you the comfort and support you need on hard surfaces. These are the **lightest**, most durable boots we've ever made and they're ready for you now. **Northern Lites** by Weinbrenner... the Craftsmen of the Northwoods.

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STOP BURGLARS BEFORE they enter your home

Protect your Home and Business with this new micro-computer burglar alarm "FREE" for 30 days.

Burglars seek easy targets. Few have the daring or the knowledge to challenge the new Perim-A-Tron™ Home Security System. No other burglar alarm under \$2,000 can give you more protection...or match it for features that will give you and your family safety and peace of mind. For starters, it is wireless, installs in minutes, and is portable should you ever move.

THE BRAIN VS. THE BURGLAR

Perim-A-Tron's™ central console, or "BRAIN", employs a microprocessor, making it the most advanced security system available for consumer use. With Perim-A-Tron™ on duty, small sensors monitor doors and windows ready to signal the "Brain" from as far as 250 feet, in the event of a break-in attempt. The "Brain" processes each signal instantaneously and sounds not only a self-contained 85db internal alarm, but also a second 95db remote siren to augment the inside alarm or for placement outside to alert neighbors and police.

The Perim-A-Tron™ is so easy to live with that pets can come and go through partly-open windows or sliding glass doors without triggering it, yet so vigilant that an intruder will set it off before he can enter.

THOUSANDS OF OPTIONS

Perim-A-Tron's™ micro-computer lets you choose from thousands of three digit disarm codes. Only you know your code. But if your son's friend receives a "demonstration", you can easily change the code again...and again. You need no specially coded key which can be lost, misplaced, or stolen. The system even has two separate channels, each with its own distinct alarm sound. This feature allows you to zone your system. For example: Channel 1—house, Channel 2—garage, or Channel 1—doors, Channel 2—windows.

HOW IT WORKS

Operating the system is simplicity itself. When leaving, a light on the console tells you that you've armed the system properly, and have from 5 to 45 seconds to leave the house. This variable delay feature, not found on some expensive commercial systems, is selective so that it can apply only to frequently used doors. All other openings would be set for instant alarm. Upon returning home, you have ample time to turn the system off, thereby avoiding a false alarm.

If a break-in attempt occurs while you're away, an alarm memory light on the console tells you so. What's more, after sounding for



Perim-A-Tron's™ 20 button keyboard gives you protection a \$2,000 commercially installed system can't beat. Includes powerful remote horn.

10 minutes and scaring away the intruder, the system shuts off automatically and re-sets itself.

A CONSTANT GUARDIAN

Leave Perim-A-Tron™ in Test Mode during the day and it will signal when anyone leaves or enters. This thoughtful signal will not operate the remote horn but gives a 2 1/2 second warning on the internal speaker only.

If power fails (or is cut-off), the console has a battery back-up. And each battery powered transmitter/sensor will signal at the console if the battery runs low.

The Perim-A-Tron™ system is highly resistant to false alarms because it is not sensitive to motion or sound. Pets can roam at will, curtains can blow in a breeze, you or your children can visit the kitchen for a midnight snack—all without setting off an alarm.

COMING HOME SAFELY

There is nothing more frightening than finding a prowler lurking near your house when you arrive home at night. Our system's EXTRA PROTECTION DESIGN lets you carry a transmitter in your pocket, purse or glove compartment (it's about the size of a cigarette pack). With simple modification, it serves as a PANIC device and will set off the alarm at the press of a button.

COMPARE IT

Hard-wired "commercial" burglar alarms can cost \$2,000 PLUS a monthly fee (and you still never own it). Motion and sound detectors cost up to \$200 per unit and cover only limited areas. Your home may require two or three of these units and, in most cases, no alarm will sound until AFTER a prowler is inside for 30 seconds or more. Perim-A-Tron™ combines pre-entry protection with micro-electronic circuitry to provide the most protection at the lowest cost.

U.L. LISTED

The Perim-A-Tron™ Home Security System is listed by Underwriters Laboratories as a burglary protection device, a rating which goes beyond electrical safety. To earn this listing our alarm was thoroughly tested for critical burglary protection functions such as transmitter range, sound volume, battery back-up, keyboard component life, battery failure warning, and test function. This tough-to-get U.L. listing resulted from the exacting standards engineered into the Perim-A-Tron™.

YOU BE THE JUDGE

We urge you to order just the basic Perim-A-Tron™ system (pictured above) for a 30-day trial period. Use it to protect your family while you sleep and to protect your home while you're away. Then if you're not convinced that the Perim-A-Tron™ is the most advanced, efficient security system available today, return it undamaged for a complete, no-quibble refund—including return postage. You are protected by a 90 day manufacturer's warranty as well as Shelburne's 25 year reputation for satisfied customers.

HERE'S HOW TO ORDER

To order simply send your check for \$199.95 plus \$5.65 for shipping and handling to the address below. Credit card holders can speed delivery of their system by using our toll-free number listed below. We will then promptly ship your Perim-A-Tron™ unit complete with easy-to-understand instructions and decals warning that the premises are protected. Additional transmitters are available for \$29.95 each, but one is not required for every door and window. Instead, magnetic contacts can be purchased and easily connected to the transmitter, allowing you to cover additional openings for as little as \$5 each. The instruction booklet is quite useful in helping you determine the correct combinations to protect your home or office at the lowest possible cost.

Give yourself some peace of mind—order a Perim-A-Tron™ today at no obligation.

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This photo shows a transmitter & magnet installed. If a break-in attempt occurs, the transmitter and magnet become separated triggering a wireless radio signal which activates the alarm. Installation takes only a few minutes and doesn't even require a screwdriver.

**Dodge announces
Ram Miser.**
Best mpg increase 29 **21**
EST HWY * EPA EST MPG
Lowest price \$5899.[†]
Equipped. Not stripped.



**"No other full-size pickup gives you so much for so little."
SAYS EX-FORD OWNER WALT GARRISON.**



The new generation of Dodge Rams—toughest Dodge pickups ever—just got gas stingier than ever. New 1982 Ram Miser gives Dodge the biggest mileage increase of all full-size pickups. Yet it still delivers Ram Tough performance, thanks to a *standard* drivetrain that teams a 4-speed overdrive manual transmission and 2.94 axle ratio with Dodge's famous Slant Six engine. No Ford or Chevy standard model matches that tough combination.

But Ram Miser is a lot more than just your basic brute force. From its chrome-bright grille to its easy operating tailgate, Ram Miser is loaded with handsome styling features—inside and out. When you add it all up, at \$5,899† nobody else gives you so much for so little.

See your dealer about buying or leasing a new generation Dodge Ram today. You'll discover the pickup that made an ex-Ford owner out of Walt Garrison.

	Dodge Ram Miser	Ford FS-100	Chevy Spec. Econ.
Price	\$5,899†	\$7,097†	\$7,094†
Trim Material	Deluxe	Standard	Standard
Floor Covering	Carpet	Rubber	Rubber
Body Tape Stripes	Yes	No	No
Grille Insert	Chrome	Painted	Painted
Horns	Dual	Single	Single
Cigar Lighter	Yes	No	No
Day/Night Inside Mirror	Yes	No	No
Bright Wheel Covers	Yes	No	No
Axe Ratio	2.94	2.47	2.56
Fuel Tank (gal.)	20	16.5	16
Ammeter Gauge	Yes	No	No
Galvanized Steel (sq. ft.)	310	217	250



**DODGE TRUCKS
ARE RAM TOUGH**

†Use EPA est. mpg number for comparison. Your mileage may vary depending on speed, distance and weather. Actual hwy. mileage will probably be less. Calif. est. lower.
†Base sticker price excluding title, taxes and destination charges. Prices effective September 28, 1981.

ALL OUTDOORS

How to—where to

For snowbelt sportsmen in the North who spend part of their time indoors this time of year, there are several new manuals worth studying. Some John Deere snowmobile dealers should have on hand *The Snowmobiler's Family Fun Guide*, by Robert Tracinski. This 160-page, pocket-sized booklet is a sequel to last year's *Snowmobiler's Handbook* and covers where-to-go suggestions, snow camping and trail cooking, snowmobile driving-skill games, how to keep warm, trouble-shooting hints, ice fishing and snow photography instructions, and tips for towing a trailer. A list of places to write for trail information is also included.

At Ski-Doc dealers is the *Bombardier Snowmobile Vacation Guide*, which describes in detail a number of snow-country resort areas where you can arrive with your machine in tow, or rent one when you get there. Usually, well-groomed trails radiate out from a central lodge or hotel, and you can choose runs over wooded mountains or speed trials across open fields and lakes. You merely take your pick, and call ahead for reservations.

Handy for drivers in snow-belt and sun-belt states alike is a *Highway Assistance Directory*, which is \$1 from the National Highway Safety Foundation, 116 East State St., Ridgeland, Miss. 39157. A size that fits in the glove compartment of any car, the guide lists emergency telephone numbers for highway patrols in every state; truck stops that are open for fuel 24 hours a day; AM, FM and weather radio stations; accident procedures; driving regulations for specific states and addresses to write for travel information. Much is information you hope you'll never need, but will feel better for having.

Bass are the most popular of game fish today and for beginners, particularly, who want to get in on the action, noted angling writer Ken Schultz has put together *Bass Fishing Fundamentals* that comes with a bonus. The book is a down-to-earth-and-water guide that is \$17.45 post-paid from World Angling Services, Box 52-Y, RD 1, Forestburgh, N.Y. 12701. (N.Y. residents add \$1.05 sales tax.) The bonus that comes along with the book is about \$15 worth of free plastic worms, hooks, sinkers and line. It's a bargain way to get started.

Sportsman Sheldon Coleman

One of the country's most active outdoorsmen-businessmen had a birthday November 15. As a dedicated hunter and fisherman and the very active head of companies that make premier camping lanterns, coolers and stoves, camping trailers, RV air-conditioners, air guns, water skis and sailboats, Sheldon Coleman does not have the time or inclination



From early Quick-Lite Arc Lantern (1917), Sheldon Coleman's outdoor and camping products have grown into array at top.

to retire or grow older, but this birthday is his 80th.

The parent Coleman company was started in 1900 by his father, W. C. Coleman, a young Kansas school-teacher who was moonlighting as a salesman. W.C. found a gasoline lantern that could produce bright light equal to a number of kerosene lamps or the new Edison electric bulbs. When he tried selling it in a small Oklahoma Territory community, however, he found a similar but defective light had already been extensively peddled by another salesman, who had then skipped town. W.C. met the challenge by

starting the Hydro-Carbon Light Co. to rent his dependable models for a dollar a week with a "no light—no pay" guarantee. It turned out to be an offer local tradesmen and farmers couldn't turn down, and he soon bought out the makers of his "Efficient Lamp," gave it additional improvements and went into production.

The glow from Coleman lanterns became an accepted source of illumination out beyond the power-line poles. In Wichita, Kan., in 1905, W.C. lighted the first night football game with his Coleman Arc Lamps. But rural electrification was spreading, and the company diversified into more portable lamps, stoves and camping equipment. Soldiers of World War II remember the Coleman Pocket Stove. Sheldon Coleman started work for the company in 1920, took time out for a Cornell engineering degree, became president of the company in 1951 and has been chairman since 1957. Over the years, he has added products like insulated coolers, Crosman air guns, canoes, Peak 1 backpack equipment, O'Brien water skis, tent trailers and Hobie Cat sailboats to make Coleman a major outdoor supplier. Sheldon still field-tests all Coleman equipment, and his thousands of sportsman friends like to think the outdoors helps keep him and his company so young and vigorous.

More for less

The International Game Fish Assn. (IGFA) in Fort Lauderdale, Fla., keepers of world records, has announced a new one-kilogram (two-pound) line category for freshwater catches. A skillful fisherman with very light tackle and line that breaks at less than one kilogram may now try for a listing in the record books. And so can young anglers, who often get that popular gift this time of year—a small rod and reel for Christmas. **PM**



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THE PM GARAGE

CAPSULE REPORTS ON NEW AUTO PRODUCTS

Torque ratchet

In your owner's manual you often find torque specifications for components such as sparkplugs, hose clamps and valve covers. Some of these parts are buried and impossible to reach with a conventional torque wrench. The Lowell Corp. has just come out with T-handled, full-ratcheting torque wrenches that will allow you to reach hard-to-get parts. The torque wrenches can handle 20 to 80 in.-lb. of force.



T-handled torque wrench has full ratchet action and will accept any 1/4-in. drive tool.

The wrench is called T-Torker and costs \$9.50 from The Lowell Corp., Box 158, Worcester, Mass. 01613.

—Joel Breault

Boost for your bike

Every motorcycle's fork springs will eventually begin to sag and create a mushy ride. Instead of replacing the springs, S&W Engineered Products solves the problem with its Air Boost Fork Kit.

The deluxe air-kit I tested consists of two aluminum fork caps with air fittings, a handlebar-mounted, 100-p.s.i., air-pressure gauge and a set of plastic air lines. A hand-operated



Air-boost kit can fine-tune any motorcycle's front fork tubes for a perfect ride.

mini-pump is also included. The object of the air system is to supplement the stock springs with an air-spring cushion of up to 30 p.s.i.

The kit retails for \$65.95 at motorcycle dealers. S&W's address is 7051 Village Drive, Buena Park, Calif. 90621.—Joel Breault

Overdrive converter

If you've been unwilling to trade in your gas hog for something with better mpg, B&M has just come out with something to stretch your mileage. It's an overdrive torque converter called SuperDrive which, depending on engine size, axle ratio and wheel size, will improve your mileage anywhere from 14 to 25 percent.

Currently it's only available for GM 350 and 400 Turbo Hydramatic transmissions. Other applications will follow. The SuperDrive is a straight swap for your stock converter.



Overdrive torque converter will improve mileage anywhere from 14 to 25 percent.

It's priced at around \$600 and you'll have to add the cost of labor for the installation. To receive further information, contact B&M Automotive Products, 9152 Independence Ave., Chatsworth, Calif. 91311.—T.A.

Lighting up

Saturday Mechanics never have enough light, especially when working in the dark recesses of an engine compartment. Spearco Performance Products has come to the rescue with Illum-a-space, a handy light fitted with a powerful 40-watt bulb.

It can be hung from either of the two hooks or, by using the suction cup at the base of the lamp, you can attach it to any smooth surface. I've used this light in some instances when even the conventional trouble light wouldn't do. The 20-foot power cord allows more than ample mobili-



This goosenecked worklight can reach the most remote areas of your auto's engine.

ty. The light is \$25 from Spearco Performance Products, 10936 South La Cienega Blvd., Inglewood, Calif. 90304.—Joel Breault

Early warning

Low-octane fuels have made engine-damaging detonation a very real problem with many high-compression, older engines.

There are even new engines, running on very lean fuel/air mixtures, that suffer from pinging. Very often you aren't even aware that the engine is pinging.

Pingalert, an early-warning system for pinging, produces an audible



Warning system tells drivers when engine-damaging pinging is about to happen.

and visual warning signal when ping occurs. Installation is very simple and only requires three wiring connections. The unit costs \$59.95 and carries with it a one-year warranty.

The manufacturer is Geraghty Performance Products, 2696 Lavery Court, Newbury Park, Calif. 91320.—Joel Breault



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Outdoor lighting tips for the holidays

Outdoor lighting adds sparkle to a holiday setting. However, it's important to take safety precautions when stringing lights outdoors. First, make sure that light sets and extension cords you choose are rated for outdoor use.

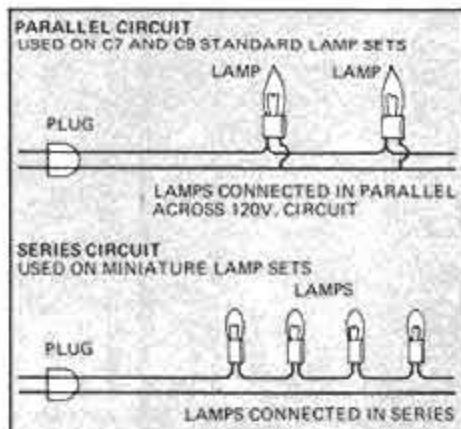
Today, standard-size Christmas lights are wired in a parallel circuit (see drawing) so that a set remains lighted despite the failure of one or more bulbs. Miniature lights are wired in series, somewhat like the original Christmas light sets were. The difference is that each minibulb has a shunt, which lets the rest of the set operate even when one light fails. Loose bulbs, however, will cause the entire set to go out.

The ideal way to power outdoor Christmas lights is via an outdoor electrical receptacle. The National Electrical Code requires that outdoor receptacles have a weatherproof outlet box, weatherproof cover and a ground fault circuit interrupter (GFCI). The GFCI protects against hazardous electrical shock by sensing any short circuit to ground and instantly shutting off power. A GFCI is far more sensitive, thus quicker to respond than a circuit breaker.

Using a yard-light socket with a screw-in adapter may be dangerous, since the adapters aren't listed for outdoor use. If you must use a light socket, be sure the switch is off during hook-up. If the wire or the adapter displaces the glass globe or otherwise allows moisture to get to the



Outdoor Christmas lighting sets the holiday mood for house guests and passers-by.



Fused safety plug at the outlet eliminates overloads; New York Merchandise Co., 32 West 23rd St., New York, N.Y. 10010 makes it. Rustproof outdoor-light hangers (inset) by Beacon Electric Corp., 437 D St., Boston, Mass. 02210, eliminate nailing, wire damage.

socket, find another way. Water will run into the threads of a socket whose opening faces upward.

Running an extension cord through a window must be done carefully, to prevent cord damage. Use a length of weatherstripping to cushion the wire and keep out the cold. Remove the cord and lock the window each night.

Some other suggestions:

- Make certain the light sets you buy are tested by a recognized laboratory such as the Underwriters Laboratory (UL).
- Check light strings for cuts or breaks in the insulation wires. Discard strings with chipped or broken lamp holders.
- Plug in lights indoors for 15 minutes before installing them outdoors. If they smoke or start to melt, discard them.
- Don't join more light sets than specified on the packages.—P.S.

PHOTO HINTS

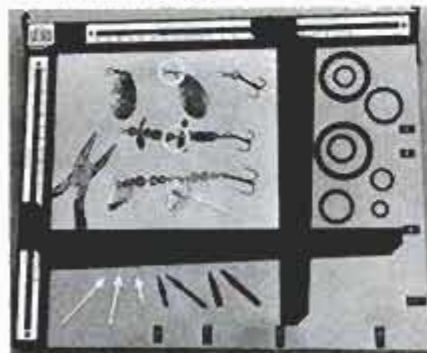
Get a grip



Carrying a tripod around can be awkward. Use a long piece of web strapping, the same length as the upper section of a tripod leg. Attach with two hose clamps. Long length always lets you find a balance point.

—C. Boyd Pfeiffer

'O' what a shot



To make a white circle on a print, place "O" rings on your enlarging board atop the paper. Use a red, nonfogging filter on enlarger light so you can position the rings. You can also buy plastic arrows.—C. Boyd Pfeiffer

Out, darn spot



Touch up pesky black spots on your prints with typewriter correction fluid.—Robert Hertzberg

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Reindeer of the road

Turbodiesel Volvo 444 joins the 200 Series next year as the top-of-line, luxury model.

When the oil begins to thicken and batteries are slow to stir, Swedish cars feel right at home. It's exhilarating on a frigid, yet sunny, winter's day to take off in one of Volvo's or Saab's sophisticated sedans: Throw back the sunroof, switch on the floor-level blower and feel the heated driver's seat warming what it warms so well. Appropriately, Vol-

vo's new 400 Series is getting a winter introduction in Sweden. Latest photos of the car show more of its details than we saw in September (*Imports & Motorsports*, page 8). We'll see the car itself the winter of '82-'83. Meanwhile, Volvo's getting its '82 models off the boat, led by the 245 GLT sport wagon, now available with turbocharger; and Saab '82s are on sale at no price increase over last year.

Off to the races

Even if you're not an avid motorsports fan, heading for the Bridgehampton Race Circuit is always an occasion to anticipate eagerly—it's located on one of this world's almost perfect places, the East End of Long Island. Early this fall, the big event was the Sports Car Club of America's Nationals. You can pick almost any spot around the "Bridge" circuit and see the racers battling for the fastest line through the turns. There's another battle going on: keeping Bridgehampton from the housing developers. Battle headquarters for the Friends of Bridgehampton is 5 Sinclair Martin Dr.,



Bridgehampton is fighting developers.

Wagon will differ slightly from prototype.

vo's new 400 Series is getting a winter introduction in Sweden. Latest photos of the car show more of its details than we saw in September (*Imports & Motorsports*, page 8). We'll see the car itself the winter of '82-'83. Meanwhile, Volvo's getting its '82 models off the boat, led by the 245 GLT sport wagon, now available with turbocharger; and Saab '82s are on sale at no price increase over last year.

Cream of the coupes

It's a mystery car to those who first see it: Where's the prancing horse of Ferrari, the spearlike trident of Maserati, the charging bull of Lamborghini? There are only the four interlocking rings on the grille and then the answer, *Audi Coupe* on the rear deck. So that's what it is! I

finally got to fly a few hundred miles in the five-speed Coupe and found it five-cylinder fast, unflappable on rough roads and fuel efficient (22 mpg overall with airconditioner on). The driver gets a perfect shot at all the controls, and a good seat with lots of lateral support; it does take a day or two to adjust to the sharply raked windshield. I think the Ingolstadt engineers let a few things by, but we'll forgive the cheap glove-box door, dumb head restraints and clumsy trunk lid, because it's a terrific car to drive.



Smooth, fast, fwd Audi Coupe will soon be joined by 4wd Quattro, now selling in Europe.

Roslyn, N.Y. 11576. The New York Region of the SCCA is also manning the bulwarks; they're at 3807 Corporal Stone St., Bayside, N.Y. 11361. During the day, we watched Ken Slagle take the C Production event in his TR8 (finishing nine seconds ahead of Paul Newman). In the Pro Formula Ford 15-lapper, Frank Ber-



Mike Andretti gets ready for the FF race.

stein took top spot. Mike Andretti, son of Mario, didn't finish. Complete results are in the SCCA mag, *Sports-Car*. It's \$18 a year from Paul Oxman Publishing Inc., Box 534, Santa Ana, Calif. 92704.

Here, Rex?

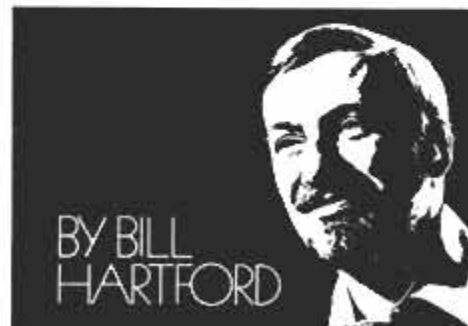
What's got 31 snarling horsepower, stands 1,350-mm high, 1,395-mm wide and stretches, from bumper to bumper, a total of 3,195 mm? Rex, the wondercar, of course. Subaru



The Subaru Rex 5 is new 550-cc five-door.

has just restyled its ugly little mutt and the result is a handsome five-door, the Rex 5. If it showed up here, it would probably be mistaken for a Shriners' parade toy car. Will it be sold here? Not for a dog's age, if at all, I'd guess.

PM



BY BILL HARTFORD



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With the price of oil today, you don't dare waste a single drop. Neither does the Datsun King Cab diesel. It gets better mileage than any gas-powered truck. And while it's conserving fuel, the King Cab is comforting people — with more room than any compact diesel; enough room to recline the bucket seats for regal relaxation. Behind those buckets, up to 7.1 cubic feet of inner space for available jumpseats or safe cargo. (That's a comfort!) King Cab, Long Bed or Standard, you can't buy a better-built compact than Datsun.

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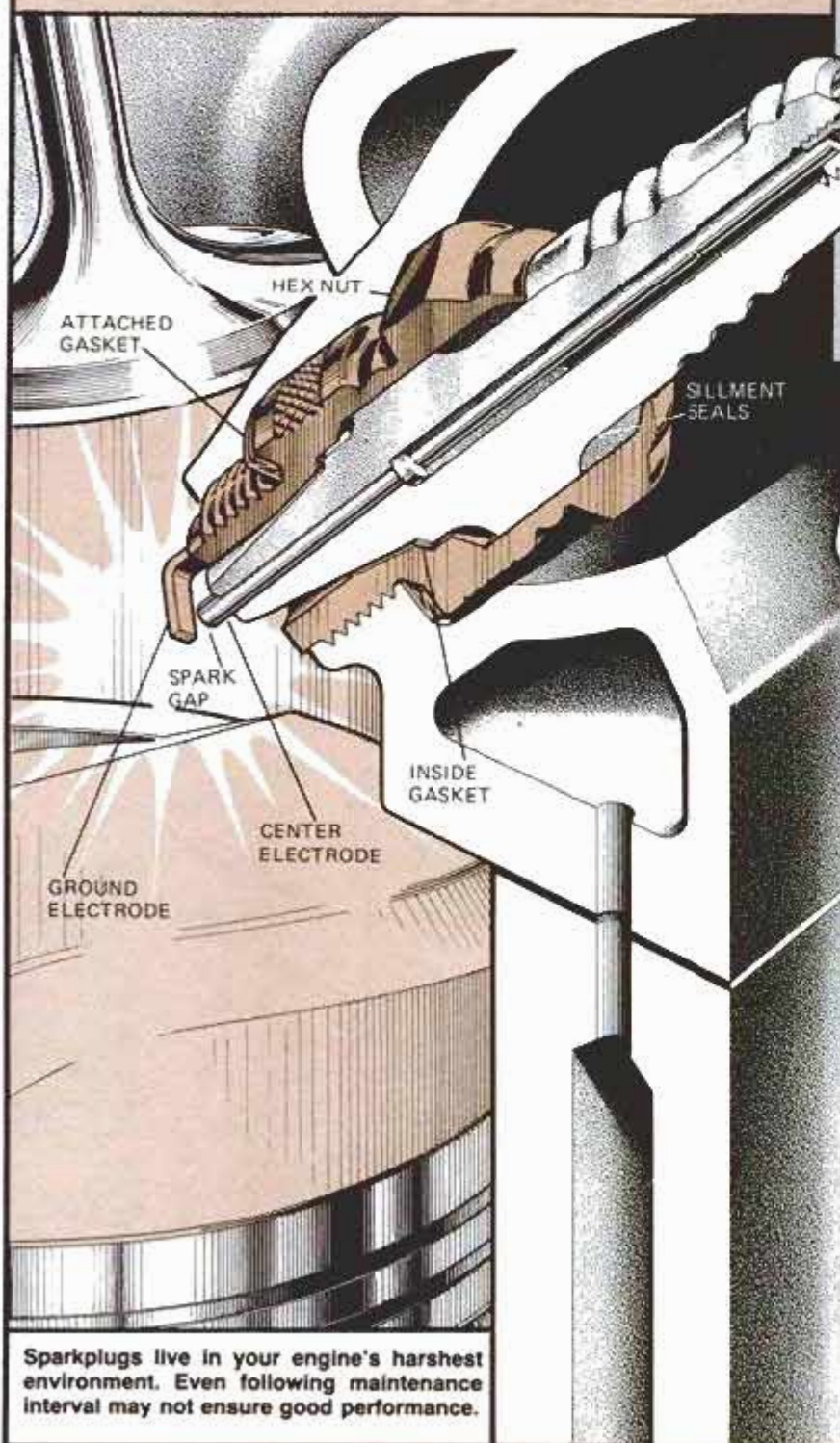
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Photographed at Whistler Mountain, British Columbia, Canada

New facts about servicing sparkplugs

Sparkplug maintenance and replacement—at intervals you determine—pay off in performance and reliability, and save you money on gas, too.

by Mort Schultz

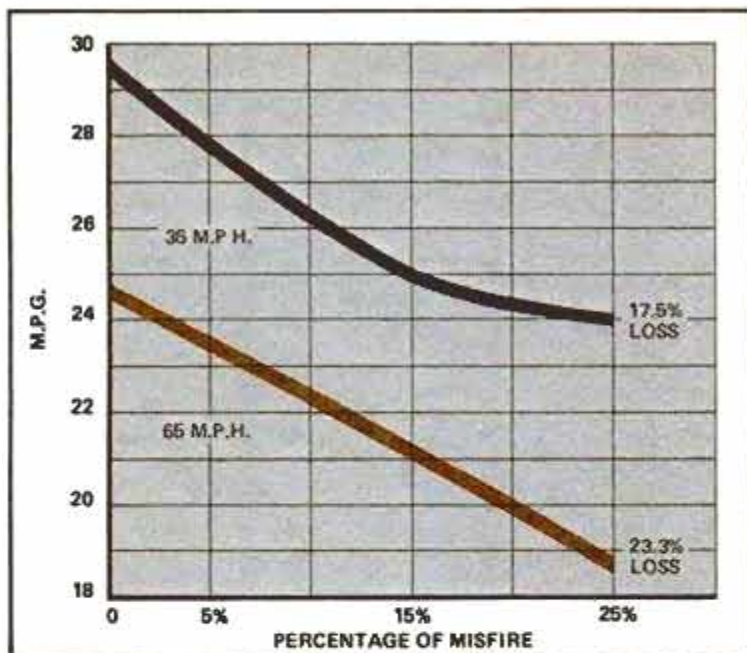


Sparkplugs live in your engine's harshest environment. Even following maintenance interval may not ensure good performance.

Sparkplugs of most cars on the road are in need of servicing. So claims a recent U.S. Department of Transportation (DOT) analytical study.

According to this report, 70 percent of the sparkplug sets examined by the DOT team were in poor enough condition to cause one or more of the following sparkplug-induced performance problems:

- High fuel consumption.
- Misfiring (rough running) at idling, low, moderate and/or high driving speeds.
- Engine pinging, which is also referred to by drivers as spark knock, spark rap, preignition and detonation.
- Surging, which was best described by Jimmy Durante when he sang, "Did you ever have the feeling that you wanted to go; then had the feeling that you wanted to stay?"
- Hard starting and/or stalling.
- An increase in hydrocarbon emissions. States such as New Jersey, where emissions testing is part of the annual vehicle inspection program, cite fouled sparkplugs as one of the chief causes for cars that



Graph shows fuel loss in four-cylinder engine when a plug misfires.

fail to register a passing grade.

"What is indicated from the data we've gathered is a lack of proper and timely (sparkplug) maintenance," says the DOT report, *Passenger Motor Vehicle Electrical System Integrity*.

Significant fuel loss

Two other recently concluded tests emphasize the relationship between sparkplugs and fuel mileage. One, done by the AC Spark Plug Div. of General Motors, involved eight-cylinder engines. The other, done by Champion Spark Plug Co., involved four-cylinder engines. These are the findings:

■ A car with a V8 engine traveling at 40 mph will experience a 15.2-percent loss in fuel economy if one sparkplug misfires and an extraordinary 36.7 percent loss if two sparkplugs misfire. Thus, a car that normally gets 20 mpg at 40 mph with all eight plugs firing would suffer a 3-mpg loss when one plug misfires and a 7.3-mpg loss when two misfire.

■ A car with a four-cylinder engine traveling at 35 mph will experience a 17.5-percent loss in fuel economy if one sparkplug misfires. (You can't accurately establish how much loss there'd be if two plugs misfire, since a four-cylinder engine won't run with two cylinders out of action.) Thus, a car that normally gets 40 mpg at 35 mph with all four plugs firing would suffer a 7-mpg loss when one sparkplug misfires.

Types of plug failure

The DOT survey team separated sparkplug failure into three categories: 1. plugs fouled by carbon or oil; 2. plugs showing excessive electrode gap, caused by either extreme elec-

trode erosion or improper adjustment; 3. plugs with damaged insulators, through which current was short-circuiting before reaching electrodes.

Why, one wonders, did the DOT survey uncover so many sparkplugs needing attention? Even allowing for the relatively small number of cars (approximately 3,000) involved in the test, the disproportionate amount showing sparkplug failure is still startling.

Sound sparkplugs are necessary for sound engine performance—most know this, or so we thought. How do you account for a 70-percent failure rate?

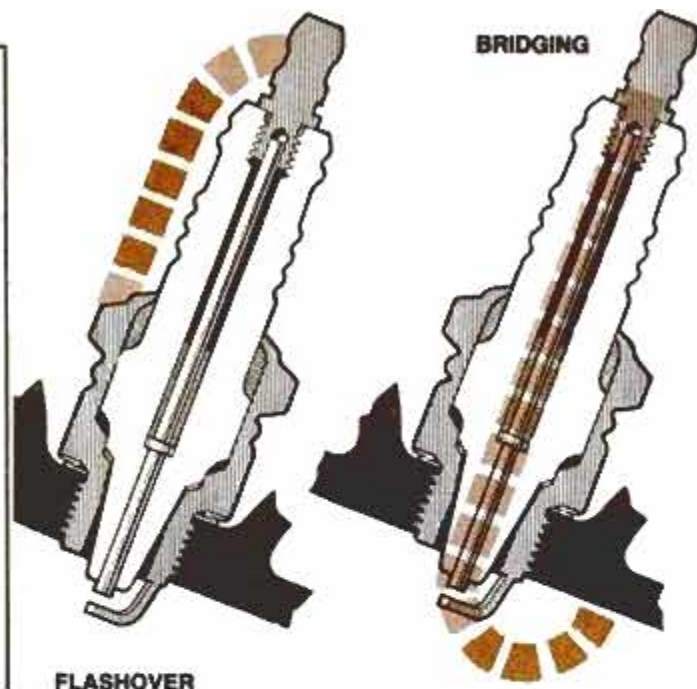
I think part of the problem may lie with the prevailing battle going on between automobile and sparkplug manufacturers concerning how many miles sparkplugs can remain in service.

Since the advent of unleaded gasoline in 1975, auto manufacturers have been claiming in owners manuals that drivers can get as many as 30,000 miles from a set of sparkplugs. Compare this with a statement found in a consumer publication issued this year by the Autolite Div. of Bendix Corp.:

"Electrodes can erode up to .010 in. during a normal service life of 10,000 miles. Use beyond that point in an otherwise well-tuned engine increases the voltage required to fire efficiently."

What Autolite is implying is that sparkplugs be replaced 20,000 miles sooner than GM recommends for its J- and X-body cars, Chrysler recommends for the K-car and Ford recommends for the Escort/Lynx.

How can you, the car owner who is caught in the middle, resolve the



FLASHOVER

BRIDGING

issue? I think by finding out for yourself if the sparkplugs in your car can be kept in use. If they are usable, clean them, reset electrode gaps and put them back in the engine.

Manufacturers can't agree

Oddly enough, sparkplug manufacturers can't agree if servicing used sparkplugs is wise or not.

"Changing plugs is relatively low-cost insurance for maximum efficiency, good mileage and low emissions. For these reasons, Autolite engineers do not recommend reuse by cleaning and regapping," Autolite states.

"Servicing used sparkplugs is a sound technical procedure to reduce emissions, increase fuel economy and improve performance," Champion Spark Plug says.

In the final analysis, you have to judge who's right. This is what we did:

We installed a new set of sparkplugs and, for 6,000 miles, kept careful records of fuel economy and performance, noting any problem that may have been sparkplug-induced. Then, we pulled the plugs and serviced them. We did this every 6,000 miles without noticing any drop in fuel economy or any performance problem until plugs had accumulated 22,100 miles.

At this point, an engine miss developed and there was a drop of approximately 3 mpg. We saw it that other variables, which could affect performance, weren't present before removing plugs for inspection. We found that electrode erosion had reached the point of no return. New plugs restored performance to a satisfactory level.



Flashover is caused by dirty insulator or cracked boot. This plug can be serviced and reused. Bridging is caused by deposit buildup between the ground electrode and center electrode. This plug can be serviced by cleaning off deposits. A shorting plug is caused by a cracked insulator. This plug must be replaced.

SHORTING

Categorizing used plugs

If you follow this method, you'll find that plugs removed for inspection will normally fall into one of four categories:

1. Plugs without a problem—no damage, no contamination and no visual electrode wear. Check electrode gap, just to be sure, and return plugs to the engine. However, on subsequent 6,000-mile inspections, plugs may start to show a buildup of deposits and some electrode wear. Service them, as explained below.

2. A plug that is physically damaged. The insulator is cracked, terminal is broken, threads are stripped or electrodes are broken. Replace this plug. Physical damage

is usually caused by improper installation or by the use of the wrong tools.

3. Plugs that have extreme electrode erosion, with the center electrode worn to a nub and the side (ground) electrode badly dished. If extreme electrode erosion appears by the first 6,000-mile inspection and is accompanied by blistered and ghost white-colored lower insulators, the engine may need colder sparkplugs (see below). Lower insulators of used plugs should be of a tan or pale gray color.

4. Plugs that at the first 6,000-mile inspection are contaminated, but show negligible electrode wear. If fouled by oil or carbon, plugs may not be the correct heat range (too cold) or an engine problem may exist. Plugs could be slightly glazed, which also suggests an improper heat range (too hot).

If heat range is a factor and driving conditions are going to change, service these plugs and reinstall them. Or, if you are going to switch to a colder or hotter sparkplug, service these plugs and save them for possible future use.

Servicing sparkplugs

The last sparkplug servicing article to appear in PM was almost four years ago (see *How to 'Read' Your Sparkplugs*, page 78, Jan. '78). The methods outlined in the article generally apply. But, remember, when it comes to servicing and replacement intervals, *you're* the judge.

Follow these procedures:

1. **Remove plugs from the engine.** Use the electrode-bending

part of a sparkplug gapping tool (not pliers) to open the gap between electrodes an additional .010-.015 in. Bend the ground electrode—never the center electrode.

2. **If plug tips are oily, wash them in a grease-cleaning solvent.** Then, apply short bursts of air from an air gun, if one is available, to dry them. If an air compressor isn't available, use compressed air from a spray can, which is sold in photography stores under trade names such as Dust-Off and Dust Remover.

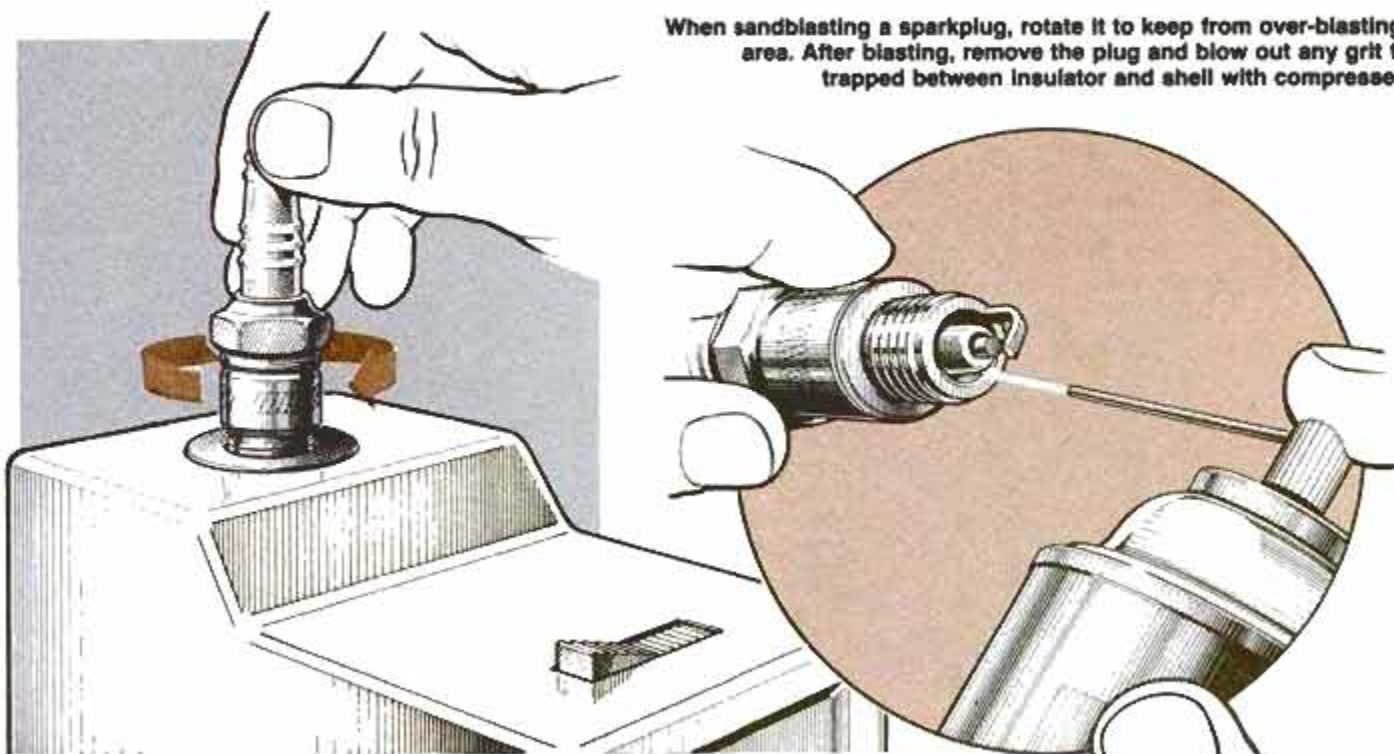
3. **If you have a high-pressure, sparkplug abrasive-cleaning machine, place one plug at a time in the machine** and apply the abrasive as you rotate the plug. Make sure the plug is kept in motion to prevent the abrasive from wearing down one area. Then, examine the firing end and repeat the procedure until no deposits remain.

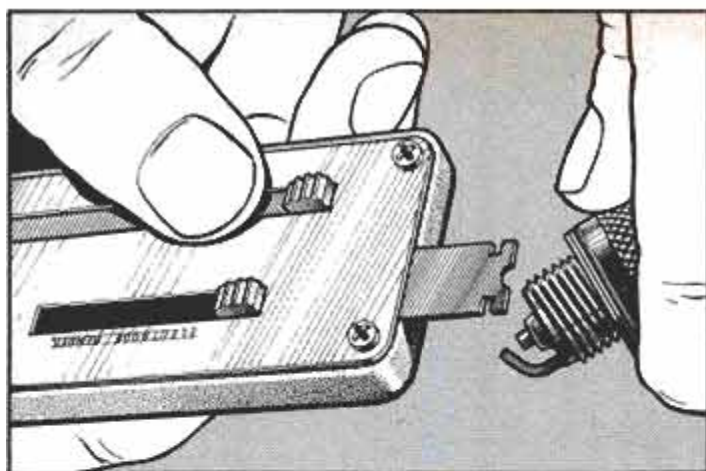
If you don't have an abrasive-cleaning machine, take plugs to a garage that does. The owner may let you use the machine, or may charge a nominal amount to clean them.

4. **When the plug is clean, air-blast the lower end** with your air gun or compressed air-in-a-can to remove abrasive compound. Aim air in the space between the insulator and shell to blast out any abrasive that's trapped there.

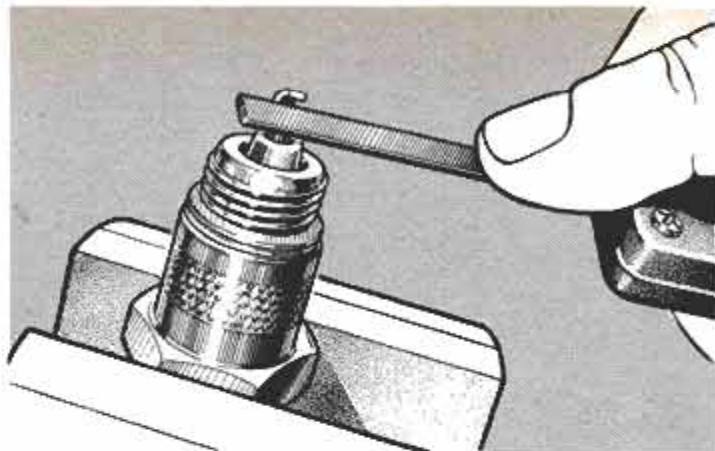
5. **Place each plug in a vise and grip it by the shell.** Don't overtighten the vise. You may damage the plug. Using a point file, shape the center electrode to attain a flat surface. This should require no more than two strokes of the file. If you remove too much metal, you won't

When sandblasting a sparkplug, rotate it to keep from over-blasting one area. After blasting, remove the plug and blow out any grit that's trapped between insulator and shell with compressed air.





When you are gapping a sparkplug, be certain that you use only a gapping tool. Pliers will cause damage to the electrodes.



In order to brighten the metal and to restore a flat top, you should pass a small file lightly over center electrode.

be able to reuse the sparkplug.

Now, lightly pass the file over the side electrode to remove any high spots or nicks and to brighten the metal. Don't overfile!

6. After filing, aim a blast of air at the firing tips to blow away metal filings.

7. Use a small wire brush to clean plug threads, but don't let the brush touch the plug insulator. Since the insulator is harder than the brush, a metallic coating may be transferred from the brush to the insulator. This could cause the plug to short circuit. Don't use a power bench brush, as we indicated in '78. You might wear too much metal from the threads and cause improper sealing.

8. Gap the plug to manufacturer's specification. Don't guess. Sparkplug gap varies from engine to engine by as much as .055 in. The wrong gap will cause engine performance problems.

If your car is set up to run on both LP-gas (propane) and gasoline, but you use propane as your primary fuel, reduce sparkplug gap by .010 in. from specification. The fuel-air ratio of propane is leaner than the fuel-air ratio of gasoline. Decreasing sparkplug gap is a compromise that will allow adequate performance on gasoline, without placing an excessive demand on the ignition system's voltage reserve when propane is used.

If you find that engine performance on gasoline leaves something to be desired with sparkplugs gapped .010 in. less than specified, regap them to provide a .005-in. reduction instead.

If your vehicle runs only on propane, gap plugs to .025 in. if it has a conventional breaker point ignition system; .030 in. if it has electronic ignition.

9. Before putting restored plugs back in the engine, wipe upper

insulators and terminals with a clean, dry, lint-free rag. The rag will remove greasy finger marks and smears that may cause flashover. Flashover—the shorting of voltage over the insulator to ground on the plug shell—results in misfire.

Hot facts about heat range

Recent data from car manufacturers indicate that some engines coming from the factory have been equipped with sparkplugs that are too hot. They overheat and ignite the fuel mixture prematurely (that is, before spark occurs), causing the engine to knock (ping) which could damage engine parts.

Heat range is the measure of how fast the tip of a sparkplug dissipates combustion heat. If you were to lay sparkplugs made to fit your engine side by side, you'd see that the lengths of lower insulators differ. Heat is transferred by means of the insulator from the combustion chamber to the cylinder head. Therefore, the length of an insulator determines if the plug is cold, medium or hot. A plug with the longest insulator is the hottest plug, since it dissipates heat more slowly than the

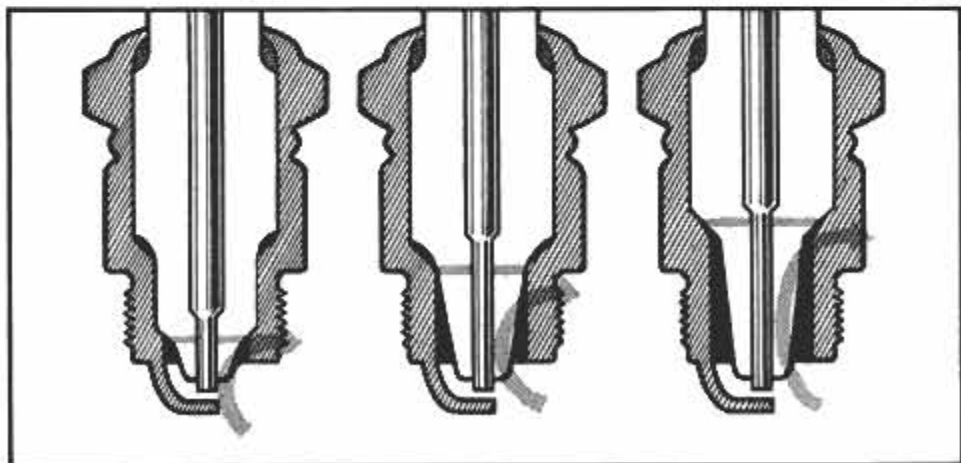
others. Thus, the plug operates at a higher temperature. Conversely, the plug with the shortest insulator is the coldest plug.

The ideal sparkplug is one that operates hot enough to burn off deposits that may cause misfire and cool enough to prevent premature ignition of the fuel mixture. How do you know if the plug heat range is suitable for your new engine? After 3,000 miles of driving your new car, remove plugs for examination and do the following, if necessary:

■ Switch to a colder plug if the engine has been pinging, and if the center electrodes are eroded and insulator tips are white. Generally, a colder sparkplug than that recommended by the manufacturer may be needed if the car is used primarily for high-speed driving and/or hauling heavy loads.

■ Switch to a hotter plug if the engine is missing and tips of plugs are fouled with carbon or oil. Generally, a hotter sparkplug than that recommended by the manufacturer may be needed if the car is used primarily in circumstances where prolonged idling and stop-and-go driving are called for. **PM**

A plug's heat range is determined by the length of the lower insulator, and its thickness in relation to the plug shell. The thinner the insulator is, the hotter the plug.



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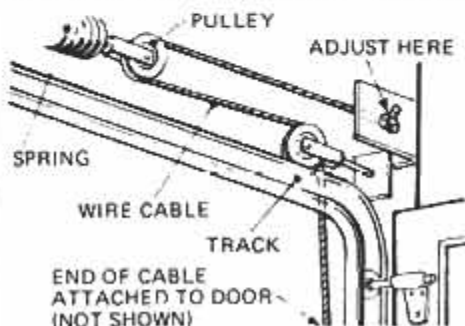
HOMEOWNERS' CLINIC

QUESTIONS ANSWERED

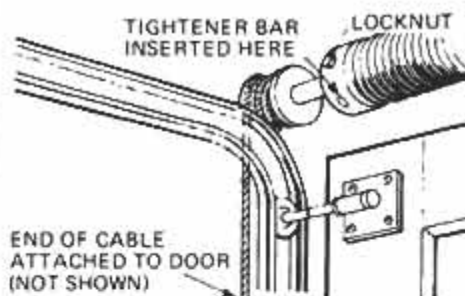
Garage-door adjustment

My garage door is very hard to raise and lower. Would you please explain the mechanics of door springs and their adjustment? Do I need new garage-door springs?—Jim Nagy, McKees Rocks, Pa.

The door springs assist you in overcoming the weight of the door when raising it. They also keep the door from crashing to the floor when being lowered. In other words, it would take an extremely strong person to raise and lower a garage door without the assistance of springs.



This garage door has a spring on both sides. You can adjust tension by shortening the cable at the designated plate.



This type has a single spring across the top of the opening. To adjust the tension, loosen locknut with a wrench, insert the tightener bar and wind the spring tighter.

Even a child should be able to raise a well-balanced door (as my 7-year-old daughter can). The sketches show the two types of springs most commonly in use today.

When adjusting spring tension, make certain that the door is in the raised (least tension) position. I prefer to prop the door open with a 2x4 to assure that it won't drop to the floor if I lose control of the spring.

Use extreme caution when adjusting spring tension, and wear safety goggles and gloves. It may be a good idea to have a helper stand by.

Cleaning unpainted stucco

I don't wish to paint my unpainted stucco, but mud splash during winter

rains and summer watering has discolored the stucco from ground level upward about two ft. Washing and scrubbing doesn't seem to touch it. Is there any solution short of sandblasting or painting?—Ralph H. Surface, Hesperia, Calif.

The Portland Cement Assn. (PCA) is in the midst of updating its bulletin IS-214 on cleaning and removing stains from concrete. It won't be available until early 1982. For price and more information, contact: Order Processing, Portland Cement Assn., 5420 Old Orchard Rd., Skokie, Ill. 60077.

I do know, however, that a solution of 1 ounce of commercial laundry detergent mixed with 1 quart of commercial bleach and 3 quarts of water has done the job in the past.

Be sure to wear goggles and rubber or plastic gloves while applying the solution with a soft brush. Don't use a wire brush, as particles of steel may become lodged in the stucco, resulting in future rust stains. Rinse with water after treatment.

To prevent future mud splashes, lay a 3-ft.-wide strip of black polyethylene along the base of your house. Cover the plastic with peat moss, pine straw or pebbles. Although I don't recommend planting anything closer than three feet to the house, you can cut holes in the plastic to accommodate plantings.

Correction

In "Paneling a Sitting Room" (*Homeowners' Clinic*, page 6, Aug. '81), we recommended that you apply paneling directly to polystyrene insulation boards. Dr. Joseph T. Ponessa, Associate Specialist in Housing and Energy at Cook College, New Brunswick, N.J., was the first to point out that the polystyrene should first be covered with 1/2-in. drywall material. The paneling is then glued to this.

Polystyrene may give off toxic fumes if there is a fire in the room. The drywall allows occupants of the room time to escape before flames reach the polystyrene.

Do you have a home-maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in this column. For more home repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send order(s) to PM, Radio City Station, Box 1014, New York, N.Y. 10101

The maker of Styrofoam, one brand of polystyrene, gives specific instructions: "Styrofoam brand insulation must be fully protected from the interior of the building by 1/2-in. gypsum board or equivalent."

Thanks, Doctor, for taking the time to write.

Distributing the heat

Nick Lagios, Aliquippa, Pa., sent a well-detailed drawing and description of the family room he built which joins his house to the garage. Even though he has a warm-air supply, return registers and a fireplace with its own supply of combustion air, this room with a cathedral ceiling isn't adequately heated. The room is well insulated and is weatherstripped on all doors.

Nick has many queries, but I believe that one question should have been asked at the time of the room's conception: "Is my present heating system adequate to handle this 2,100-cu.-ft. addition?" Unfortunately, this is overlooked all too often. An open fireplace usually attains efficiency of only 10 to 15 percent (heat output divided by amount of energy consumed).

Adding glass doors, a fireplace insert or a wood stove, although costly, will undoubtedly help. The existing chimney can probably be used, depending on the directions for the unit chosen. As the addition appears to be the farthest room from the central heating system, Nick might install an air booster, such as the one that appeared in *Add-on Blower Moves Air to the Farthest Rooms* (page 148, Sept. '79).

This is all conjecture, however. I would consult a licensed mechanical engineer. His fee of perhaps \$100 to \$200 will be well spent when compared to the cost of the addition. Hindsight is great (and easy), but consulting with an engineer before building would have saved Nick much of his present grief. **PM**



BY JOHN GAVNOR



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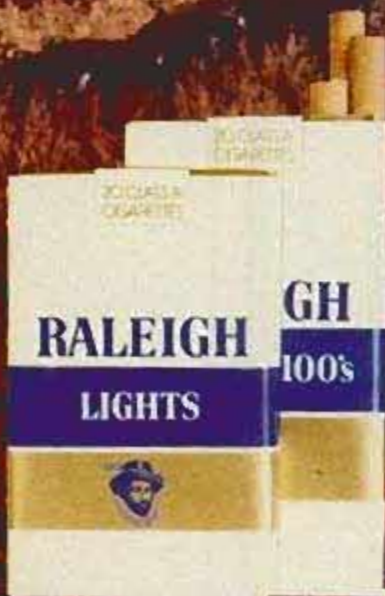
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Take the road to flavor
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RALEIGH LIGHTS

NEW NOW for home and shop

A A new wide paintbrush claimed to give better results than a roller is now available from J.B. Ward & Sons Inc., 170 5th Ave., Hawthorne, N.J. 07506. According to the manufacturer, this brush is particularly useful on rough surfaces, eliminating the splatter typical of rollers, while giving the smooth-finished surface common to paintbrushes. It measures $2\frac{1}{4} \times 8$ in. and has $\frac{3}{8}$ -in.-long nylon bristles attached to a laminated maple base. The handle doubles as an unthreaded broomstick holder so it will accommodate any extender you use. The price is \$9.95 postpaid from the maker.



B The Waterbug is a recently introduced portable, gas-powered, water pump that weighs 10 pounds and can move 1,350 gallons of water per hour. It features a self-priming centrifugal pump, a 1.6-cu.-in., two-cycle engine, solid-state ignition, and a 25-ounce fuel capacity. According to the manufacturer, the unit is designed for home and light commercial work, such as pumping water from flooded basements. The retail price, \$164.95, includes 12 ft. of 1-in.-dia. hose, a strainer and garden-hose attachment. Available at home centers and from Homelite distributors, it's made by Homelite Div. of Textron Inc., Box 7047, Charlotte, N.C. 28217.



C Marston Hall is a new pattern of residential resilient flooring that simulates 6-in.-square, softly fired quarry tiles and features a never-wax wear layer. The product is approximately $\frac{1}{8}$ in. thick, including a double backing for added cushioning, and comes in 6- and 12-ft. widths. Offered in four colors—almond white, terra cotta, oatmeal and cameo brown—it costs about \$22 to \$25 per square yard at flooring-supply stores nationwide. It's made by Mannington Mills Inc., Box 30, Salem, N.J. 08079.

D The Infinity Bath Whirlpool is a reinforced acrylic tub with four fully adjustable jets for hydromassage. It measures $20 \times 42 \times 60$ in. and features a built-in filler spout, handles for getting in and out, and dual air controls that regulate the jets. The preplumbed unit comes with a UL-listed, $\frac{3}{4}$ -hp motor. A low-voltage timer (mounted on a wall away from the tub) regulates the length of the whirlpool action and keeps the pump from operating if the water level is too low. Available in many colors, the top-of-the-line model retails for about \$3,100 (without whirlpool, the tub starts at about \$900) at plumbing-supply stores. Made by Kohler Co., Kohler, Wis. 53044. **FM**



CAR CLINIC

SOLUTIONS
FOR MECHANICAL
HEADACHES

BY
MORT SCHULTZ



Solid block

How do I drain the engine block of a 231-cu.-in. (3.8-liter) V6 engine in a 1978 Pontiac Phoenix? The owners manual says to remove the block drain plugs, but I can't find them. Please give me a clue as to where they are.—Eugene A. Lieb, Red Bank, N.J.

The manual is in error, Eugene. There are no block drain plugs in this GM engine. To drain the block, just remove the lower radiator hose.

Livable loss

I own a 1978 Honda station wagon. The car is equipped with a 1,488-cc engine, which I service faithfully according to owners-manual instructions. Through the first 25,000 miles, the car required the addition of only two quarts of oil between the recommended 5,000-mile oil change. Now, at 32,000 miles, I have to add a quart every 1,000 miles. The dealer claims this is normal, but it seems excessive to me. I've not found any oil leaks, and there is no unusual exhaust smoking. Is there anything I should check or repair?—David Schiff, Middletown, N.Y.

According to official Honda policy, your dealer's claim is valid. Using one quart of oil in 1,000 miles is, indeed, considered normal.

If there is an oil leak, your loss would be greater than this. However, the sudden sharp increase in oil consumption may indicate that oil-control rings or cylinder walls are starting to wear. Another reason for a sharp, sudden increase in oil consumption is oil leaking past worn valve guides. Usually, though, this condition is accompanied by visible exhaust smoke, so I don't think it applies in your case.

At this point, I suggest you disregard the situation. Having to add one quart every 1,000 miles isn't hard to live with. If it gets worse, you can decide at that point if you want to do something about it. "Something" will probably have to be an engine overhaul.

Two rights; no wrongs

Hey, what are you trying to do to us? In your article on the GM diagnostic connector (see Saturday Mechanic, page 35, June '81), you recommend extending a jumper from the tachometer (TACH) terminal of the connector to the ground (GRD) terminal of the connector, thereby making it impossible for a burglar to start the engine unless he knows about the connection. However, my GM service manual says this: "The tachometer terminal (of the High Energy Ignition system) must NEVER be allowed to touch ground as damage to the module and/or ignition coil can result."

If GM is right, as I assume they are, your advice is going to cost your readers a lot of bucks.—Arthur R. Tomek, Shoneview, Minn.

You've got sharp eyes. GM is 100 percent correct. NEVER ground the TACH terminal of the HEI distributor. However, you can ground the TACH terminal of the diagnostic connector, as I explained in the article, because there's resistance built into the circuit between the TACH terminal of the distributor and the TACH terminal of the diagnostic connector. This resistance will prevent you

from blowing the module or pickup coil.

Speedy solution

My 1981 Oldsmobile Omega ES 2500, which is equipped with the 151-cu.-in. (2.5-liter) L-4 engine, has 1,600 miles on it. It's a fine automobile, except for two things. First, after the engine reaches operating temperature, the idle gets quite rough. It will smooth out when I shift to NEUTRAL, but within two or three seconds after shifting into DRIVE, the roughness returns. Second, there is frequent surging when bringing the car to a stop.

The dealer has tried, on three different occasions, to correct the trouble. He says engine idle is set low at the factory to save fuel and all this is controlled by a computer. "Too bad, but that's the way it has to be," the dealer claims.

Please, Mort, tell me it isn't so.—William G. Speed III, M.D., Baltimore

Okay—it isn't so; that is, now it isn't so. When your dealer worked on the car, maybe it was so. Let me explain:

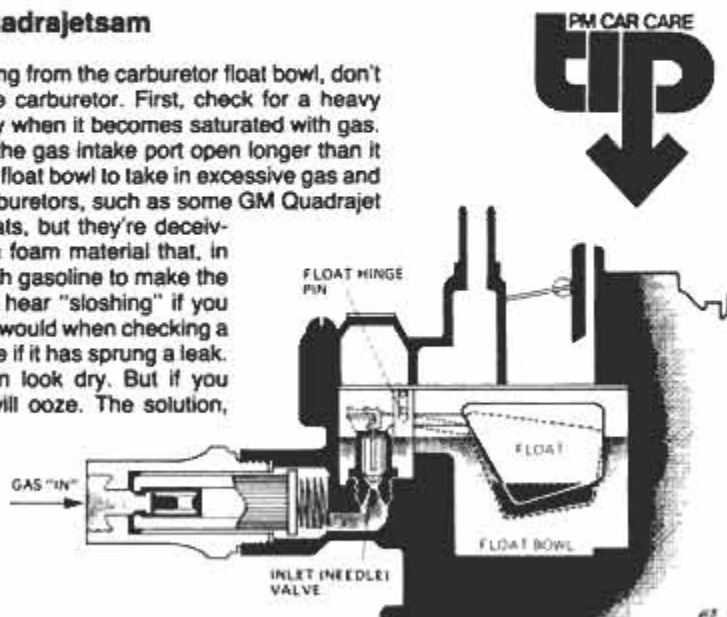
In attempting to solve your problem, which GM calls "idle-speed instability," your dealer should have adjusted the PARK-NEUTRAL switch, ignition timing, idle-speed control motor and carburetor float level. Procedures are outlined in Pontiac service bulletin 81-T-7, dated Dec. '80. I've not been able to establish the number of the corresponding Oldsmobile service bulletin, but if your dealer isn't able to find it, he can get the Pontiac bulletin. The 151-cu.-in. (2.5-liter) L-4 engine is made by Pontiac.

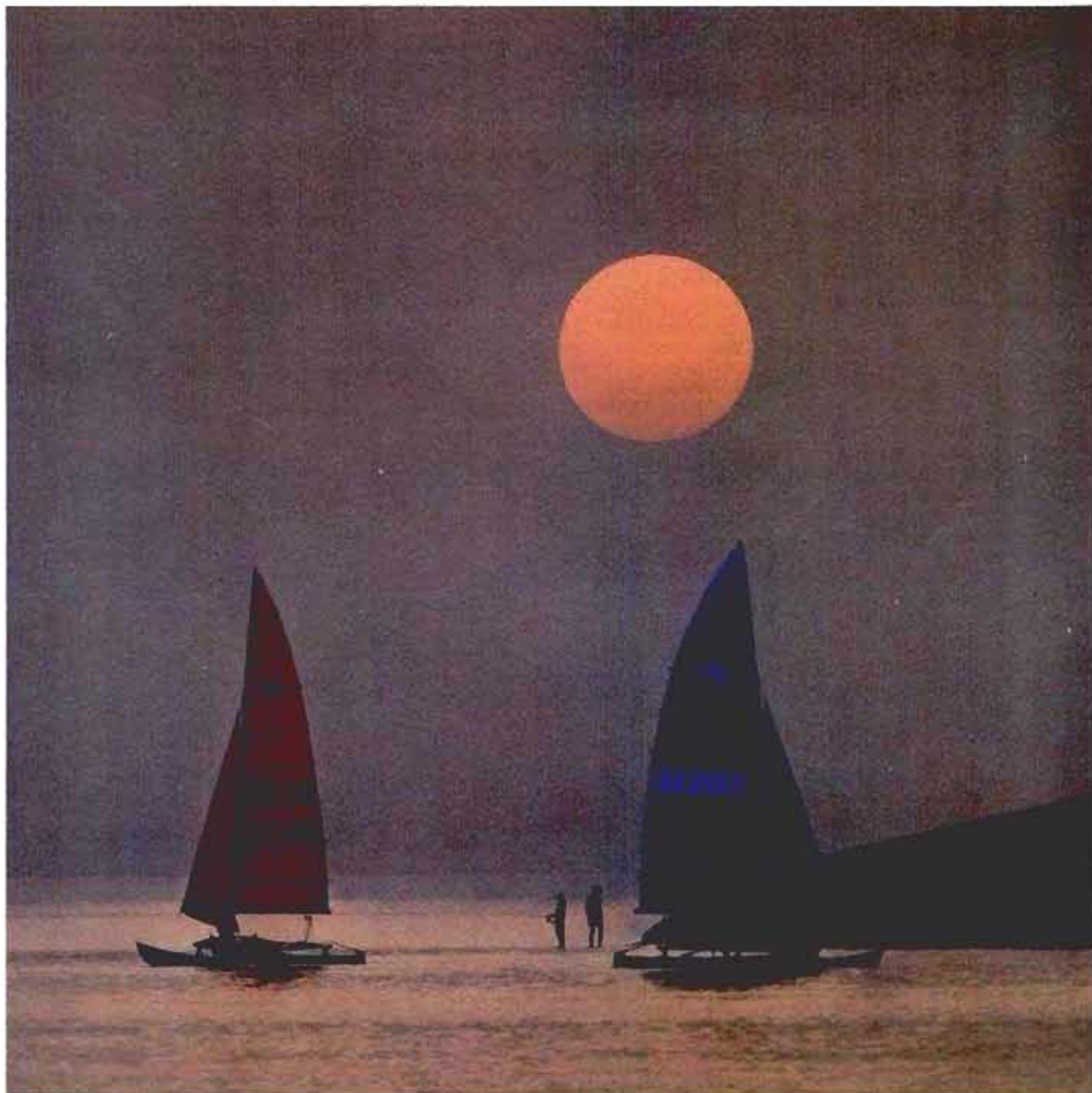
Once the procedures described in this bulletin are applied, but fail to

(Please turn to page 48)

Floatsam and Quadrajetsam

If gasoline begins leaking from the carburetor float bowl, don't panic and overhaul the carburetor. First, check for a heavy float. A float gets heavy when it becomes saturated with gas. When heavy, it keeps the gas intake port open longer than it should be, allowing the float bowl to take in excessive gas and start leaking. Many carburetors, such as some GM Quadrajets models, have solid floats, but they're deceiving. They're made of a foam material that, in time, will absorb enough gasoline to make the float heavy. You won't hear "sloshing" if you shake this float, as you would when checking a hollow metal float to see if it has sprung a leak. A solid float may even look dry. But if you squeeze it, gasoline will ooze. The solution, whether the float is solid or hollow, is to replace it—a far less expensive repair than tearing apart and rebuilding the carb.





This photograph was taken in Saudi Arabia

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5. There was a great sailing breeze until just before we took this picture, honest.

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CAR CLINIC

(Continued from page 46)

solve the problem of idle speed instability, there's an additional step to take which was recently announced by GM. Thus, your dealer may not know he is authorized to install a new PROM in the ECM of your CCC. Welcome to the world of automotive electronics.

CCC stands for Computer Command Control, which is a system installed in all '81 and '82 GM cars, except diesels, to help control exhaust emissions. One way it does this is by maintaining the air/fuel ratio at or near the optimum level of 14.7 to 1.

ECM stands for Electronic Control Module. It is a solid-state computer, and is the heart of the CCC system. The ECM processes information it receives from various sensors and sends out signals to parts that control engine functions.

The PROM, or Programmable Read-Only Memory, is the ECM calibration unit that tailors the CCC system for your car's specific size, engine, transmission and final drive ratio. The PROM is plugged into the ECM.

What all this means in your case,

Dr. Speed, is that your car may have a bum PROM. Tell your dealer to replace it with one having part No. 1225280.

All work that has to be done on the ECM is covered by the 5-year/50,000-mile emissions control system warranty. This new PROM and all labor necessary to have it installed should be free of charge.

Masterful solution

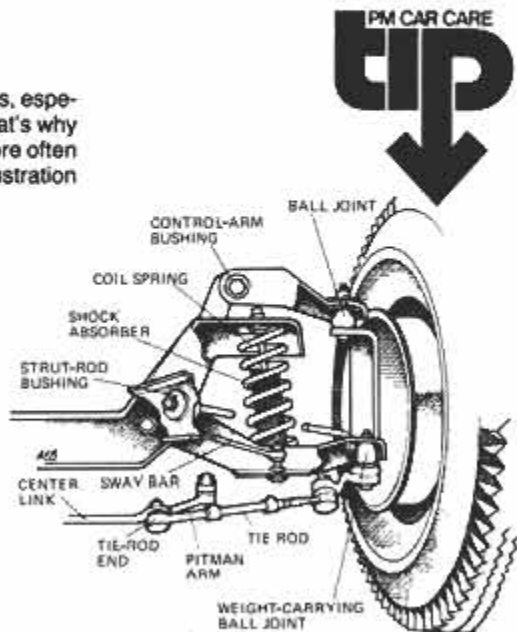
My 1979 Mercury has had a problem with its 302-cu.-in. (five-liter) engine from the day I bought the car. Tune-ups and adjustments by the dealer have failed to correct a holding-back condition as I accelerate.

It's annoying, because this is the only problem I've got with this otherwise good automobile. Please help me

Under wear

An undercarriage problem can be dangerous, especially when you're driving at high speed. That's why an inspection every time you change oil (more often as the car gets older) is sensible. The illustration shows you what to check. Here are some tips:

- Look to see if the car slants from front to rear or side to side. If so, suspect weak springs.
- Check all bushings for any noticeable signs of cracking, frayed areas and looseness.
- Grasp each section of the steering linkage and shake each to see if it's loose. I mean each section—pitman arm, center link, idler arm and tie rods. Replace loose parts.
- Look for leaking shocks. Grasp and shake shocks to determine if top and bottom mounts are solid. Replace bad shocks.



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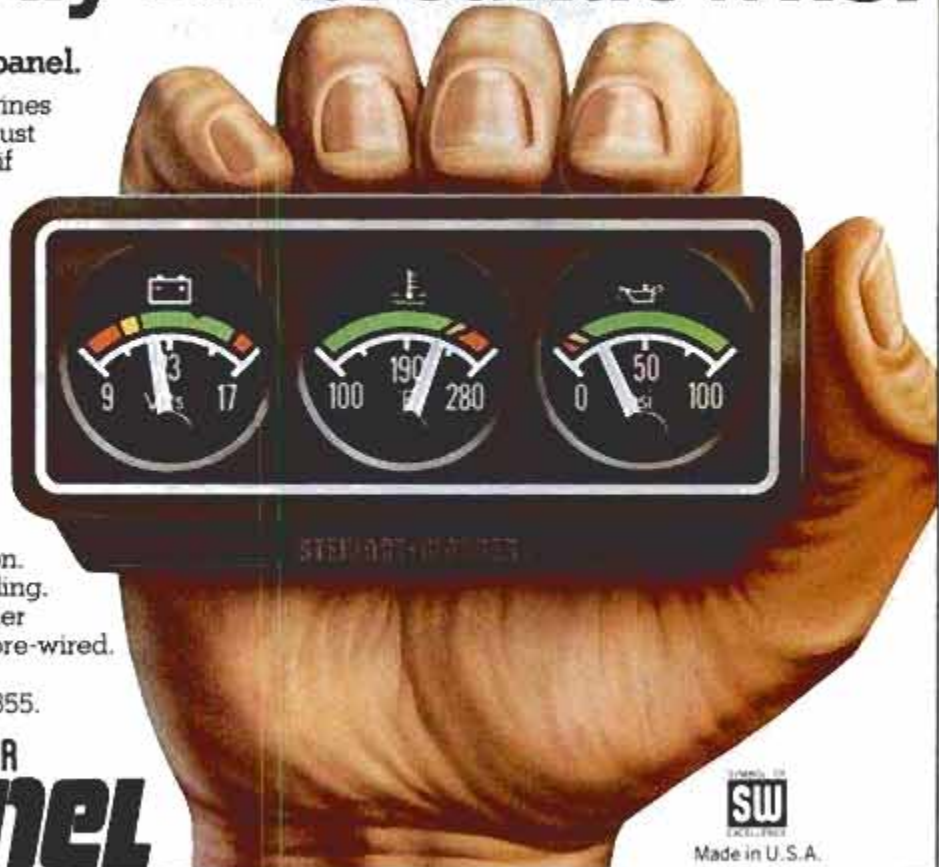
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out of this predicament.—Allen Masters, Elkhart, Ind.

One possible solution for this engine surge that your dealer may have overlooked involves removing the spark-delay valve (SDV). The SDV is part of the vacuum hose between the distributor vacuum-advance chamber and carburetor port, and may be causing the problem by delaying spark too much. It may also be contributing to more gasoline use.

Discard the hose with the SDV assembled to it and replace the two with a 16-in.-long piece of 3/8-in.-dia. vacuum hose—no SDV. If you get the new hose from a Ford or Mercury dealer, order it by using part No. DOPZ-12226-B.

The same repair applies to those who own 1979 Fords with 302-cu.-in. (five-liter) engines exhibiting the same problem as Mr. Masters' engine. In case you're wondering if this throws off the engine's certified emissions calibration, the answer is no. The repair is an authorized Ford Motor Co. procedure.

Bending the rules

Twice last winter my 1981 Buick Century diesel engine ran out of fuel with the fuel gauge reading above

empty. On both occasions, I had to get the car towed to a station selling diesel. The first time, thinking the problem was something else, I went through a hassle and a lot of expense trying to track down a cause that didn't exist. Anyway, the fuel gauge seems accurate enough in warm weather. What happens to it in cold weather?—Bob Bender, Milwaukee

Not a thing. It's probably just as accurate.

All of the 1981 GM diesel engine-equipped cars and trucks have a check valve in the fuel-tank filter that permits fuel to pass if the filter gets plugged with paraffin wax during cold weather. However, because of where the valve is located, the final four gallons of fuel left in the tank can't be drawn to the engine. At four gallons, the fuel level is below the check valve. This is why in cold weather (temperatures below 20°F) you should keep enough fuel in the tank to keep the fuel gauge above the 1/4 mark.

GOT A PROBLEM WITH YOUR CAR?

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

SERVICE TIPS

■ When replacing sparkplugs in your 1981 GM X-body car (Citation, Omega, Phoenix or Skylark), if you use the recommendations in your owners manual, check the manual against the following information. Some of the early manuals contained incorrect data. If your car has the 151-cu.-in. (2.5-liter) L-4 engine, use AC Type R44TSX sparkplugs. If your car has the 171-cu.-in. (2.8-liter) V6 engine, use AC Type R43TS plugs for normal service and AC Type 42TS sparkplugs for heavy-duty service. If your car has the 171-cu.-in. (2.8-liter) V6 high-output (H.O.) engine, use AC Type R42TS plugs all the time.

■ Chrysler may have solved the problem of excessive spark knock in 1981 models equipped with the fuel-control computer; this includes all cars and trucks except those with 2.6-liter, four-cylinder and six-cylinder engines. The knocking occurs when the engine is warmed up. Details of how to test the engine coolant temperature sensor, which may be the culprit, are given in service bulletin 08-05-81 (12/19/80).

■ According to Ford Motor Co., if your 1978 or earlier-model car is equipped with an FMX automatic transmission, you should replace the metal transmission oilpan screen with a Dacron filter. It improves filtering of the fluid circulating in the gearbox. You must also replace the retaining clips. Part numbers for ordering are DBAZ-7A098-A for the filter and C8AZ-7A097-F and C8AZ-7A097-E for the clips.

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Created by the pioneer of both electronic and quartz photography, the unique *FX-D Quartz* is designed to be an integral part of the world's most accurate, totally adaptable 35mm system with more than 300 technically advanced accessories including the new CS-201 automatic dedicated flash, auto winder plus a host of sharp Yashica and Carl Zeiss T* lenses.

Find out more about the *FX-D Quartz* at your local Yashica dealer.



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YASHICA

411 Sette Drive, Paramus, N.J. 07652
In Canada: Yashica Canada, Inc., Ontario

Yashica Quartz, Symbol of Precision and Quality.

Dual control makes this ceiling fan more efficient

If you think ceiling fans are only good for summer use or nostalgia, you'll be surprised to learn their practical value during the heating season, too. And you'll be happy to know a way they can be more effective, as well.

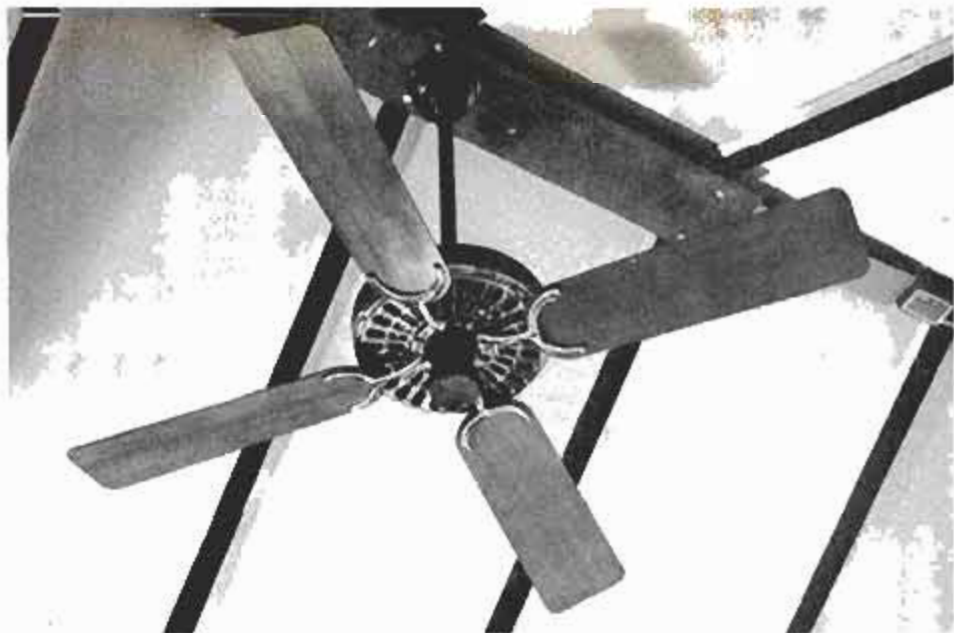
During summer, ceiling fans create a cooling effect by increasing the circulation of air around our bodies. In winter, the same fan can increase our comfort and the efficiency of our heating systems by recirculating the warm air that has a natural tendency to rise and nestle against the ceiling. The higher the ceiling, the greater the air-temperature difference. The upper layer of air in a cathedral-ceiling room may be over 90° F., while air by the room thermostat, 5 ft. from the floor, is only 70° F.

However, it is neither desirable nor fuel efficient to leave the fan spinning continuously, especially when your heating system is off.

The solution for homeowners is to use a line-voltage thermostat to control the fan. When installed on the ceiling in a series circuit with the fan, a heat-control system is established that keeps the room more comfortable and saves fuel.

How it works

When the house temperature drops to the lower limit of the thermostat's setting, the heating system is activated, and warm air is generated. As the warm air rises and begins to concentrate heat near the



Line-voltage thermostat (under ridge, far right) activates the fan as temperature rises.

ceiling, the contacts in the high-voltage thermostat begin to close. This thermostat is set at a temperature 7° to 10° warmer than the house thermostat. At the ceiling, this temperature is reached soon after the heat begins to concentrate. When the contacts close, the fan turns on and sets the warmer air in circulation. This equalizes the air temperature throughout the room.

An evenly heated room is more comfortable, of course, but that's not the only advantage. The temperature equalization allows the house thermostat to reach its shutoff setting sooner, saving fuel.

We installed a Hunter fan with a 52-in. blade spread (about \$200) in a 17 x 20-ft. room with a 14-ft.-high cathedral ceiling. We also installed a thermostat-override switch, in a handy location. Next to it, we installed a variable-speed-control switch (about \$12). This allows us to fine-tune the speed of the fan to meet the optimum comfort requirements.

For more information about Hunter fans, send \$1 for a catalog from Robbins and Myers Inc., Box 14775, Memphis, Tenn. 38114, or call toll-free, 1 (800) 238-5358.

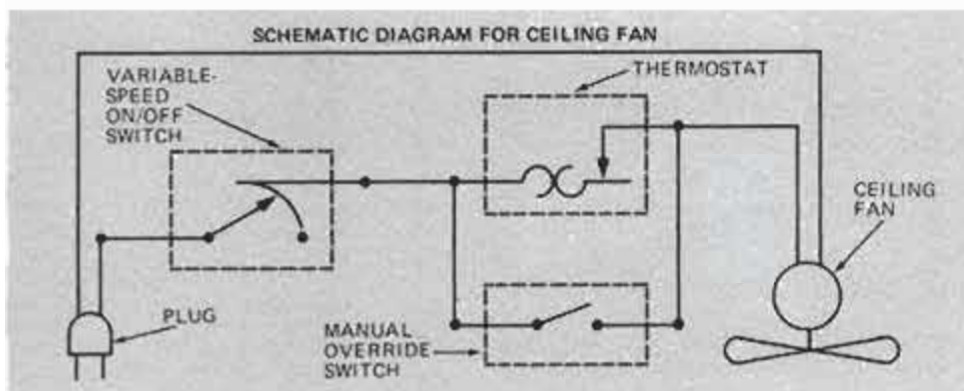
—Russell James



Contacts in line-voltage thermostat close with a rise in temperature. Set it 7° to 10° higher than house thermostat. It's about \$25 in airconditioning-supply stores.



The ideal fan height from the floor is 10 to 12 ft. Switches are to right of window. Heat from the stove also activates fan and thereby contributes more to fuel savings.



PM WORKBENCH

PM EXAMINES PRODUCTS AND SERVICES

Professional-quality glue

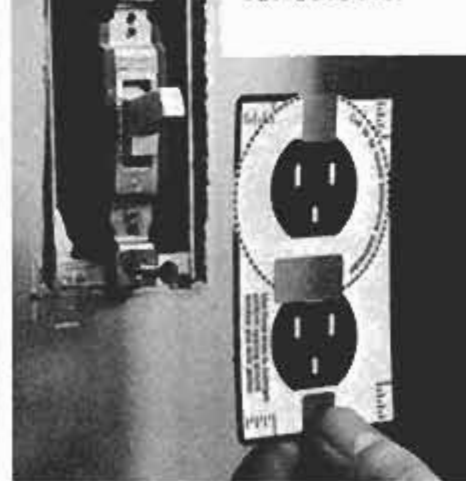


Aliphatic resin glue comes in four home sizes and a pro's 5-gal. pail (not shown).

The latest manufacturer to offer an aliphatic resin glue is Leech Products Inc., Box 2147, Hutchinson, Kan. 67501. Available at lumberyards, home centers and hardware stores, Woodcrafter Glue is sold in five sizes: 8 oz., \$2.29; pt., \$3.75; qt., \$5.75; gal., \$14.25; and 5-gal. pail (not shown), \$69.25.

The glue is in a class often referred to as "yellow" or "carpenter's" glue and is excellent for furniture making and general woodworking because it sets fast.—H.W.

Template for cutouts



Template gives handymen professional results. It can be reused several times.

The Hole Thing is an adhesive-faced and backed template that's ideal for locating cutouts in drywall and paneling. Just stick it on an outlet box and press a properly positioned panel against it. The template will transfer to the panel back and can then be traced. A pack of 10 costs \$4.49 postpaid from W-B Kingston Co., Box 7112, Lancaster, Pa. 17604.—S.W.

Home and shop updates

There's good news for PM readers who made, or intend to make, the Lincoln (Butler) mantel clock which appeared in the Feb. '81 issue. Some readers complained of difficulty in obtaining the necessary components, so we located a new and reliable source for the items needed.

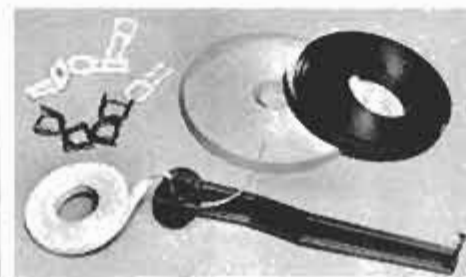
Armor Products, Box 290, Deer Park, N.Y. 11729, will furnish the following items: two-piece polished brass bezel with glass and mounting instructions, \$15.50; paper dial, \$1.25; and battery movement with hands, \$8.75—all postpaid. As a special offer, the firm will furnish a fine quartz movement complete with dial, glass and polished bezel assembled and ready to insert (with minor modifications to the case) for \$25.50 postpaid. A catalog is \$1.50.

In our story *Coal Makes a Comeback* (page 110, Oct. '81), we did not mention an important source of information: *Heating With Coal*, by John W. Bartok Jr. This book is available in bookstores and from Garden Way Publishing, 1520 Ferry Rd., Charlotte, Vt. 05445, for \$6.95. Add \$1 if ordering by mail.—H.W.

New clamping system

The Mity-Tite Tensioning System is a combination of simple components (shown below) that provides a wide range of clamping and banding capabilities. For temporary clamping, such as gluing boards together, the tensioner pulls the strap tight and the handle hook keeps the tension on until it's released. For banding cartons or clamping odd shapes, the strapping is threaded into the buckle and pulled tight. Friction between the buckle and strapping holds it.

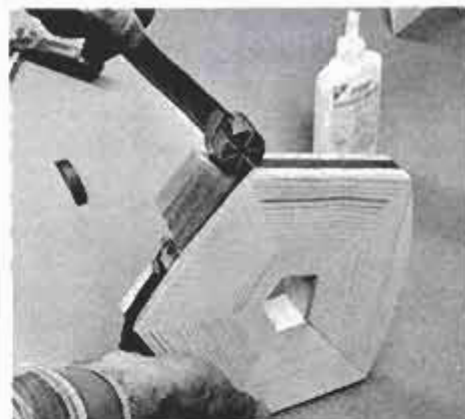
The kit contains the tensioning tool, 50 ft. of 1/2-in.-wide polyester strapping, 100 ft. of 1/2-in.-wide polypropylene strapping, and 10 metal and 10 plastic buckles. It's \$11.25



Kit contains tensioning tool, strapping, metal and plastic buckles, instructions.



Clamping for gluing is done by threading strap ends through tool barrel, pushing handle down, catching hook under strap.



When clamping odd shapes, small wood wedge is needed to give a prying surface.

postpaid from Mity-Tite Systems, 3712 Lakeridge Drive W., Sumner, Wash. 98390. —Rosario Capotosto

Channellock gift kit



Gift pack contains multipurpose and pocket-size pliers.

Channellock Inc. of Meadville, Pa. 16335, is now offering two of its non-slip, undercut groove pliers in one gift package. Included are the No. 426G 6 1/2-in. plier and the No. 420G 9 1/2-in. plier. Made of high-quality steel, these tools come with plastic grips and a high-polished finish. The set is \$15.66 at hardware stores or home centers.—S.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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You see, in this neck of the woods, I'm the guy who cuts Christmas trees.

Have you ever cut down a Christmas tree? The first couple trees aren't hard, but after that it can get tiring. That's why I like my John Deere Chain Saw. I just don't get tired.

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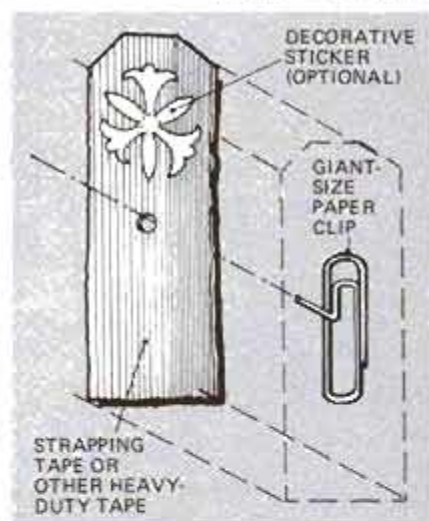
HINTS FROM READERS

No-holes hook



If you don't want to drive nails in your wall, or you have tile or other walls that don't readily accept nails, try this hanger made from a giant-sized paper clip and heavy-duty tape, such as strapping tape. Bend one end of the clip and poke it through the tape, as below. For a decorative effect, trim the corners off the top of the tape and add a sticker or decal. Colored vinyl tape may also be used to match room accessories. Use the hanger only for small pictures and lightweight objects.

—Walter E. Burton



Clay holds nails

Modeling clay pressed over a nailing surface holds a nail in place when you can't grasp it to hammer it. Remove clay once nail is started.—Lane Olinghouse

Unclogging spray paint

To unclog a spray-paint nozzle, remove it and drip lacquer thinner into the feed tube. This softens dried paint so it can be sprayed out.—H. Miller

WORKSHOP MINICOURSE

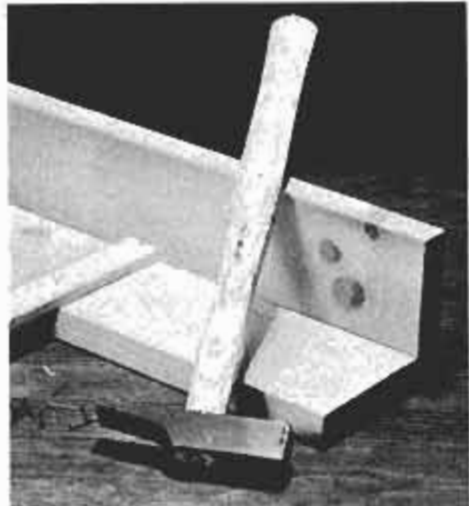
SPECIAL-PURPOSE TOOLS



It's a snap to start a small nail using cross-peen end of hammer; its shape seems to "fit" between thumb and index finger.



To complete driving a small nail, you rotate the hammer head and finish the driving with the broad, square face.



Shop hammer is a must for woodworker who uses brads. Source is listed in text.

You don't have to be a totally committed woodworking buff—or a master craftsman—to take advantage of unusual shop tools that make certain pesky chores a lot easier. Despite the money spent by tool manufacturers to advertise their products, it's been my experience (with students in my adult-education woodworking class) that a great many people simply aren't aware of some very useful tools.

Thus, I have selected a number of out-of-the-ordinary tools to share with you in this and next month's columns. The fact is, they really aren't that unusual, or new, at all;

experienced woodworkers have been using them for years. Some of the tools are available at local hardware stores and home centers. Others must be ordered from a craftsman supply house. Thus, we will list a source for each tool we discuss.

Working with brads

One of the paradoxes of woodworking, it seems, is that most workshopers have good-sized hands. Consequently, a relatively easy task—such as starting $\frac{1}{8}$ to $1\frac{1}{4}$ -in. brads—is often a nuisance job. But it won't be if you work with the right tools.

The two shown on this page are among my favorites. It's safe to say that one or both are used on just about every project I undertake.

The hammer shown above is called a French joiner's hammer and is claimed to be the favorite of our counterparts in Europe. Whether or not it is, is immaterial; what counts is that it really is an excellent tool for working with small nails, and in close quarters. The striking head and the body are square-shaped and the underside is flat, as well. The result is a hammer with a full striking surface, even when working in a tight corner.

I use mine with small nails and the like, employing the method shown

above. To start a brad, I use the cross-peen end and, usually, I finish driving with the square end.

The hammer sells for \$9.10 post-paid from Woodcraft Supply Corp., 313 Montvale Ave., Woburn, Mass. 01888.

Working with tiny brads

For the very small brads—for me those are any under $\frac{1}{8}$ in. in length—I turn to a magnetized brad pusher. The one I use is made by Hyde Mfg. Co., 54 Eastford Rd., Southbridge, Mass. 01550. Tagged at \$8.80, it is available at hardware stores and home centers that stock Hyde products.

When driving brads, you can simply dump a small batch on the worktable and pick them up individually with the tool's magnetized tip. The sleeve is returned to full extension for the driving, as shown in the photo at lower left. You then push the handle down to drive and set the brad.

Next month, we will discuss an old-time way for making your projects smooth, as well as a tool for pulling nails.

PM



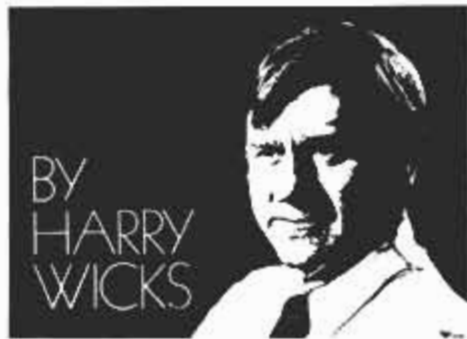
Brad pusher's tip is magnetized. To pick up a small brad, you simply retract the sleeve and touch the tip to the brad head. Then you gently release the sleeve.



Next, tool is positioned where you want to drive the brad, and its handle is pushed downward. In one operation, the pusher drives and sets the nailhead.



Close-up view shows nails that have been set. The tool shown has been in use in author's shop for more than 10 years.



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Double-wall construction in the cargo box side panels that the imports can't match. Every S-10 features both an inner and outer steel wall in the hood, doors, front fenders, cargo box side panels and the tailgate.

Chevy S-10, with optional Tahoe trim, in Cinnamon Red.



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Use estimated MPG for comparisons. Your mileage may differ depending on speed, distance, weather. Mileage will be less in heavy city traffic. Actual highway mileage lower.

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Chevy S-10. There's never been a truck like it before. A great combination of features. High mileage. Optional V6. Quality assembly. Big payloads. Roomy cab. Smooth ride. The Chevy S-10 has all this and more. Lots more. The S-10's paint finish is brilliant. You can choose your cargo box in a 6-ft.-1-in. or 7-ft.-5-in. length. Plus

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APPLIANCE CLINIC

QUESTIONS ANSWERED

Moaning refrigerator

Our Norge model No. 1764 refrigerator/freezer continually makes a moaning, whirring sound. I suspect the motor and compressor are out of sync.—W.J. Mitchell, Lincoln, Neb.

We suggest you take the back off your box and have a look. Today's units sport combo motor-compressors which are hermetically sealed as one unit. However, the rubber mounting pads or rubber bumpers in chassis holes for the unit may be loose or twisted. If they are, fix them. Make sure nothing in the compartment is rubbing on or vibrating against the unit.

So much for checking outside the compressor. If the trouble is inside the unit, forget it! If something is wrong inside, it would be next to impossible to repair it yourself.

Incidentally, while you've got the system open, now is a good time to give it a good brushing. Use the tools and ideas suggested in "Condenser Brush Update" (*Appliance Clinic* page 33, Oct. '81).

Disappearing ice cubes

Ice cubes and ice cream stored in our Whirlpool frost-free Model EMT 14J refrigerator have a way of disappearing after about two weeks when we leave the unit. Is there a remedy?—C.D. Harmon, South Gate, Calif.

Freezing itself is a method of dehydrating or removing water from substances. When the inside of your box is unopened for any length of time, there is no exchange or occasional inrush of outside, moist air. Consequently, the system dries out what is inside. Storage of products like fruit and vegetables, which have lots of moisture, and the frequent opening and closing of the refrigerator all help to offset this drying out. Also, in the damper areas of the East and the South, this is rarely a problem.

As for your vanishing ice cream, even in supermarkets, ice cream is dated for sale. This is not because it spoils but because the freezing continues to crystallize moisture out as ice. This changes the smooth, silky consistency most buyers prefer.

Water collection

My Coldspot automatic-defrost refrigerator/freezer, No. 106.6673301, has a water-collection trough halfway up on the inside back wall. Recently, this has been full of ice,

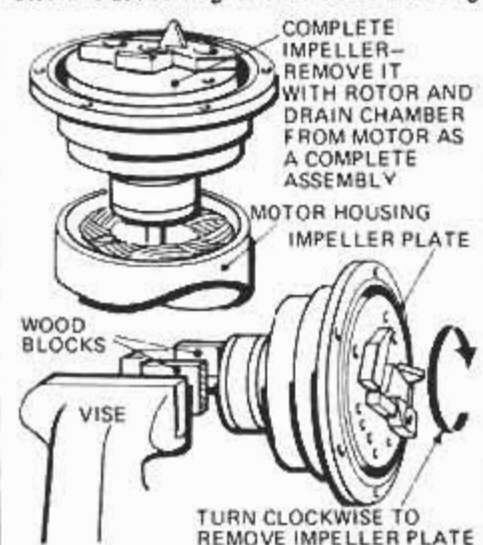
letting water accumulate in the bottom of the box at the vegetable crisper. How can I correct this?—John Sever, Dayton, Ohio

It sounds to us as if your thermostat is on the fritz. Before you replace it, however, we suggest you try the following:

Run a thin wire down the trough drain tube to poke out any food particles that might be causing a blockage. You can also try pouring some warm (not hot) water down the tube to melt any ice that's formed there. (Hot water might crack the cold plastic material.)

Leaking food disposer

I have a Maytag food-waste disposer model No. FC 5, serial No. 52063 WD series 02 with a separate on-off switch. Recently it has been leaking



To locate the food disposer's boot seal, remove the impeller, rotor and shaft assembly and drain chamber. Then remove the impeller plate with a clockwise twist.

water from the square opening in the drain chamber. With the grinding chamber removed, the grinder itself seems to be keyed onto the motor shaft. I tried to get it off, but since I wasn't sure whether the grinder was keyed or threaded onto the shaft, I didn't want to take a chance on breaking it. The grinder seemed very tightly secured when I tried to pull it off. Also, can I get a repair manual on this unit?—P.W. Armbruster, Petaluma, Calif.

Sounds like a leaking boot seal. To get at the boot seal, you first have to pull the complete impeller, rotor and shaft assembly and drain chamber away from the motor.

Next, secure the rotor shaft in a

vice or with lever-jaw pliers. Grip the area between the groove on the shaft and the rotor. Use a cloth or wood blocks to protect the shaft. Hold the shaft firmly and turn the impeller to the right (in a clockwise direction).

Once the impeller is removed, you can inspect the boot seal for cuts or a damaged carbon ring. The boot seal, part No. 809, is available from Maytag for approximately \$10.90.

Maytag publishes a service manual (part No. 56251) for food-waste disposers, which costs about \$1.50. Write to the Maytag Co., Newton, Iowa 50208. The manual provides step-by-step instructions on how to install this seal.

Suds saver

Occasionally, our General Electric Suds Miser washer returns the suds water during the rinse cycle, causing an overflow. What causes this and how can I fix it?—Paul Kish, Natrona Heights, Pa.

There are four things that could be causing this condition. First, you may have a defective solenoid on the drain line. To check this, rotate the timer by hand and listen for the "solenoid click" inside. If you don't hear one, replace the solenoid. (You can also check this out with an ohmmeter: No resistance across the solenoid means it is no good.)

Second, you may have a plugged or blocked drain line. To check this, take the drain hose out of the drain pipe and put it into a bucket. Put the timer on the rinse cycle and see if water comes out of the hose.

If these two checks don't reveal the source of the problem, then check to see if you have loose, broken, or disconnected wires in the machine. The simplest test here is to pull or jiggle the wires.

If all these checks still don't solve your problem, you may have a defective timer. To check this, disconnect the two wires from the solenoid to the timer and read across them with a voltmeter or test lamp while you rotate the timer dial.

And always, always—unplug your appliance after troubleshooting and before working on it!

If you have a question about any appliance, send it, 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.

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4 last-minute Christmas gifts from kits



Shaker candle stand

This is a beautifully crafted piece of furniture, one which you'll be proud to add to your collection. Of hardwood, the Shaker table actually consists of just seven parts. Assembly is super easy, since all parts are accurately machined. One word of caution: Make sure you give the top an adequate sanding. On the model we assembled, the top did show some factory sanding marks: Part of the top had received more sanding than the rest of the surface. A good sanding session with 120-grit paper (followed by 150-grit) in my large pad sander readied the wood for finishing. The stand shown was given a coat of the stain that comes with it, followed by satin-finish varnish. Shaker table No. 381 is \$45.50 postpaid from Cohasset Colonials, Cohasset, Mass. 02025. Orders are shipped the day after receipt; catalog is \$1.



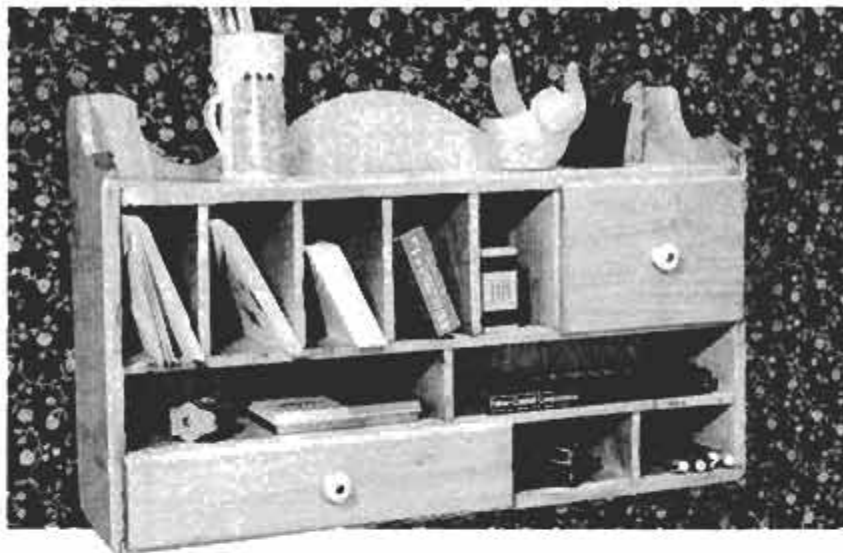
By the time you read this, there will probably be less than 30 days until Christmas. This means that you have four weekends, at the most, to put together gifts in your workshop—if that's what you'd hoped to do this year. For that reason, we have rounded up four good gifts you can make from kits. If you



act right away, you will receive them in time to assemble and finish them before December 25. We assembled all four in the PM shop, and none took more than a one-evening work session. One—the music box—took less than a half hour of time to assemble and finish.—*Harry Wicks, Home and Shop Editor*

Music box

This project goes so quickly that you will think you've left something out. All the parts of the unit I put together were cut perfectly and fit together without a problem. Instructions are clear and easy to follow; just make certain that you put the hole template on the bottom the right way (for boring the music box fastener holes). The box shown was given a coat of light cherry stain, then finished with satin-finish varnish. The Woodworker's Store, 21801 Industrial Blvd., Rogers, Minn. 55374, sells music box kit No. A-9332 for \$19.50 postpaid. A choice of 19 musical movements, each playing a different tune, is \$7.25 each postpaid. Allow two to three weeks for delivery; the complete catalog is \$1.



Wall organizer

Though this shelf in the colonial motif resembles a collector's shelf, it's actually intended to serve as a wall organizer by desk or phone. Of 1/2-in. pine, it has numerous parts, which take time to assemble. To be safe, line up all parts and mentally run through the assembly. (If you put a shelf in backward, for example, you might have to scrub the project.)

Because the project had a look of "newness" about it, I antiqued it, adding distress marks and, in fact, a "Dutchman" wood patch (to one of the shelves) to create the "country look." The parts required some sanding, but not a great deal. To assure that country look, I used a very light pine stain and a flat varnish to finish. The Cubbyhole Organizer kit is \$31.50 postpaid from Yield House, Dept. JK1A, North Conway, N.H. 03860; catalog is \$1. **PM**

Cane stool

This is a particularly easy project to assemble and (as with all the kits we assembled) comes factory-sanded to a point which leaves little sanding for the assembler. Materials are of top quality and the stool can be assembled in about 30 minutes. Do take the time to soak the cane and spline as instructed so that it can be stretched properly and seated securely with the spline. The stool shown was left natural and finished with two coats of satin-finish varnish. From H.H. Perkins Co., 10 South Bradley Rd., Woodbridge, Conn. 06525, Kit W-15 is \$22 postpaid. Orders are shipped within a week of receipt; catalog and a booklet on seat weaving cost \$1 together.

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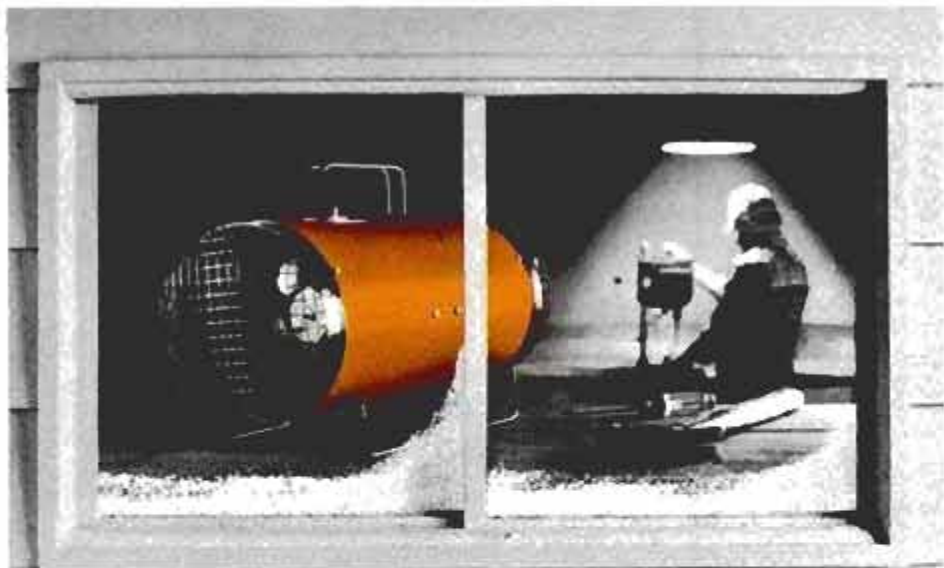
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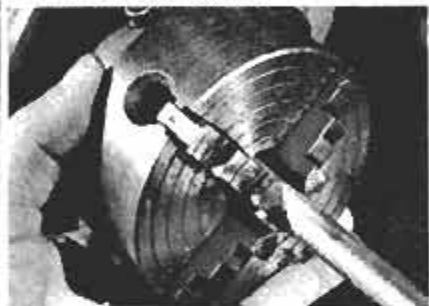
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HINTS FROM READERS

Lathe-chuck holder



To avoid any chance of dropping a lathe chuck onto the bed when removing it from a hollow spindle, first run a drill rod shaft into the spindle. The rod will give support if the chuck slips while being removed.—*Bob Berger*

Tight-space paintbrush



Here's how to modify inexpensive paintbrushes of varying sizes for use in tight quarters. Saw off their handles, grind the ends round and bore a 1/4-in.-dia. hole in the ends so you can hang them.—*Kenn Oberrecht*

Glass cutter cuts paper



A glass cutter with a sharp, free-running wheel can do a neat job of cutting paper. Lay the paper on a scrap sheet of glass, hold it firmly and run the cutter along a guide. A circular glass cutter (right) cuts a neat disc in seconds.

—*Walter E. Burton*

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PM's Whatsit

Despite appearances, you know that's really not a man-sized kettle filled with enough stew for a regiment. Have any idea what the cauldron-shaped vessel really is? If you can't take the pressure, turn the page for the answer.

You can say that again

Budget austerity could still cost NASA the much-ballyhooed mission to intercept Halley's Comet with a spacecraft in 1986. The space agency wants \$300 million for the project, but doesn't want to jeopardize other planned planetary probes by insisting. "We just want the federal budget-makers to understand that it's a once-in-a-lifetime opportunity," said a NASA spokesman with a straight face.

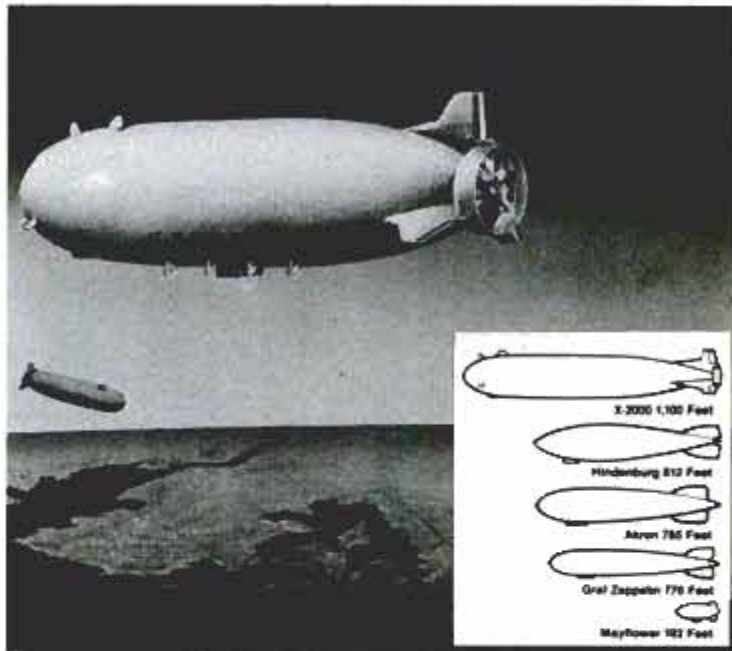
The comet enters the solar system roughly every 75 years.

Born-again Zeppelin

An Ohio-based group of scientists, executives and military men, known as Concept Development Institute, is urging the U.S. Government to develop the largest lighter-than-air vehicle ever conceived. The group, which includes retired management men from both B.F. Goodrich and Goodyear, says the giant, rigid airship would be filled with helium and could serve as an aircraft carrier, launching its own flotilla of VTOL jet aircraft.

The Institute's projected prototype is known as the X-2000; it would be 1,100 feet long, with about 100 times the cubic contents of familiar blimps. (The *Hindenburg*, most ill-fated and remembered of the great, rigid airships, was 812 feet long.)

The ship would serve as a self-contained patrol force, effective anywhere on earth and remaining aloft with in-air refueling and reprovisioning. Most important, says the CDI, it could serve to implement and police a Strategic Arms Limitation agreement between the United States and the Soviet Union.



Why aren't these people smiling? (See next page.)





Whatsit revealed

The vessel—which was being steam-cleaned on the previous page—is now seen in its upright position, ready for installation at the Geysers Geothermal Power Plant in California's Napa Valley. It's the impeller housing section of a cooling water pump, manufactured by Borg-Warner Corp.'s Byron Jackson Pump Division. The king-sized pump can circulate water at the rate of 88,000 gallons per minute.

Why those people weren't smiling



Engineer places builder's bridge in a hydraulic press, and...

They were all entrants or interested observers in an annual model-bridge competition sponsored by Brookhaven National Laboratory. Entrants—mostly students from nearby Long Island (N.Y.) schools—were all required to build with the same two materials: balsa wood and Elmer's glue. The bridges were then stressed to the failure point in a hydraulic press. The winning bridge would be the one that supported the highest multiple of its own weight.

Charles Nostrand of Cold Spring Harbor High School produced the 1981 model-bridge winner. His very simple design weighed 120.8 grams and failed under 2,502 pounds of pressure—or 9,387 times its weight.

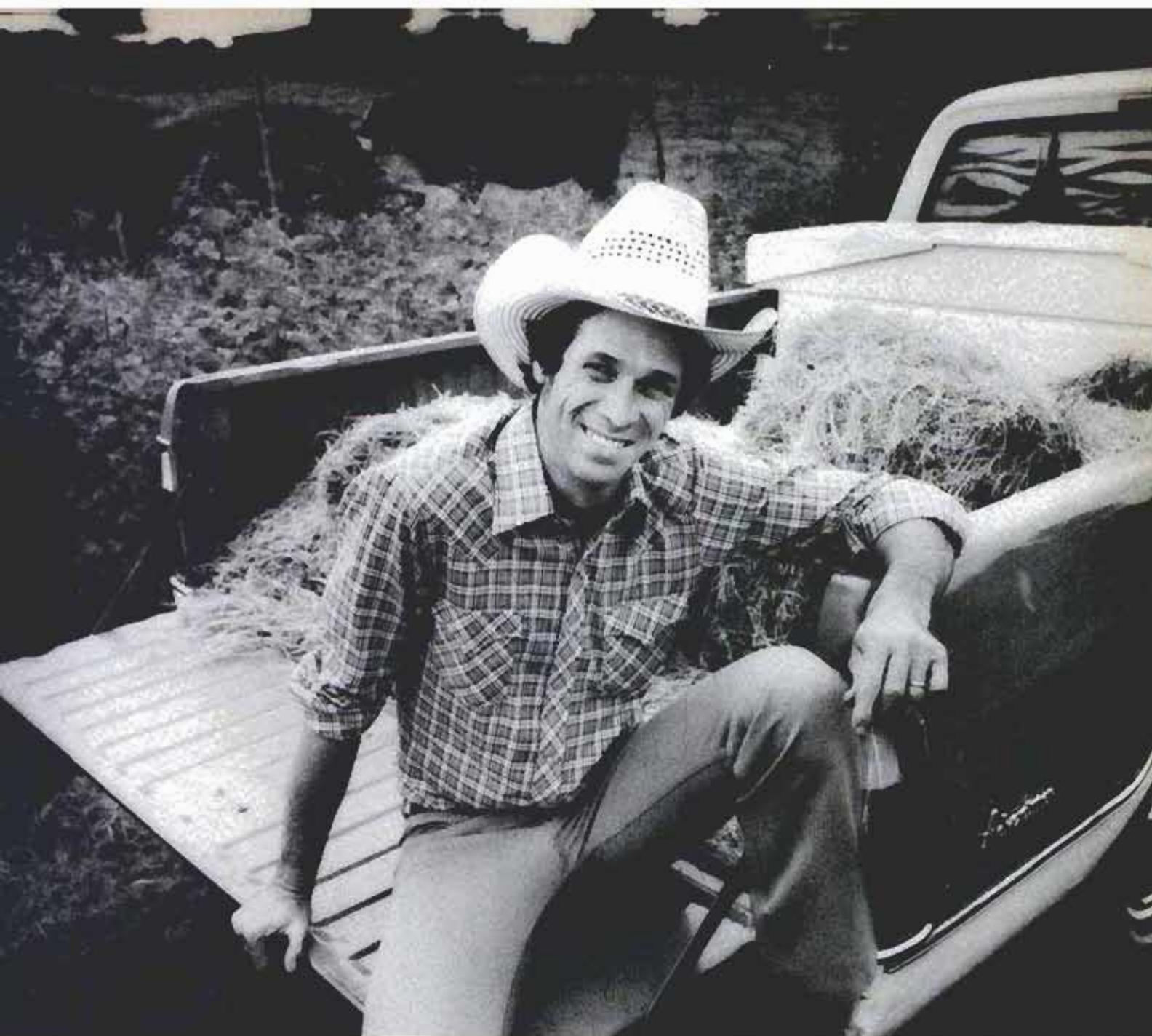


...proceeds to crush it while the creator watches helplessly.



Winning entry was among the least elaborate designs. Inset shows that failure—at 9,387 times its weight—did not occur in a glued joint. Bridge supported over 2,500 pounds.





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Was Whitehead first?



The Wright Brothers' claim of primacy in powered flight still can't shake the ghost of Connecticut's 'crazy German.'

by Roy Bongartz Jr.

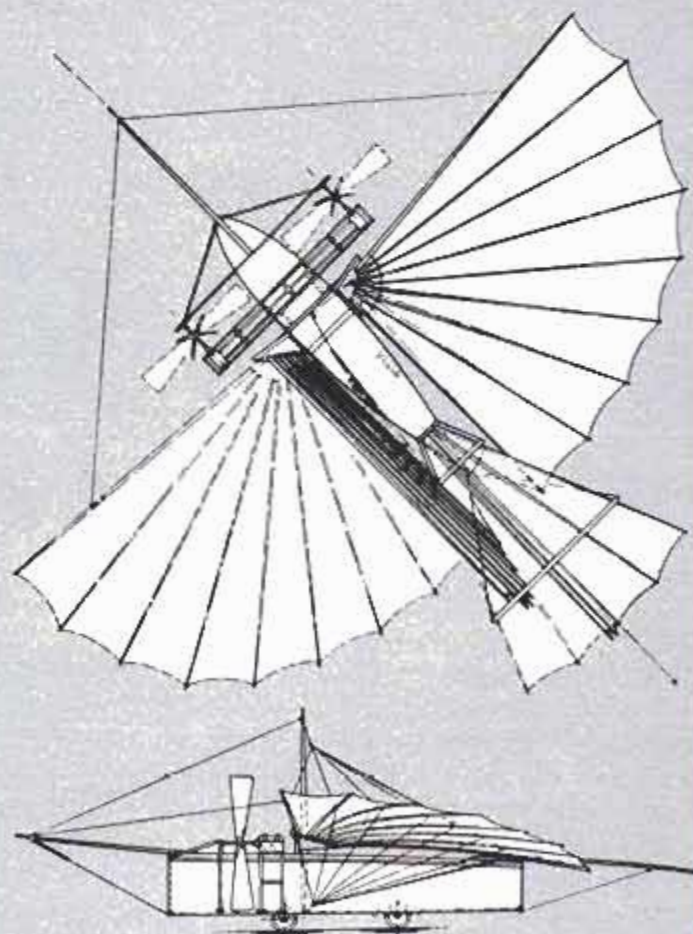
More than two years before the Wright Brothers' historic flight at Kitty Hawk in 1903, a German immigrant named Gustave Whitehead made what some believers still claim was the world's first flight of a heavier-than-air craft under its own power.

The last of any eyewitnesses of this feat, which took place on Aug. 14, 1901, in Fairfield, Conn., are no longer alive, and the group of historic aircraft buffs most interested in Whitehead, the 700-odd members of the Connecticut Aeronautical Historical Assn., are still not positive whether their neglected favorite son should get credit for the very first successful flight or not. They all agree that he did, at least, accomplish something pretty close to powered flight.

Whitehead was a tinkerer and builder of engines run by steam, gasoline, and various gases. He had been associated with an even earlier claim to powered flight—that Whitehead had flown a steam powered plane into the side of a building in Pittsburgh in 1899, that his copilot, Louis Darvarich, had been hospitalized for burns from the exploding boiler in the craft, and that the plane had damaged the building sufficiently to prove the flight.

But it was the Fairfield flight, in 1901, that eventually established Whitehead as the father of aviation—in the eyes of his supporters. Yet he is mentioned nowhere in the books on aviation history, although his greatest champion, a writer named Stella Randolph, has dedicated over 40 years and two books to estab-

(Please turn to page 70)



At top, Gustave Whitehead, born Weisskopf in Bavaria, stands with his No. 21 aircraft, the same in which he claimed to have made a significant powered flight two years before Wright Brothers flew at Kitty Hawk. Schematic drawings of No. 21, courtesy of *American Aircraft Modeler*, are reproduced by permission.

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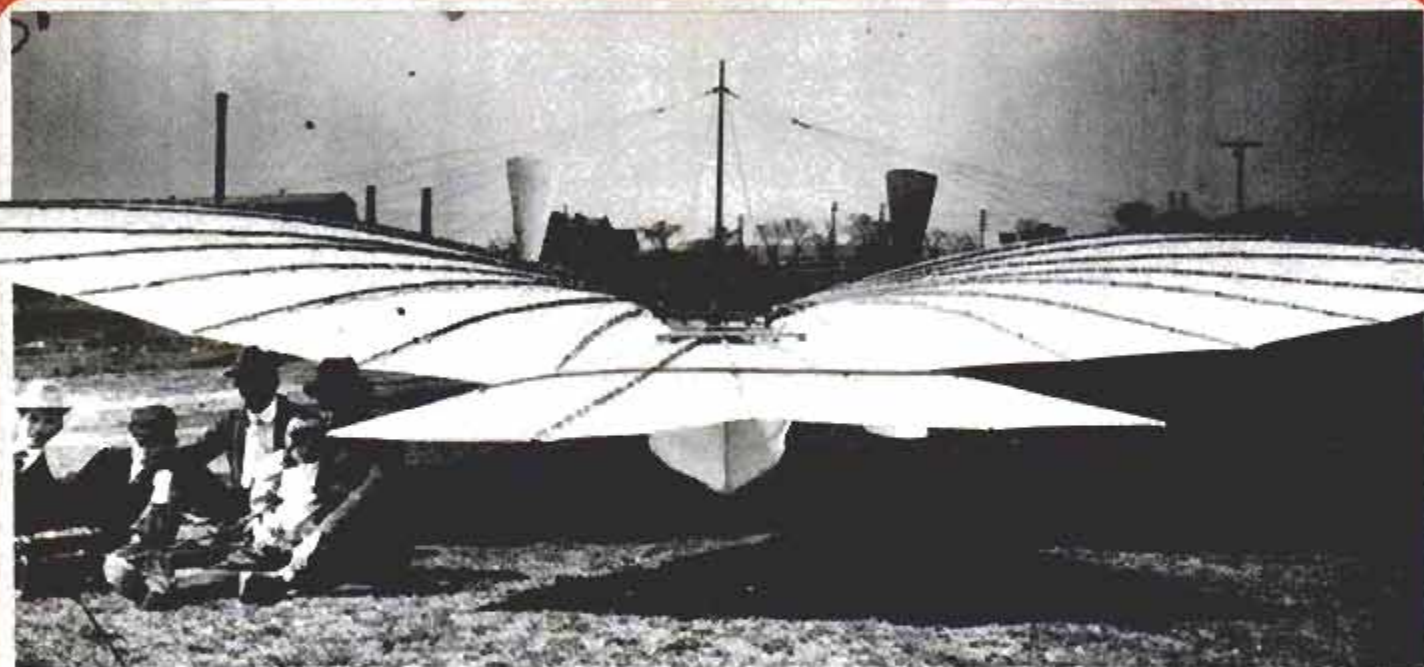
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WAS WHITEHEAD FIRST?

(Continued from page 68)

lishing Whitehead's rightful place in the history of aviation.

Among the many planes Whitehead built, it was No. 21 that took him on his most nearly documented flight, in which Whitehead, alone in the craft, took off, rose 50 feet in the air, managed to steer around a clump of saplings on a knoll, flew half a mile, and came to a gentle landing. Although the machine was photographed on the ground, as were his others, none was ever shown actually flying. It is primarily the lack of acceptable photographic evidence that has so far kept his backers' attempts to win him an exalted place in the annals of aviation from succeeding.

A few weeks before that claimed 1901 flight, the plane was described in the *Scientific American* along with a photograph showing it batlike, with white arching wings of canvas over bamboo ribs, and two six-foot propellers. Gustave, determined and confident of expression, wearing a dark suit, a fedora and a handlebar mustache, is seen squatting beside his creation. The "novel flying machine," the writer of the magazine article called it. He was Stanley Y. Beech, who was later to support some other Whitehead projects.

Beech described the plane as self-powered on the ground, like an automobile, having four wheels that were moved by a 10-hp engine. It had a rudder that "can be moved up and down, so as to steer the machine on its horizontal course." It also had "a mast and bowsprit to hold all the parts in their proper relation."

Present with Whitehead at the scene of the famous flight, just past midnight of Aug. 14, 1901, on Tunxis Hill, Fairfield, were two assistants, Andrew Cellie and James Dickie, as well as the editor of the *Bridgeport Sunday Herald*, Richard Howell, who ran his story four days later.

Whitehead and Cellie took places in the plane and drove through the streets of Fairfield to the takeoff point, while Dickie and Howell followed them on bicycles. Howell wrote, "The machine rolls along the ground on small wooden wheels, only a foot in diameter, and, owing to their being so small, the obstructions in the road made it rock from one side to the other in an alarming fashion. After reaching the Prot-



Top photo shows Whitehead with young daughter picnicking under 21's wing. Photo above was said to have been taken after a crash landing in which the plane was slightly damaged.

estant Orphan Asylum at Fairfield Ave. and Ellsworth St., there is a clear stretch of good macadam road, and the flying automobile was sent spinning along the road at the rate of 20 mph. For short distances from there on the speed was close to 30 mph, but as the road was not straight or level for any distance, this rate of speed could not be maintained."

Howell watched "Crazy" Whitehead, as he was affectionately called around Bridgeport, and his helpers check over the craft, whether by moonlight or by lantern he does not say. "It was about two o'clock Wednesday morning when the great white wings of the airship were spread out ready to leap through the air. Mr. Whitehead was excited and enthusiastic and his two partners were almost as bad. The light was not very strong and everything looked like a ghost. Whitehead spoke in whispers, although the reason for it was not apparent. But probably the very time selected for trying the machine was responsible for that."

The craft had two motors, one to power it along the ground and another that ran the two propellers. Before trying to fly himself, Whitehead tried out the craft to see if it would rise. He and his helpers ran alongside the moving plane as he reached for the controls, shut off the power to the wheels, and turned on

(Please turn to page 72)

Gas Saver Patented

Low Cost Water/Vapor Injector

DENVER—The Copley News Service reported that United States Patents have now been issued to Wm. Trevas-kis, veteran electrical engineer, for his Vapor-Jet® brand water vapor injector.

Trevaskis has developed what can amount to a 15 cents per gallon "rebate" potential on gasoline, by designing a low-cost injector for automobiles, light trucks, vans and recreational vehicles.

Water injectors were developed to a highly refined state during World War II, to give combat planes increased speed and range improvement potential. However, up to now, the low price of gas and the high cost and extremely difficult installation required for earlier injectors combined to make them unattractive.

The Vapor-Jet® has an unconditional 60-day money-back guarantee. **How does the Vapor-Jet® system work?**

Vapor-Jet® operates very simply with no moving parts to wear out. It uses engine vacuum to pull outside air through a reservoir containing a water/methanol mixture which is attached to the car under the hood. This causes the fluid to bubble and a mist to form in the upper part of the reservoir. This mist is then drawn by vacuum through a hose which is connected to any intake manifold suction hose. This connection is made very simply by our exclusive hypodermic-like injector nozzle which contains a regulator to allow just the right amount of mist to pass into the combustion chamber.

The introduction of this mist into the fuel air mixture has a cooling effect that increases the mixture density, extends the burning rate, and improves combustion efficiency. This significantly reduces ping (predetonation) and dieseling (after running of engine). Since steam is a good cleaner, it also helps dissolve carbon deposits on the spark plugs and cylinder walls of older vehicles and helps prevent carbon buildup in new ones.

How much mileage increase can be expected?

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Will Vapor-Jet® fit all cars, and is it easy to install?



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The reservoir measures 3½" x 5½" x 7½" and has capacity of just under ½ gallon fluid. A full reservoir should last about 1,000 miles. Methanol (wood alcohol) is mixed with water mainly to prevent freezing and to keep the injector nozzle clean in non-freezing weather.

The cost of methanol is minimal (about \$5 a gallon) and will last up to 8,000 miles when mixed with water. Sources of methanol are chemical supply houses, paint stores, and drug stores. Substitutes are gas line anti-freezes that contain methanol such as "Heet."

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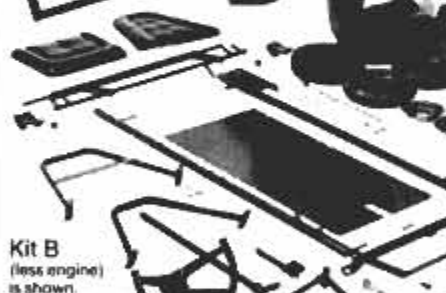
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Kit B (less engine) is shown.

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RUSH Kit B (shown) I enclose \$199.95 (\$179.95 plus \$20 freight)	<input type="checkbox"/>	PM12
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go cart

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Electronics allows water injection on a graduating basis as needed; mechanical units do not.

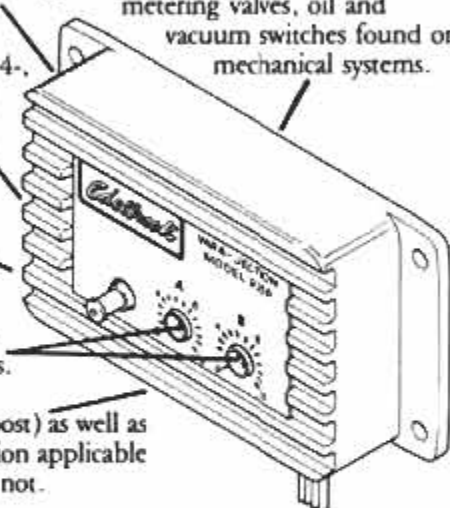
You set the system electronically for 4-, 6-, or 8-cylinder engines specifically; mechanical units do not.

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Reliable, solid state electronics allows essential functions impossible to achieve with any mechanical water injection system. As vehicle and application vary, so do the amount and timing of water required to control detonation. Vara-Jection assures broad adjustment capability through a combination of fine tuning and nozzle selection. Synchronize water delivery to match your specific engine's needs through the accuracy of Vara-Jection electronics.

Receive a free 4-page brochure by writing 411 Coral Circle, Dept. PM1281, El Segundo, CA 90245.

Edelbrock

WAS WHITEHEAD FIRST?

(Continued from page 70)

the propellers. Wrote Howell, "Almost instantly, the bow to the machine lifted and she raised at an angle of about 6°. The great wings were working beautifully. She looked for all the world like a great goose rising from the feeding ground in the early morning dawn. The two men with the ropes were tumbling over the hummocks in the field. Whitehead waved his hands as he watched his invention rise in the air. He had set the dials so the power would shut off automatically. The airship settled down as lightly on the ground as a bird and not a stitch was broken or a rod bent."

Shot up like a kite

Now Whitehead took out of the craft a couple of sandbags weighing 220 pounds altogether, which more than equalled his own weight of 165, and climbed aboard. Wrote Howell, "An early morning milkman stopped in the road to see what was going on. The nervous tension was growing at every clock tick and no one showed it more than Whitehead. He stationed his two assistants behind the machine with instructions to hold onto the ropes and not let the machine get away. He opened the throttle of the ground propeller and shot along the green sod at a rapid rate. 'I'm going to start the wings!' he yelled. 'Hold her now!' The two assistants held on the best they could but the ship shot up in the air almost like a kite.

"It was an exciting moment. 'We can't hold her!' shrieked one of the rope men. 'Let go, then!' shouted Whitehead back. They let go, and as they did, so the ship darted up through the air like a bird released from its cage. Whitehead was greatly excited and his hands flew from one part of the machine to another. She was flying now about 50 feet above the ground and made a noise very much like the 'chung, chung, chung' of an elevator going down the shaft."

According to Howell, Whitehead skirted a clump of "sprouts" on a hilltop and landed gently half a mile beyond.

But Whitehead's flight was never officially recognized, nor were others he claimed to have made later. In a letter published in *The American Inventor* in April 1902, Whitehead said he had flown an improved craft, No. 22, out over Long Island Sound at an altitude of 200 feet, circling back to land after flying seven miles. When a doubtful editor wrote to Whitehead for confirmation, the in-

ventor replied: "Yes, it was a full-sized flying machine, and I myself flew seven miles and returned to my starting place."

But the flights, if they actually did happen, brought Whitehead little success. His engine designs, however, did eventually appear in working craft. But with his flights ignored, he gave up aviation and went into the concrete business. He died in 1927, at 53, leaving his modest house in Fairfield (an object of planned restoration by the Historical Society) and \$8. It was not until 1934 that Stella Randolph, a free-lance writer, discovered some Whitehead papers and decided on her own, to interview possible witnesses of those early flights.

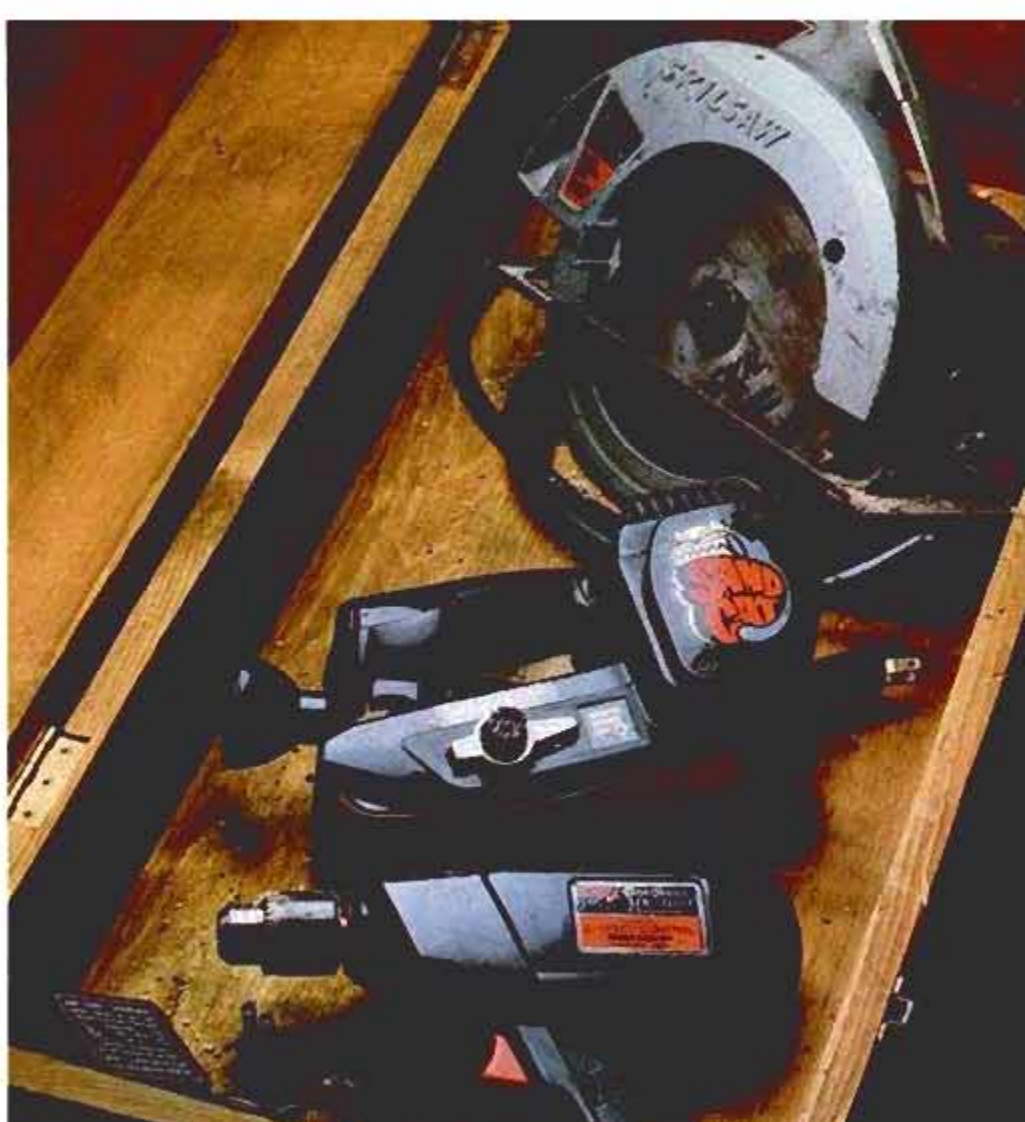
Eyewitness reports

Combing the Bridgeport area, she got affidavits from several people who said they had seen Whitehead fly in 1901 or 1902. They included Whitehead's mechanic, Anton Pruckner; the copilot on the alleged disastrous Pittsburgh flight, Louis Darvarich; and several who had been boys back then: Thomas Schweikert, Junius Harworth, Joe Ratzemberger, John Lesko, Alexander Gluck, Michael Werer and John Ciglar. A mysterious lapse came in the form of a denial from James Dickie, supposedly a rope holder on the 1901 flight, who said: "I was not present, and did not witness any airplane flight on Aug. 14, 1901."

Over 40 years ago, Randolph's book entitled *Lost Flights of Gustave Whitehead* was published, but won the inventor no recognition from the Smithsonian Institution or other aviation historians. But years later, in 1964, the Whitehead story got new impetus from the officers of the Connecticut 9315th Air Force Reserve Squadron, who were doing research with the Connecticut Aeronautical Historical Assn. Sparked by one reserve officer, Maj. William J. O'Dwyer of Fairfield, another project was begun to take affidavits from people who claimed to have seen Whitehead fly some 63 years earlier. Helping the effort, author Stella Randolph supplied her notes and files. She was already at work on another book that came out in 1966: *The Story of Gustave Whitehead: Before the Wrights Flew*. Again, it defended Whitehead's original claims.

In 1966 author Randolph and Maj. O'Dwyer were the guests of Whitehead's original home town, Leuter-

(Please turn to page 74)



We build tools that last

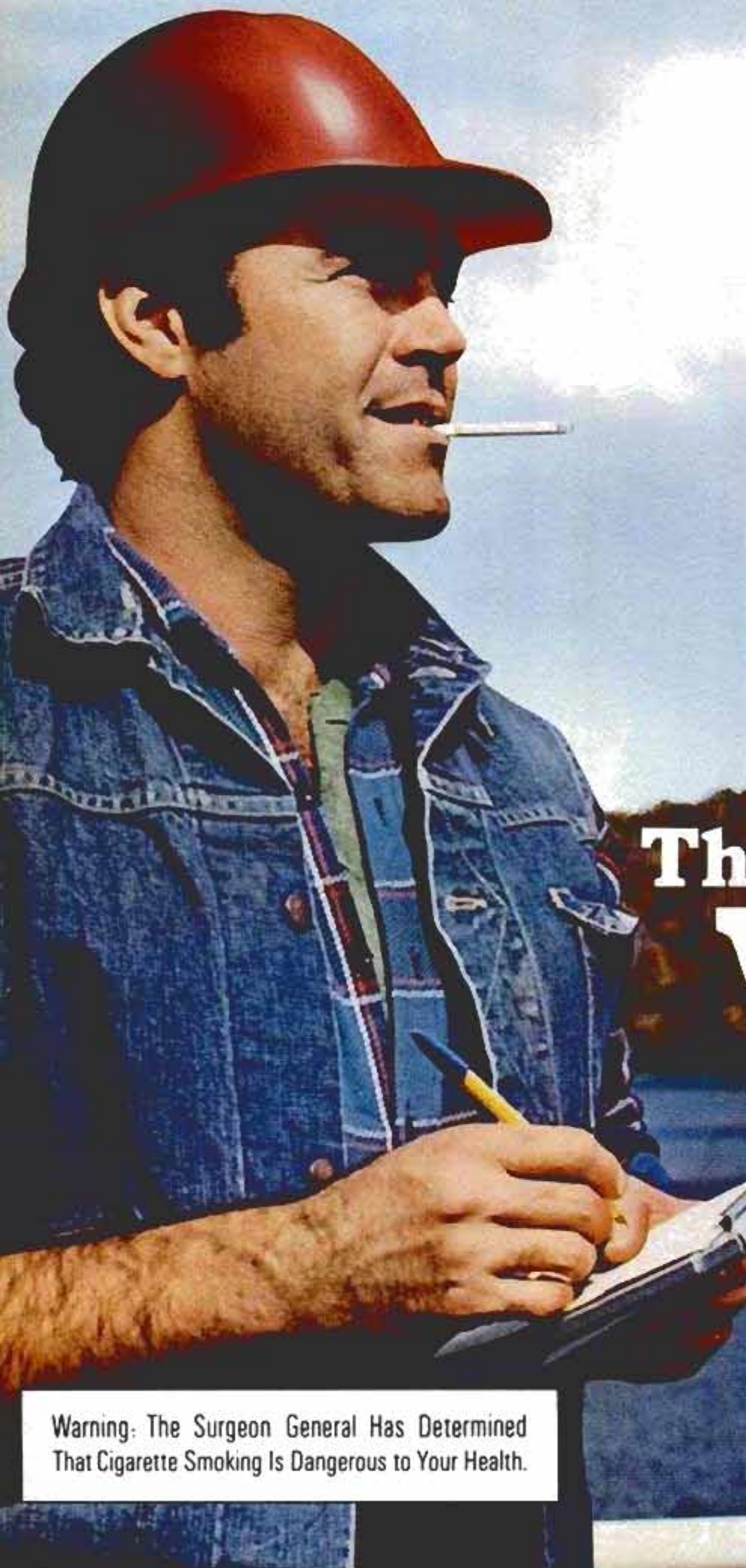
When Skil introduced the first portable electric saw in America it was built to be rugged and efficient. And most of all, durable. We thought it was the right way to build tools over 50 years ago, and we feel even stronger about it today. When we developed the Skil® Sandcat,™ we combined the handling ease of an orbital sander with the muscle of a belt sander. And we engineered our Skil cordless drills to have the power to drill hundreds of holes on just one charge. So whenever you buy a Skil power tool, you can count on getting a working partner that will stay with you a long, long time.

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WAS WHITEHEAD FIRST?

(Continued from page 73)

shausen, in Bavaria. Visiting a recently dedicated Weisskopf (his non-Anglicized real name) Hangar at one Bavarian airport, they watched a scale model of Whitehead's No. 21 flying under radio control.

Home-town hero

Today members of the Connecticut historical group still like to talk about Whitehead. Director of museum development for their main enterprise, the Bradley Air Museum at the Hartford-Springfield Airport, is Harvey H. Lippincott, who takes the position that Whitehead should have a place accorded to him in history without diminishing the fame of the Wrights or any other aviation greats.

Historian Lippincott, a casually professional man, takes a calm view of the Whitehead controversy. Many people call the claims a hoax, pointing out such harebrained Whitehead schemes as a helicopter fitted out with a huge screw that was supposed to spiral straight upward, or a different helicopter with 60 propellers, or his experiments with motors powered by gunpowder, which soon lost him the love of his Fairfield neighbors.

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"He was a mechanic with ingenuity and perception," Lippincott says. "When the wing edge of a model of No. 21 is bent," he notes, there is a definite aileron, or warping, effect—so he did have control." As for the eyewitness evidence that Whitehead did fly in 1901, Lippincott will only comment, "The sources are all dead now."

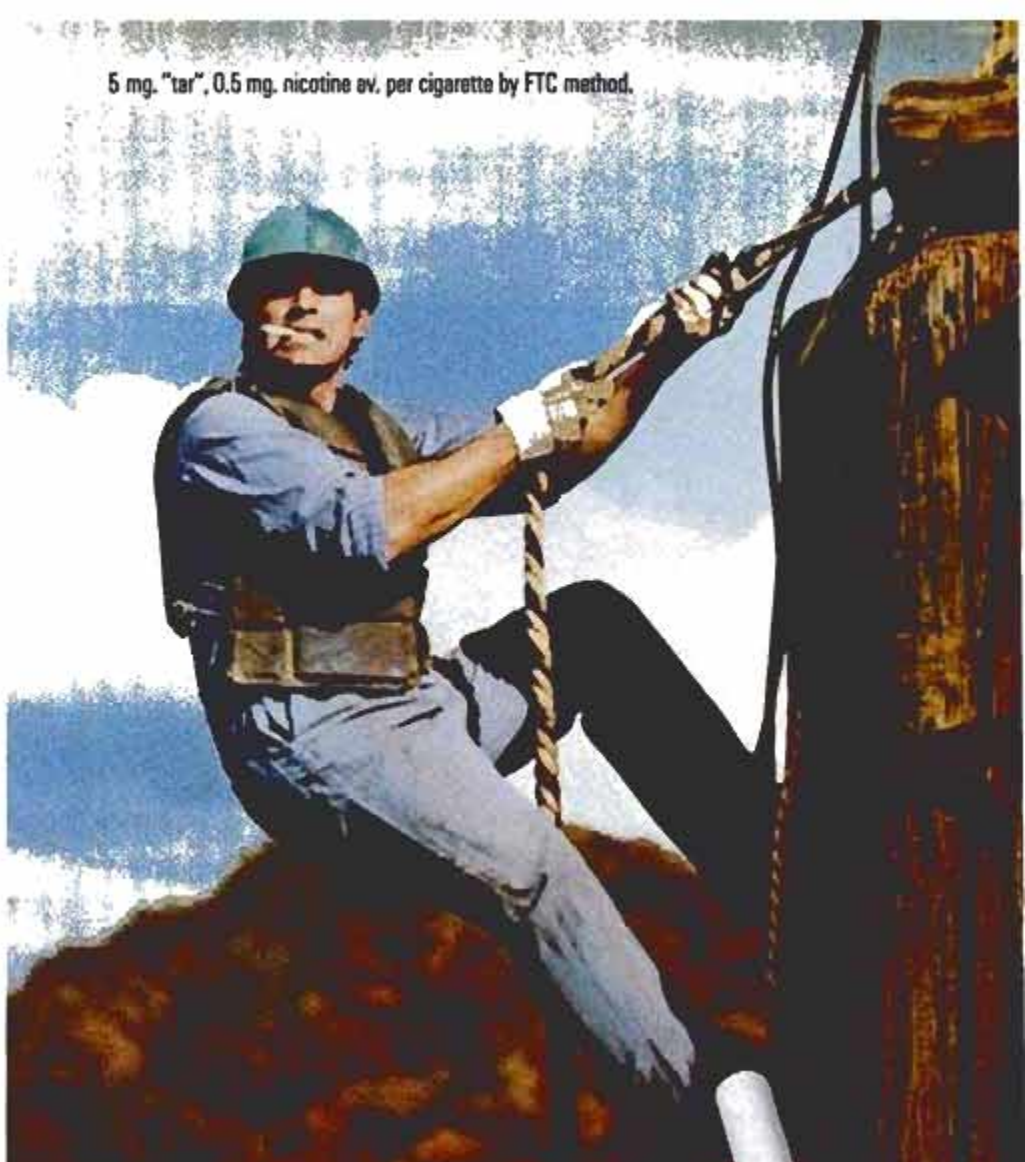
Considerable skepticism

A more technical criticism of Whitehead's flights is involved with the question of whether there was any flight beyond that produced by the "ground effect" cushioning of air beneath the wings at low altitudes. Lippincott recalls that "no witness said he did much in the way of turning." As for the later seven-mile flight in No. 22, Lippincott says, "We think that's poppycock."

The historian suspects that Stanley Yale Beech, who put money behind some of these flights, exaggerated the claims of success. "He wrote that fiction just to make his own investment in Whitehead look good."

Without taking any sides, Lippincott also explains how Whitehead apologists explain the lack of photographs of any craft in flight: Flights were made in dim, predawn light

(Please turn to page 76)



low tar built on taste.

Winston
Ultra

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5 mg



and, anyway, ordinary cameras of that time could not make stop-action pictures.

Summing it all up, Lippincott believes that Whitehead was a "dedicated, resourceful early experimenter. He used the cut-and-try method in trying to solve the problem of flight, with backers who made exaggerated claims for his work—we have pictures of 14 different Whitehead planes." But there are differing views on what constitutes real flight.

Charles Gibbs-Smith of the Smithsonian Institution says a plane must travel "at least 1,300 feet" to qualify (which actually rules out all the Wrights' attempts during the entire day of Dec. 17, 1903). Lippincott doubts that Whitehead ever made it all the way.

Wrights were scientific

But Lippincott still admires Whitehead and his helpers. "His mechanic, Pruckner, said, 'We eyeballed it.' Nobody measured it precisely. Whitehead was a tinkerer, like Glenn Curtis—a mechanic, not a scientist. The Wrights were scientific. They had wind tunnels, studied

wing shapes and propellers, and measured and photographed carefully. Whitehead did not develop a science of aerodynamics as the Wrights did, not set up a formal proof he had flown, nor found a school to teach others, nor a factory to build his planes. He did sell his engine designs, but did not keep advancing over his early work, as the Wrights did. So they do deserve credit still as the fathers of fully controlled, powered flight."

All that is today of Whitehead planes is one transmission gear, one distributor from an eight-cylinder engine, a helicopter rotor blade and two wooden fitting patterns. Somewhere in the Farmington River there is also an entire Whitehead engine that was washed out of a garage in a 1955 flood.

Lippincott emphasizes that the association takes no stand on the Whitehead claims. He does say, however, "Gus needs a pat on the back for a hard try. All his money went into his work, and he took a lot of ridicule. That 'Crazy Whitehead' nickname hurt him a lot. But he made the mistake of not keeping a scientific record." PM

And before Whitehead?

History does record other powered flights and claims besides Whitehead's that go back a long way, beginning with the batlike crafts of Clement Ader that flew 160 feet under steam power in France in 1890. Dirigibles start much earlier: According to the *Encyclopedia Britannica*, "The beginning of man's practical conquest of air" was Henri Gifford's steam-driven airship in an 1852 voyage from Paris to Trappes. Otto Lilienthal, an idol of young Whitehead, made some 2,000 unpowered flights in gliders of a type that were eventually modified for use with gasoline engine. Lilienthal lost his life in one of them.

Octave Chanute, a friend of the Wrights, made around 1,000 similar glider flights on the Indiana Dunes of Lake Michigan in 1896 and 1897 that also helped bring about powered flight. Only a few weeks before the Wrights' success on Dec. 17, 1903, Samuel P. Langley was dunking his powered "Aerodrome" in the Potomac near Washington, D.C. By the time this plane flew, a decade after—by which time Langley was dead—the Smithsonian, which had backed it, billed it, "the first airplane capable of sustained free flight with a man." This endorsement of Langley's craft so angered Orville Wright that he sent his "Flyer" to the Science Museum of London. It stayed there until the Smithsonian apologized for the affront to the Wrights 20 years later.

The advertisement features a large, ornate glass filled with beer. The glass has "MOLSON" written at the top and "GOLDEN" at the bottom. The center of the glass is a window into a snowy mountain landscape with evergreen trees. To the right, a bottle of Molson Golden beer stands next to a smaller glass of beer with a thick head of foam.

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Canada?

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BREWED AND BOTTLED IN CANADA; imported by Martlet Importing Co., Inc., Great Neck, N.Y.

3 aerodynamic devices for better mpg



These air dams, side skirts and headlight covers certainly do work, but the payback period may be too long.

GROUND-EFFECTS SKIRT

AIR DAM AND EXTENSION

HEADLIGHT COVER

Introduction to the high-mileage files

It seems that wherever you look these days, there's somebody huckstering a product to increase your car's fuel economy. Some of these products work, some don't. But how will you know, without buying one and trying it?

You'll get the answers in the High-Mileage Files. Our staff will investigate alleged gas savers in a real-world trial of carefully monitored driving. We'll monitor fuel consumption with three Zemco ZT-3 driving computers, accurate to one-tenth of a gallon.

We hope to tell you what works and what doesn't, whether it's worth the price, whether it holds up over the long run, whether it will affect your exhaust emissions and performance, and whether it will save you enough fuel to make it worthwhile.

If you find a gas-saving device that you'd like to know more about, or if you've had good luck with something which increased your mileage, drop us a note and we'll try it out. Write to the High-Mileage Files, Popular Mechanics, 224 West 57th Street, New York, N.Y. 10019.

We started with a totally stock Renault LeCar, newly tuned up, and established a baseline of 29.4 mpg over our test course (a combination of divided highway and country roads). The driver remained the same throughout the test. This was in warm weather and we had the sunroof open. Renault's fabric sunroof opens up an area 34 inches square, and closing it improved mileage by 1.5 mpg. This is graphic proof that smooth airflow is essential to good fuel economy. It was also a terrific bargain—a 5.1-percent improvement in fuel economy, absolutely free.



In order for a front air dam to be really effective, it must almost touch the ground.



Smoked headlight covers may be illegal in some states, but they do improve mileage.

Produced by the PM Auto Dept.
Text: Rich Taylor

Next, we added a front air dam, made for the Renault by Kamei. We had to drill seven holes in the Renault bumper, but bolting the dam on was very easy. The Kamei air dam worked. Over our test loop, it consistently added 1.0 mpg. Because it is made of fairly thin, molded plastic, however, the Kamei air dam was vulnerable to vibration and impact. It broke twice around the mounting bolts within two weeks and had to be rebolted.

The Kamei air dam added about 4 inches to the bottom of the LeCar bumper. But aerodynamic theory

(Please turn to page 82)

AMERICA'S BUILT FORD



NEW FORD F5
WITH 4.9L SIX &
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31 EST.
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COURIER
WITH 2.0L &
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OVERDRIVE

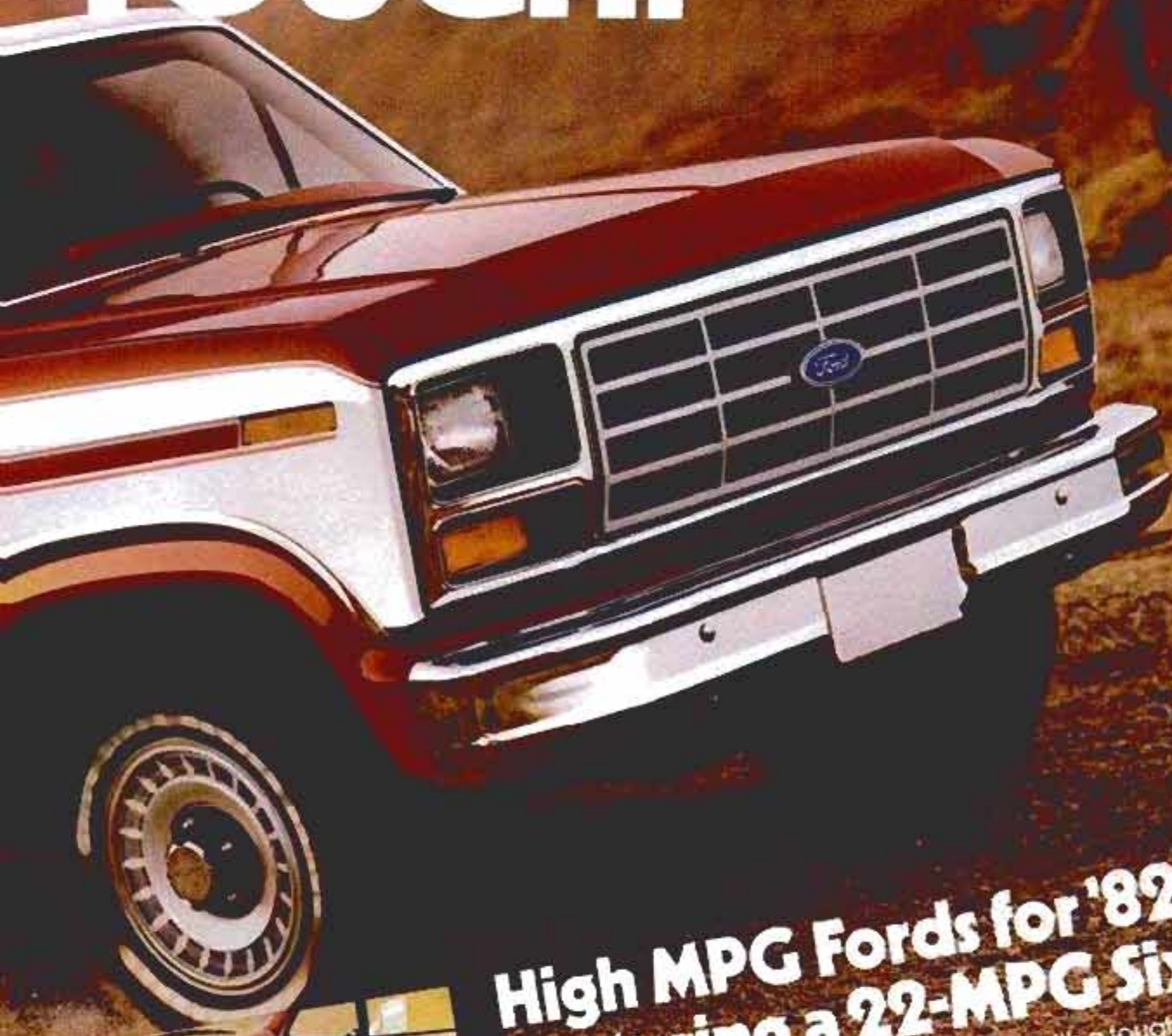
38 EST.
HWY.*

27 EPA
EST.
MPG*

* Compare these estimates with others. Your mileage may differ depending on speed, distance and weather. Actual highway mileage and California ratings lower.

* F5 model and V-6 not available in Calif.

TRUCK TOUGH.



High MPG Fords for '82... featuring a 22-MPG Six.

Introducing Ford's new fuel-saving FS pickup. It's a tough, full-size pickup with comfort for three, and a big 4.9L Six, with an EPA estimated MPG of 22, 31 EST. HWY.* For even heavier hauling, pick Ford's F-150. This rugged truck delivers 20 EPA estimated MPG plus 2,500 lbs of payload. Or Ford's Courier, the compact with 27 EPA estimated MPG.* And now there's more from Ford.

New V-6 engine. Modern 3.8L V-6 is a high-technology engine with excellent horsepower per liter. Standard in F-100 models.

Adjustable Twin-I-Beam. Ford's tough suspension is now designed with lubed-for-life ball joints and adjustable camber.



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The \$149⁹⁵ personal computer.

Introducing the Sinclair ZX81

If you're ever going to buy a personal computer, now is the time to do it.

The new Sinclair ZX81 is the most powerful, yet easy-to-use computer ever offered for anywhere near the price: only \$149.95* completely assembled.

Don't let the price fool you. The ZX81 has just about everything you could ask for in a personal computer.

A breakthrough in personal computers

The ZX81 is a major advance over the original Sinclair ZX80—the world's largest selling personal computer and the first for under \$200.

In fact, the ZX81's new 8K Extended BASIC offers features found only on computers costing two or three times as much.

Just look at what you get:

- Continuous display, including moving graphics
- Multi-dimensional string and numerical arrays

*Plus shipping and handling. Price includes connectors for TV and cassette, AC adaptor, and FREE manual.



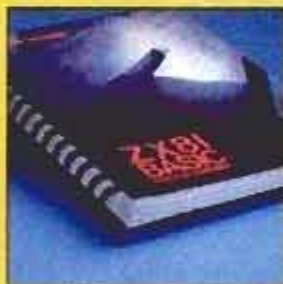
NEW SOFTWARE: Sinclair has published pre-recorded programs on cassettes for your ZX81, or ZX80 with 8K BASIC. We're constantly coming out with new programs, so we'll send you our latest software catalog with your computer.



ZX PRINTER: The Sinclair ZX Printer will work with your ZX81, or ZX80 with 8K BASIC. It will be available in the near future and will cost less than \$100.



16K MEMORY MODULE: Like any powerful, full fledged computer, the ZX81 is expandable. Sinclair's 16K memory module plugs right onto the back of your ZX81 (or ZX80, with or without 8K BASIC). Cost is \$99.95, plus shipping and handling.



ZX81 MANUAL: The ZX81 comes with a comprehensive 164-page programming guide and operating manual designed for both beginners and experienced computer users. A \$10.95 value, it's yours free with the ZX81.

- Mathematical and scientific functions accurate to 8 decimal places
- Unique one-touch entry of key words like PRINT, RUN and LIST
- Automatic syntax error detection and easy editing
- Randomize function useful for both games and serious applications
- Built-in interface for ZX Printer
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The ZX81 is also very convenient to use. It hooks up to any television set to produce a clear 32-column by 24-line display. And you can use a regular cassette recorder to store and recall programs by name.

If you already own a ZX80

The 8K Extended BASIC chip used in the ZX81 is available as a plug-in replacement for your ZX80 for only \$39.95, plus shipping and handling—complete with new keyboard overlay and the ZX81 manual.

So in just a few minutes, with no special skills or tools required, you can upgrade your ZX80 to have all the powerful features of the ZX81. (You'll have everything except continuous display, but you can still use the PAUSE and SCROLL commands to get moving graphics.)

With the 8K BASIC chip, your ZX80 will also be equipped to use the ZX Printer and Sinclair software.

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The Sinclair ZX81 is covered by a 10-day money-back guarantee and a limited 90-day warranty that includes free parts and labor through our national service-by-mail facilities.

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Introducing the ZX81 kit

If you really want to save money, and you enjoy building electronic kits, you can order the ZX81 in kit form for the incredible price of just \$99.95*. It's the same, full-featured computer, only you put it together yourself. We'll send complete, easy-to-follow instructions on how you can assemble your ZX81 in just a few hours. All you have to supply is the soldering iron.

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We urge you to place your order for the new ZX81 today. The sooner you order, the sooner you can start enjoying your own computer.

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CALL 800-543-3000. Ask for operator # 509. In Ohio call 800-582-1364. In Canada call 513-729-4300. Ask for operator # 509. Phones open 24 hours a day, 7 days a week. Have your MasterCard or VISA ready.

These numbers are for orders only. For information, you must write to Sinclair Research Ltd., One Sinclair Plaza, Nashua, NH 03061.

sinclair

AD CODE	PRICE†	QTY.	AMOUNT
12PM			
ZX81	\$149.95		
ZX81 Kit	99.95		
8K BASIC chip (for ZX80)	39.95		
16K Memory Module (for ZX81 or ZX80)	99.95		
Shipping and Handling	4.95		\$4.95
To ship outside USA add \$10.00			
TOTAL			

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† U.S. Dollars

3 AERODYNAMIC DEVICES

(Continued from page 77)

says that the more air you can keep from flowing under the car, the better your mileage will be. So we added another four inches to the bottom of the Kamei air dam, by bolting on a flexible rubber skirt made by Gila River Products.

With this modification, static ride height was now only about one inch off the ground. This lash-up not only looked funny, it dragged the pavement over even the smallest road bump, as well. But it greatly improved aerodynamic performance. Bringing the air dam down to meet the pavement was worth an additional 0.8 mpg over the Kamei air dam alone, or 1.8 mpg over the stock Renault.

Why don't the car companies do this? Well, because nobody would drive their cars. This air dam scraping the ground was unbelievably irritating—our driver couldn't wait to get out of the car. By the time the test was over, the bottom edge of the

Tune-ups and the way you drive

It does pay to keep your car in tune, just as the sparkplug companies have been telling us all these years. Witness our Renault LeCar. It came to us in sluggish running condition, with a tendency to stall at idle. It was also delivering a pathetic 21.2 mpg.

A tune-up revealed that the electronic sensor for the exhaust gas recirculation circuit was disconnected. By fixing this, adding new sparkplugs, setting the timing and changing the oil, we were able to bring the mileage up to 25.6 mpg. That's a full 20-percent improvement, but it was still nowhere near the car's potential.

At that point, we changed drivers for the duration of this test. The car's mileage immediately went up to 29.4 mpg, an additional increase of 3.8 mpg and 14.8 percent over our previous findings. This improvement had absolutely nothing to do with the car itself; it was strictly a matter of driving technique.

The lessons learned from this are clear. If you want to save gas, you have to keep your car in tip-top tune and recognize that your gas mileage also depends on the way you drive.

The irony of the entire situation is that while the car manufacturers are spending billions of dollars to achieve a 1- or 2-mpg increase, you can negate that gain easily by neglecting regular maintenance or by hot-rodding around.

air dam looked like black shredded wheat from dragging across asphalt, and the driver involuntarily winced every time he spotted an approaching bump. On a race track, it might be a different story, but for the street, there's a practical limit of how low an air dam can be.

Gila also makes heavy rubber side skirts, which bolt on under the rocker panels between the wheel wells. The concept is the same as that used on "ground effect" Indy and Formula One racers. The front air dam prevents airflow beneath the car; the side skirts prevent the air from flowing around the nose and front wheels and then slipping in under the sides to create drag.

On the LeCar, the Gila side skirts ride about three inches off the ground, which is high enough to keep them from bottoming.

The side skirts look silly, but they do work. Used with our homemade, ground-scraping front air dam, the side skirts added another 0.6 mpg to the total. To be honest, that's more than we ever expected.

Finally, we added smoked plastic covers over the Renault's headlights. Like the lights on many cars, the Renault's are set into chromed buckets which look like they might

Mom, here's an "Eveready" bright idea for Dad this Christmas...

The "Eveready" "Commander" Lantern

A portable fluorescent light in a practical lantern. Great for indoor and outdoor use. Powered by two 6-volt batteries, or from a car cigarette lighter [see package for details to purchase the cord set adaptor]. The "Commander" goes anywhere. It's versatile and dependable.



EVEREADY INDOOR/OUTDOOR
Commander
FLUORESCENT
LANTERN

ONE NO. 5208 LANTERN



Dad, here's an "Eveready" bright idea for Mom and the kids this Christmas.



The "Energizer" Disposable Flashlight
A dependable bright, clear light. Small enough to fit in a purse, pocket, or briefcase. Compact, convenient, and complete.

The "Energizer" AA Penlight
A handy little flashlight. Perfect for a pocket. Always available to shine bright and clear. Powered by two "Energizer" AA batteries that are included.



catch the wind. They do. Covering up the headlight buckets with a set of SuperCover headlight covers added exactly 0.2 mpg to our total.

All together—pavement-sweeping front air dam, side skirts and headlight covers—our aerodynamic changes were worth 2.6 mpg, raising the Renault's mileage from 30.9 mpg to 33.5 mpg. That represents an impressive improvement of 8.41 percent, at a cost of \$175 and an hour's time. That raises the inevitable question: Was it worth it?

Well, the full air dam was annoying on everything except super-smooth, billiard-table roads. The Kamei air dam broke at the mounts and had to be removed after six weeks. The headlight covers are illegal in most states, and because they're tinted, must be removed at dusk in order to use the headlights at all. Only the Gila side skirts seemed to be troublefree—but they're ineffective without a ground-scraping front air dam.

These aftermarket aerodynamic aids make sense only if you drive almost exclusively on smooth highway, since they don't have a measurable effect at speeds under 25 to 30 mph. Even then, if you figure gasoline at \$1.40 a gallon, it would take



Zemco ZT-3 driving computer (mounted under the dash) monitors fuel consumption.

49,800 miles of highway driving before you'd have paid for the air dams, skirts and headlight covers. For the average American driver, that's a four-year payback period, not counting the time spent idling in city traffic. To be honest, your mon-

ey would be better spent on more frequent tune-ups and fresh spark-plugs.

There is another way. For a few dollars, you can buy a couple of pieces of scrap plexiglass at the lumberyard and make your own headlight covers. The SuperCovers are a "universal fit," which means they must be jigsawed to fit your particular car in any case. Homemade clear Plexiglas covers cost very little, and you can get away with leaving them on at night, as well.

The rubber Gila skirts look very much like the rubber baseboards sold in any discount-store paneling department. With a few dollars and a few minutes ingenuity, you can fabricate your own flexible air dam and side skirts that will work just as well. You can duplicate the fuel saving, but not the expense of these aerodynamic devices. **FM**

AFTERMARKET AERODYNAMIC DEVICES

Kamei front spoiler	\$45.89
Kamei USA, 300 Montowese Ave., North Haven Conn. 06473	
Gila front skirt	\$41.89
Gila side skirts	\$66.88
Gila River Products, 6615 West Boston St., Chandler, Ariz. 85224	
SuperCover headlight covers	\$19.98
The Saturn Corp., 2221 Ross Way, Tacoma, Wash. 98421	



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

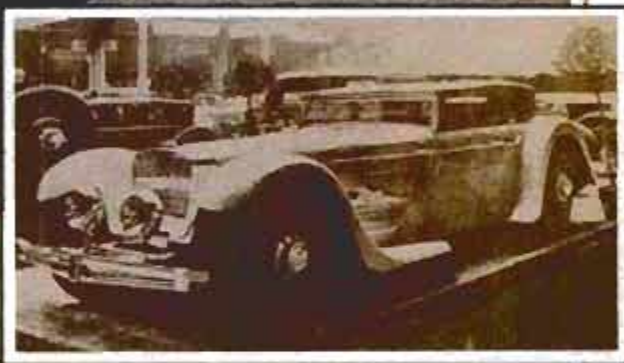
16 mg "tar," 1.1 mg nicotine av. per cigarette, FTC Report Mar 81

One-of-a-kind dream cars— built from scratch!

It took Bill Tishman eight years to build his Bucciali working from a photo of the original car (lower right). It was a one-of-a-kind show car which was destroyed soon after it was shown in 1931.



Bill Tishman's Bucciali



Production cars, kit cars or custom coachwork couldn't fill the bill—so these men built their own.

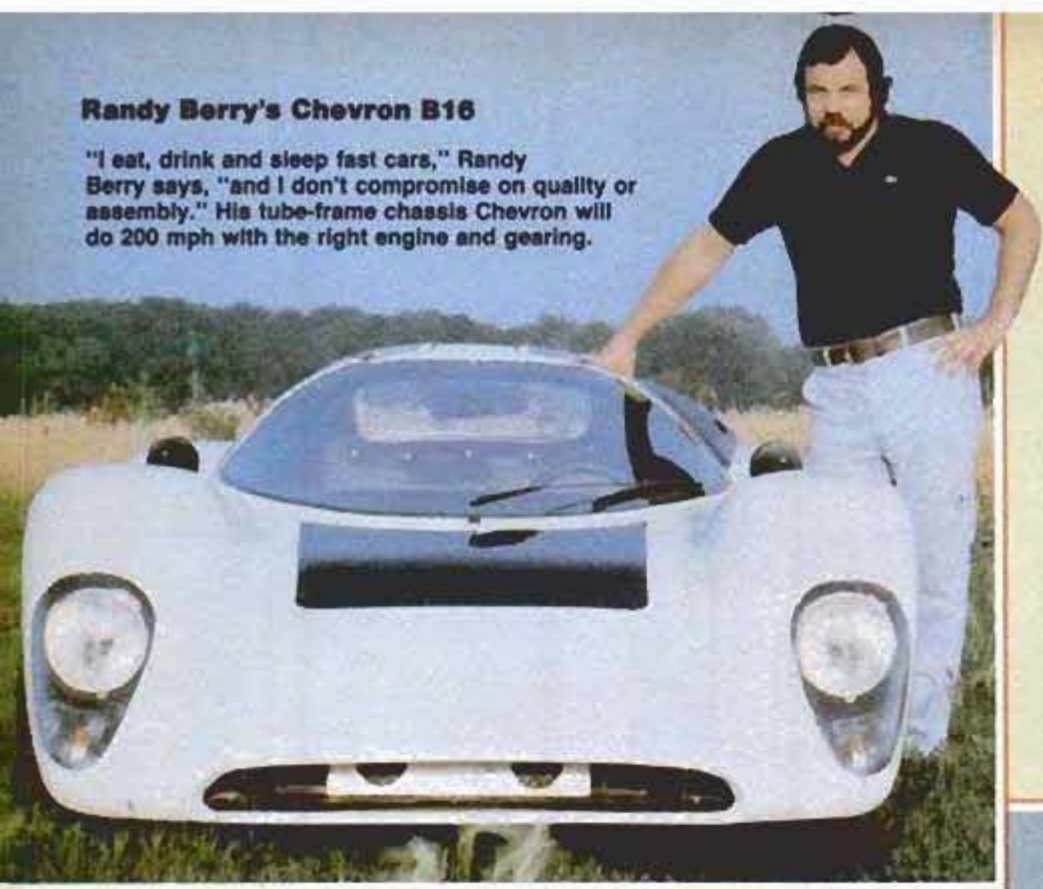
Bill Tishman is not your average car fancier. The grandson of Julius Tishman, founder of the huge, worldwide Tishman Realty and Construction Co., has made a habit of putting his full effort into whatever project he is involved with. The result of eight years of this latest effort is what he calls the Essence of Bucciali, a

classically elegant bit of coachwork which seats two and which is mounted on a thoroughly modern chassis and drive train.

"Though I continue to pursue other interests, I always return to classic cars," says Tishman. "I purchased a 1929 Rolls-Royce Phantom II touring car, as well as a 1929 Marmon Speedster and a 1931 SS

Randy Berry's Chevron B16

"I eat, drink and sleep fast cars," Randy Berry says, "and I don't compromise on quality or assembly." His tube-frame chassis Chevron will do 200 mph with the right engine and gearing.



Mercedes-Benz. However, my attention kept being drawn to one car in particular."

That car was a 1931 front-wheel-drive Bucciali, displayed only once—at the Paris Auto Show that year—and heard about since only in rumor. The Bucciali was one of the final products of the Bucciali brothers, who built some fine touring and racing cars in France.

However, this car never made it anywhere but that Paris auto show. It never came to American shores, and the only one built was destroyed many years ago.

But Bill Tishman found the only picture of the car that existed, pasted it to the wall of the shop where he stores his other classics, and set out to build a copy of the Bucciali. You can do that when you have lots of money, and though Tishman doesn't



Ron Will's Phantom

The Phantom is powered by a one-liter, turbocharged, Honda Gold Wing engine, which is good for 130 mph. At legal speeds, it yields a whopping 50 mpg.



like to talk about it, sources close to the project say that over eight years Tishman has spent between \$600,000 and \$650,000 on this single project.

Tishman's Bucciali is powered by a turbocharged, Chevrolet V8, 350-cu.-in. engine. Essentially a modified Blazer power train, the car has four-wheel drive, power four-wheel disc brakes and front and rear antisway bars.

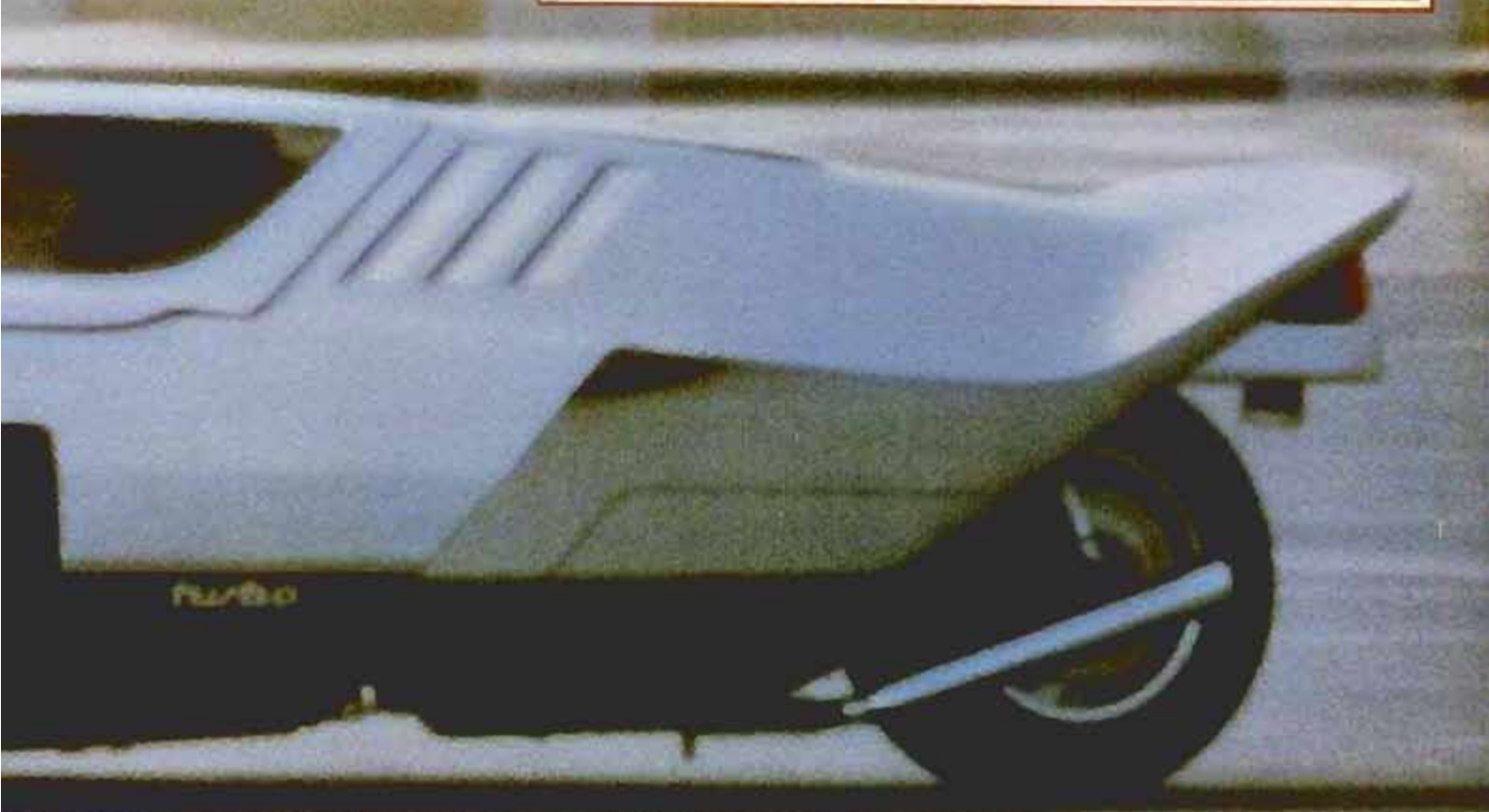
The engine produces 304 hp at 4,000 rpm. The car sits on a 140-in. wheelbase with a 219-in. overall length; it weighs close to 6,000 pounds. Wheels are specially cast aluminum. The body is hand-fabricated steel, interior is leather, and a Steuben crystal eagle-mascot radiator cap lights up at night.

Tishman is currently showing the

Charles Ophorst's Feora



The tandem, two-seater Feora is powered by a 175-cc Honda motorcycle engine and gets 80 mpg on the highway, 60 in city driving. The fiberglass-bodied trike boasts a top end of 93 mph.





Jerry Wiegert's Vector W2



car at museum openings, auto shows and design colleges around the nation.

Chevron B16

Randy Berry has been carrying on a passionate love affair with hyperfast exotics for as long as he can remember. He has owned a Shelby



Vector's cockpit (below, left) resembles that of a jet fighter. Twin-turbo, 350-cu.-in. Chevy V8 (far left) cranks out 650 hp. To keep car from leaving the ground at speed, a negative-lift wing is installed at rear (left). The materials and construction techniques reflect the aerospace industry; many parts are riveted and glued, rather than welded.

Cobra, a Lola coupe, eight DeTomaso Panteras and a Ferrari 512M. And yet, as awesome as these cars were, they just weren't awesome enough. He decided, 12 years ago, that he could do better.

Berry set himself a nearly impossible task—building a hyperfast race car with all the tractability and creature comforts of less exotic production cars. Imagine negotiating downtown traffic in a poorly ventilated McLaren M6 GT mated to an unsynchronized gearbox with straight-cut teeth. It's like bringing Attila the Hun to a church social.

Berry's first project was the Chevron B16. He started literally from the ground up and built his own tube-frame chassis covered with stressed-aluminum sheet panels. This is called semimonocoque con-

struction and Berry uses this method, rather than the race-version full monocoque, because the semimonocoque holds up better in the real world of potholes, frost heaves and highway expansion joints. Full monocoque, with its stressed-aluminum box sections, works fine on the race track, but loses its strength on Main Street.

The other bits and pieces come right off race cars. These include highly durable, precision-built hub carriers, A-arms, massive ventilated discs and steering racks.

The tub on the Chevron was wid-

Produced by the PM Auto Dept.
Text: Tony Assenza, Auto Editor;
John Ethridge; Ray Hamilton;
Steven Parker; Rich Taylor
PM photos: David Gooley, Ray Hamilton

ened from racing specs to allow two adults to sit comfortably on Recaro seats. To keep driver and passenger from baking in the sun or freezing in winter, he installed production air-conditioning and heating units. Squeezing these items into an engine compartment that was never built to house them is, according to Randy, an exercise in creative packaging.

The race car's nonsynchro Hewland transaxle is swapped for a ZF five-speed with synchros so he doesn't have to heel-and-toe his way into parking lots and driveways.

His first attempt at building his personal supercar was so successful that eventually he found himself bombarded with requests to make copies. He was literally forced into opening up a business.

Since then, he has been in the business of making some other people's dreams come true—sort of a *Fantasy Island* for high-rolling addicts of speed.

He currently has in production authentic replicas of the Chevron B16, Lola MK IIIB, Ferrari 512M, McLaren M6GT, DeTomaso Pantera and Lamborghini Countach.

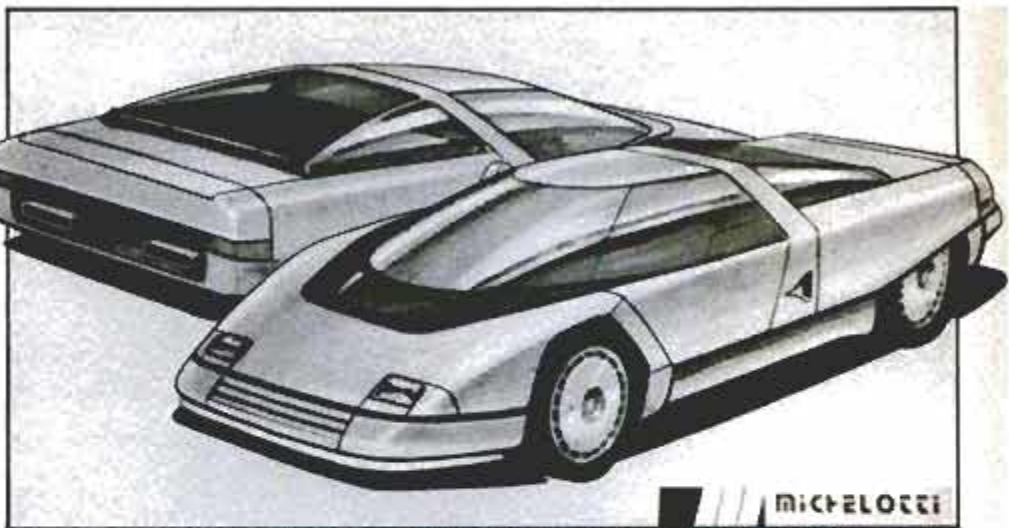
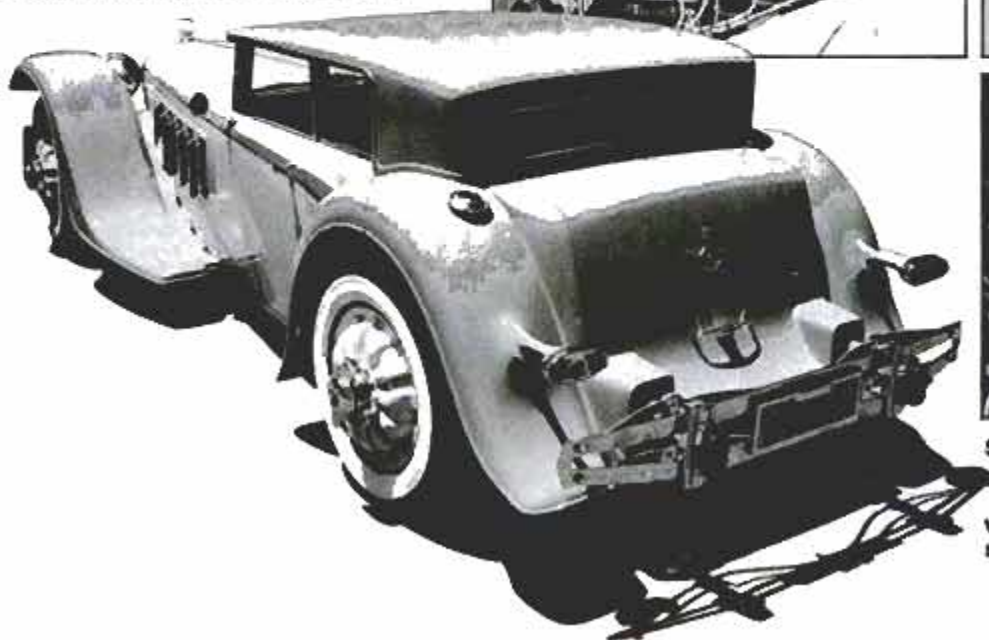
All the cars use hand-built tube frames and two of them, the Chevron and Lola, are also available on a VW Beetle platform for low-rollers who like to look sharp.

All the bodies are line-for-line reproductions in fiberglass, or as in the case of the Lola, are completely original.

Wiegert calls his firm Marauder & Co., but we think he should call it

(Please turn to page 156)

The Bucciall's 6,000-pound bulk is pushed by a turbocharged 350-cu.-in. V8 Chevy engine, that produces 304 hp (right).



Sidney Frank's dream car still in the making

It's really a pretty normal car nut's dream. "What if I took the fastest racing car I could find, and had it converted for street use? It would be the ultimate street machine, right?" Wrong! What keeps most enthusiasts from losing their sanity over a project like this is spelled m-o-n-e-y. But what if you not only had the dream, but the cash to make it all happen?

Well, you'd be Sidney Frank. Frank is a Canadian entrepreneur, living in London, who has a house in southern France just so he can drive fast on the weekends. That's where he keeps his Lamborghini Countach and Ferrari 512 Boxer. But those are just interim toys until he finishes his dream.

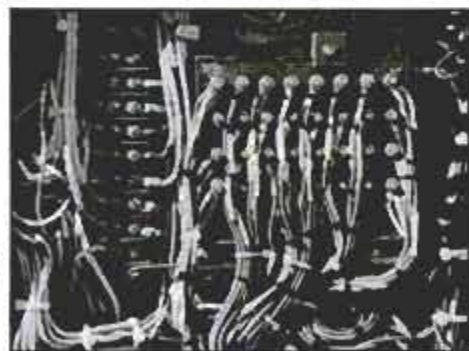
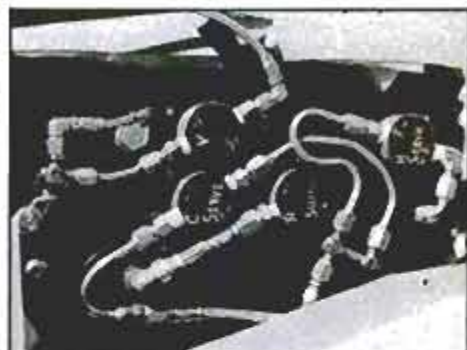
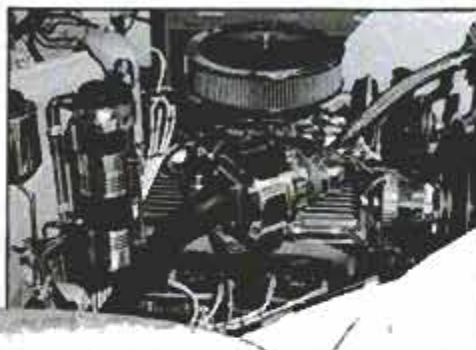
Frank's dream is pretty steep. The figure he uses is 200,000 pounds, or roughly \$450,000. What he's done is bought an old

Lola T70 Mk IIIB chassis from Lola in England. The car was built for LeMans, but never finished. It's a pretty typical mid-engined Can-Am/Endurance racing chassis from the early '70s, designed to compete with Porsche 917s and Ferrari 512s.

Frank brought the chassis to the Swiss customizer Sparo—most famous for his BMW 328 replicas—and Sparo fitted it with a 454-cu.-in. 625-hp Chevy big block engine.

The body for this racer is being built by Eduardo Michelotti, the son of Piero Michelotti, who designed the Triumph TR-4 and the original BMW M1, among others.

Frank expects 220 mph, a good 40 to 50 mph faster than his Lamborghini or Ferrari. Oh, yes, once it's built, he'll have to find a name for it.—R.T.



Stainless-steel, braided aircraft hoses and connectors (top) keep fluids circulating in Bucciall. The car has running water for the bar. This is just part of wiring system (above); all of it is hand-loomed.



The plane that taught America to fly

Celebrating its 50th anniversary this year, the historic Piper Cub is still up to its old tricks, delighting pilots and spectators with its amiable manners, antic ways and indestructible will.

by John K. Lancaster

When pilots talk about an airplane being docile, forgiving and easy to fly, they generally end up saying "just like a J-3 Cub." For half a century, the famous little Piper Cub has served as a standard of excellence by which other aircraft are judged.



The venerable Piper Cub was famous for making the impossible look easy. One daring Piper distributor regularly flew a J-3 out of his small, tree-lined back yard. His trick? He lethered the craft to a pole, raced around in circles until gaining flying speed, then released the cable and sailed off over the treetops, frequently plucking off leaves with his landing gear. (Unfortunately, history fails to record how he managed to get back home, but the Cub was noted for its uncanny ability to land in a peapatch.)

Even more amazing is the fact that, 50 years after it first flew on June 15, 1931, the Cub is not only still being made, but is essentially the same aircraft today that it was back then. The only basic differences in the present-day Super Cub are a more powerful engine, modern

instrumentation and a few structural refinements—remarkable testimony to a truly timeless design.

Conceived as a safe, inexpensive, two-place trainer, the Piper Cub has proved itself to be one of the most successful and versatile aircraft ever produced. In the late '30s, it was to

flying what the Model T Ford had been to driving a decade earlier—a plane that came as close as any to bringing the lofty dream of personal flight within reach of the average man.

The J-3 Cub, the best known of the early models, probably taught

more Americans how to fly than any other single aircraft. During World War II, four out of every five U.S. military pilots got their primary training in a J-3—and fortunately, too, for few other aircraft would have been as tolerant of students' mistakes. Original J-3s, lovingly restored and maintained, are still in use at many flying schools—and still bringing their bumbling tormentors back in one piece.

Cubs of various vintages are active in every corner of the world, performing an astonishing array of aerial missions—rushing medical supplies to a remote jungle outpost in Brazil, towing gliders in Switzerland, carrying oilmen into the icy outbacks of Alaska, delivering engineers to diamond mines deep in Africa. Fitted with skis in place of wheels, Cubs brave mountain glaciers and arctic wastes; on seaplane floats, they ferry fishermen, campers and doctors to wilderness lakes unreachable by road.

In 1931, when the first Cub rolled tentatively down a rough cinder

runway in Bradford, Pa., it was, by today's standards, shockingly primitive, little more than an overgrown model airplane. Called the E-2, it had a high wing, steel framework, wing spars of spruce and a fragile fabric covering. It offered barely enough room for a pilot and passenger to wedge themselves into the breezy open cockpit, one behind the other, tandem style.

The pilot sat in back. (Instructors used to joke about putting the student up front to serve as padding in the event of a crash; actually, it was because early-model Cubs were designed to be soloed from the rear seat so that's where the instruments were.)

There were, in any case, few instruments to concern a pilot or confuse a student. A rudimentary altimeter, tachometer and gauges for oil temperature and pressure were all that showed on the Cub's meager control panel. There was no compass or airspeed indicator, the latter a luxury that wasn't much

(Please turn to page 122)

Converted to seaplane use (top photo, below), the Cub was—and still is—a common sight on lakes and in harbors. On floats or skis, it could ferry men and supplies to wilderness outposts unreachable by other means. Original prewar Cubs reg-

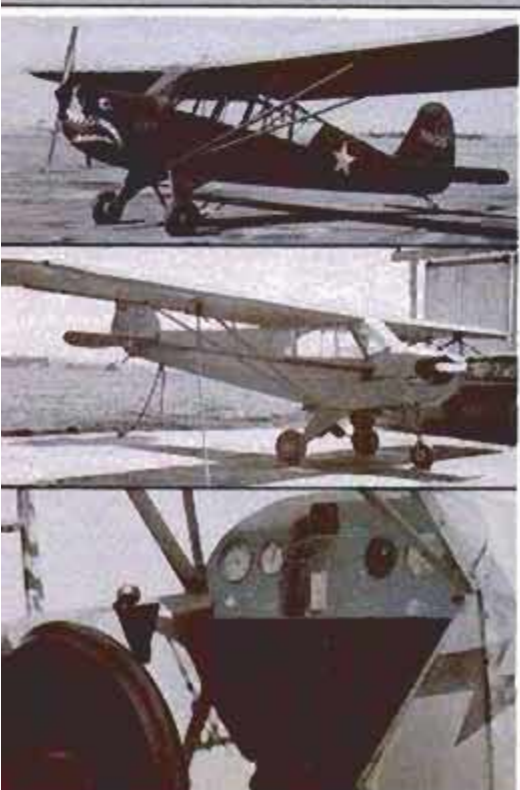
ularly show up at country fly-ins; the one at bottom left is a prized restoration. At bottom right is modern Super Cub, not greatly different from its ancestors. The major changes: a 150-hp engine, \$40,000 price tag and—oh, yes—you get a choice of colors.

A Cub comes in for a landing on "the world's smallest aircraft carrier": a miniature platform mounted on top of a pickup truck. Stunts like this thrilled airshow crowds in the '30s and are still being performed using restored prewar Cubs (photo on facing page was made at last summer's EAA Fly-In at Oshkosh, Wis.). Though requiring a highly skilled pilot, such feats were not as unbelievable as they may have appeared, considering that the plane had a normal landing speed of around 35 mph. The Cub's familiar yellow garb was like the Model T Ford's basic black—it was the only color you could get.





An L-4, military version of the J-3 Cub (top photo, below), sports a "fearsome" shark's mouth on its nose, an adornment made famous by Flying Tiger P-40 pilots. To keep student pilots from nosing over in poor landings, some Cubs were given a nose wheel (center). It looked funny, but saved embarrassment and broken props. The Cub's sparse instrument panel (bottom) had few gauges to confuse beginners.



Bold new look for a fine old name

It looks nothing like a Piper Cub, but the trim little canard-wing beauty above does trace its bloodlines to the famous Piper name. Called the PAT-1, it's a revolutionary new design from Piper Advanced Technology, a company founded by the late Harold "Pug" Piper, son of William Piper of Cub fame. Inspired by Pug's inventive genius, it was developed by George Mead, a noted designer of homebuilt sports planes (see *500 Miles on 15 Gallons . . . in an Air Race*, page 82, June '80).

The PAT-1 is a prototype for a 160-hp, all-composite, sport/business four-seater featuring a canard (nose wing) configuration for stall- and spin-resistant safety. Though it's still experimental and no specs are known yet, it's rumored that the PAT-1 is aimed at being competitive with the Cessna 172 and Piper Warrior in speed, power, comfort and price—with superior performance.

If the PAT-1 can make a good showing, it might well shake up the light-plane industry.—Shel Gallager

FORD EXP

Sporty, economical and well built—but owners think that this car needs more zip to match its zingy good looks.

For a sports car, the engine needs more horsepower.

Owners loved overall styling, but some wanted pop-up headlights.



Owners of EXPs really love their cars' styling, they're jubilant about quality and thrilled about the seating comfort.

It might be a little early to say for sure, but judging by responses from owners of Ford's new two-seater sporty car, Detroit could just be catching up with the imports, after all. Besides praising design, quality and comfort, EXP owners also had a lot of good things to say about fuel economy, mechanical reliability, dealer service and handling.

Among the very few complaints we heard, approximately 16 percent of the owners we surveyed told us that the EXP engine could do with a few more oats. As it happens, the EXP does have one more horse than its parent Escort, but it also weighs about 100 pounds more.

Another grumble came from 9.2 percent of our respondents—those who'd expected better gas mileage. The EPA states that the EXP will deliver 29/46 mpg



Seating comfort, dash layout, high standard-equipment content got rave reviews.

city/highway. Our owners say it's more like 28/38.

But enthusiastic praise for the EXP far outweighed any grouching and, judging by owner reaction, Ford has come up with another Better Idea.

"Here's a car that's fun to drive," says a North Carolina tire salesman. "It looks good, attracts attention and it's economi-

cal. I plan to keep my EXP until it becomes a collectors' item, but for the moment I'm happy and satisfied to own an economical, sporty car with appealing good looks."

And these comments from a New York coach and physical-education instructor: "The EXP combines economy with style. I've wanted a sports-type car for a long time, but can't afford a 280-ZX or another car like that. I'm very pleased with the EXP, particularly its gas mileage, style, the storage area and handling."

A financial analyst in Michigan told us, "Quality is excellent—a marked improvement over the 1979 Mustang I own. In addition, the EXP's front-wheel drive gives superb cornering and handling characteristics. I can't wait for the winter to try it on ice and snow. I also like the car's instrument-panel layout and the fact that I get 41 mpg on the freeway."

Ford has aimed the EXP at young peo-

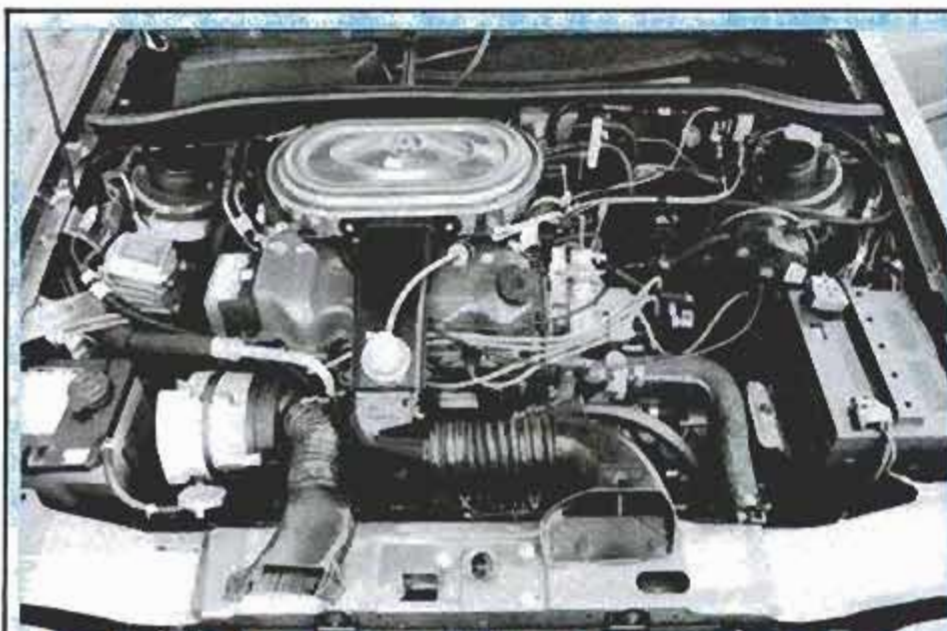
(Please turn to page 128)



The 27.9 cu. ft. of cargo space can handle most hauling chores.

Owners want a more positive lockout for reverse gear.

Front-wheel drive and all-independent suspension give terrific handling and ride quality.



Engine box is fairly neat and uncluttered, but the oil filter is hard to reach, owners say.

THE EXP EXPOSED

This is Ford's first two-seater since the 1957 Thunderbird. It's derived from the Escort and shares not only the Escort's basic floor plan, but its engine, fwd power train, independent rear and front suspension, brakes and rack-and-pinion steering.

The EXP also borrows the Escort's 94.3-inch wheelbase, yet the sporty coupe stands approximately 3 inches lower and 6.4 inches longer, and weighs 100 pounds more.

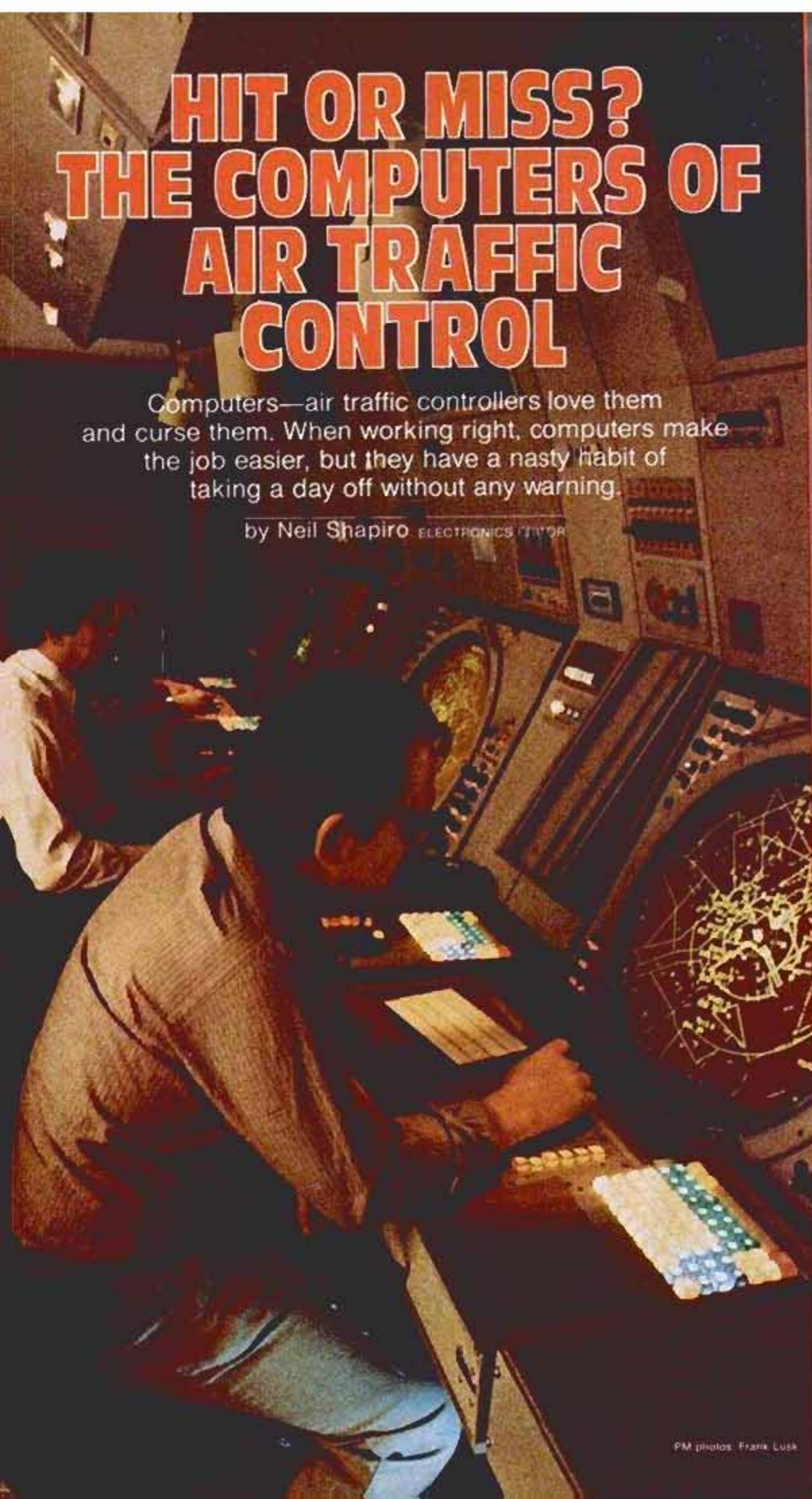
Cargo capacity for the EXP is rated at 27.9 cu. ft. as opposed to 30.6 cu. ft. for the Escort hatchback with its rear seat folded.

The EXP's standard equipment includes tachometer and full instrumentation, digital rally clock, miniconsole, reclining bucket seats, light group, remote hatch release, rear-window defroster and a standard AM radio with twin speakers.

HIT OR MISS? THE COMPUTERS OF AIR TRAFFIC CONTROL

Computers—air traffic controllers love them and curse them. When working right, computers make the job easier, but they have a nasty habit of taking a day off without any warning.

by Neil Shapiro ELECTRONICS EDITOR



The crowded skies are watched over by air traffic controllers seated in front of monitor scopes which show them computer-enhanced images of what's going on overhead. The controllers must maintain minimum separation distances between aircraft for their entire flight and see that no aircraft strays off course. Most airliners are guided from one end of their flight to the other.

PM photos: Frank Lusk



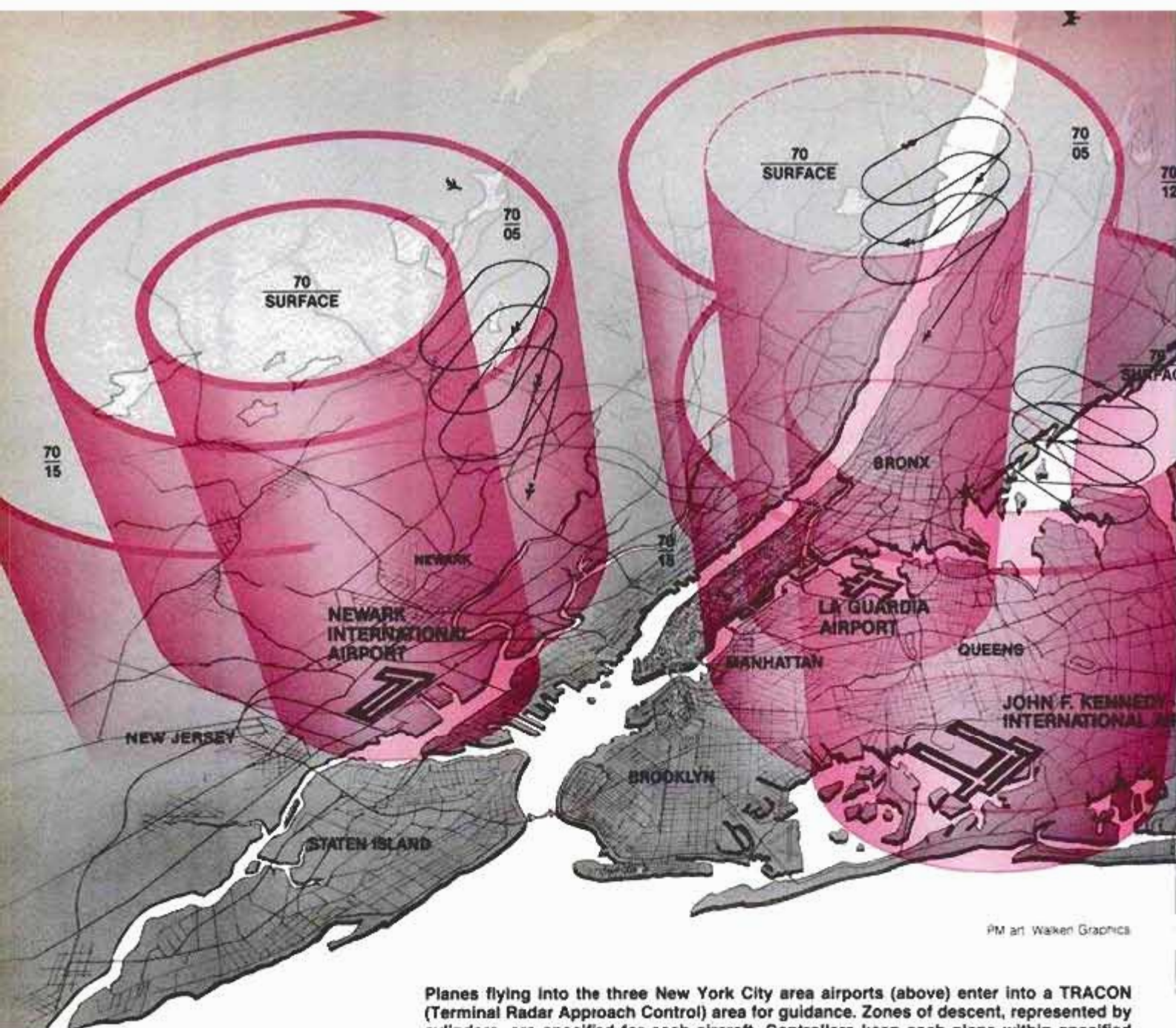
The huge room is a dimly lit cavern, filled with futuristic technology: glowing screens, colorful keyboards, mammoth gray consoles that dwarf—almost mask—the presence of the casually dressed men and women.

Each of the air traffic controllers sits attentively. Many sit one at a screen—the screens angled almost vertically like glowing green dresser mirrors. Others sit in hushed groups of two or three around horizontal screens which resemble circular tabletops—like participants in an electronic seance.

Each controller wears a headset and a microphone and



Simulated scene of an airliner flying too low and in danger of crashing into Manhattan skyline is shown pictorially and also (above) as it might look on a controller's scope. The "LOW ALT" warning would flash over the plane's flight number (represented by UA991) and a bell would ring—if the computer were working properly.



Planes flying into the three New York City area airports (above) enter into a TRACON (Terminal Radar Approach Control) area for guidance. Zones of descent, represented by cylinders, are specified for each aircraft. Controllers keep each plane within specified altitude ranges; 70/05, for example, represents 7,000 feet maximum and 500 minimum.

can be in instant communication with any of the planes represented on his monitor screen. On that screen, the planes are shown as dim green dashes. Each dash trails a set of numbers behind as it moves across the screen.

The numbers trailing each plane label it with its altitude, its rate of descent or ascent, whether it is a prop or jet, its flight number. This group of numbers—called a “tag”—is generated and maintained by a huge computer located in a basement below the tense “operations floor.”

Twelve planes are represented on one controller’s screen—all but one private plane under his direct authority. Each of the green dashes has its associated tag.

The controller speaks softly into the microphone suspended from the side of his headset. He alerts a fellow

controller seated across the room that he is “handing off” an aircraft, passing it safely out of his area of responsibility to that of the other controller.

Suddenly, the tags flicker. The numbers change rapidly, like so many out-of-control odometers, then disappear completely. The green dashes are now anonymous slices of “raw radar.”

The computer has gone down, is out of the circuit.

The controller swears softly under his breath—but is already moving to put a 20-years-out-of-date system into operation as a backup. He scribbles numbers onto plastic strips (called “boats”) and begins to move them on the screen manually. Meanwhile, he contacts each pilot via radio in the first of many repetitive position checks.

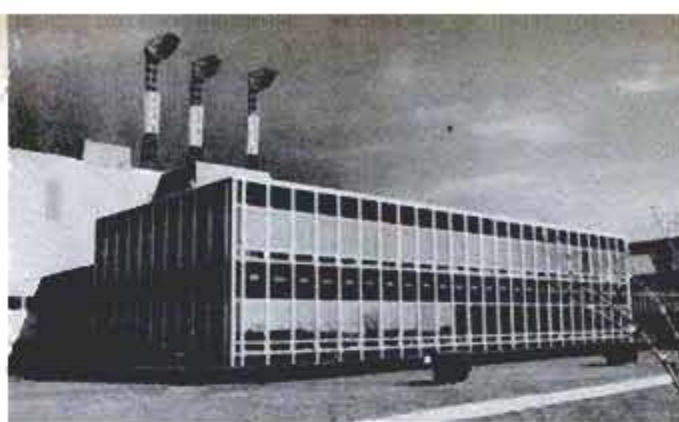
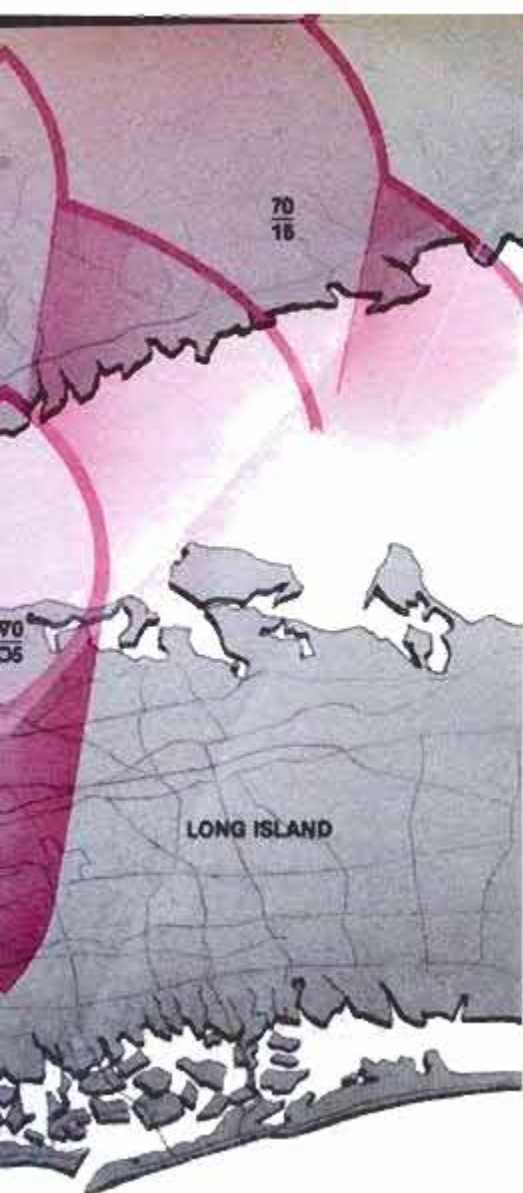
This is nothing new—or even un-

expected. The computer goes out sometimes as often as three or four times a week—usually for a few moments, but hours aren’t unusual.

If the controller were not so busy, he might pause to reflect that depending on a computer can be similar to using a hammer made of ice on a hot day—the tool may melt away long before the job is completed.

Computerized numbering

The Federal Aviation Agency (FAA) has 18 regional air traffic control centers in various areas in the country. These 18 centers are responsible for the in-flight guidance of all planes flying under Instrument Flight Rules (IFR), and this includes just about all passenger airliners. The trained cadres of air traffic controllers in these centers



The Eastern Region Air Traffic Control Center (left) is a huge building. Much of its area is devoted to operations floor (below). Large antennas receive raw radar transmissions from airports and other areas. Computer processes the radar and adds numerical information.



must place much of their trust in computers.

But many times, the computers—as in our fictionalized scenario above—prove less than completely reliable.

"The system," according to Norbert Owens, FAA Chief of Air Traffic Control for the Eastern Region, "is quite safe."

But George Kerr, vice president of the Eastern Region of the Professional Air Traffic Controllers' Organization (PATCO), gave us a different viewpoint—just a few weeks before the recent strike that took thousands of controllers off the government payroll.

"I don't want to sound like a mer-

(Please turn to page 162)



TRACON controllers cooperate via microwave radio with airport control towers. One controller helps airport schedule take-offs, while others assign planes—as they leave ground—to other TRACON controllers. Guidance continues until a regional center takes over.

LIGHTER MACHINES FOR COLD ADVENTURE

Refinements improve performance this winter
—and forecast innovations to come.

by Bill McKeown OUTDOORS EDITOR

Snowmobilers will have better choices from fewer brands this season. Every year, for the last several, more sportsmen have joined the action with sleds from a smaller number of manufacturers. The five makers that do remain seem to be here to stay, and all have upgraded their machines for the coming winter.

"More from less" is the trend when it comes to building in more performance, flotation and speed, with less weight to sink in the snow. With speeds that already top 60 mph for family machines and up to 100 for racing sleds, there's no longer a need for bigger engines and more brute power. Instead, refinements in durability, engine efficiency, transmissions and low-wind-drag streamlining are features for 1982 and beyond. In addition to the latest standard production machines, there are also limited-edition prototypes. Direct-drive, from John Deere, and twin-track, by Bombardier, may be features on snowmobiles to come. And the healthy growth of the sport seems

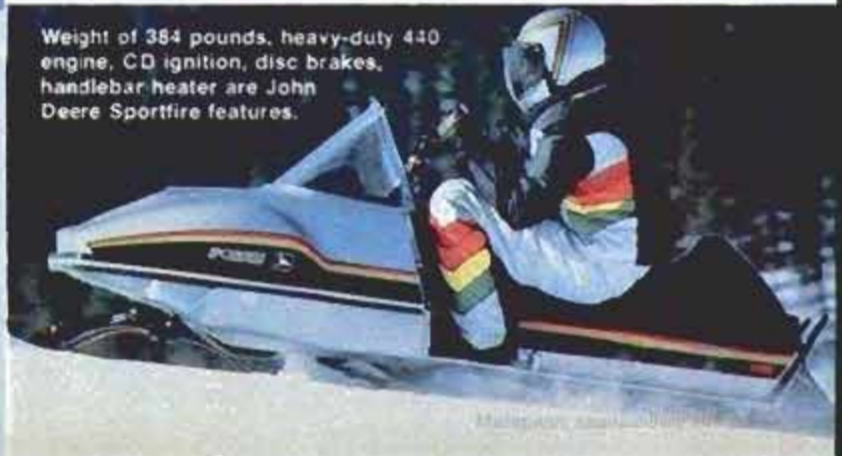
[www.outdoors.com/page/131](#)



Notably quiet and versatile, Kawasaki's Intruder has a fan-cooled, 436-cc engine with oil injection. Vari-Ride suspension.



Weight of 384 pounds, heavy-duty 440 engine, CD ignition, disc brakes, handlebar heater are John Deere Sportfire features.



Long track and low ground pressure of Ski-Doo Citation SS (left) offer snow-drift flotation. New Blizzard 9500 (right) is the line's speedster.





For one rider or two, over hills or trails, Bombardier recommends its new, liquid-cooled Ski-Doo Everest 500, with manual or electric starting.

Twin-track SnoPro machine for oval-sprint racing



Designed for Moto-Ski and Ski-Doo factory team drivers Jacques Villeneuve and Brad Hulings, the 1980-'81 model with rear wing (left) and new machine (far left) for '81-'82 both have twin-drive tracks. Powered by a new Bombardier-Rotax 340-cc, twin-cylinder, liquid-cooled engine, the 7½-inch-wide tracks receive variable thrust through a differential system that works in conjunction with the steering gear. Streamlining changes are reported to lower wind resistance, and will be tested by factory drivers on the Sno-Pro professional circuit this winter.

7 new shapes in stereo

Kenwood 44



Aiwa CS-880



Sansui CR-M7



JVC PC-5



Toshiba KT-R2

Look what's happened to stereo—it's more portable and versatile than ever before, and some units even have TV.

by Fred Petras

To most people, a stereo is a compact table-top music system, a big console, or a group of audio components and a pair of speakers. But a look at the latest crop of audio products reveals many exciting trends in the design of new stereos.

Custom racks and cabinets

Many manufacturers now offer ensembles of components and the furniture to house them. Previously, it was up to the buyer to choose and match components—even if he stayed with one manufacturer. These “designer” systems feature perfectly matched components along with the beautiful furniture.

The “caseiver”

Here's a new audio component that combines two traditional ones. A combination of

Pictured here and detailed in text are seven products that have changed the “look” of stereo. The Kenwood 44 system is the first of the lowboy-style, rack-mounted components; Aiwa's CS-880 features a super-low, bassy sound circuit; Sansui CR-M7 combination cassette deck and receiver is called a “caseiver”; JVC's PC-5 is a set of five snap-together components; Toshiba's KT-R2 cassette not only records, but has two cassette-shaped tuners to receive AM and FM; Sharp 3M95 features 9-inch black and white TV along with its powerhouse audio; Sharp's VZ-3000 has upright turntable with two tone arms to play both sides of a record without flipping it.

Sharp VZ-3000



Sharp 3M95

RM photo: Bill Ashe

cassette deck and receiver is used as the heart of a one-brand component system—instead of a receiver—or a tuner, amplifier and separate cassette deck.

Stand-up turntables

Here's a trend brought about by both the downsizing of electronics and the demand for stereos that take up less space. These turntables

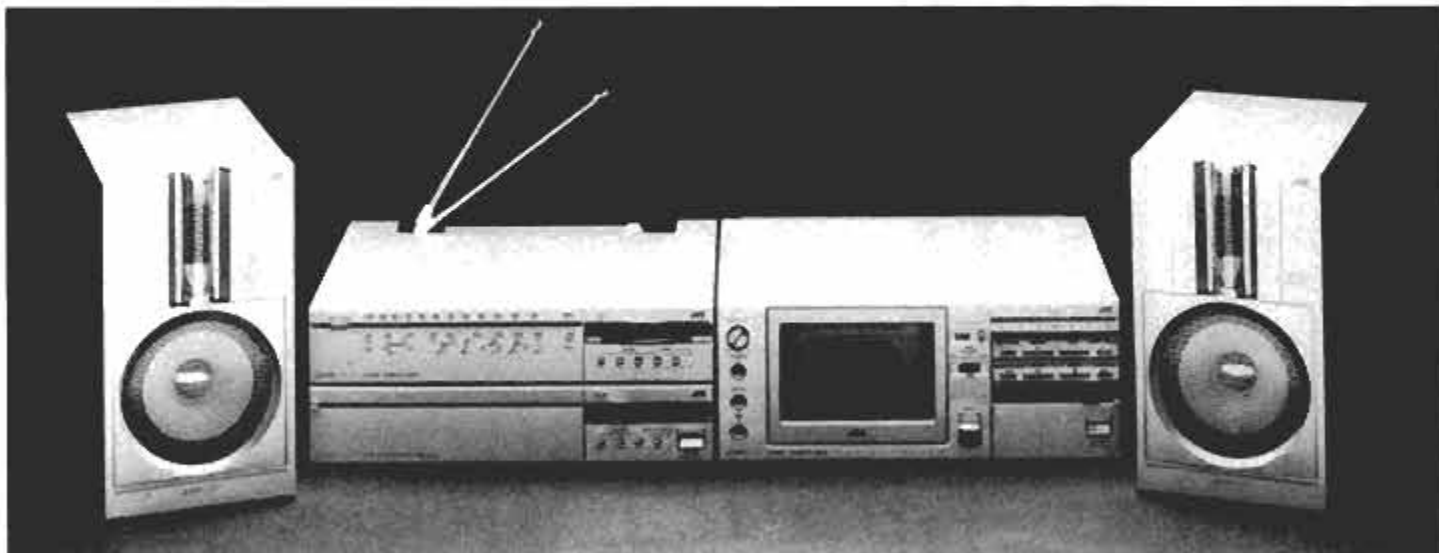
superior speaker systems and better electronics are being used.

Pocketable carry-alongs

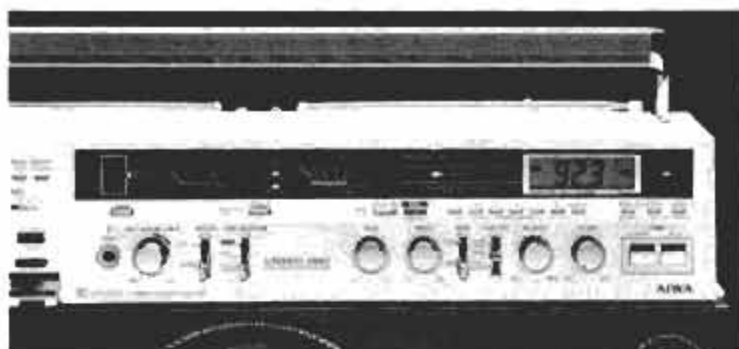
The hottest trend of all in the audio world is the miniature stereo cassette player and tiny headphones now worn by countless music lovers. From a single manufacturer offering such systems two years ago, the market now supports 20 suppliers.

al digital-clock timer. The Model 44 retails for \$1,199; the timer is \$125. A graphic equalizer is also available for \$225.

■ **Alwa Model CS-880** portable features "Acoustic 3D" sound, made possible by the firm's Dynamic Super Loudness (DSL) circuit. This circuit accentuates the low-range frequencies without affecting the middle and high frequencies, for an



Components of the PC-5 system from JVC can be separated, as shown above, and set up on a bookshelf. The hinged front panel of Sharp's VZ-3000 vertical record player (right) provides access to the drive system and cartridges (arrows). Aiwa's portable CS-880 has the circuit features of a component system, with all controls conveniently laid out on a single panel. It also has a digital frequency readout.



enable you to install a component system in a shallow area, such as on a bookshelf.

Microcomponents

Microcomponents—sometimes called minicomponents—have developed into a strong trend in the audio field. Now, manufacturers are making them portable, in some cases even designing in a carrying handle.

Hot-sounding portables

Large, twin-speaker radio and cassette players have been around for a few years, and have acquired the nickname "boom boxes," which suggests they are noisemakers, rather than music machines. But that image is changing, now that

Almost-stereo TV

Though stereo TV is not yet broadcast, you can get a taste of it now. A few companies offer portables with cassette and radio—and TV. The TV's monophonic sound is played back on the two stereo speakers.

Those are the trends; following are seven representative units.

■ **Kenwood Electronics' Model 44** Spectrum Series stereo-component system exemplifies a new direction in one-brand audio ensembles—toward "low-boy" styling, as opposed to the "high-boy" styling that has prevailed so far. The system, as shown, is comprised of a cabinet finished in simulated walnut and chrome, integrated amplifier, AM/FM stereo tuner, cassette deck, turntable and speakers, plus option-

extra measure of audio realism. The unit uses a 6 $\frac{1}{4}$ -inch passive radiator in conjunction with four other drivers. Other features include Dolby noise reduction, metal-tape capability, quartz-PLL synthesizer front end with digital frequency readout, 12 station presets and a 15-program taped-music sensor with digital indicator. It's nationally advertised at \$590.


■ **Sansul CR-M7** caseiver is a tabletop system. Also available is a semi-automatic, direct-drive turntable with cartridge and cabinet in silver metallic vinyl finish (not shown in the photo on page 102). The system has a suggested retail price of \$900.

■ **JVC's Model PC-5** is named "Quin-"
(Please turn to page 161)

Driving the Mercedes Turbodiesel 300D

The blown, three-liter Five finds another new home in a less expensive neighborhood.

by Rich Taylor



The new 300D sedan (shown here) and 300CD coupe are virtually identical to last year's models on the outside, but now they've got the turbodiesel under their hoods.

What can you say about a new Mercedes? You know it will be expensive, conservative, well built and, while not exactly exciting, rather satisfying in a king-of-the-road sort of way. It will also look and drive—at least in general—just like every other car Mercedes has ever built.

Still, some Mercedes are more equal than others. And the newly introduced 300D sedan, now fitted with the three-liter, turbocharged diesel engine first introduced in the longer wheelbase, S-class 300SD, is definitely the "middle-class" Mercedes. (The 240D is still the "econocar" of the M-B model lineup.)

The interior of the 300D isn't quite as nicely laid out as in its big brother, the 300SD. The overall look, inside and out, isn't as imposing. The handling doesn't seem to be as positive as on the 300SD, and though the four-wheel independent suspension is similar, it transmits more road harshness and noise into the interior.

There's also a good bit of wind and engine noise, more than you'd expect from a \$28,483 car. The 300SD, even though it uses the same engine, has considerably better sound deadening. At 70 mph on the highway, the 300D sets up a racket which makes the genteel conversation of a Mercedes owner impossible. You end up shouting at each other. Compared to last year's 300D, the new turbodiesel provides a nice performance improvement, of course, but we still can't help comparing it to the superb SD, which Mercedes can't make enough of to satisfy the demand.

Mercedes has always been known for superb quality control so we were

a little mystified by what we found in our test cars. We drove two externally identical 300Ds. One had steering which seemed very heavy and pulled to the side, a couple of small gaps in the upholstery—unheard of in a Mercedes—and sluggish performance. The other car had very light steering, a misfit gap around the glovebox and only one spring on the hood counterbalance (it should have two), which meant you had to have someone hold the hood up while you checked the oil. On one car, both windows rolled down flush with the doors. On the other, the driver's window left a half-inch of glass poking above the door. This may sound like picking nits but, on a car which costs *that* much, you expect absolute perfection, all the way down to a hood spring.

None of this is typical Mercedes, and you have to assume that these early production cars with the turbodiesel aren't typical of what you will actually be able to buy. But it is disconcerting to find that one of the great verities of life—Mercedes-Benz quality—can slip to less than


perfection. Isn't anything sacred?

Yes, Mercedes-Benz performance is sacred, indeed. With only 120 hp in a 3,585-pound car, the 300D is understandably no ball of fire off the line. The turbocharger contributes to this lack of bottom-end grunt, exhibiting typical "turbo lag" at low rpm. But when you eventually get the car rolling and the turbo wound up, the acceleration is surprisingly good. From 50 to 100 mph, the 300D will simply fly.

And all with that safe-as-houses feel which is typical of every Mercedes. The Mercedes chassis is "underpowered," in the sense that it can handle far more horsepower than the engine can deliver. The result: A 300D at 85 mph feels like a lesser car at 55 mph. Almost inevitably, you find yourself rolling down the highway far faster than you think you're going.

All this is not to say the 300D is a bad car. It's a Mercedes, after all, and Mercedes really has put itself in a market where it simply has no competition. Think about it. If you

(Please turn to page 160)



The cockpit of the 300D doesn't lack creature comforts. Climate control and power windows are standard. Road and engine noise, however, was more than expected.

Art deco furniture you make from rods and plywood

This stylish rod furniture proves that good design doesn't always require expensive materials.

by Rosario Capotosto

Just looking at art deco buildings, furniture and furnishings of the late '20s and '30s, you know that the designers had fun creating them. Few styles have such exuberance built into items that are, basically, practical. Working with the Borden Chemical people, we think

we've captured that same spirit and practicality in the lamps and table shown on the facing page.

However, the stylishness of these projects is only part of the story. Made of plywood and threaded rod, they are also easy and inexpensive to build. And

because all three are painted, you can readily adapt them to your individual decor by simply changing the colors. Complete plans and building instructions for the table lamp, hanging lamp and roll-about table appear on this and the following pages.

Table lamp

Begin making the table lamp by cutting out nine squares—slightly larger than the finished diameters of the discs—from a $\frac{3}{4} \times 36 \times 48$ -in. piece of fir plywood. Then draw a diagonal line between each opposing corner and bore a $\frac{1}{16}$ -in.-dia. center hole through each block where these two lines intersect.

Next, use a protractor to position the three rod holes on the top disc square as shown. Once marked, use an awl to establish the precise boring point, then bore the rod holes. Use this square as a template to bore the other squares.

You can stack and bore several squares at once by inserting a $\frac{1}{16}$ -in.-dia. nail into the center holes to maintain alignment.

After each stack is bored, remove the squares, one at a time. Use a pencil to darken the same hole on each piece so when the discs are assembled, they'll be properly aligned. Don't bore the rod holes in the bottom square until the three $\frac{1}{8} \times 1$ -in.-dia. holes have been counterbored on the underside to receive the Teenuts. Otherwise, you'll lose the drilling center.

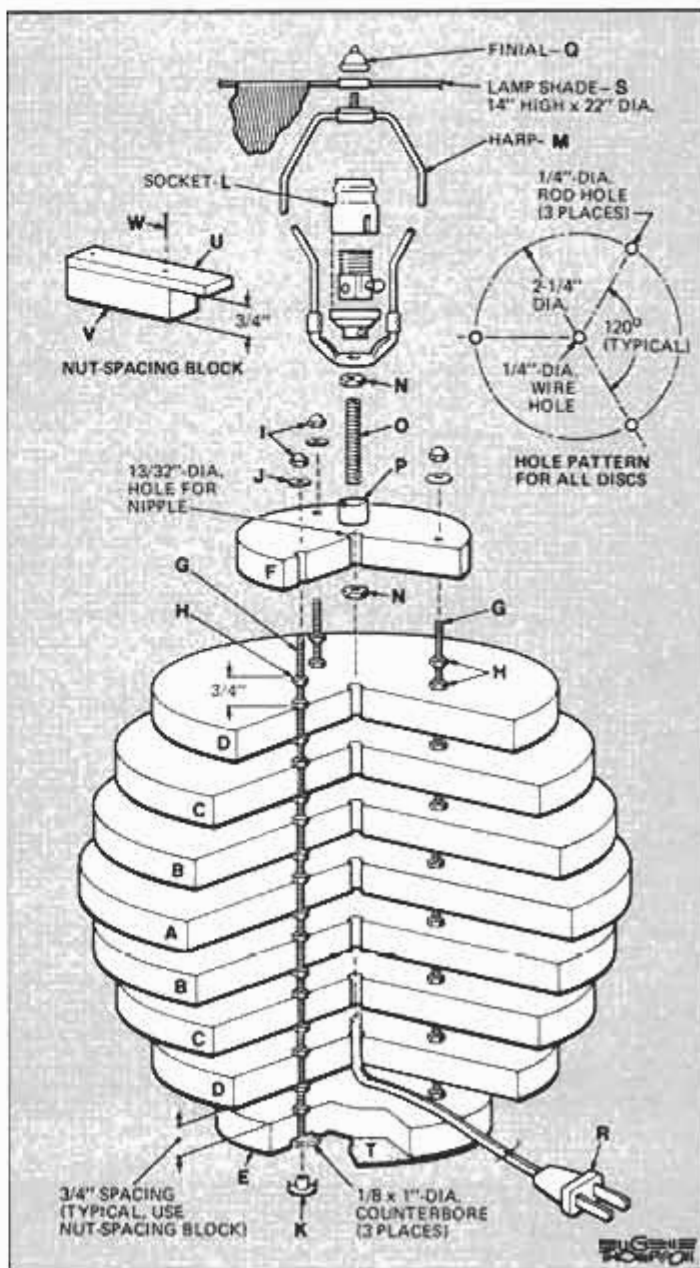
Next, cut the discs from the squares using a sabre saw with a circle-guide attachment. Bore a 1-in.-dia. hole in the waste side of the disc outline for blade entry. For your cut to be accurate (no spiral, in or out), the distance from the pivot point to the guide arm must be the same distance as that between the cutting edge of the saw teeth and the guide arm.

Once the discs are cut, fill voids in the plywood edges and surface with a wood filler, such as Elmer's Professional Carpenter's Wood Filler.

If you don't have a stationary disc sander, you can sand the disc edges with a portable finishing sander. Just make the simple jig shown on page 144 by tracing the top of your sander on a piece of $\frac{3}{4}$ -in. pine and cutting out the matching hole. Clamp this block to your workbench and place your sander in it.

Bolt the disc-holding handles to the T-block which is also clamped to the workbench. Since the discs are held between the handles by a $\frac{1}{4}$ -in.-dia. bolt, the center

(Please turn to page 144)



PM color photo: Harry Hartman; black and white photos: the author; project design: Bob Pfreundschuh



Original home furnishings created for PM readers include a hanging lamp, table lamp and roll-about utility table. The designs are a variation on the art deco theme, which is currently undergoing a revival.



How to master fine wood joinery

This month's installment takes you through two more important joints—dowel and lap.

by Rosario Capotosto and Harry Wicks HOME AND SHOP EDITOR
PM photos by the authors

PART 2

Doweling is the surest way to strengthen a joint in wood. The type shown is commercially prepared with glue-escape channels

machined in, corner cut to 3-in. length. Joint here uses hidden (blind) dowels, which aren't visible; notice match marks.

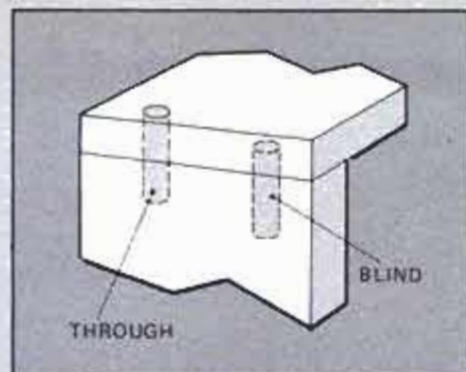


Chances are you will turn to doweling more than any other method when you want to beef up a joint's strength. Dowels can be used in almost any joint from butt to mitered—the techniques for using them remain basically the same. The important thing is to master the basics. Once you get fundamentals under your belt, the more sophisticated joinery techniques will come easily during your practice-with-scrap sessions.

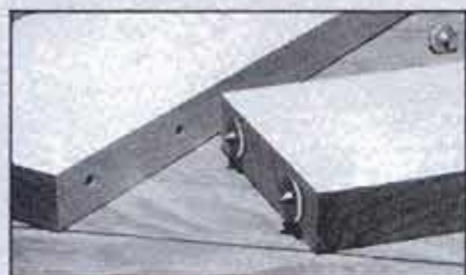
Working with dowels

If you intend to seriously pursue woodworking to build your own furniture, cabinets and the like, you must master dowel joinery. In the beginning, you can work with dowel centers (in fact, these are often the handiest tools in the shop, even after you may have more advanced equipment on hand). However, as your workshop production increases, so will your need for the quicker and more accurate doweling jig.

Making joints with dowels



Dowels in a butt joint make it considerably stronger. The through dowel is the stronger of the two, but the blind dowel is used when you want to make the joint invisible from the front (on a drawer front, for example).



With holes accurately transferred, the dowel holes can be bored in the second piece to complete the blind dowel joint.

The usual practice with dowels is to select a diameter that is about half the workpiece thickness: It should *never* be greater. Thus, for example, you would use a $\frac{3}{8}$ -in. dowel with $\frac{1}{2}$ -in. stock; a $\frac{1}{2}$ -in. dowel with $\frac{3}{4}$ -in. wood, and so on.

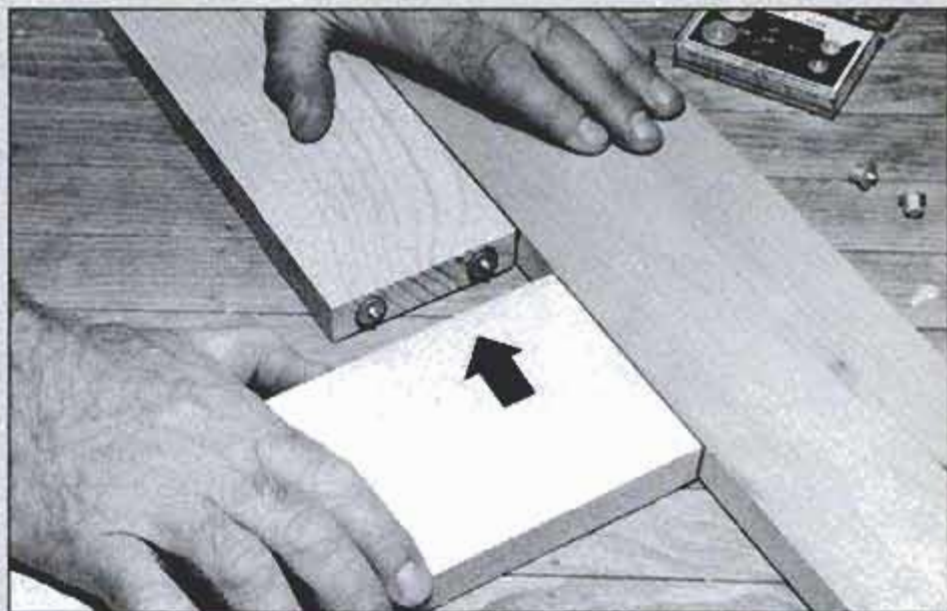
The easiest way to use dowels is to buy the commercially made versions (see photo, page 108). These are 3 in. long, chamfered both ends, and come with escape air and glue channels routed in. (The chamfered ends make it easier for you to insert the dowel.)

If you have a lot of doweling to do, you can hold down cost somewhat by buying dowel rod by the 3-ft. length and cutting lengths to suit the job. If you choose this course, remember to cut the glue-escape channels and to chamfer the ends. We do the first by raising the table-saw blade a scant amount (maybe $\frac{1}{16}$ in.) and feeding the rod in, before cutting pieces to length. Cut about half the rod, lift it off the saw, then repeat for the remaining half length. Finally, cut the pieces to length.

Chamfering can be done with a sander or plane, or very quickly in a pencil sharpener.

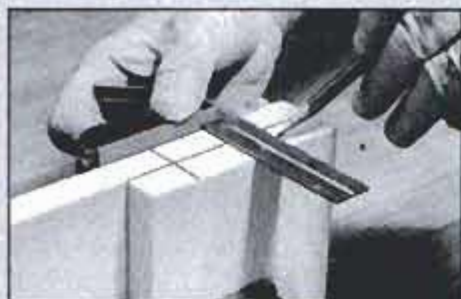
Aligning dowel holes

Obviously, if the dowel holes aren't aligned, the two pieces of



Dowel centers are an inexpensive—yet accurate—way to ensure perfectly aligned mating holes for dowels. Always locate and bore the holes in the end grain first (see text

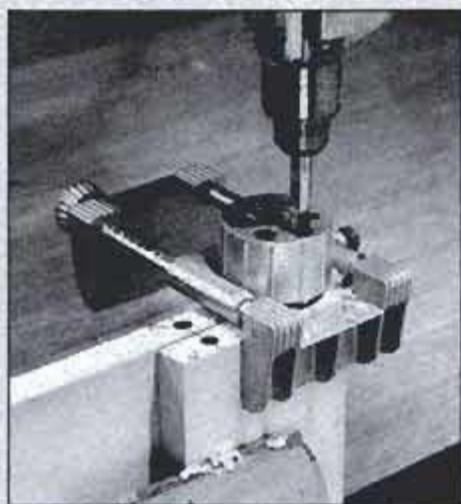
for reason). Then, butt the work against a straightedge, as here, slide the piece to be marked (arrow) against the centerpoints and press the boards together firmly.



Or, use a dowel jig—the authors' preferred method for handling a dowel joint. To start, clamp the parts to be joined securely in a vise. Then, use a square and a sharp pencil to make the dowel locations on the edges of both boards.



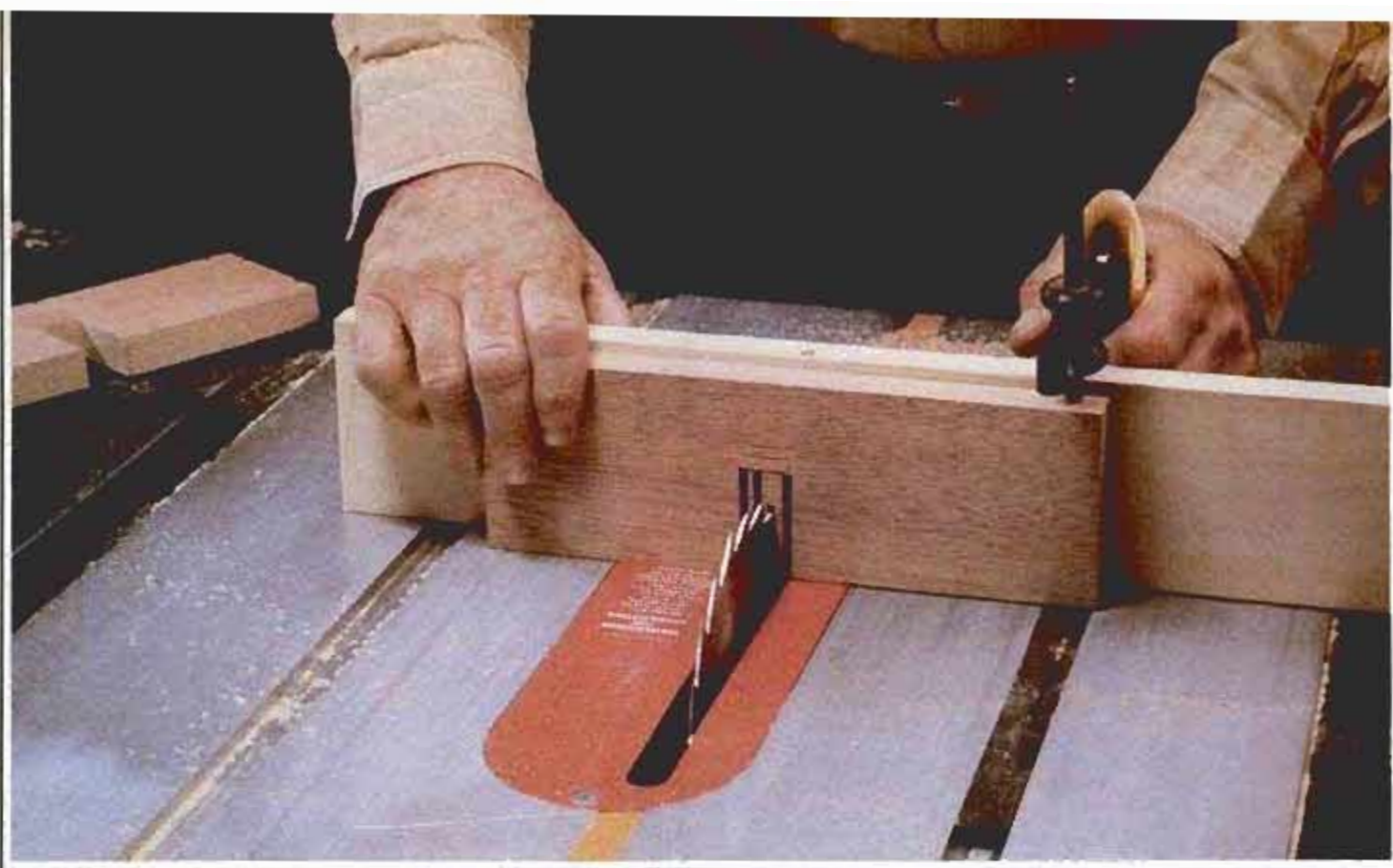
Next, locate hole centers, using a combination square. Here, on $\frac{3}{4}$ -in. stock, square's blade projects $\frac{1}{4}$ in. Make certain the hole centers on both boards are marked from the same surfaces; that is, surfaces you want to line up after joint is made.



Bore the holes using appropriate bit in a portable drill and a doweling jig. Position the jig with its registration mark in line with the first line drawn. Properly positioned bit guide will ensure that the hole is bored at the center of the cross marks. Make certain that the jig is rotated 180° in order to bore the mating hole.



If you must bore a number of dowel holes along the centerline of long boards, using a portable drill and a guide such as the Portalign tool makes the task much easier—and you can be sure of on-target holes. Next, dowel centers will be used to locate the dowel holes on the board to be edge-joined to the board shown.



Edge lap actually consists of a dado cut made across a board edge, rather than its face (often called a notch). If you are making just one or two joints, start by making the shoulder cuts, then

make several saw kerfs in between, as here. Finish the cleanout with a chisel. If you have a lot of edge laps to cut, it's faster to make the notches in one pass using a dado head.

board they are in won't be, either. For that reason, always do your marking from the same side of the board. For example, mark what will be the underside on the two boards being joined—then do the measuring for center for both boards from the same finish surface. This way, should your mark be off a scant amount on the first board, it will be off the same amount—in the same direction—on the second. This is especially important when working with dowel centers, or a doweling jig.

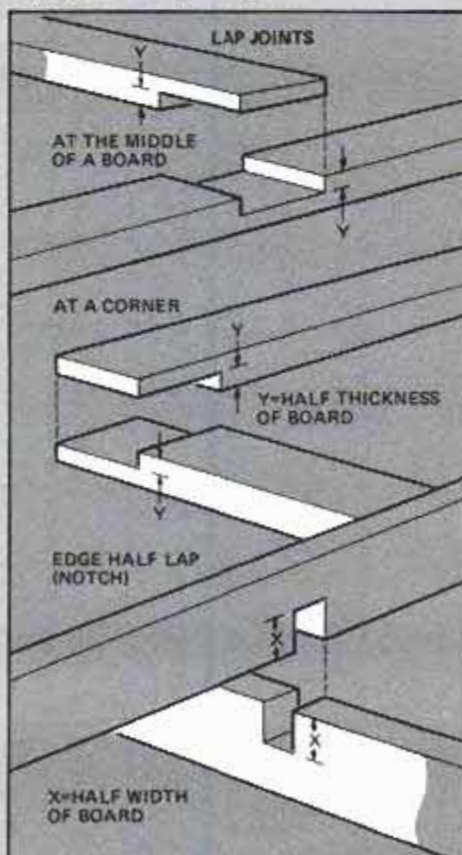
After locating dowel hole positions on the first board, bore the dowel holes. Then insert the appropriate-size dowel centers into the newly-drilled holes, and press the two boards together. Make a light match mark before separating the two boards. Remove the board and bore holes in the second edge.

The holes should be bored first in the end grain when joining an end grain to another edge, since an end grain doesn't have a uniform surface; that makes it likely the center point will hit a hard or soft spot and move the mark ever so slightly. When this happens, of course, the resulting joint won't be flush.

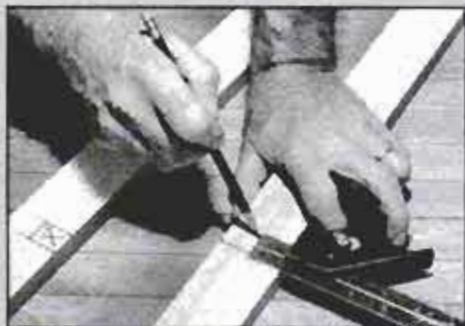
Apply glue sparingly to the dowels and insert them into the holes in one of the boards. You'll probably have to tap the dowel lightly with a mallet to get it halfway home. Using a

Technique of making an edge lap joint

These are the three most commonly used lap joints. A surface lap joint lacks holding power and, if strength is important, should be reinforced with hardware (see Part 1). The edge lap, (or interlocking) joint is a solid, dependable joint by itself.



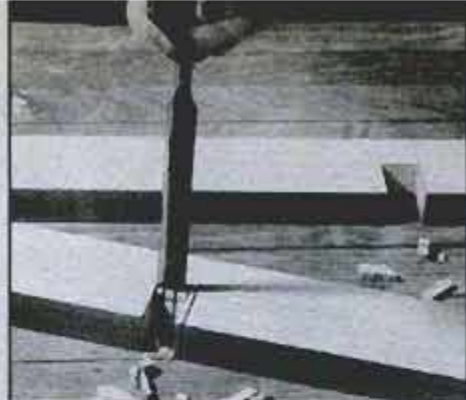
Using a square and the stock itself, mark the width of the notch on the first piece at the desired location. Repeat this step on the mating piece of wood.



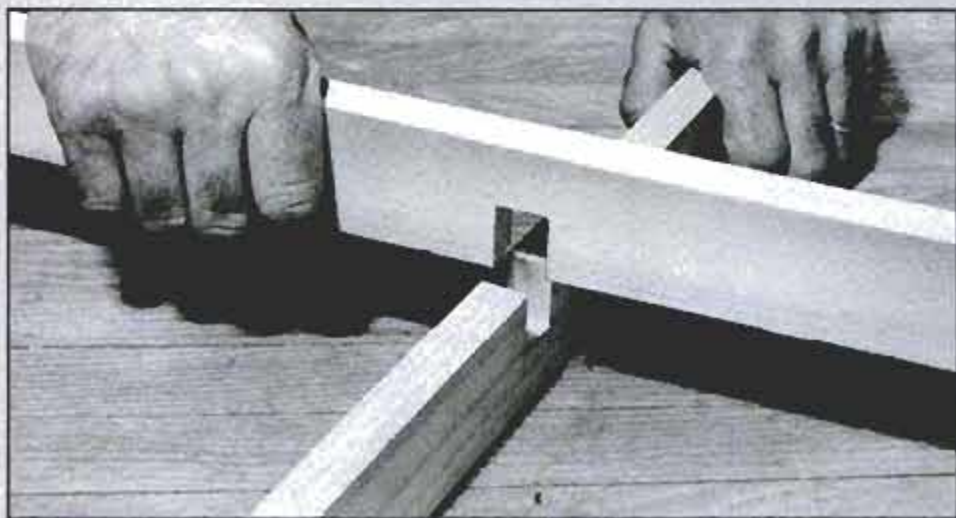
Next, extend the combination square to a length equal to half of the width (of the boards to be notched) and lock it in place. Then use the square to mark the depth of cut on all of the pieces to be cut. Layout accuracy for all joints is a must.



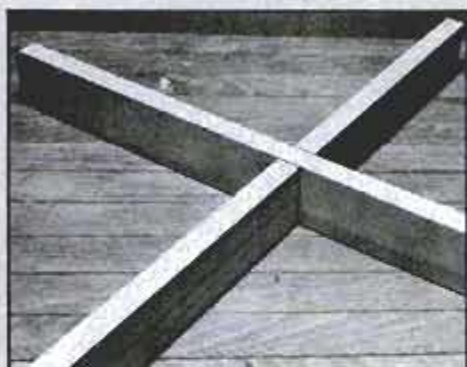
You can cut the notches by hand, using a fine crosscut saw or backsaw. To ensure accuracy, clamp the workpiece in a vise and use a simple, U-shaped wooden block as a guide to keep the saw on a straight cutting line (when you are making the two end or shoulder cuts).



Use a sharp chisel, with its bevel edge facing the waste side, to remove the material from the notch. In soft woods, you can rap the chisel with your hand; for hardwoods, hammer taps are best. Chisel out only a small section of scrap at a time—don't try to clean out the notch in one shot.



When the notch is almost fully cleaned out, test-fit the pieces to avoid overcutting and a resulting sloppy joint. Use chisel or a file to clean out additional material, if necessary.



A well-executed edge lap gives a joint that is nearly invisible with no space or gaps between boards and edges perfectly flush. Thus, the boards are locked securely.



To notch an edge lap with power (table saw), affix a small piece of masking tape to the table in front of blade. Elevate blade to equal the notch depth and make a test cut in scrap. Then, holding test piece firmly against miter gauge, back latter up and turn off saw. Use a sharp pencil to mark blade position on tape as shown.



Make the two outside cuts first, using the tape registration marks as your guide.



Make repeated passes over the spinning blade to remove all of the interior waste.

brush or small-diameter stick, apply glue to the remainder of the board edge—and remove all excess glue from around the dowels. Align the two boards and join them by applying pressure with clamps. Bar clamps are best when edge-joining boards and scrap wood should always be placed beneath a metal clamp's jaws to prevent damage to the workpiece.

Often, edge-joined boards have a tendency to "curl" or bow. You can prevent this with clamps and additional boards across the bow. Apply clamp pressure until you can spot slight glue squeezeout along the glue line (joint) and set the work aside to dry for 24 hours.

Using a doweling jig

With one of these, you can become an expert with dowels in less time than you might imagine. There are several types of doweling jigs available; the one shown on page 109 is the authors' favorite.

To use the jig, you first lay out the hole locations with a square, as shown on page 109. Use a pencil with a very fine point, or a scratch awl. Then place the jig on the workpiece after aligning its registration mark with the mark you just made on the wood. When it is aligned, lock the jig in place with its clamping device.

Next, the appropriate-size bit guide is lined up and locked in place. (In the example shown, the $\frac{1}{8}$ -in. guide is in place on the jig because we wanted to bore $\frac{1}{8}$ -in. holes.)

Measure the distance from workpiece edge to top of jig and add $1\frac{1}{16}$ in. to determine the drill bit's total depth of penetration. Put your depth stop on the bit at that point—a masking-tape flag works fine—and stop drilling when the flag touches the top of the jig.

Since the jig is, in effect, a round tunnel that your bit must follow, you will get the most accurate holes using spur or brad point bits. These aren't as fast drilling in wood as spade bits are, but the results will be more accurate because the bit is in close proximity to the guide.

Several professional tips

- Always use at least two dowels in a joint to gain maximum strength. A pair also prevents the joint from pivoting.
- Make certain you use only hardwood dowels. The commercial type available at lumberyards and home centers will be either birch, maple or hickory.
- Keep your dowels in a dry, well-ventilated place. If you work with a wet dowel it will shrink as it ages.

(Please turn to page 132)

A craftsman's tips for drilling in hard material

A PM expert shares his secrets for drilling in glass, ceramics and more.

by Walter E. Burton

Drill three holes near the rim, attach chain, and convert an ordinary ceramic cup into a miniature hanging planter.



A new world opens up for many craftsmen when they discover ways of drilling in hard material. Suddenly, a variety of new projects are possible, as more materials become available for the craftsman's use.

By using specialized drills and techniques, it's possible to drill into hard materials such as glass, porcelain, hardened steel, petrified wood, quartz, turquoise and various other stonelike substances.

For making holes in masonry, there are conventional star drills and power-driven, carbide-alloy drills. The common method of making holes in hardened steel is by annealing, drilling with ordinary steel bits and then rehardening. For glass, stone, ceramic materials and hard metals, tungsten-carbide and diamond drills are the ones most often used.

One of the methods outlined here should be adequate in the workshop for making small and medium-sized holes in things that are too hard for ordinary drills.

The terms "drills," "drill bits" and "bits," as used in the text, all mean the same thing. Manufacturers customarily call a bit that does the cutting a "drill." Also, they call a motor unit that drives the bit a "drill."



Make your own bits like the three at upper left, or buy diamond bits (in plastic tubes) and tungsten-carbide bits (in foreground). Valve-grinding compound holds abrasive grit.

Abrasive-grit drilling

An inexpensive method of making a hole in glass, china or similar material is to grind it through with abrasive particles, preferably on a drill press. The bit can be made from rods of aluminum, copper, brass or even a headless nail. As these bits have tubular cutting ends, they are known as "core-type bits." The desired diameter is usually milled in a lathe from a rod, then the bit is center-drilled to form a recess in which cores develop from the material being drilled.

Granular abrasive is used between the material and rotating drill. It is the abrasive that does the actual cutting. Abrasive is usually aluminum-oxide or silicon-carbide

grains of 80- to 120-grit size. Types of abrasive include loose grains produced by abrasive manufacturers, valve-grinding compound (such as Permatex water-mixed), aluminum-oxide or silicon-carbide grains from "sandpaper." Grain type and size are indicated on the paper back. Try wetting the coated surface of sandpaper with lacquer thinner and scraping grains off with a screwdriver or putty knife. Whatever the abrasive or its source, it is usually mixed with water to make a "soup."

Drill-press speed should be low or moderate for core-type bits. Raise the bit every 10 seconds or so to permit fresh soup to flow over the cutting area. When the hole is almost through, control the feed pressure

carefully to prevent chipping on the underside. Don't become discouraged if this method seems exasperatingly slow. Drilling rate depends on such things as hardness of the material being drilled, grit characteristics and drill rpm.

Carbide-alloy drills

A typical masonry drill that's available commercially consists of a steel shank tipped with a flat piece of tungsten carbide. These bits have two cutting edges at a broad angle to each other. So-called "glass drills" are of similar construction, but the carbide pieces are shaped like an arrowhead, the tip angle being smaller (sharper) and the web thinner at the point.

Such glass bits are particularly suitable for a drill press, and can cut through glass or ceramics at a rapid rate. Somewhat blunter glass bits are also available and are used in handheld drills.

When using carbide-alloy bits, support the glass on a firm surface, such

studded bits. A typical set of Micro-mite drills includes 1-, 1¼-, 1½-, 2- and 2½-mm sizes. Retail price for the set is about \$20. These bits consist of tiny diamond grains bonded to lengths of hardened-steel wire. They always should be used wet, with the workpiece being wholly immersed in water or a special drilling fluid.

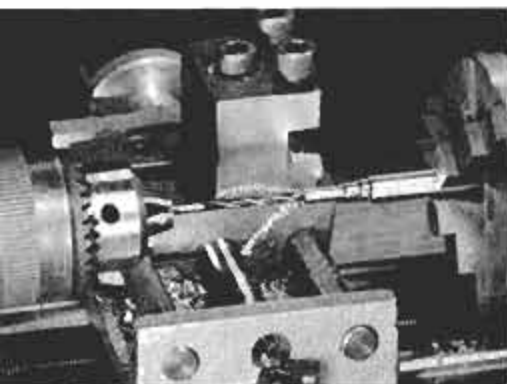
Sometimes a dam is constructed around the workplace to hold the fluid. This dam is formed with a caulking material (such as Mortite) or anything else that will make a water-retaining cup. The bit should project from its chuck no more than necessary to reach the desired hole depth.

A small, variable-speed hand grinder is suitable for driving diamond bits in the workshop. The manufacturer of Lapcraft Micromite diamond drills, however, has suggested that they be powered by a Dremel variable-speed Moto-Tool mounted on its drill-press stand. When drills are handheld, it is difficult to drill in small, hard objects with precision,

but a drill press does make it easy.

To master the technique of using diamond bits, apply pressure carefully to the workpiece until the bit "bites." Then the bit will run without jumping or crawling sideways. Drilling pressure is increased until the drill really starts cutting, as indicated by the appearance of cloudiness in the fluid. Be careful not to apply too much pressure. If the motor slows down, reduce pressure at once: Prolonged pressure can overheat and damage the drill bit. The bit should be backed out frequently—say, every 10 seconds or less—so fluid can refill the hole to cool the tip and clear away loosened solid material.

Make sure the workpiece is supported firmly enough to keep it from shifting, tilting or being grabbed by the drill bit. In the bottom photo on this page, a plastic typewriter-ribbon box was fastened, with caulking material, on a piece of aluminum. This forms the reservoir. One end of the aluminum is under a metal bar



Brass bits are made on a metalworking lathe. A center hole is being drilled ½ in. deep in a ¼-in.-dia. brass rod. Core bits of this type cut slowly but effectively.



A ¼-in.-dia. hole is drilled in the bottom half of a glass jar, using a drill press with a brass bit and abrasive compound.



This ¼-in. tungsten-carbide bit mounted in a drill press can easily drill through ¼-in. plate glass in several minutes.

as wood or hardboard, and clamp it securely. Keep the carbide cutter lubricated; a few drops of turpentine serve as a good lubricant. Run the press at moderate speed, and feed the bit carefully to prevent overheating and possible glass breakage. Although the bit can pass easily through the glass, there's a chance that it will cause chipping around the hole as it emerges. To decrease this possibility, turn the glass over as soon as the drill tip emerges (set the depth stop first) and finish drilling from the second side.

Various sizes and shapes of solid-carbide drills are available from tool suppliers for \$4.50 to \$10 each.

Diamond bits

For drilling small, hard gemstones and the like, I recommend diamond-



Drilling in stones is done with the Dremel variable-speed Moto-Tool and drill-press stand (No. 210), used by many jewelers.

clamped through table slots with 6-32 bolts. Stones can usually be anchored firmly to the box bottom with caulking material, and further steadied with your fingers.

As in all shop work, take precautions—wear safety glasses while drilling and gloves while handling glass and glass particles. **PM**

SOURCES—DRILLING MATERIALS

Carbide glass drills: Edmund Scientific Co., 7082 Edscorp Bldg., Barrington, N.J. 08007.

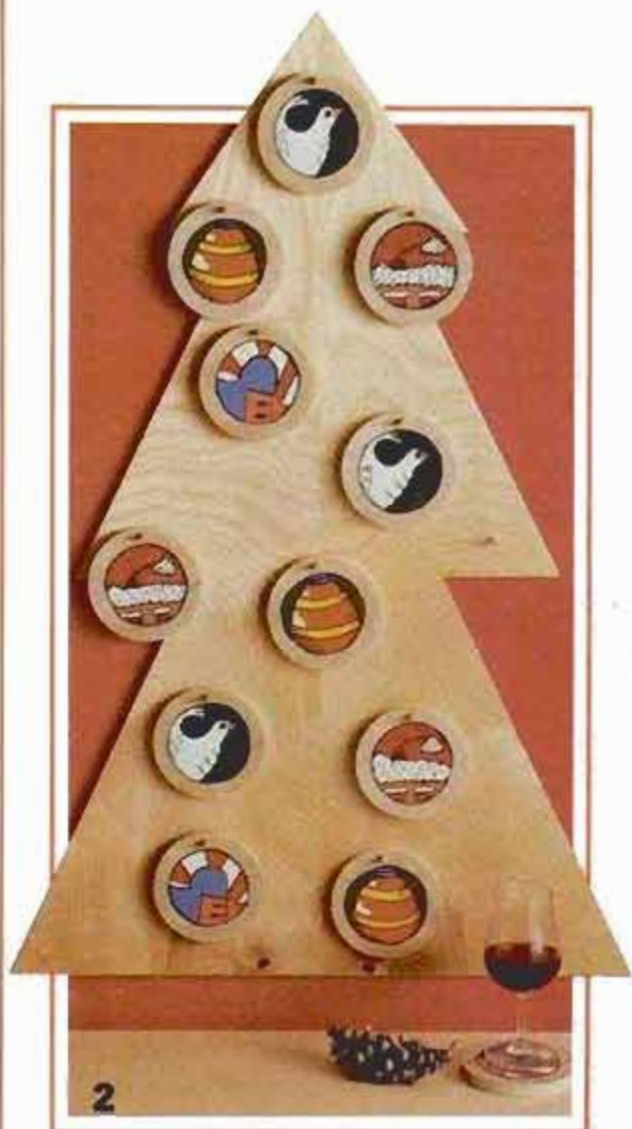
Tungsten-carbide drills and solid carbide for steel: Ash & Co., 5100 Grand River, Detroit, Mich. 48206; Brookstone Co., Brookstone Bldg., Peterborough, N.H. 03458.

Diamond drill bits, diamond core drills, drilling fluid and Dremel Moto-Tool drill press: The Lapcraft Co., Box 389, 195 West Oletangy St., Powell, Ohio 43065.

Aluminum-oxide and silicon-carbide abrasive grain: Carborundum Co., Niagara Falls, N.Y. 14302; the Norton Co., Worcester, Mass. 01606.

Light and color

PM's best-ever Christmas



Quaint village shops, with their windows illuminated by miniature

Village shops display their Christmas wares in the windows. You can cut out the gaily painted art (far right) to give a professional touch to your project. After painting the buildings, secure the cutouts using a thin bead of white glue around window perimeters; then apply window trim as in the drawings that follow. A dab of mineral oil applied to the artwork will increase translucency. The other side of the page is clear of type to ensure an uncluttered view through the "windows."



make Christmas spectacular

decorations incorporate a rainbow of colors and several festive lighting techniques.

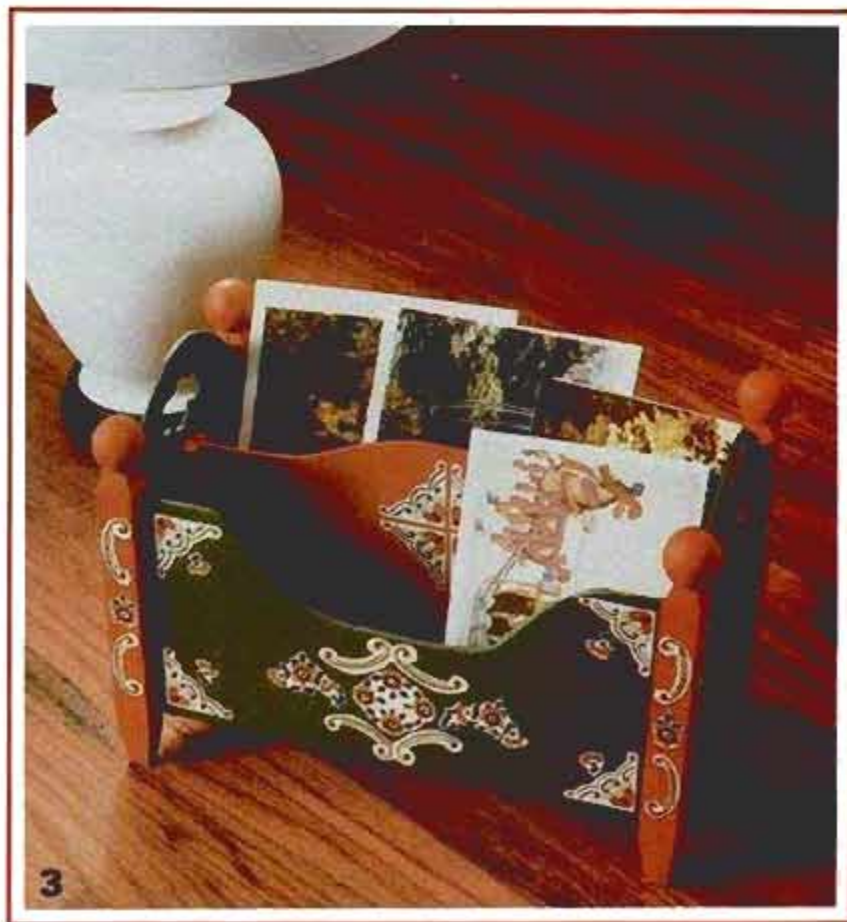
by Penelope A. Spangler
ASSISTANT HOME AND SHOP EDITOR

The approaching holiday season and its festivities give us the opportunity to celebrate with friends and family. This year, PM's Christmas decorations reach out with color and light to help provide a convivial Yuletide setting for your gatherings.

On the contemporary side, we show you how to make a natural-finish welcome wreath for your front door, and a Christmas-tree wall hanging with colorful coasters as decorations.

We've borrowed from tradition, in our rendition of an English village to light up your fireplace mantel, and our antique-looking Christmas-card box. The metal decorations are also steeped in history, as diverse as the Aztec-sun tree decoration and the American folk-art sconce.

You can make any of the decorations, which will become part of your family tradition, by following



1 Give your guests a holiday welcome by hanging this wooden wreath on the front door. A strategically focused floodlight accents the message.

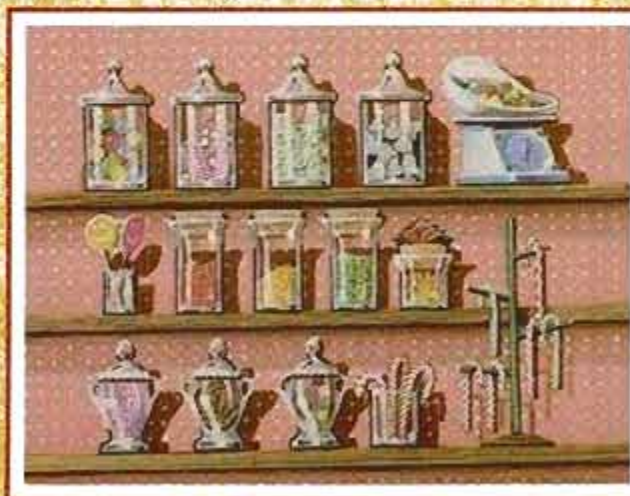
2 The colorful decorations on this Christmas-tree wall hanging also serve

as handy drink coasters for your holiday cheer.

3 Display your Christmas cards in style with our wooden box. Its shape is adapted from cradles commonly used in the southern provinces

of Sweden during the 19th century. **4** Shops come alive at Christmas in our English village designed for a fireplace mantel. Windows are covered with frosted paper or drawings (below) and lighted by miniature lights.

Christmas lights, will brighten a fireplace mantel





5 Mexican-style Christmas decorations are painted in brilliant colors with glass-stain paints.

6 Chamber candlestick is reminiscent of those used on Christmases past.

7 Heart-shaped sconce is adapted from 19th-century folk pieces crafted by tinmiths in the eastern United States.



the construction directions given here.

Before you begin work on any project, assemble all the materials you'll need. Sources for hard-to-locate materials are noted at the end of the instructions for each decoration.

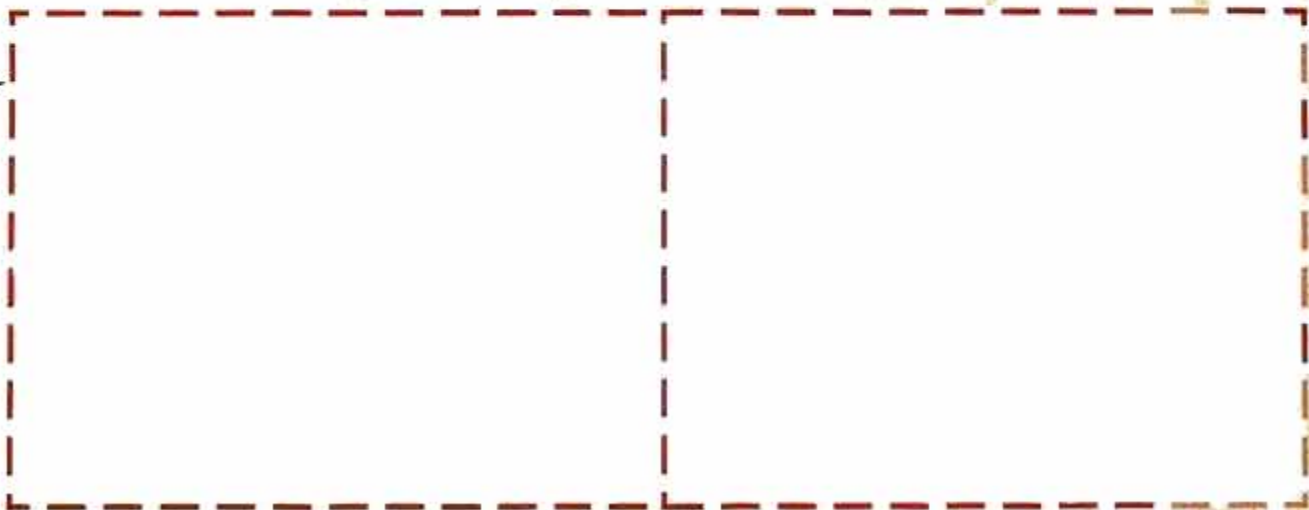
Before applying finish to the wood projects, sand them smooth, finishing up with 150-grit abrasive paper. Dust and wipe with a tack cloth.

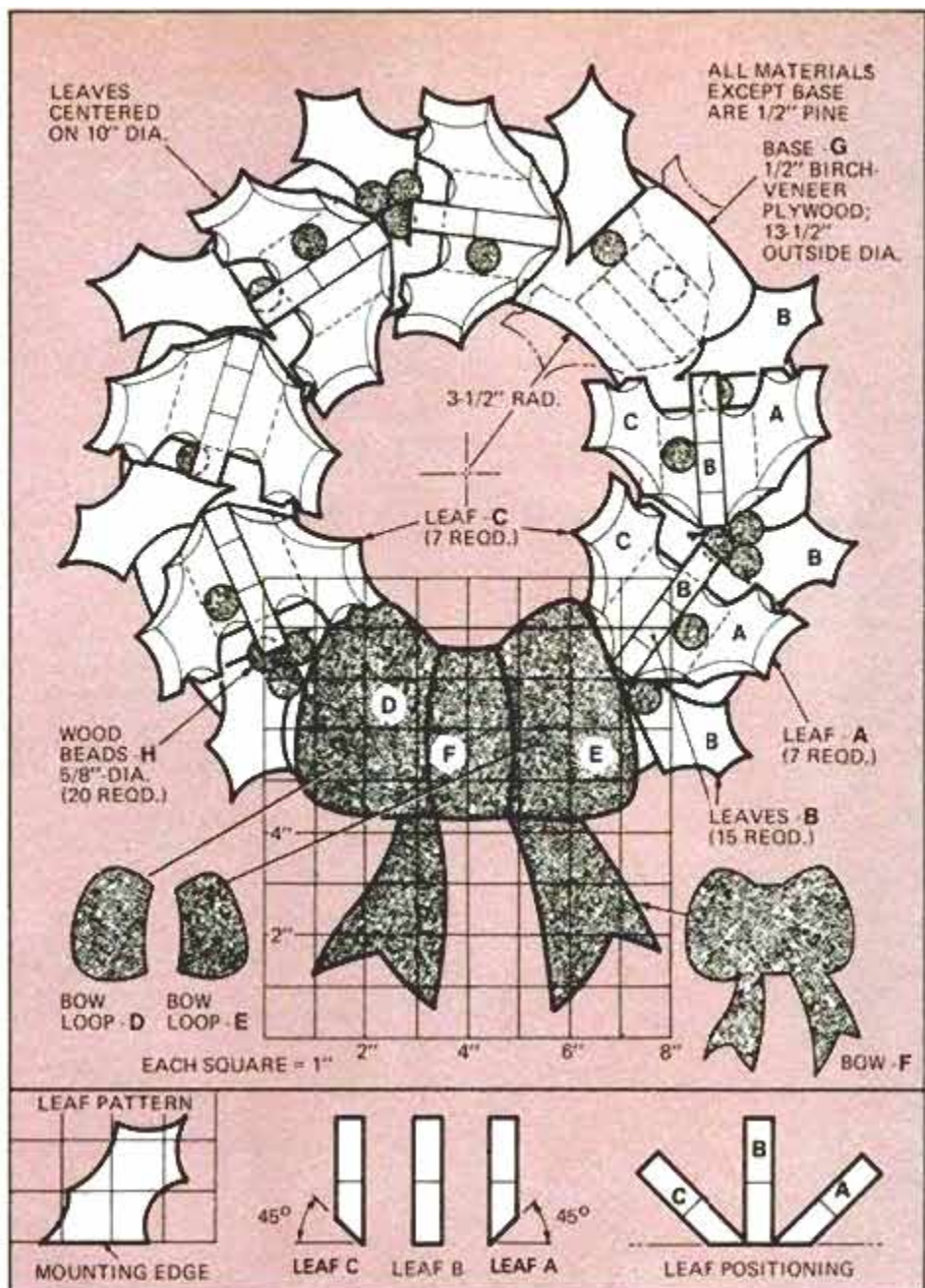
Apply a sealer-primer such as Bin or Enamelac before you paint a decoration. Let it dry overnight, then sand lightly with 180-grit abrasive; dust, wipe with a tack cloth.

Apply the finish colors of your choice, using the color photos on these pages as a guide. If you use latex paints, protect the finish with a coat of satin-finish varnish.

Designs: No. 1, Suzy Taylor; Nos. 2, 5, Douglas Eisman; No. 3, Stan Duna; No. 4, Bette Foster; Nos. 6, 7, Jack Cunningham, The Saltbox Shop-window illustrations: Jeff Mangiat
PM color photos: Harry Hartman
Technical art: Eugene Thompson

Cutouts of village store windows on reverse side





1 Holly wreath

All leaves on this holly wreath are cut from the same pattern. Then they're left flat or given a 45° right or left bevel on their mounting edges, so they slant at different angles.

1. Cut out the doughnut-shaped plywood base with a scroll or sabre saw. File and sand the inside and outside edges as needed.

2. Draw the leaf pattern full size on a scrap of 1/8-in. hardboard or on the pine stock you plan to use for the wreath leaves. Cut out this shape carefully with a band or scroll saw for use as a template to make the rest of the leaves.

3. Cutting the leaves is the most time-consuming part of the project. However, it isn't difficult if you break down the job in the following manner:

Rip four boards, 3/4 x 2 1/4 x 20 in. Set the blade of a table saw to a 45° angle and bevel one edge of two boards. Place the template so its mounting edge aligns with the beveled edge of one of the boards; outline the template to make seven leaves (leaves A, see drawing). Flip the other beveled board over and position the template to make seven leaves C. The remaining 15 leaves (B) have flat mounting

edges. On a band or scroll saw, finish cutting the leaf shapes. It is easiest if you take time to separate the leaves into groups of two, beforehand.

4. Sand the leaves smooth with 150-grit abrasive paper, dust them, tack them off and put them aside.

5. Carefully draw 1-in. squares on pine stock and sketch in the three parts of the ribbon: the base and the left and right loops (D, E, F).

6. Cut out the three parts using a band, sabre or scroll saw.

7. Assemble all the parts with resorcinol glue.

8. The next day, smooth the surfaces with 150-grit abrasive.

9. When you space the parts for assembly, draw a centerline on the base with a compass. This helps place the center leaves. Test-fit the ribbon, center the upright leaves and the flat leaves; the side (beveled) leaves will fall in line.

10. Glue the upright leaf and the two side leaves, one group at a time. Continue gluing until all leaves are in place; don't glue the ribbon yet.

11. When the glue is dry, finish the wreath with a brush-on polyurethane for use outdoors,

or use Flecto Varathane Clear Plastic in a satin finish.

12. Paint the bow, using either an exterior enamel paint or red Flecto Varathane colors in plastic.

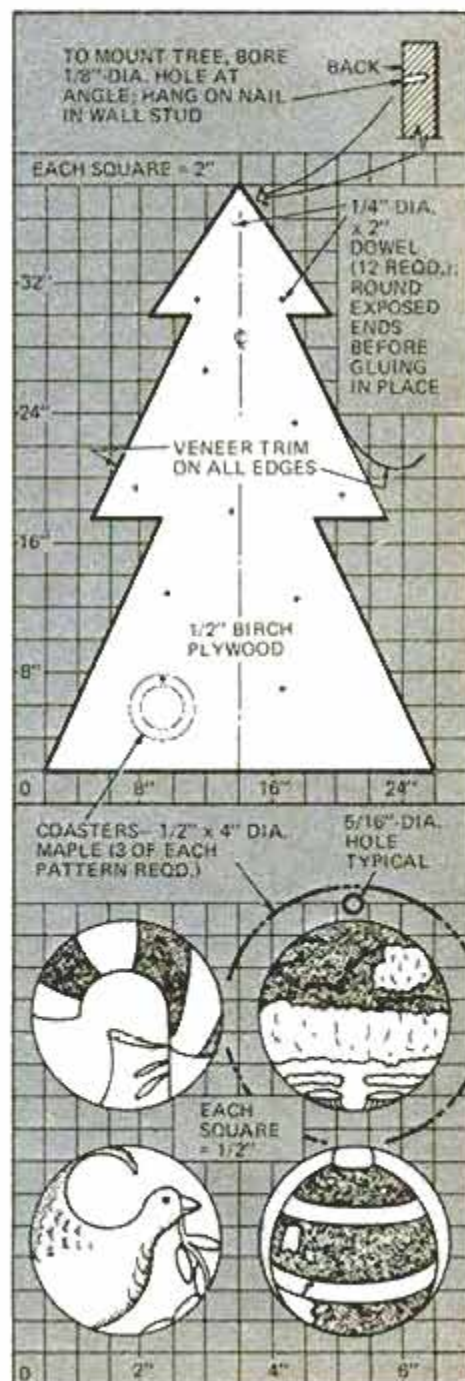
13. The next day, glue on the ribbon. Sand the red beads flat at their attachment points and glue them in a random pattern.

2 Coaster tree

To give the tree a distinctive grain pattern, you may want to use plane-sliced birch veneer plywood as shown in the photo of the finished tree on page 114.

1. With a T-square and a yardstick, draw the tree directly on the plywood. Use the seam of plane-sliced veneer plywood as the centerline, or if you use standard-veneer plywood, locate a centerline.

2. Cut out the tree with a sabre or circular saw.



3. Sand the edges smooth and square with 100-grit, open-coat abrasive paper wrapped around a block of wood.

4. Apply the veneer trim with white glue. To secure the trim while the glue dries, first cut 1/2-in.-thick boards for clamping against the positioned trim. Cover the adjoining face of each board with masking tape. After you have applied glue to the plywood surface and pressed the veneer in place, press the masked board in place and secure it with masking tape until the glue has dried.

5. Sand the entire piece with 150-grit abrasive paper, then dust and tack off.

6. Locate and bore 12 dowel holes 1/4 in. deep. Also bore a hole on the back of the tree for hanging it. Before cutting each dowel to size, round the exposed end with sandpaper.

7. Glue the dowel pegs in place.

8. Finish with two coats of polyurethane varnish, lightly sanding, dusting and tacking between coats.

9. To make the coasters, glue two pieces of 2 1/4 x 4 1/4 x 15-in. maple and clamp them together securely to make a piece 4 1/4 in. square x 15 in. long.

10. Mount the block on a lathe, centering it at both ends.

11. Shape the block into a 4-in.-dia. cylinder. Smooth with 100-grit abrasive paper.

12. Separate the coasters on a table saw, holding one end flush with the fence.

13. Locate and bore the attachment holes.

14. Sand all surfaces smooth with 150-grit abrasive paper, dust and wipe with a tack cloth.

15. Locate and draw a circle the size of each design in the center of each coaster.

16. Apply a coat of white acrylic to this area to seal and prime it.

17. With a pencil, complete the grid in the magazine, so it continues over the patterns.

18. On paper, draw the grid full size and sketch in each pattern.

19. Cut out the disc patterns and cut a disc of carbon paper the same size.

20. Using the carbon paper, transfer the patterns onto the coasters.

21. Paint the areas with colored acrylics and a No. 1 brush. Let them dry.

22. Define the shapes and shade areas with a permanent-type black marker.

23. Finish the coasters with two coats of gel medium for acrylics. Apply finish on the entire coaster, front, back and sides. Apply finish to seal coasters against moisture and warpage.

3 Christmas-card box

1. With a pencil, complete the grid over the box pieces in the magazine drawing.

2. On 1/4-in. hardboard, carefully draw a full-size grid of 1/2-in. squares.

3. Draw in the outline of the divider, an end and a side, using the drawing in the magazine as a guide and the dimensions given on the exploded view as a check.

4. Cut out the three parts mentioned above on a band, scroll or sabre saw for use as templates. Make the interior cutout on the end by boring four holes with a 3/8-in.-dia. bit, centered and tangent to the four concave curves of the cutout; clear waste with a rasp.

5. File and sand all edges smooth.

6. Trace around each template as you hold it in place on the plywood. Make two ends, two sides and a divider.

7. Cut the parts with the same saw you used to cut the templates; also cut the end cleats, side cleats and bottom. Make the interior cut-outs on the ends.

8. Sand the plywood smooth.

9. Cut the four posts and two retainers to size on a table saw.

10. Carefully center and bore holes in the post tops for the wooden drawer-pull attachments.

11. Taper the sides of the posts near the top and bottom with a plane. You can line up the posts and taper one side of each at the same time. Turn the posts until the tops and

bottoms of all sides are gently tapered.

12. Raise the blade of the table saw to 1/4 in. and cut the grooves in the posts and retainers. Sand parts smooth.

13. Fill the drawer-pull hole with a wood filler; position the dowel in the hole and let the filler dry.

14. Carefully line up the center retainers and glue them in place; also glue the end cleats in place and let dry. Make sure there's space between the retainer and the end cleat for the bottom.

15. Fasten the drawer-pull dowel into the post hole with glue and let dry overnight.

16. Test-fit parts. Fit the bottom between the ends, add posts and sides, and fit the divider in its grooves.

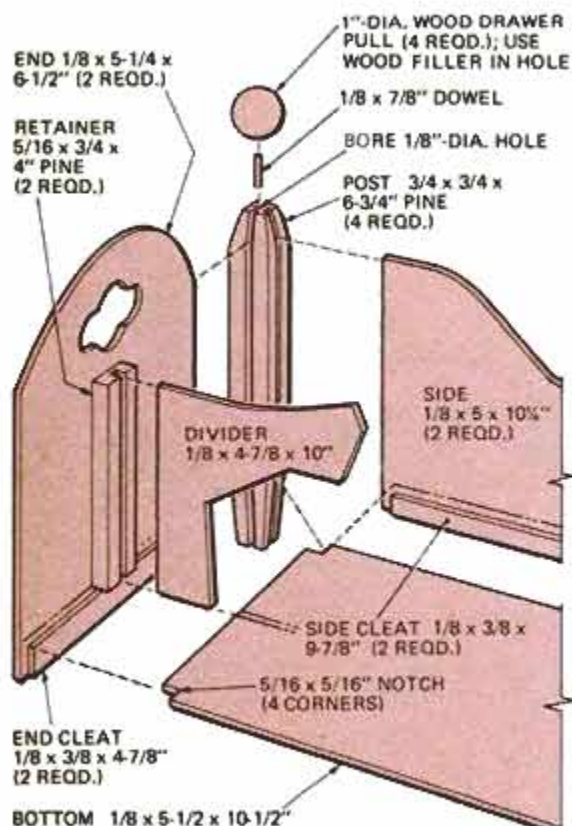
17. Lightly sand, dust and wipe with a tack cloth before applying a pigmented shellac to all parts. Be careful not to get the shellac in the saw kerfs and on joining edges.

18. Paint parts with latex paint, keeping the kerfs and edges clear before assembling them.

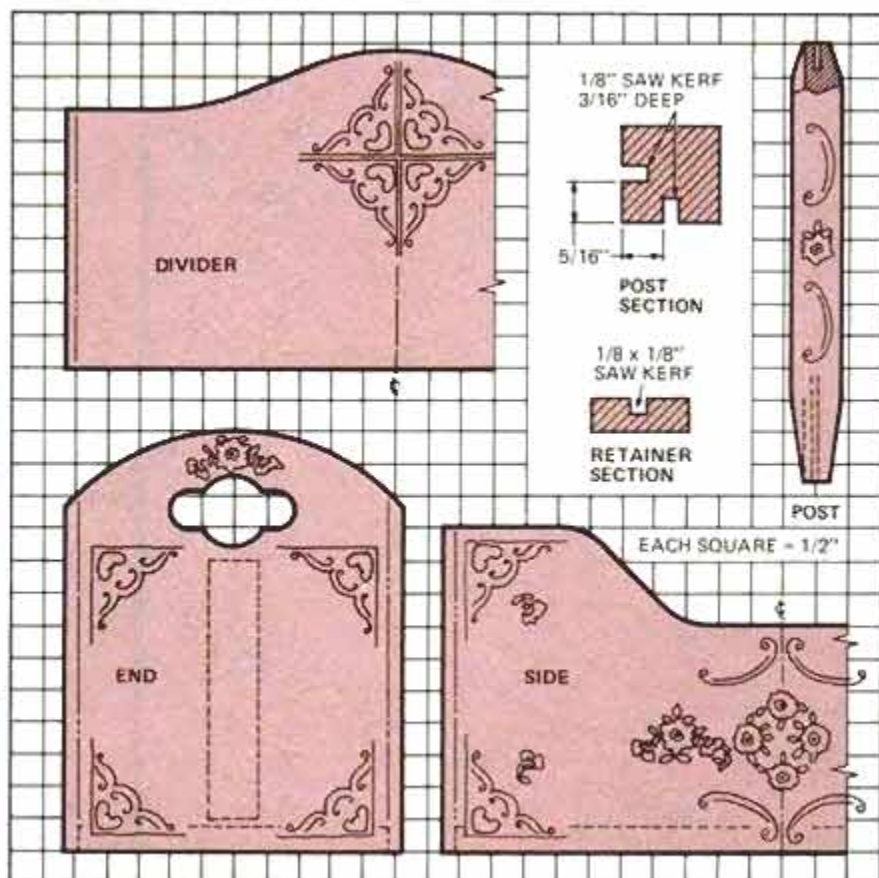
19. When dry, assemble with glue in the same order that you test-fitted parts in Step 16. Wrap a string around the box to keep parts in contact until glue sets.

20. When dry, apply several coats of satin-finish polyurethane varnish.

21. Finally, decorate with a self-adhesive plastic in your choice of flower patterns.



ALL PARTS 1/8" LAUAN PLYWOOD UNLESS OTHERWISE INDICATED; ASSEMBLE WITH GLUE





4 English village

1. With a pencil, T-square and rule, draw the building shapes on $\frac{1}{8}$ -in. hardboard. Locate the windows and draw them, as well.
2. Cut out the shapes with a band, scroll or sabre saw. Cut out the windows with a scroll or sabre saw. File and sand all edges smooth.
3. Place the templates made in Step 2 over $\frac{1}{8}$ -in. birch plywood; outline the building shapes and window cutouts.
4. Cut out the shapes with the same saw you used to cut out the templates; also cut the window holes. Cut the three bases used to keep the buildings upright.
5. File and sand all edges smooth. Attach the bases with glue and countersunk nails; fill holes with a wood filler.
6. Sand the wood smooth, dust and wipe with a tack cloth. Then apply pigmented shellac to seal and prime the pieces.
7. Next day, lightly sand, dust and tack off residue. Paint the buildings and the roofs; also

paint strips of balsa before cutting to size for window trim; let paint dry.

8. Apply two coats of polyurethane varnish.

9. Cut out all tape strips and apply them as needed to the buildings, using the color photo as a guide.

10. Apply press-on lettering for each building to a strip of colored paper. Cover the lettering with transparent tape to protect it. Then attach it to the building face.

11. Cut out frosted acetate for the windows; cut it oversize, so you can attach the material to the building. Apply tape strips for window panes. Cut out the magazine drawings for use in the windows. Apply a bead of white glue to buildings and secure windows in place.

12. Cut the balsa trim strips to size. Touch up ends with paint and glue the strips in place.

13. As a finishing touch, paint on doorknobs. Also, color paper candy canes and door wreaths and secure them in place.

Note: Press-on lettering is available at art-supply stores. We used 35-point Italia Bold on the inn and toy shoppe and 36-point Bookman Bold on the confectionery.

5 Tin ornaments

You can create dozens of these ornaments with one 4x4-ft. sheet of aluminum and a handful of glass stains.

1. With a pencil, continue the grid over the three patterns shown in the magazine.

2. On paper, draw the grid full scale and sketch in the patterns. Then cut out the shapes. Make as many identical patterns as you plan to make decorations.

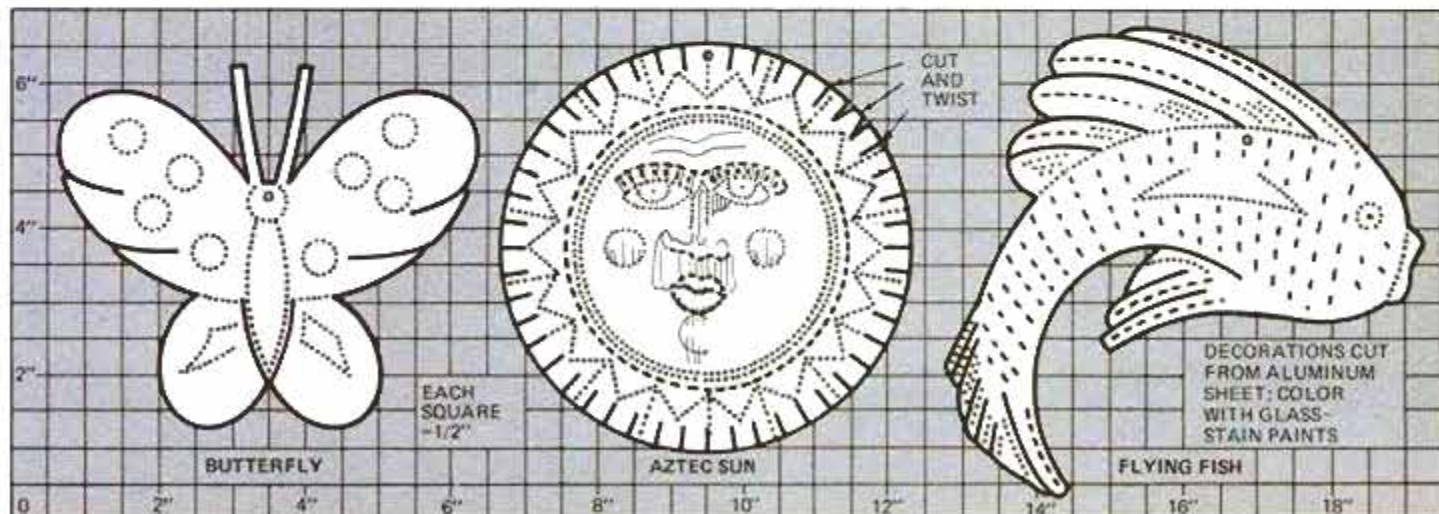
3. Tape the pattern onto the metal and cut out the decoration.

4. Place the metal on a scrap of wood. File the point off a common 6d nail. With the pattern still taped over the metal, use the nail to create texture and define lines. To use the nail, position it and give it two quick taps with a hammer at each point to be marked.

5. Remove the pattern and texture any spots that need it.

6. Clean the surface with 4/0 steel wool.

7. Paint the surface with glass-stain paints and let dry.



8. Use a permanent-type black felt marker to accent the details.

9. Bend the metal to create curvatures, such as those on the body of the flying fish.

10. Use a sharp nail to hammer a hole for hanging.

Note: Sheet aluminum, such as Reynolds Do-It-Yourself aluminum, is available in hardware stores and home centers. Glass stains are available in hobby and craft stores or by mail from American Handicrafts, Box 791, Fort Worth, Tex. 76107.

6 Chamber candlestick

1. Use a metal rule, compass and scribe to lay out the four candlestick parts on 25-ga. tinplate according to the dimensions in the drawing.

2. Cut out the parts with tin snips or aviation snips. Hammer edges flat and file them smooth if needed.

3. The handle, candle sleeve and candle-plate base require folds. The ideal way to make them is with a bar folder. However, you can achieve good results by lightly scribing the fold line and following the three "Steps for Folding Edges" shown below: 1. In a vise, sandwich the area to be folded between two hardwood blocks, one having a beveled edge; line up the blocks with the fold line. 2. Use a wooden mallet to tap along the fold to bend the metal over the bevel. 3. Remove the metal from the vise and reposition the blocks to sandwich the double thickness of the fold; slide the sandwich in the vise and slowly apply pressure until the metal fold is flat. Repeat until all seams are made.

4. To flute the edges of the candle plate, follow the "Procedure for Bending Flutes" shown in the drawing. Lightly scribe a centered, 2 1/4-in.-dia. circle on the plate. Use a protractor to divide the plate into 18 sections, spaced 20° apart on the circumference. Flute the plate with

needle-nose pliers. Secure the pliers in a vise as shown. Hold the plate over the pliers, hands on both sides of the plate, with pliers directly beneath a plate mark. Press down on both sides of the plate until it forms a flute in the center. Work clockwise, making sure the flutes have equal depth.

5. Bend the candle-plate base around a 2-in.-dia. pipe or other cylinder.

6. Bend the candle sleeve around a 3/8-in.-dia. dowel.

7. Bend the end of the handle around a 3/8-in.-dia. dowel to form a loop.

8. Brush on liquid-acid flux and use an 80-w. soldering iron and 50-50 solder to solder ends of candle-plate base; use solder sparingly.

9. Flux and solder base to candle plate.

10. Flux and solder candle sleeve in place.

11. Flux and solder handle to base.

Note: To locate tinplate, look in the Yellow Pages under "Sheet Metal-Working Equipment and Supplies." For tinplate stock to make this project, send \$2.95 postpaid to: Chamber Candlestick, c/o The Saltbox, 2229 Marietta Pike, Lancaster, Pa. 17603. For preshaped tinplate parts, send \$4.95 postpaid to the above address; lighting catalog, \$1.

7 Heart sconce

1. On cardboard, carefully draw a grid and sketch in the heart shape shown below.

2. Cut out the heart shape for use as a template.

3. Position the template on 25-ga. tinplate and scribe the outline. Use a metal rule, compass and scribe to lay out the candle sleeve, plate, arm and two hanger pieces.

4. Cut out the parts with tin or aviation snips.

5. Group the four parts that must have side folds as noted in the drawing. To make the folds, see Step 3 of the candlestick project.

6. To form the fluted edge on the candle plate, see Step 4 of the preceding project.

7. Shape the candle sleeve around a 3/8-in.-dia. dowel.

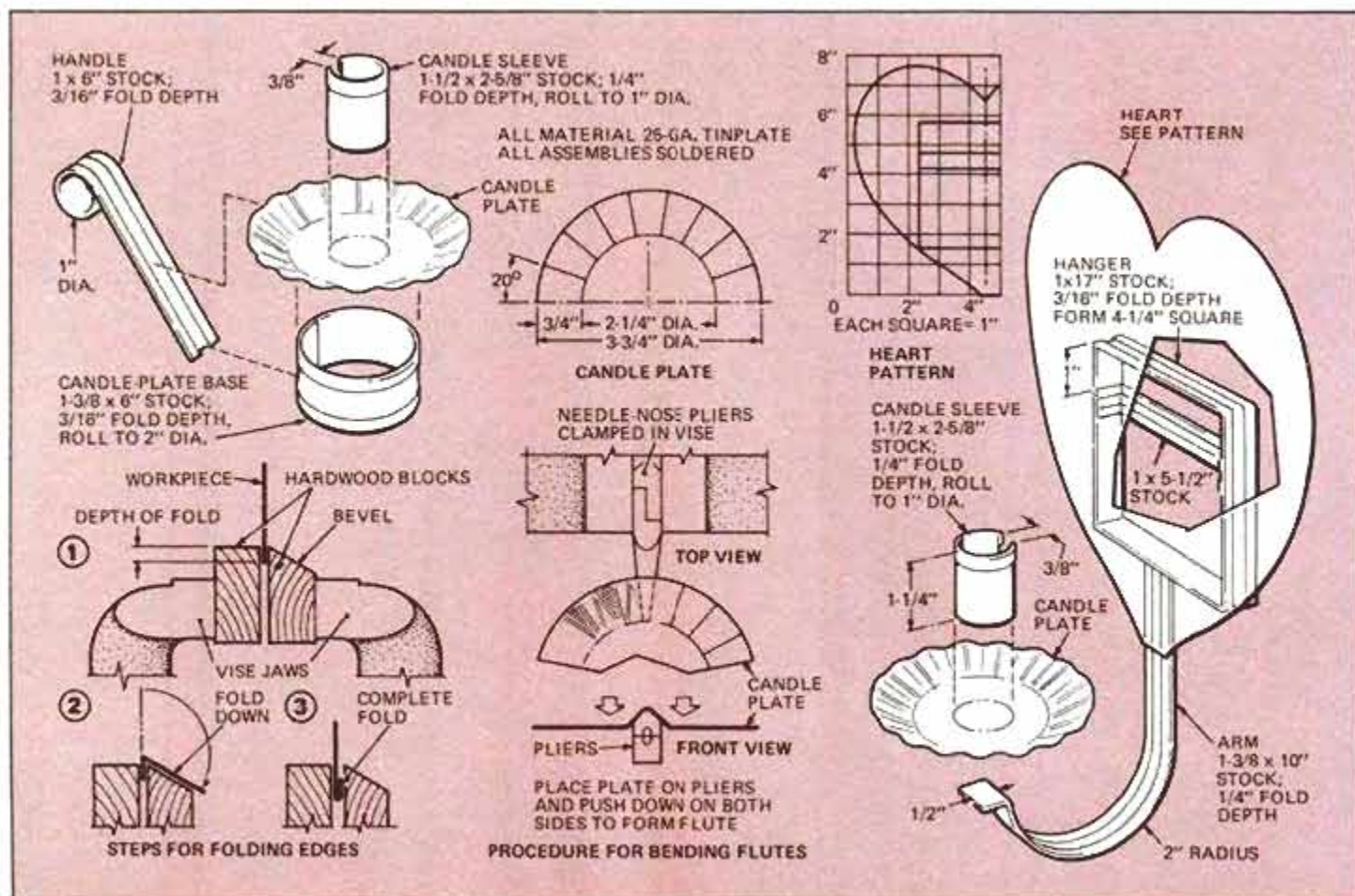
8. Press the arm of the sconce over a 2-in.-dia. pipe to form the U shape.

9. Bend the tip of the arm and the support parts in a vise to shape.

10. Flux and solder parts together in this order: candle sleeve to candle plate; candle plate to arm; arm to heart; hanger pieces together and to the arm and heart.

11. To give the sconce an antique appearance, apply gun bluing with a soft cloth. Gun bluing is available at sports shops.

Note: To locate tinplate, check the Yellow Pages under "Sheet Metal-Working Equipment and Supplies." For tinplate to make this project, send \$3.45 postpaid to: Heart sconce, c/o The Saltbox, 2229 Marietta Pike, Lancaster, Pa. 17603. For tinplate parts already shaped and ready to solder, send \$5.95 postpaid to above address; lighting catalog, \$1.



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Old-time Riverboat Playing Cards

Both of these decks are prettier than a painting, and so is the antique tin card case. Each card is a bit larger and thicker than normal—like those used on riverboats in the 1890's. There's a black and a green deck—both with an antique gold "distillery design." The face cards are reproduced from 100-year-old artwork. So it's a real unusual set of cards for the serious player. Twin deck in antique case. \$8.50. Postage included.

Send check, money order or use American Express, Visa or MasterCard, including all numbers and signature. (Add 6% sales tax for TN delivery.) For a color catalog full of old Tennessee items and Jack Daniel's memorabilia, send \$1.00 to the above address in continental U.S. or call 1-800-251-8600. Tennessee residents call 615-759-7184.

PIPER CUB

(Continued from page 92)

needed anyway—in any kind of headwind, an E-2 was no match for a fast-moving freight train.

Up in the nose perched a flat, horizontally opposed, four-cylinder Continental engine rated at 37 hp. The round, black cylinder heads protruded from the sides of the cowling like the eyes of a giant prehistoric bug—good for cooling purposes, if not for a svelte appearance. (Cubs weren't supposed to be sleek and sexy; they were supposed to fly, and that they did marvelously well.)

An early STOL aircraft

The Cub was a STOL aircraft before the term STOL (Short Take Off and Landing) was even invented. Although early models had no flaps, a Cub with its big, high-lift wing could take off in 300 feet—the length of a football field—and land in half that space at a leisurely 35 mph.

The Continental engine burned three gallons an hour and on a good day could manage a cruise speed of about 75 mph. Given this combination, operating costs worked out to around a third of a cent a mile. A Cub weighed 925 pounds, and you could fly one away from the Piper factory for just \$1,325—less than half the price of a brand-new '31 Packard. (A later-model Cub actually sold for just \$995.)

In short, the E-2 Cub was just what William Piper had commissioned from his partner, famed aircraft designer C. G. Taylor. Taylor had sold the assets of his bankrupt Taylor Aircraft Corp. to Piper for \$600 in 1931, agreeing to stay on as partner and chief designer. Piper was a Pennsylvania oilman who knew little about flying except that it had priced itself out of the reach of most Americans. He hoped to do for aviation what Henry Ford had done, for the automobile.

As with Ford's Model T, which came only in black, you could have your Cub in any color you wanted—so long as it was yellow. Piper considered the color's high visibility to be thoroughly appropriate on two counts: It would serve the interests of safety in the air and, at the same time, help to advertise the Cub's presence to potential customers on the ground—both worthy objectives, whether you happened to like yellow or not.

Despite its low price, the Cub was not an instant success—Piper sold only 17 in 1933. Times were bad. The nation was in the midst of a depression, and not many people had the money for frivolities like airplanes.

A shoestring operation

In its early years, the Piper/Taylor partnership was very much a shoestring operation. Cub engines were shipped to the Bradford Railway Express office, where they remained until Piper could pay for them. When a customer arrived at the factory to take delivery of a Cub, Piper would graciously accept his check and usher him into his office for coffee while he took care of "a few details."

While the office staff distracted the customer, Piper would race to the bank, cash the check, pick up an engine at the express office and dash back to the factory. The engine would be hastily bolted onto the purchased Cub and the plane "test-flown" once around the field. Finally, after finishing his fifth cup of coffee, the customer would then be ceremoniously presented with his new airplane.

While the Cub was a superb design aerodynamically, its biggest liability during the first few years was its engine: It failed with embarrassing regularity. An E-2 rarely flew more than 20 miles without making a forced landing. The Continental A-40, as the culprit was called, would self-destruct without provocation or warning. Gaskets blew, magnetos died, crankshafts tied themselves into knots—often at very awkward moments.

On one demonstration flight for a prospective customer, Piper and his passenger wound up in a ditch—unhurt but not happy. But such incidents, though not the sort of publicity that Piper preferred, only testified to the safety of the Cub's basic design and the resiliency of its airframe.

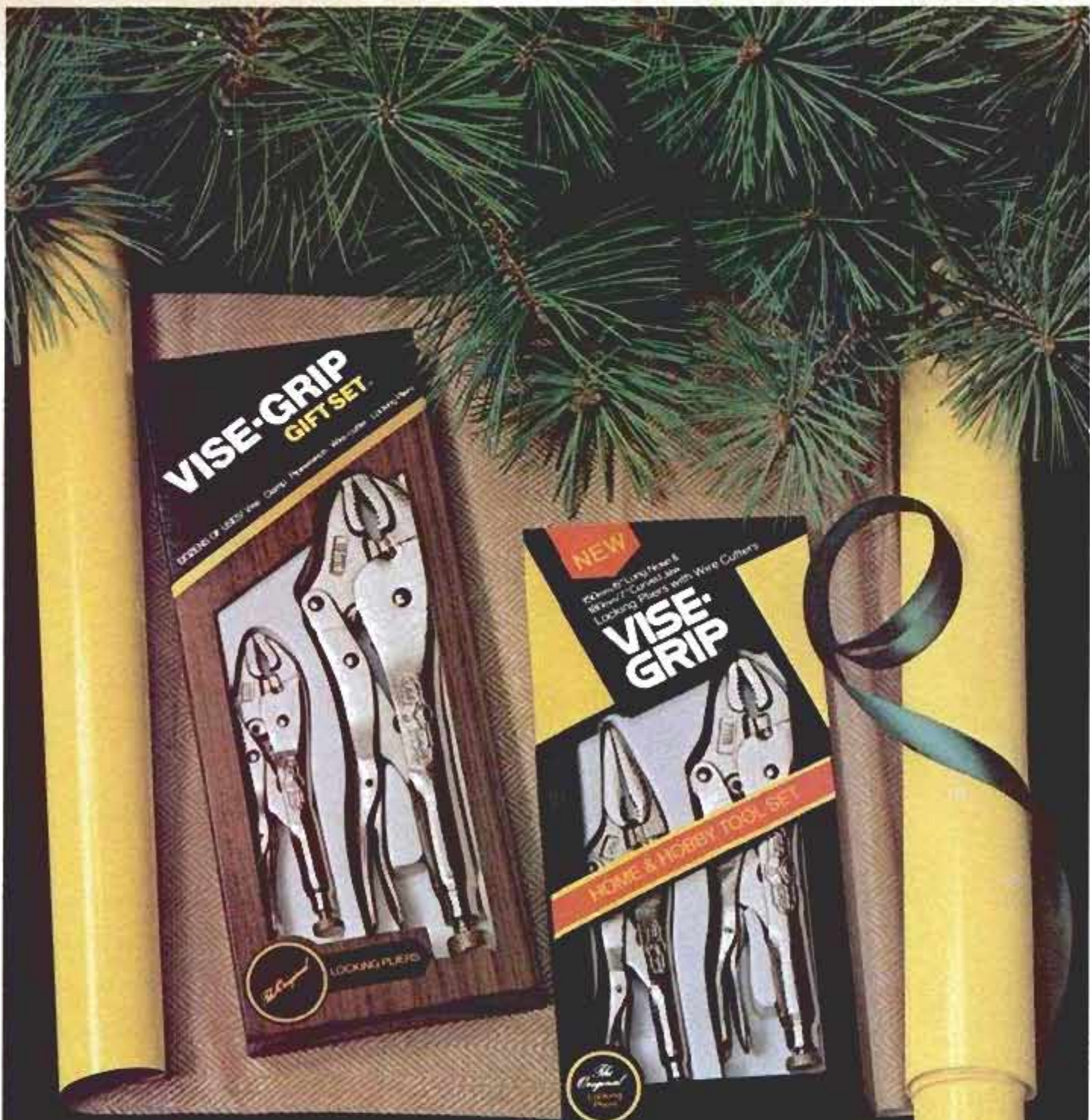
Forced landings were easy

The Cub had perhaps the safest stall characteristics of any airplane ever built. Forced landings were not really a problem for a craft with a stall speed of around 35 mph. With a little headwind, a skilled pilot could make a power-off, dead-stick landing in less than 100 feet—without brakes!

And the Cub was virtually spin-proof; hence it made an ideal trainer. Even if a student did manage to get one into a spin, recovery was a simple matter: Power off, hands off the stick, feet off the rudder pedals, and the Cub would fly out of it all by itself.

In 1934, Continental redesigned the A-40 engine, and Piper's fortunes began to grow along with the

(Please turn to page 124)



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Cub's improved reliability. By 1936, annual sales had climbed to 500. This was the first year of the new J-2 model, which featured an enclosed cockpit.

Cub distributorships sprang up around the country, and the J-2, in its now-familiar yellow paint, began to make a name for itself at small-town airshows, performing such hair-raising antics as landing on top of speeding cars—a stunt that continues to thrill spectators at country fly-ins. A Cub became the first light

plane to execute a complete outside loop.

The slingshot caper

The Cub always put on a good show, and sometimes its quixotic capers bordered on the unbelievable. One Cub distributor is said to have demonstrated the plane's remarkable short-field abilities by flying it out of a small back-yard clearing surrounded by tall trees. His method was ingenious, if a trifle precarious. With the craft tethered to a

pole by a cable, he would race around in circles until gaining flying speed, then cut loose the cable and sling himself over the treetops, frequently in a shower of leaves clipped off by his landing gear.

Thanks largely to Hitler and the threat of approaching war, Cub sales really took off in 1939. The nation needed trained pilots, and the Cub was just the airplane to teach them in. Nearly 2,000 Cubs were sold that year.

Meanwhile, the Cub continued to improve. In 1937, Piper introduced the now-legendary J-3 Cub Sport, by far the most common of the prewar Cubs still flying today (14,000 were built). This upgraded version boasted a compass and airspeed indicator—and even came with upholstered seats, though its sole color was still yellow.

Over the next two years, Piper added other embellishments. The Cub acquired brakes for the first time and a tailwheel to replace its skid. By 1939, you had your choice of a Continental, Franklin or Lycoming engine in various sizes up to 50 hp. With the bigger engines, a Cub could climb to 10,000 feet.

In 1939, Piper also brought out the J-4 Cub Coupe and J-5 Cub Cruiser. The J-5, a wide-bodied Cub with room for two passengers on a bench seat behind the pilot, eventually helped spawn a new family of post-war Cubs.

The Cub goes to war

With the coming of World War II, the Cub exchanged its traditional yellow for olive drab and went off to join the Air Corps as one of its L-series liaison aircraft. Designated the L-4 and fortified with a "big" 65-hp engine, it soon earned a reputation as a rugged and heroic warrior on every front—though it actually never fired a shot.

The Cub's low-speed STOL capabilities and near-stallproof safety made the L-4 ideal for military observation. During the Allied assault on Sicily and Italy, it proved so devastating as an artillery spotter that any German soldier who shot one down was rewarded with 15 days' leave, though there's no evidence that many collected.

Because of its greenish color and uncanny ability to hop and hover over treetops, the L-4 was affectionately dubbed the "Grasshopper" by friendly ground troops. Used by officers to get quickly from one scene of action to another, it also became known as the "flying Jeep." During the U.S. drive in the South Pacific, L-4s dropped lifesaving supplies to

(Please turn to page 126)



7:23 A.M.



3:57 P.M.



7:48 P.M.

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William Wescott
Willoughby, Ohio 44094



Husband and wife have a going spare time shop

"I'm a construction foreman, and my wife is a nurse's aide. Our Foley shop fits in nicely with our regular jobs, and we earn extra money. Our sons help out too, so ours is a real family business."

"I'm still too young to retire, but when I do I'll have a very good business built up. Foley equipment helps us to do good work and brings customers back with more jobs on a regular basis... we have a lot of repeat business the year around."

Victor Kosloski
Sturgis, Michigan 49091



Glad he chose Foley for his saw shop

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Victor Johnson
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The sharpening business allows you to get started with only a minimum investment, requiring little space and effort for a successful operation. It lets you build and expand as fast, or as slowly as you like. You pocket most of the money you take in, because there are exceptionally high profits with no investment in merchandise.

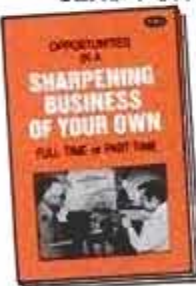
If you need only \$200 or \$400 extra income each month, a sharpening business is ideal for spare time. The additional dollars can be SPENT for more of the good things of life. Or they can be SAVED in a rainy-day fund that the family can bank on.

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isolated troops in jungle foxholes, then returned later to ferry out the wounded.

The Cub could take tremendous abuse, and its toughness spared the lives of many of its pilots. One L-4 pilot flying an observation mission along the Italian coast slammed into the cable of a barrage balloon, slicing off part of his right wing. Unfazed, the plane flew on for three hours.

Following the war, Piper continued to develop new variations of the classic Cub. In 1945, he introduced the PA-12 Super Cruiser, a spruced-up J-5 Cub Cruiser that offered a 100-hp engine and such extravagances as an electrical system and radio. Its cost? Still a bargain at around \$3,000.

The Super Cub, unveiled in 1949, is still in production today, little changed from its historic ancestor. Its major differences: an engine now rated at 150 hp and a price tag of around \$40,000. There have, of course, been a few other changes. Wood spars gave way to aluminum ones in 1946, the airframe has been beefed up, and the bug-eyed look is gone, the cylinder heads now neatly

hidden under streamlined fairings. And you now get a choice of color schemes.

Flying a Super Cub

Probably the most awkward task a Cub pilot faces is getting into his machine—the narrow cabin was not designed for easy access. "There's no graceful way to do it," says Piper demonstration pilot Bob Reinhold. "Just don't put your foot through the fabric."

Once you strap yourself in, you are really quite comfortable. The stick between your knees is just like the one in the original E-2; Piper has not yet gone to the fancier control wheel used in some modern light planes.

The Super Cub is soloed from the front seat, so visibility is superb. Takeoff is really impressive: From a standing start, you're airborne in 200 feet, and you climb out like a monkey scrambling up a coconut tree—at nearly 1,000 feet per minute. Communication between passenger and pilot consists mainly of taps on the shoulder and an occasional shout; the Cub is not well insulated against noise.

Try a stall and you'll be amazed.

With the flaps extended, the Super Cub stalls at around 43 mph. But you'd hardly know it. First comes a mild buffet and then—nothing. The nose doesn't pitch down, and there's no tendency to drop a wing. Hold the stick all the way back and the Cub just oscillates gently as it gradually loses altitude. A good pilot can put a Cub down in 300 feet of pasture.

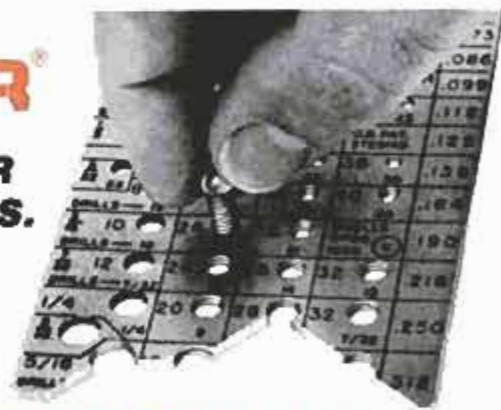
Like the L-4 in World War II, the Cub's low stall speed makes the plane ideal for aerial observation work, such as patrolling highways, spotting forest fires and riding herd on cattle. "Against a moderate headwind," says Reinhold, "you can hold your position relative to the ground just like a helicopter."

More than 33,000 sold

While Piper never quite realized his dream of seeing a Cub in every back yard, he hasn't done too badly. Over their 50-year history, more than 33,000 Cubs, in one form or another, have been built and sold. And the Cub's production run, unbroken over five decades and still going strong, represents the longest in aviation annals. Those figures speak well for an airplane that has spanned an era from the Great Depression to the space shuttle. **PM**

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DRILLS →	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1 1/16	1 1/8	1 1/4	1 3/8	1 1/2
DRILLS →	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1 1/16	1 1/8	1 1/4	1 3/8	1 1/2
DRILLS →	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1 1/16	1 1/8	1 1/4	1 3/8	1 1/2
DRILLS →	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1 1/16	1 1/8	1 1/4	1 3/8	1 1/2
DRILLS →	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1 1/16	1 1/8	1 1/4	1 3/8	1 1/2
DRILLS →	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1 1/16	1 1/8	1 1/4	1 3/8	1 1/2
DRILLS →	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4								

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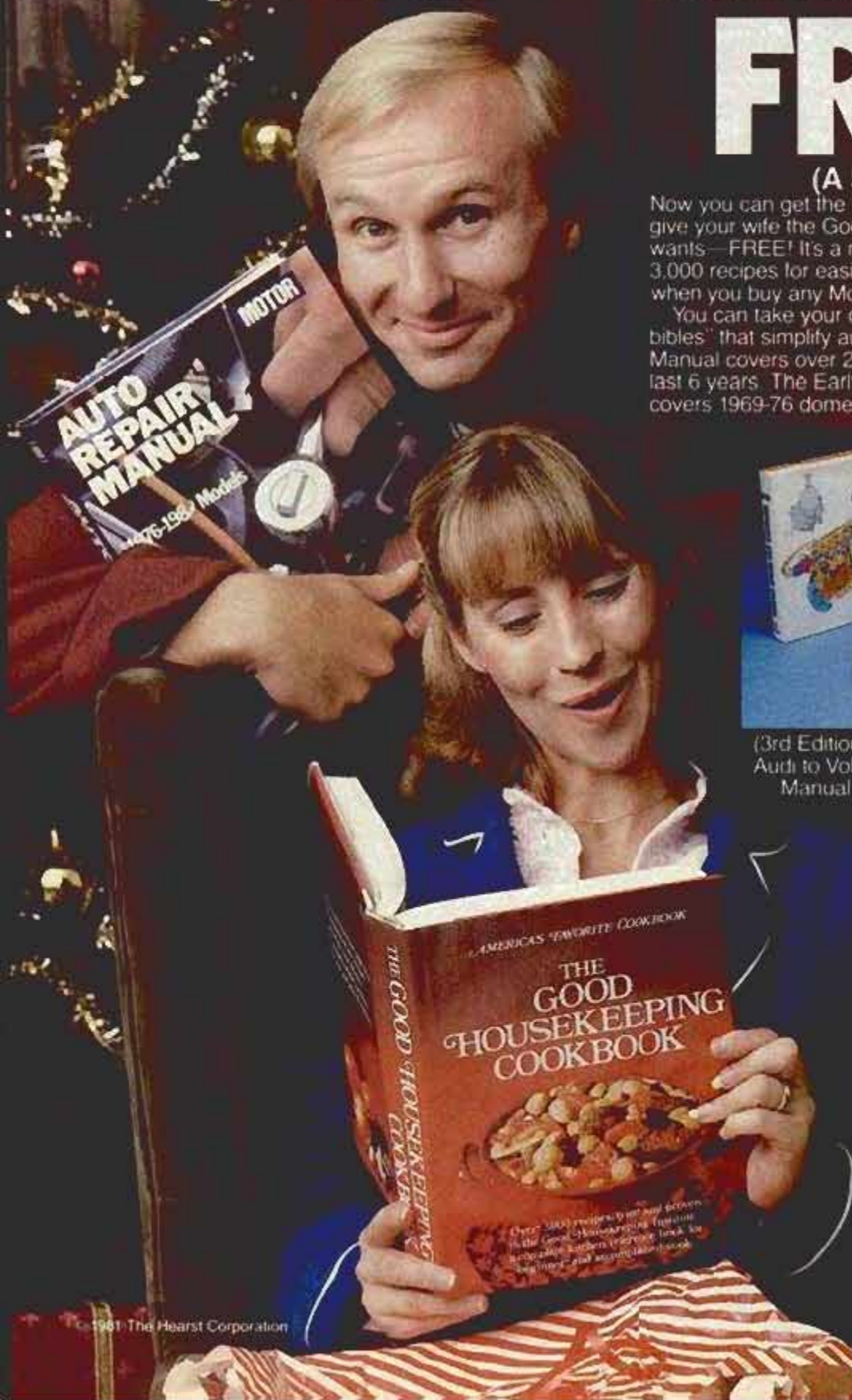
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BOOKS



OWNERS REPORT: FORD EXP

(Continued from page 94)

ple, and that's who buys them. Nearly half the owners we surveyed were under 30. Because they're so young, it's reasonable to assume that many will marry soon and raise families, which means they'll outgrow a two-seater.

Considering that trend, it's quite a testimonial to the EXP that 88.3 percent of our respondents said they'd buy another one next time around. Nearly 95 percent, too, told us they'd purchase another Ford product, even if it weren't the EXP.

Ford loyalty ran high, as did loyalty to what owners perceived as an American-made car. Over half our EXP buyers own other Ford products, and a significant 10.6 percent told us that a primary reason for purchase was "made in America."

A Louisiana business and management consultant is typical. "I bought the EXP," he volunteered, "to save money on gas and because it's an American car. I strongly support American manufacture, but I do demand quality. Workmanship is good—I'm very satisfied with that aspect—but I feel that the cost of \$8,500 is too high."

Again, young buyers tend to be more cost-conscious than older ones, probably because their incomes are generally lower. "Sticker shock" has become more

common in recent times, especially with cars that appeal to youthful buyers. In the EXP's case, 5.6 percent of our respondents specifically criticized price—yet they did buy the car.

The EXP's ride and handling received a good deal of praise, and while neither Ford nor owners consider this an all-out sports car, some of the comments might have come from sports-car drivers.

"Outstanding steering response, European handling, good instrumentation," noted a South Carolina electrician. And a Texas flight attendant added, "The front-wheel-drive handling of the EXP is really great; a very solid feel."

An Iowa pump repairman: "Very solid and quiet inside, with a smooth ride for a small car." And a Michigan security supervisor: "Sports-car looks combine with sharp and crisp handling, which makes the EXP lots of fun to drive."

We did note some mixed feelings, as mentioned, about engine horsepower. Seems that some people feel that the number of cylinders determines power output. An Ohio speech and language pathologist stated, "I would like more power for better acceleration, but I realize that a four-cylinder engine is necessary for good gas mileage."

An Ohio development assistant opined, "The engine feels sluggish. Our Dodge Colt, which also has a four-cylinder

engine, has more power." In all, 15.9 percent of our respondents complained about lackluster performance.

Yet that didn't include everyone, and for the defense, here's a comment from a South Carolina hairdresser. "When I'm on the open highway and need to pass," she wrote, "the EXP gives me all the performance I need. The overdrive four-speed transmission will pick up at once, and I never have to worry about making it."

EXP owners sounded genuinely surprised with the space and roominess they found inside their cars. An Iowa home demonstrator confessed, "I am amazed at the amount of cargo space. I sell home products and never have any problem fitting in all my deliveries."

A Michigan construction worker echoed, "I'm 6-4 and find the EXP's seating very comfortable. I've taken a few trips in this car, and just about everything I own fits inside."

When we asked EXP drivers—as we always do—what changes and improvements they'd recommend, we got a variety of suggestions. A five-speed transmission and more horsepower topped the list: Both are forthcoming from Ford. Other recommendations included these:

A New York salesman noted, "First and reverse gears are too close together. There ought to be a pushdown or lockout for reverse."

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A Louisiana mechanic griped, "The headlights look funny. They ought to be the hideaway variety. I'd also like to be able to get a T-top with the EXP."

A Maryland secretary: "The door moldings should be moved upward to prevent dings. As they are now, they're too low and don't do a thing."

"The glovebox is too small to hold even the owner's manual," noted a Wisconsin production manager, and a Michigan truck driver recommended, "Put the fuel filler on the left side of the car. The clutch, too, is very slotty and quick. And I find the oil filter much too difficult to reach."

Basically, though, EXP owners had many more good things to say about their cars than bad ones, and a hefty 18.7 percent said they wouldn't change a thing. Most even love their dealers.

Among the voluntary comments, these summed it up for the majority of EXP owners.

A legal secretary in Colorado wrote, "It's nice to have people who are driving very expensive foreign cars pull up and ask me about my EXP. I have a relative with a Porsche, and he'd rather drive my car than his own."

A New York service-station owner:

"Best quality and engineering of any American car I've ever owned. Beats the imports."

And finally, from a secretary in Wisconsin, this summation: "I think the EXP is very sharp and sporty—a car that's not just attractive, but practical and economical, as well. I used to have a big car, though I never once utilized the space it provided. The EXP will carry just as much, but it gets infinitely better gas mileage. It's comfortable, drives smoothly and is easy to handle. When people ask me how I like my EXP, I tell them I don't like it; I love it!"

FBI

SUMMARY OF 1982 FORD EXP OWNERS REPORTS*

Total miles driven 1,030,580	Not enough power 15.9	Had any mechanical trouble?	Two cars 46.4
Average miles per gallon	Mileage lower than expected 9.2	No 65.3%	Three cars 11.7
In town 26.3	Initial cost 5.6	Yes 34.7	Four or more cars 5.2
Long trips 38.0	Quality of finish 5.2		
Why did you buy the EXP?	What changes would you like?	What type of trouble?	Makes of other cars owned:
Styling 73.7%	No changes 18.7%	Carburetor 22.3%	Ford 52.6%
Economy 69.7	Five-speed transmission 12.1	Electrical 11.7	Chevrolet 20.8
Handling 12.4	More horsepower 11.3	Fuel gauge 8.5	Mercury 8.7
Made in the U.S.A. 10.6	Change seating 6.2		Pontiac 7.5
Size 8.8	Revamp styling 6.2	Dealer repairs satisfactory?	Dodge 5.8
Specific likes:	Workmanship opinion:	Yes 72.7%	Age distribution of owners:
Economy 71.3%	Excellent 52.5%	No 27.3	15-29 years 46.7%
Styling 66.8	Good 40.2	Dealer service opinion?	30-49 years 39.9
Handling 54.3	Average 6.5	Excellent 36.0%	50-plus 13.5
Comfort 26.8	Poor 0.7	Good 36.4	Would you buy another Ford product?
Ride 12.8	Comfort opinion:	Average 18.7	Yes 94.8%
Specific dislikes:	Excellent 69.7%	Poor 8.9	No 5.2
No complaints 29.5%	Good 27.1	Number of vehicles owned:	Would you buy another Ford EXP?
	Average 2.5	EXP only 36.9%	Yes 88.3
	Poor 0.7		No 11.7

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

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LIGHTER MACHINES FOR COLD ADVENTURE (Continued from page 100)



On lake speed runs and enduro contests, the Polaris Indy 500 has a winning name.

assured by the silencing of sleds; the quiet ones from Kawasaki are an example.

Innovations of a few years ago are now becoming standards or options on the snowmo trails: adjustable suspensions for smoother ride, automatic oil injection rather than pre-mix for two-cycle, liquid or air-cooling, and extras such as electric



Only a preproduction prototype this year, John Deere's Sprintfire uses direct drive.

starting and heated handle bars.

A big boon for the sport is the accessory called the trail groomer; it's a harrow-like device that can turn packed snow and ice ruts into a smooth and comfortable trail. Snow-



A GT-type snow machine, Kawasaki LTD holds 24-hour speed, endurance mark.

mobile drivers no longer have an excuse to crisscross private property or use ski trails to find action.

John Deere is emphasizing its commitment to snowmo production with five improved models of machines. There are the Spitfire; Trailfire, in two versions; Sportfire; and the top-of-the-line Liquifire, with a major upgrading in clutch design for smoother engagement and better

acceleration. In addition, Deere is previewing two prototypes—a Sprintfire that's called the first liquid-cooled machine with a direct-drive system, and a free-air Snowfire with the same system.

Both of them feature lighter weight, easier maintenance and im-



Inspired by Ski-Doo and Moto-Ski racers, Dan Ostman's race car (inset) uses a Bombardier-Rotax 436-cc Blizzard engine.

proved performance and fuel economy. The models are expected to go into production next year.

The good times that roll with a Kawasaki come from Lincoln, Neb., where the machines are all built. The Intruder rates as an all-purpose model, with Sealed Quiet rubber engine shroud to absorb radiated noise.

The LTD, called a Grand Touring model, holds the world record for 24-hour speed and endurance, and the single-passenger Interceptor 550 is a high-performance machine. Standard features, accessories and options for these models include disc brakes, quartz headlamp, oil injection, speedometer, tach, odometer, temperature and heat gauges, and Vari-Ride suspension.

From the Moto-Ski division of Bombardier comes the light (285-pound) little Spirit; Mirage I and II plus Mirage Special; Futura 300, 500, 500 electric start and L/C (liquid cooled); the Sonic and the high-speed Ultra Sonic. An integrated front- and rear-suspension system



New, larger, liquid-cooled 499-cc engine is in Yamaha's high-performance SRX.



The Chrysler Sno-Runner is a snow-moped using a single forward ski for steering.

tested last year will be standard on Sonics.

This year, Polaris has reorganized, with top executives buying the company from Textron, the parent corporation. That should keep the TX-L Indys and TX-Cs winning on the lake-enduro and cross-country circuits. This year's high-performance Indys will include the twin-cylinder 333-cc Centurion and Indy 500 cc, both liquid-cooled. Other choices are the TX-L, TX-C and Cutlass SS.

Once again, Ski-Doo provides the largest assortment of snow machines. It will market 14 varieties of eight models, ranging from two new workhorse machines, the Nordik and Skandic, to the Blizzard 9500, said to be the world's fastest in its class. In between are the light-weight Elan and single-ski, twin-



Wider track and racing engine give speed to Moto-Ski's new Ultra Sonic line-leader.

tracked Alpine, the Citation 3500, 4500 and sporty SS, Everest 500s and L/C Electro, and the twin-tracked, side-by-side luxury model, Elite. The Special MX, SnoPro Ski-Doo and Moto-Ski racers are experimental and not in full production.

Yamaha is adding a compact new Bravo 250 and long-track workhorse ET340TF to the SRX, SR-V, SS440 and Enticer 340 of the line.

Arctic Cat has discontinued production of its machines and Scorpions pending sale of the company.

For a one-ski scooter, there's the Chrysler Marine Sno-Runner. **PM**

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HOW TO MASTER WOOD JOINERY

(Continued from page 111)

and, consequently, will cause an unwanted loose joint.

About lap joints

Webster's New World Dictionary describes a lap joint as "a joint made by lapping one piece or part over another and fastening them together." And that, in simplest terms, is exactly what a lap joint is. There are many variations, however.

The most common lap joint is the surface lap, such as those found in a garden trellis. A surface lap joint is not strong; the contact (glue) area won't resist twist or lateral stress. For this reason, it's the usual wood-working practice to create half-lap joints, as shown in the drawing on page 110. Here, the wood parts are notched to half-thickness so the joint will be an interlocking one, and the surfaces will be flush.

Occasionally, you'll need to use a full lap, generally when one of the parts is thinner than the other. The seat cut (dado) is made in the thicker piece to accommodate the thinner piece. Thus, for example, if you want to join a $\frac{1}{2}$ by $3\frac{1}{2}$ -in. member to a length of $5\frac{1}{4}$ -in. stock, you would cut a $3\frac{1}{2}$ -in.-wide dado to a depth of $\frac{1}{2}$ in. in the $5\frac{1}{4}$ -in. lumber. As with a half lap joint, a full lap should also produce members that are flush when they are joined.

An end lap occurs in framemaking (i.e., door) and the rabbet cuts are determined using the mathematics shown in the drawing on page 110.

Cutting an end lap joint

When cutting a frame lap joint (rabbet), always make the shoulder cut first, then the cheek cut. The workpiece should be clamped in a vise and, to ensure accuracy, you can clamp a depth stop block to the saw. In general, you should leave the line when making a joint—you can always take some more off with a sharp chisel. Too much removed, however, means that the resulting joint won't be flush.

Rotate the workpiece in the vise to make the second (cheek) cut. Repeat the steps for the second member. Test the parts for fit and, if necessary, clean out additional stock from mating cheeks for a flush joint.

To cut end laps on a table saw, you can use a combination blade and two cuts. Again, make the shoulder cut first, using your miter gauge. Then turn the stock on edge and use the rip fence to make the cheek cut. Work carefully when making a cheek cut and keep the part being cut out away from the fence (to ensure the

stock riding the table throughout).

It is better and safer to use a tenoning jig to make the cheek cut when using a conventional blade. With one of these, the work is securely clamped and there is no chance of kickback. In fact, if you own a tenoning jig, you can make an end-lap rabbet cut in one setup by using a dado head and elevating the cutters to desired lap width.

If the stock being joined in your end lap joint is wider than $2\frac{1}{2}$ in., use a dado head, rather than a conventional blade, to make the cut.

To do it, install the dado head set on the saw and set its cutters to project the desired distance. Using your miter gauge, make the shoulder cut first, then make repeat overlapping passes over the cutters to clear out the remainder of the joint.

More professional tips

■ When creating a notch or dado with a table saw—whether using blade or dado head set—it's not uncommon to have saw ridges remain on the cheek. Since these must be cleaned out later with a chisel to ensure a tight joint, cut a hair less than required.

■ Professionals always keep stock of the same size and dimension on hand for test cutting and fitting. Use this stock for testing all saw settings, and so on before cutting your expensive, project material.

Half laps

There are many variations of half lap joints, the simplest of which is shown in the drawing on page 110—the half lap at the middle of a board.

Here, in both members, the dados are cut to equal the stock's width and half its thickness. The cutting can be by hand or with power, as shown in the photo on page 110.

Edge half laps

These are the same as a conventional half lap except that the cutting is done in the board edges, rather than on the surface. As a result, the dados are much narrower and deeper. Frequently called notches because of this shape, the joint produced is a strong interlocking one. This is a conventional assembly technique in certain projects—that is, egg-crate or wine-rack construction.

Again, the shoulder cuts are made first, then the area between is cleaned out. The shoulders can be cut using a handsaw and a miterbox, or the work can be clamped in a vise. The cutout should be carefully marked, using a square as shown,

(Please turn to page 134)

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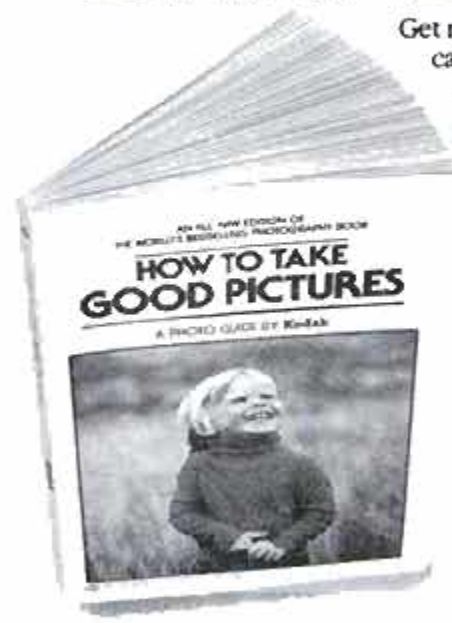
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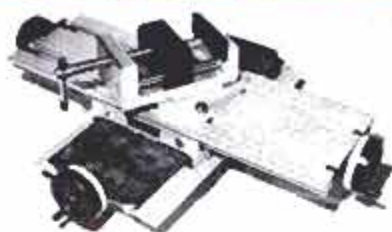
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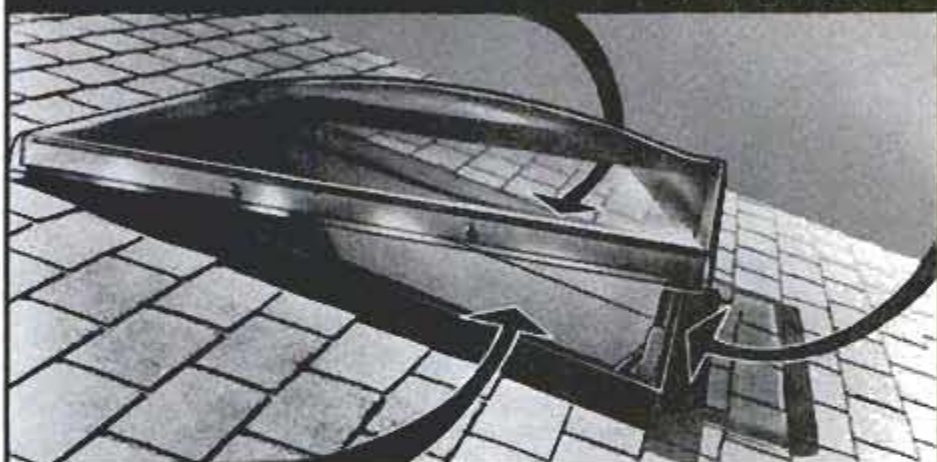
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HOW TO MASTER WOOD JOINERY
(Continued from page 132)

but, if you don't trust your ability to stop sawing at a marked line, clamp a depth stop to the saw.

After making the shoulder cuts, make one or two additional kerfs in the field (see photo, page 110), then clean out the notch with a sharp chisel. To do it, position the work on a flat, solid surface and hold the chisel with its bevel toward the waste area. Give the handle a sharp rap with the palm of your hand to clear the waste. Finish clearing the notch, using the chisel with a paring action.

Edge laps are particularly easy to cut on the table saw if it's equipped with a dado head set. If you are cutting the notches for a project requiring many members—such as a wine rack—you can save time by ganging the marked members together and cutting them all at once. Remember to clamp the pieces securely so they can't shift during the cutting step.

About joints in general

■ Always use a quality glue in your joints. Apply the glue sparingly, and never spread it on too thickly.

■ Before gluing, make certain you test-fit the parts. A lap joint should have tight shoulders and the members must be flush. If you must join a great number of parts that have been notched, you can avoid confusion during final assembly by making light pencil match marks during your dry assembly.

■ Whenever possible, use hardware (screws or nails) for additional joint strength. Though the lap joint is a considerably stronger joint than the plain butted joint, it can use some help too.

■ If you do produce a less than perfect joint, all is not lost. If you plan to paint the project, you can fill small voids, using a paste consisting of fine sawdust mixed with white glue. Or, use a quality wood filler such as UGL's Wood Patch.

For projects to be stained, you won't get off so easily. If the sloppy joint is just a hairline loose, you may be able to conceal it using a wax putty stick (of the type intended for wood paneling) after the piece has been stained and varnished.

But, as a woodworker, you should always remember that the quality of the joints in your projects is a true measure of your skill as a woodworker. As we pointed out in Part 1, there is no substitute for practice.

Next month's installment will conclude our series. In that segment, we will cover the ever-romantic dovetail joint.

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TECH LINES

New filmless camera

Photography

Sony's new Mavipak camera prototype points the way to a marriage of video and photographic techniques. While the Mavipak looks like a 35-mm camera, it doesn't use conventional film and it shows its pictures instantly—on any home TV.

The camera depends on the latest in digital electronics and computer technology to perform its magic. Lens optics are used to focus light. But instead of being directed to fall upon a film plane, this focused image hits a special integrated circuit called a charge-coupled device (CCD).

A CCD instantly converts the image, with all of its shadows and highlights, into a series of digitally coded electronic pulses. These pulses are further processed by the camera's digital circuitry. Then, these numbers are recorded onto a piece of magnetic film. The same technology is applied here as in computer floppy-disc systems.

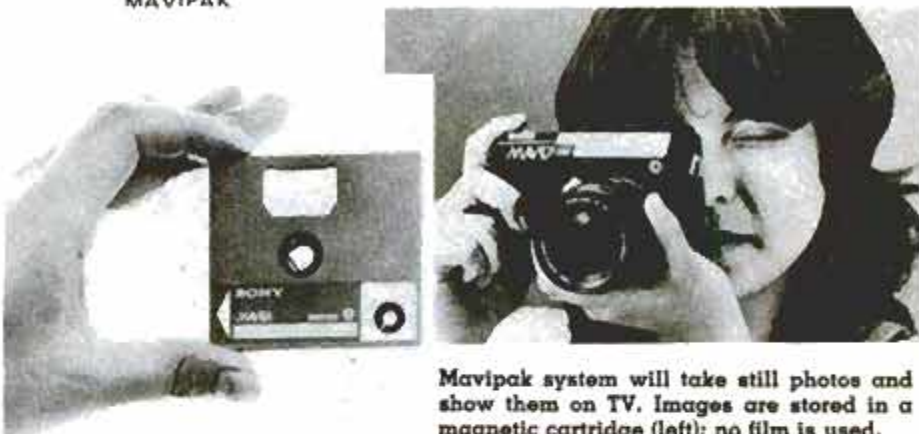
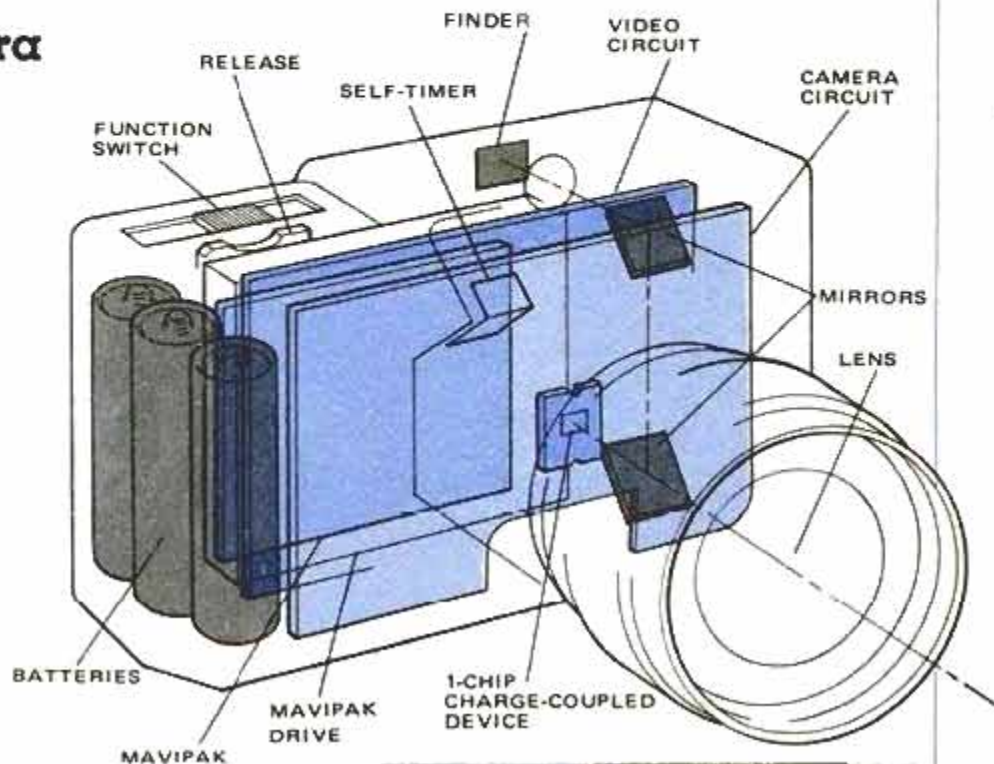
The Mavipak cartridge, all eight grams of it, is a plastic, rectangular carrier that holds the all-important recording medium. Though it is called recording "film," it is very similar to audio tape.

While all of this electronic gadgetry is at work, a tiny bit of image light is split off by a mirror and sent to the viewfinder.

The Mavipak cartridge will record 50 pictures and can be reused an unlimited number of times. To view the still pictures, remove the recorded cartridge from the camera and plug it into an accessory viewer. The viewer, similar to a videotape deck, is connected to the antenna terminals of any television set for screen display.

Because the picture is made up of digital pulses, it can be processed in other ways, too, just as if it were computer data output. And Sony has plans for accessories that will take advantage of this.

One of the first add-ons to appear for the Mavipak system will be a copier. Because the pictures are



Mavipak system will take still photos and show them on TV. Images are stored in a magnetic cartridge (left); no film is used.

stored on tape, duplicating entire cartridges of pictures should be a one-step process.

For a hard-copy picture, Sony is also planning a video picture printer. Using much of the same technology found in color photofacsimile machines, it will let you turn your video pics into wallet- or full-size paper prints.

One of the most futuristic accessories is the Mavipak transmitter. This will allow you to send a shot over normal phone lines. The codes on tape will be converted into sound pulses which can be transmitted over a phone's audio circuits—or even a radio transmitter.

When introducing the prototype, Sony spokesman indicated that the camera system is "years" away from marketing. Then why the unveiling? Some industry insiders say Sony hopes to preempt camera giant Eastman Kodak, known to be investigating similar technology. Kodak has admitted its involvement in related research, but claims the video camera system is far from being competitive with more conventional photographic techniques in terms of visual quality.

Knowledgeable observers, however, say Kodak's private appraisal of the technology was far more positive prior to the Sony coup.

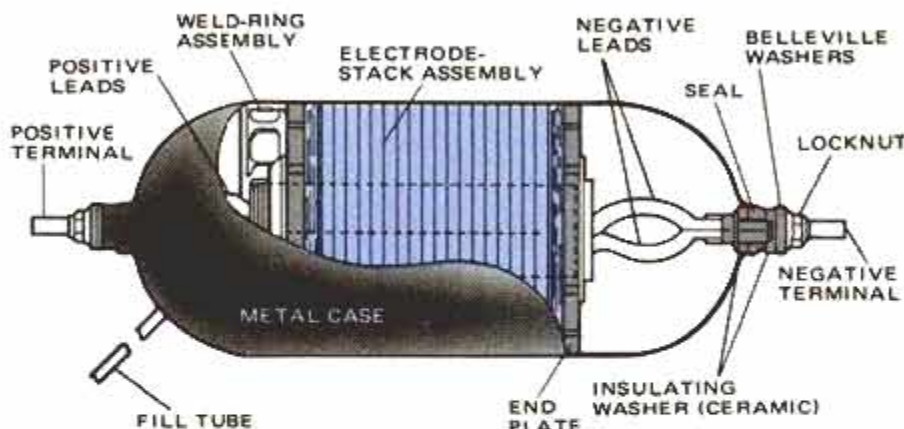
Energy

The ultimate battery?

Advances in nickel-hydrogen (Ni-H₂) battery technology have responded to the aerospace needs of the U.S. Air Force, NASA and even the Comsat communications consortium. While this type of cell was primarily developed for exotic uses, a recent study by Battelle Columbus Laboratories indicates the Ni-H₂ cell may be the ultimate way to store solar energy acquired through photovoltaic cell arrays.

"The beauty of it," says Battelle's John Clifford, evaluation project manager, "is the deep discharge capacity. This means you can get tens of thousands of cycles out of it. The Air Force has already demonstrated the feasibility of a 20-year, maintenance-free battery."

PM's drawing (above, right) shows the typical configuration of an Ni-H₂ cell developed for aerospace use. It's rated at 50 ampere-hours (1.25 volts) and would be about 5 inches in diameter by 10 inches long. The electrode stack is fitted into the case, which is then welded shut; hydrogen is introduced under a pressure of 100 pounds per square inch (p.s.i.). Since the



pressure rises and varies directly with the charge in the cell, the user always has a precise indication of its state of charge.

Other advantages: Overcharging won't damage it, and a weak cell connected in series with healthy ones won't damage the others through current reversal, a common battery problem.

Some disadvantages with present Ni-H₂ cells: A fast-discharge rate—they lose about half their charge in a week, just sitting around. But by far, the largest drawback is cost. The Air Force cell costs about \$5,000 per unit to produce. Elimination of such frills as platinum in the electrodes, not necessary for ordinary applications, would reduce the cost somewhat. And scientists foresee R&D efforts capable of reducing the costs by several orders of magnitude.

Ship of no fuels

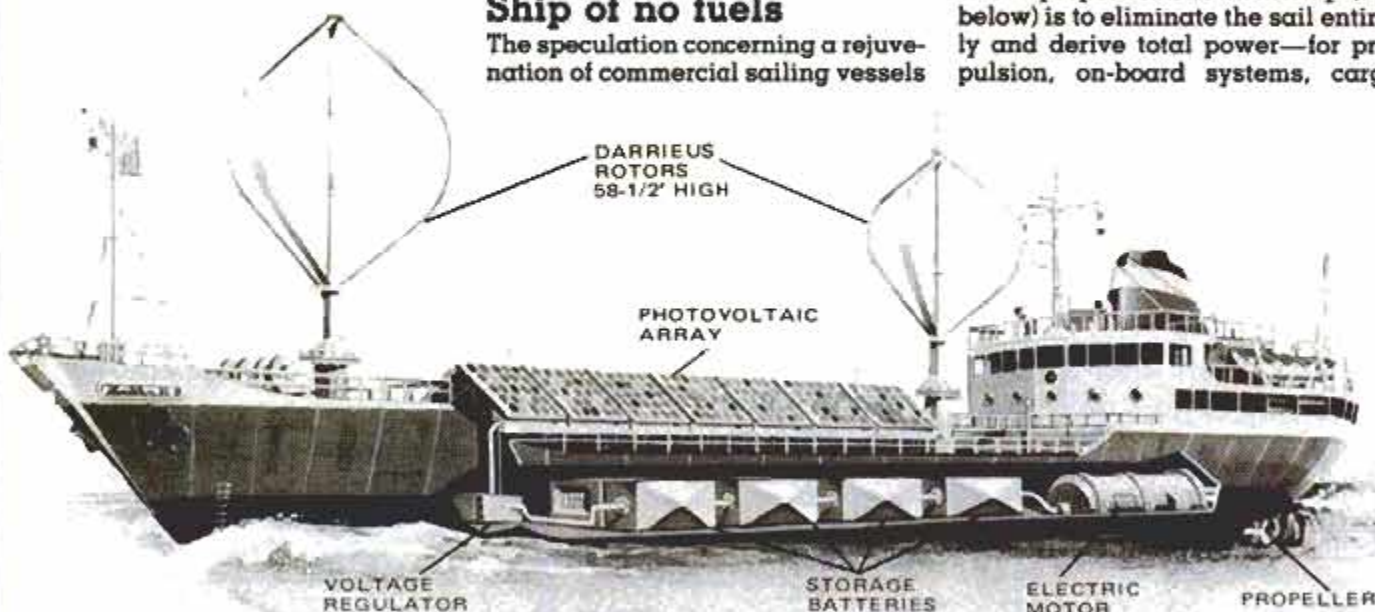
The speculation concerning a rejuvenation of commercial sailing vessels

has been accompanied by mixed and inconclusive results to date. Undoubtedly, many more wind-powered ship experiments must be undertaken before the optimum blends of new technology and old methodology are established. Among these hybrids will be prototypes based on the fact that a wind-powered ship need not necessarily be driven by sail at all.

If an internal combustion engine is used in conjunction with sail, fuel must be carried.

Using a wind turbine to trickle-charge an electric battery aboard a sailing vessel would upgrade it from an auxiliary (with a diesel or steam engine) to a hybrid.

And with a wind turbine, once the battery is charged, excess power can be diverted to provide auxiliary power through an electric motor shafted to the propeller. The next step (see below) is to eliminate the sail entirely and derive total power—for propulsion, on-board systems, cargo



This shows how a conventional small cargo ship could be converted to a testbed for a combination wind turbine and photovoltaic cell system (using thin-film technology) to both trickle-charge batteries and drive the ship's propeller.

handling and so on— from wind turbines.

In the '20s, a vertical-axis rotor consisting of thin, airfoil-shaped blades was devised by G.J.M. Darrieus in France. Fifty years later, the Canadian National Research Council undertook considerable further development of the design. It is now considered competitive with the large rotor windmills under construction in the United States by the Dept. of Energy. A major advantage of the Darrieus unit is its low cost; it is also a high-speed, high-efficiency rotor. It has one major disadvantage, however: It must be torqued initially to start.

In a wind of 17 mph, a 21-foot-high Darrieus rotor will produce 5 kilowatts. If the height is increased to 50 feet, 50 kilowatts are churned out. A rotor 92 feet tall will have an output of 200 kilowatts—in the same 17-mph wind.

It is not hard to project a true 21st century windship, 1,000 feet long, powered entirely by two externally braced Darrieus rotors standing 500 feet high. They would produce the equivalent of 26,000 hp in a 17-mph wind and about 100,000 hp in a wind twice that speed. If the wind were to die, the ship could continue at cruising speed, drawing power from storage batteries. These would be charged by large photovoltaic arrays that could unfold for orientation toward the sun.

The amount of weight a ship can carry high aloft may limit the size of the rotors that can be considered: Possibly the Darrieus units could be spread into several smaller units. Storage batteries, heavy by nature, would provide natural ballast if situated low in the hull. And unlike sails, Darrieus rotors don't have to be oriented to a specific wind direction.

With costs of \$30,000 or more for even a small cargo ship to cross the Atlantic—at about nine gallons per mile—powered by conventional fuels at today's prices, it's only a matter of time before alternative power systems incorporating wind devices, either as auxiliary or primary propulsion units, get a close look.

Electronics

Whips you into shape

The big talk among physiologists, coaches and fitness buffs is the coming revolution in microprocessor-coupled exercise equipment. Most elaborate harbinger of the new generation of sweat-inducing apparatus is the Wilson/Ariel 4000, an exercise machine developed by computer-biomechanics specialist Dr. Gideon Ariel. It's now being readied for marketing by Wilson Sporting Goods, Chicago.

The machine is based on hydraulic resistance, which can be adjusted to



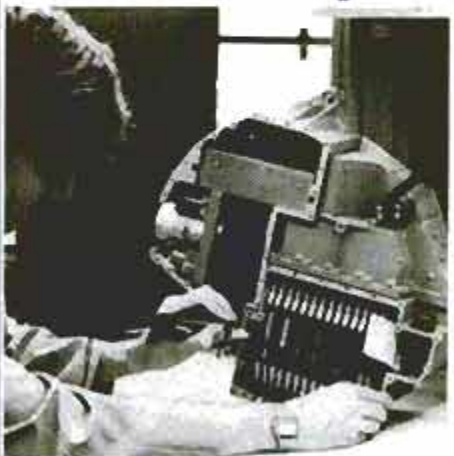
individual programs by the microprocessor. A user inserts his personal, lifetime diskette containing basic physical data. The computer reads it, tells you how much weight you've lost or gained and asks you what type of exercise you want to begin with. Along the way, it tells you how you're doing compared with past performances and norms for your age, sex, size and so on.

As of now, the prototype is being demonstrated for institutions—hotel chains, health spas. At \$75,000 per unit, not too many of us will be snapping them up. But the company says it hopes to evolve home units, possibly in the \$5,000 range, within two years.



Wilson/Ariel exercise machine uses a microprocessor to set hydraulic resistance for exercises. Then it gives user a readout on performance compared to age-adjusted norms and previous efforts.

Missile reads maps



Tomahawk missile's computer component will compare terrain below to photos of path to target for pinpoint accuracy.

The device at left, being built by McDonnell-Douglas for the Navy's land-attack version of the Tomahawk missile, is designated as a "digital scene-matching area correlator." This mouthful translates into the following operations: High-contrast photos of the intended final-phase flight path are stored, in digital form, by the guidance system's computer. As the missile nears its target, its nose lens matches images from the real terrain below to the stored photo-maps, and the Tomahawk "sees" whether or not it's on course.

Only two questions remain: Who's going to take those high-contrast photos of hostile territory? And if the Tomahawk is already accurate to "within a few feet," as McDonnell-Douglas claims, why bother?

Editor: Robin Nelson

Contributors: Marc Ameluzen, Sheldon M. Gallager, John Ingersoll, Murray Rubenstein, Neil L. Shapiro

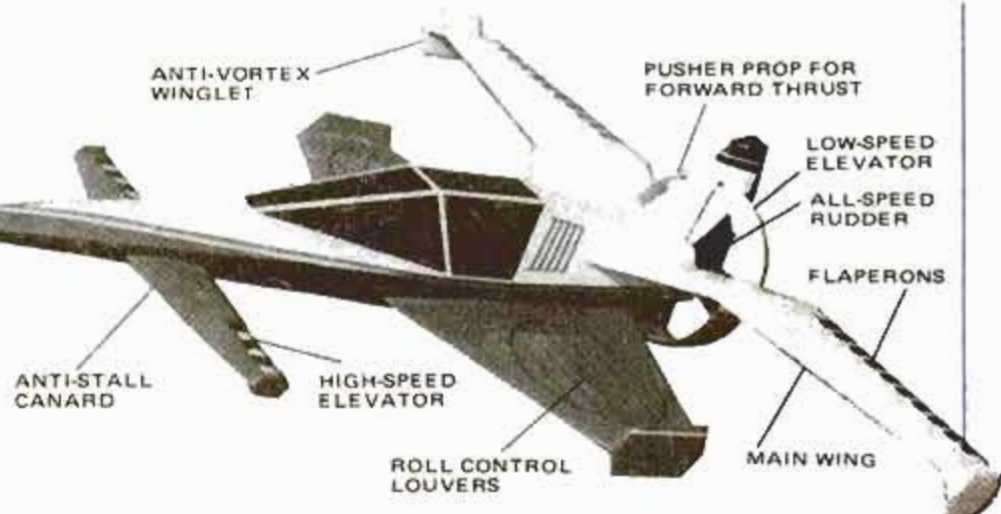
Aviation

Fly your own VTOL?

It resembles an X-wing fighter out of *Star Wars*—but the futuristic, canard-winged craft at right is more than just a scriptwriter's fancy. For years, aircraft makers have dreamed of a personal-size, VTOL (vertical takeoff and landing) sports plane you could fly out of your own back yard.

Now a young Texas designer, Rod Clifton, has come up with a startling concept. It's a small, low-powered, kit-built single-seater that takes off and lands like a helicopter, yet flies like a conventional airplane at up to 200 mph.

Called the Vulcan Starfire, it's shown here in model form. In the full-size prototype, two 60-hp Kawasaki



Louvered lift fans allow hovering, control roll at low speed; canard prevents stalls.

motorcycle engines drive side-mounted lift fans for vertical maneuvering, and a ducted pusher prop provides forward thrust. Separate high- and low-speed controls provide full response both in normal flight and while hovering, when there's no airflow over the wings.

Kit price for the needle-nosed, all-composite Starfire will be around \$10,000. Clifton's company, Dyna Con Tech (14610 Alkay, Houston, Tex. 77045), is already at work on a military version that could operate without airfields—but mum's still the word on that.

Inventions

Not exactly pick-up sticks

Oregonian Arney Custis has come up with a way logging truckers can jack up the stake extensions on their trailers from ground level. Out in tall-timber country, that's earthshaking. Previously, drivers had to scramble up with

the load to adjust their stakes and accidents were just waiting to happen. Custis's system will be marketed in the form of conversion kits by a Portland-based firm, Sussman Inc., and could cut loggers' insurance costs.



Simple jack—long overdue—keeps driver out of harm's way.

Medicine

Bad breaks

What's a mechanical engineer doing in the lab with human bones? According to Stanford University professor Robert Piziali, it's purely a matter of developing a theory of structural failure. The fact is, we don't know very much about the properties of bones. In some ways, they're stronger than concrete or steel, but they often fail.

Under a National Institutes of Health grant, Prof. Piziali is concentrating his study on the long bones that support the human body. Since bone is a composite material, similar to fiber-resin synthetics, the mechanics of failure are complex. Piziali will attempt to develop a computer model of human bone that can be used to predict stress-tolerance levels. He will use an electrohydraulic loading frame, submitting 20 to 30 identical samples of human bone to sev-



Stanford University Prof. Robert Piziali: Wanted—bones for hydraulic crusher.

en different types of testing. While small samples can be utilized, the bone must be as representative as possible of live tissue—bringing the engineer face to face with ethical questions that medical researchers have always faced. If successful, the study could prove valuable to automobile makers, as well as sporting-goods firms.

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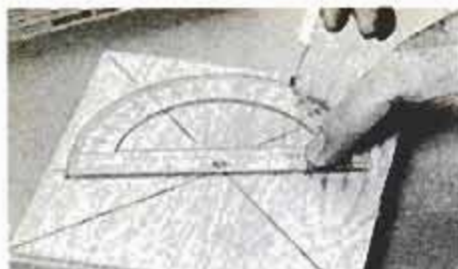
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Cut squares for lamp discs to size and draw diagonals. Using protractor, locate three rod holes 120° apart on smallest square.



Smallest square is used as a boring template. Nail in center hole (hidden under drill guide) keeps the stack in alignment.



Bore 1-in.-dia. blade entry hole on waste side of disc. Center hole (see text) acts as pivot point for the sabre-saw guide.

'ART DECO' FURNITURE

(Continued from page 106)

holes must be enlarged to accommodate this bolt. (The larger hole is also needed to feed the lamp cord through the discs during assembly.) When sanding, press down on the handles lightly while spinning the discs. If you must hesitate, release the downward pressure on the handles.

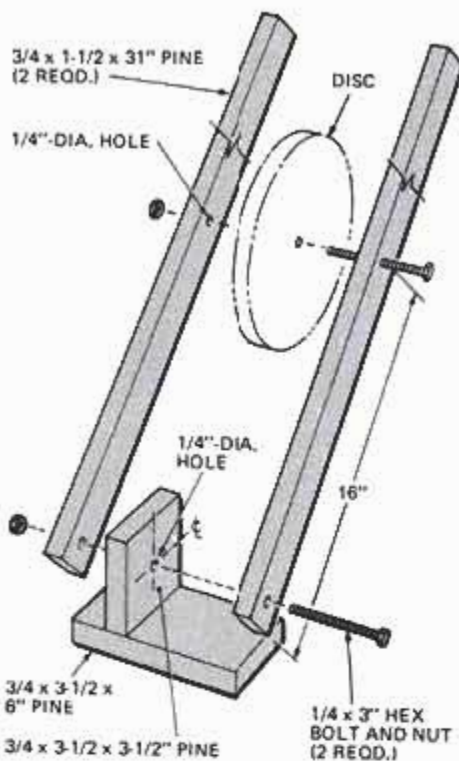
To complete the preassembly, install the Teenuts in the bottom disc as shown and enlarge the center hole in the top disc to $1\frac{3}{32}$ -in. diameter to accommodate the lamp pipe nipple.

Apply a coat of sealer to the discs, such as Bin or White Firzite, then spray a coat of Krylon primer followed by the color of your choice. We used Krylon Dove Gray, No. 1605.

Next, cut the rods to specified length and thread them into the Teenuts. Secure the bottom disc with nuts, then add the supporting nuts for the next disc, spacing them $\frac{1}{4}$ in. above the bottom disc. Use a small block made of $\frac{3}{4}$ -in. pine with a strip of $\frac{3}{16}$ -in. stock overhanging the end as a spacing gauge. Continue with the remaining discs, feeding the lamp cord through the center hole as you go.

Keep in mind that the threads on the rods are sharp and can catch the hole edges and chip out the plywood. Don't force the assembly.

The lamp hardware used is available at most hardware stores and



home centers. However the $\frac{1}{2}$ -in.-dia. spacer between the top disc and lamp harp is harder to get. (This was used for appearance only.) You can make it by cutting a $\frac{1}{2}$ -in.-dia., copper sweat coupling to length.

Paint the cap nuts on the top disc and connect a line switch and plug to the lamp cord.

(Please turn to page 150)



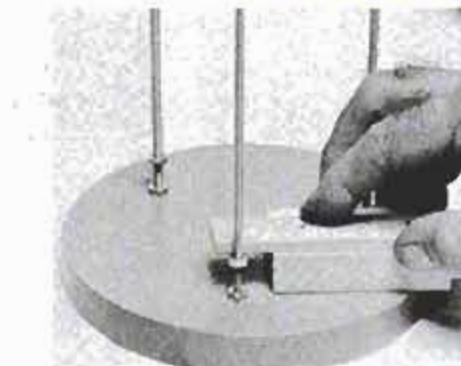
Imperfections and voids in plywood are filled with wood filler, then sanded. Simple jig (see drawing at left) allows even sanding of disc edges. Light pressure on handle and constant rotation are essential.

MATERIALS LIST—TABLE LAMP

Key	No.	Size and description (use)
A	1	$\frac{3}{4}$ x 14"-dia. fir plywood (disc)
B	2	$\frac{3}{4}$ x 13 $\frac{1}{2}$ "-dia. fir plywood (disc)
C	2	$\frac{3}{4}$ x 12 $\frac{5}{16}$ "-dia. fir plywood (disc)
D	2	$\frac{3}{4}$ x 10 $\frac{1}{16}$ "-dia. fir plywood (disc)
E	1	$\frac{3}{4}$ x 7"-dia. fir plywood (disc)
F	1	$\frac{3}{4}$ x 6"-dia. fir plywood (disc)
G	3	$\frac{3}{16}$ "-dia. x 12 $\frac{7}{8}$ " threaded rod
H	48	10-24 hex nut
I	3	10-24 cap nut
J	3	$\frac{3}{16}$ " washer
K	3	10-24 Teenut
L	1	Three-way socket
M	1	12" harp
N	2	$\frac{3}{8}$ " hex locknut
O	1	$\frac{3}{8}$ x 2" lamp pipe nipple
P	1	$\frac{1}{2}$ " piece $\frac{1}{2}$ "-dia. copper sweat coupling
Q	1	Finish
R		18-ga. lamp cord by length to suit, plug
S	1	14" high x 22"-dia. pleated lamp shade
T	1	8 x 8" pressure-sensitive felt
U	1	$\frac{3}{16}$ x 1 x 4" pins
V	1	$\frac{3}{4}$ x 1 x 3" pine
W	2	$\frac{3}{4}$ " brad



Counterbored holes allow for flush fit when driving Teenuts into bottom disc rod holes. Use dowel to avoid distortion.



Discs are sealed, primed and painted before assembly. Gauging block locates nuts for proper spacing between discs.



Thread lamp cord through bottom of each successive disc as lamp is assembled. Take care not to chip the rod hole edges.

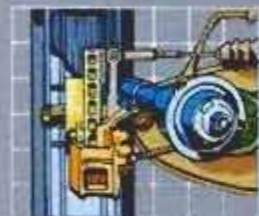
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Fairmont Futura four-door. Manufacturer's suggested retail price. Title, taxes and destination charges extra. Some cars shown with optional equipment at extra cost.

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Hanging lamp

To make the hanging lamp, cut the two panels to size and outline a 7-in. square in the middle of one panel. Next, bore a 1/2-in.-dia. hole at the inside of each corner of this square for blade entry and turning holes. Then cut out the square with a sabre saw. After you've removed the waste, cut the piece into a 6-in. square for use as the lamp-socket mounting platform.

Next, bore the four ventilation holes through the top panel, as shown in the drawing, and counterbore the eight Teenut holes—four on each side of the upper panel. Cut the spacer dowels to length and bore the screw-clearance holes through them. Then bore matching holes in the socket platform and countersink to accommodate flathead mounting screws.

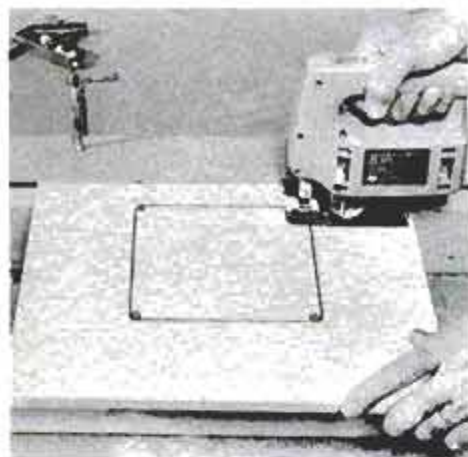
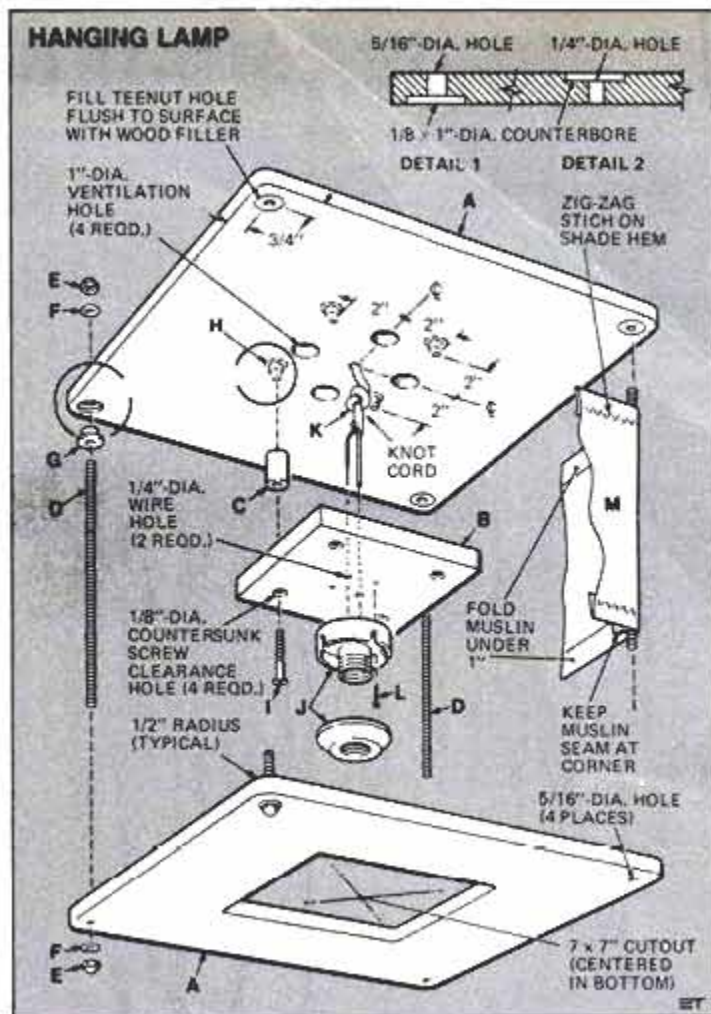
You'll also need two 1/4-in.-dia. holes in the platform for the socket-wire leads. Lamp sockets vary in dimension, so buy your socket before boring any holes.

Next, install the Teenuts and cover them with wood filler as shown. Then bore the 1/8-in.-dia., rod-clearance holes in the bottom lamp panel. Test-assemble all parts to make certain they fit properly before painting. If they do, disassemble and finish-sand all parts. Then seal, prime and paint the wood; we used Krylon Glossy Black, No. 1601.

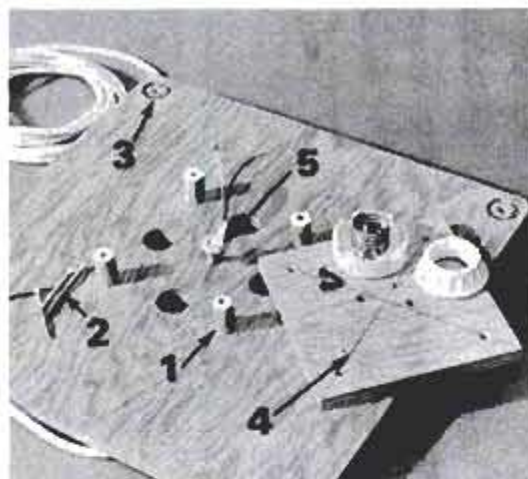
When the upper lamp panel is reassembled, install the threaded rods and glue them to the upper panel Teenuts as shown.

The shade is made from lightweight, unbleached mus-

(Please turn to page 154)



Clamped straightedge guide and four corner holes make for a professional inside cutout. Trim waste board to size and use it for lamp socket mounting platform.



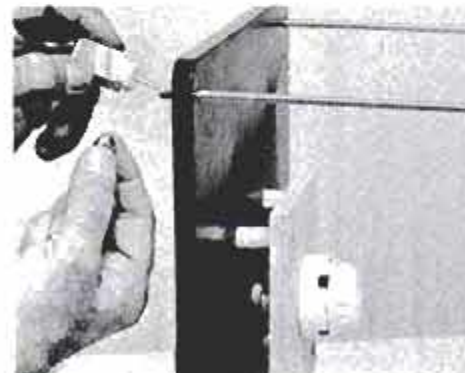
Components ready for test assembly (left): 1. spacer dowels, 2. spacer holding screws, 3. installed rod Teenuts, 4. lamp socket and mounting platform, 5. knotted lamp cord. Test assembly complete (right): Wire leads pass through platform into socket.



Rod Teenuts are recessed below surface and concealed with wood filler. Temporary screws keep filler from clogging threads.



Before filler sets, remove screws. When dry, sand filler flush, then hand-twist a countersink bit to bevel edges slightly.



Paint lamp, then assemble. Insert rods and fasten upper cap nuts in place using adhesive. Lower cap nuts are not glued.

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(Continued from page 150)

lin. Fold over 1 in. of fabric along each long side and sew the fold together with a large zigzag stitch. Then, to obtain the proper seam location, install the bottom lamp panel temporarily and circle the rods with the muslin, its inside facing out. Pin the ends of the material together, take off

the bottom panel and remove the shade. Using a straight stitch, sew $\frac{1}{4}$ in. inside this pin line for a snug fit.

When installing the finished shade, don't tear the material on the rod threads. Attach the bottom panel and add washers and cap nuts, but not the adhesive. This will allow the shade to be removed for laundering. Finally, install a 5-in.-dia., globe-type lamp bulb.

MATERIALS LIST—HANGING LAMP

Key	No.	Size and description (use)
A	2	$\frac{1}{2} \times 15 \times 15'$ fir plywood (top, bottom)
B	1	$\frac{1}{2} \times 8 \times 6'$ fir plywood (socket platform)
C	4	$\frac{3}{4}$ " dia. \times 1" dowel (spacer)
D	4	$\frac{1}{4}$ " dia. \times 10 $\frac{1}{4}$ " threaded rod
E	8	$\frac{1}{4}$ -20 cap nut
F	8	$\frac{1}{4}$ " washer with bright finish
G	4	$\frac{1}{4}$ -20 Teenut
H	4	8-32 Teenut
I	4	2" No. 8-32 fh machine screws
J	1	Porcelain socket
K	1	$\frac{1}{4}$ "-dia. pendant cord by length to suit
L	2	$\frac{3}{4}$ " No. 8 rh screw
M		11 \times 55 $\frac{1}{2}$ " unbleached muslin

Roll-about table

To start the table, cut the three shelves to size and round the corners to a $1\frac{1}{2}$ -in. radius using a sabre saw or band saw. Fill all surfaces and edges with wood filler, let dry and sand smooth. Bore $\frac{5}{16}$ -in.-dia. rod-clearance holes in the top and bottom shelves as shown. Then bore $\frac{3}{8}$ -in.-dia. rod holes in the middle shelf. This extra clearance (hidden later by the washers) will help prevent the plywood around the

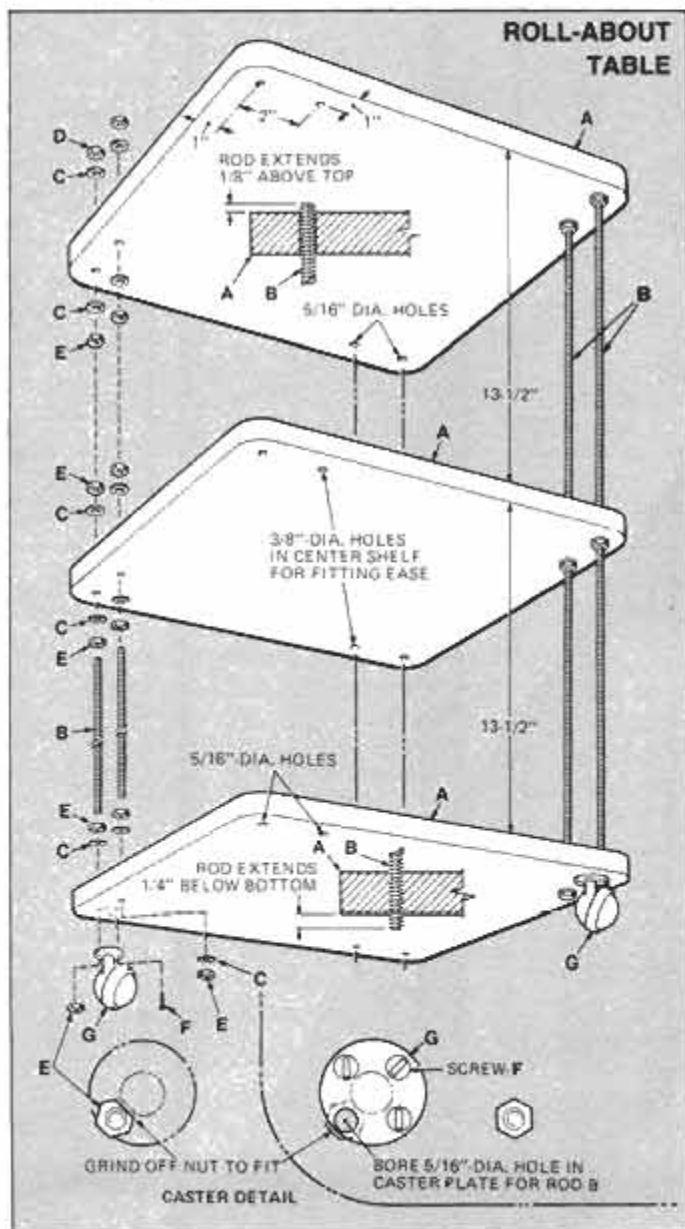
holes from splintering when the shelf is installed. Next, seal and prime the shelves.

One of the screw-mounting holes on each caster plate must be enlarged to allow the outermost corner rods to pass through. You'll also have to alter the nut for this rod by grinding off some material.

When this is completed, align the oversized hole in each caster with its corresponding rod hole, then attach the casters using wood screws.

Since the threaded rods require painting, clean the rods with lacquer thinner before installation to remove the thin coat of oil on them.

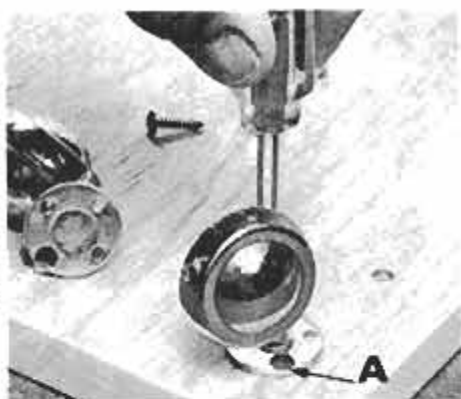
Next, install the eight rods. Then using a ruler, position the support nuts and washers for the center shelf and install the shelf. Install the top shelf the same way. Mask the casters, prime the rods, then spray the table. We used Krylon Almond enamel No. 1506.



MATERIALS LIST—ROLL-ABOUT TABLE

Key	No.	Size and description (use)
A	3	$\frac{3}{4} \times 15 \times 15'$ fir plywood (shelf)
B	8	$\frac{1}{4}$ " dia. \times 29 $\frac{1}{8}$ " threaded rod
C	44	$\frac{1}{4}$ " washer
D	8	$\frac{1}{4}$ -20 cap nut
E	40	$\frac{1}{4}$ -20 hex nut
F	12	$\frac{3}{4}$ " No. 10 rh screws
G	4	Shepherd model No. 9311, 1 $\frac{1}{2}$ " flat-plate ball caster

Mount caster by preboring hole (A) in each plate to hold a corner rod. Align plate hole over shelf hole, then attach the caster using wood screws in the other plate holes.



With all the rods installed, use a ruler to position shelf-supporting nuts and washers.



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DREAM CARS BUILT FROM SCRATCH (Continued from page 89)

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Phantom

Ron Will worked nine years at the GM Style Center when he decided to hang it all up and work on his own designs. "I was tired of designing boxes, some very sharp and beautiful, that never made it into production."

The Phantom started back in the '70s when he was working for GM. "I entered a model-toy contest for a new design—a three-wheeled auto using a motorcycle engine. I tested the scale model at the wind tunnel and it won first place in its division. A group of designers discussed the concept of a three-wheel vehicle. Everyone agreed it was a good product, but no one would ever produce it. The only way it would happen was to do it myself."

The Phantom has no metal body parts; it's constructed of rigid urethane foam sandwiched between inner and outer walls of reinforced fiberglass. Will built the auto at a cost of over \$100,000 for research and development.

The Honda GL, one-liter, 75-hp, water-cooled engine is fitted to the Phantom body and drives the rear wheel. A custom-designed turbo-charger boosts the engine to 110 hp. Power is delivered by a driveshaft and rear hub differential. The five-speed gearshift is set on a console between seats and reverse gear is electrically driven. Heating and defrosting blowers are rheostat controlled.

"Many people worry about safety in such cars," Will said. "The stability of the vehicle is determined by the center of gravity, not by the number of wheels. It's a myth that three-wheel vehicles are not safe. It's extremely low, and its center of gravity is within the triangular tread pattern. The front, VW torsion-bar suspension has been widened and a heavy-duty antisway bar added. Air-adjustable shocks have been added to the rear suspension to reduce wheel hop and all three wheels have disc brakes."

The Phantom is ready for full production when the company receives 10 orders or more. The company is also selling special kits of a completely new vehicle—the Jet Fighter Commuter, which can be built from any mid-size street bike. Phantom Vehicle Co. is at Box 2704, Newport Beach, Calif. 92663.

Feora

In many ways, Chuck Ophorst is a lot like Bruce Meyers of dune-buggy

fame. Like Meyers, he has an unflagging passion for cars and can work expertly in a variety of mediums and materials. He can work a Bridgeport milling machine as easily as he can put together a fiberglass boat hull or make a fine piece of furniture.

Ophorst has synthesized all these talents in building the Feora. His three-wheeler uses a 1020 steel frame onto which he's hung a 175-cc Honda motorcycle engine. The suspension is a trailing-arm affair with disc brakes at each corner.

The Feora gets 85 mpg and has a top speed of 93 mph. The only problem with the car is the police. He's been pulled over seven times in the 2,500 miles he's driven it. His three-wheeler—all three-wheelers, for that matter—are registered as motorcycles, regardless of their body configuration. Most of the time, the police have simply been curious and pulled him over just to take a look.

Ophorst isn't going into production, but he will sell plans and kits. He's at Box 181, Paramount, Calif. 90723.

Vector

You may have seen this car in a current Timex watch commercial on television; it's the sort of advertisement where everything in camera range is of the most other-worldly, hi-tech variety possible. The Vector fits in well with this type of scene.

Driving down the street in the Vector doesn't turn heads; it turns whole bodies—entire groups of people! And beside being fun, the Vector is, according to the designer/builder Jerry Wiegert, the shape of things to come.

Wiegert is 37 years old, holds forth with his Vehicle Design force operation in a small shop in Venice, Calif. (1623 Washington Blvd.) and is determined to change the entire shape of the automotive industry. Lots of people have tried before, but Wiegert is actually in production.

Wiegert is incorporating all of the most modern design techniques, materials and construction practices available to him. His budget may not allow for everything he wants or needs, but Wiegert is managing to turn out a space-age vehicle containing what he believes will become standard future cars.

A Michigan native educated at Ferris University, the Center for Creative Studies in Detroit and the Art Center School of Design, Wiegert finished his schooling in 1970 (paid for in great part by a General Motors scholarship) and went to work for a conglomerate of businesses trying

to construct advanced-design vehicles.

The Vector is powered by the Chevrolet workhorse powerplant—the 350-cu.-in. V8—topped off with two turbochargers producing a claimed 650 hp at 6,000 rpm. The engine has a Donovan aluminum block, an aluminum head and five main bearings. The engine sits mid-ship, and the design allows both the front and the rear of the car to have secure storage compartments.

The transmission in the Vector is a modified GM Turbo Hydramatic 425, right out of a motorhome. The B&M conversion job allows the three-speed to be shifted either manually or automatically, depending on both the driver's whim and the road circumstances. Mated with the dual-turbo engine, the three-speed sends the driver and passenger slamming into the seat cushions at the slightest burst of acceleration.

Monitoring all that energy is done in a novel way borrowed from the "heads up" school of fighter-plane flying. Bar graphs are used for measurement of pressures, fluid levels and temperature, while rpm and speed are displayed on the windshield, projected there from the rear of the dashboard. Nifty.

Heady company

Wiegert is obviously aiming for the high end of the sports-car market, attempting to compete with Ferrari, Lamborghini and Maserati. He also wants just to enter the commuter car business. He plans to take any profits he realizes from Vector sales, pump them back into his company, Vehicle Design Force, and create the freeway and in-town auto of the future, utilizing everything he has learned during the Vector project.

"I think," says Wiegert, "that I have an inherent ability to design exciting products that could blow away the competition."

The competition will have this to contend with: a semimonocoque body made of aluminum and plastic composite honeycomb sheets, which are pop-ripped and epoxied together; sheet aluminum (aircraft-quality, the kind they use in jet fighters) and steel tubing. The brakes are massive, 12-in. Hurst-Airheart ventilated discs at each wheel, the same brakes used in NASCAR stock cars. The gauges, made by Burroughs, are solid-state, gas-discharge, plasma-system, analog bar graphs.

And, just so the driver and passenger won't get tired or bored cruising at 200 mph, Wiegert has fitted the cockpit with electrically adjustable Recaro seats and a 24-speaker Blaupunkt stereo system.

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Like many homeowners, I'm concerned about any area of my house where heat is lost through uninsulated construction. That's why a paneled garage door presents a real challenge. Not only does heat escape through the single panes and panels, but moisture condenses on these cool surfaces. This allows unsightly mildew to grow and discolor the door.

My solution to both problems is simple and inexpensive.

First, add glass panes on the inside of the present glazed panes to create a dead-air space, as shown in the drawing. It's the storm-window principle: Air trapped in an enclosed space provides effective insulation.

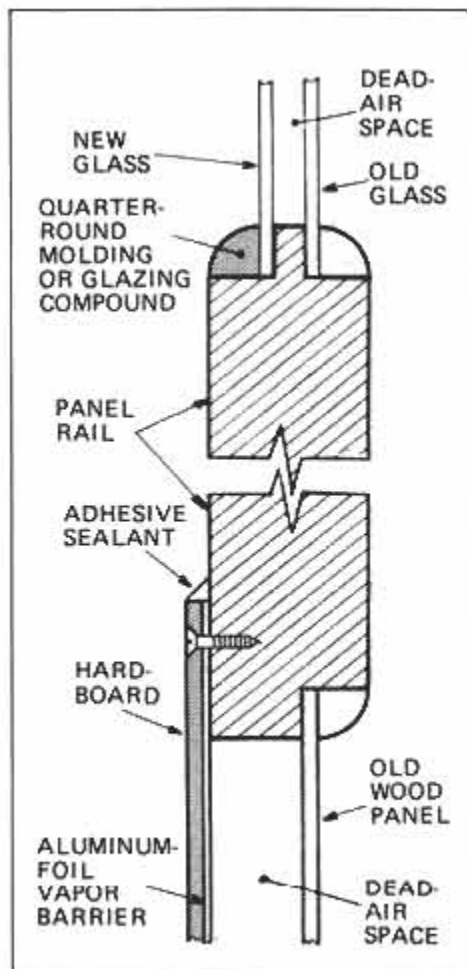
Your local hardware store or glazier will cut $\frac{1}{8}$ -in.-thick glass to your specifications. Clean both the old glass and the new glass before setting the latter into place with $\frac{1}{4}$ -in.-

round molding and small brads. Miter the corners to make a neat job.

Next, create a dead-air space over the wood panels of the door by adding $\frac{1}{4}$ -in. hardboard panels. Allow the panels to overlap the stiles and rails by at least $\frac{1}{2}$ in. around. When taking measurements of the existing door panels, you may discover that they are slightly rectangular. This can be very confusing when you are installing the hardboard panels which are also slightly rectangular. You can trust your eyes if you want, but I found it easier to match mark the panels with chalk, as shown in the photographs.

Before cutting, make a complete layout of all squares needed. Cut the panels with a fine-tooth saw. Do not bevel the edges.

Bore holes into the corners of the cut panels to accommodate $\frac{1}{8}$ -in., No. 8 flathead wood screws.



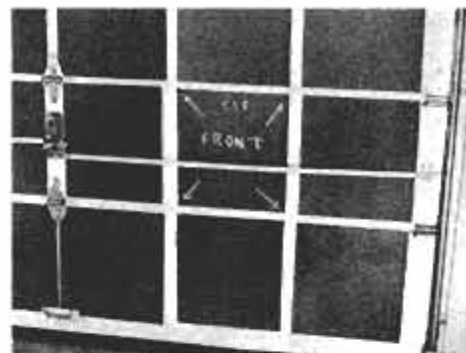
heavy-duty aluminum foil is then cut $\frac{1}{8}$ in. short of the panel edges. The foil provides some insulation, but acts more effectively as a vapor barrier to keep moisture out of the dead air space. Use a panel as a template and a straightedge to cut. Outline the foil with pencil and cut with a scissors since a knife tends to tear. The shiny side should face the hardboard. Two short strips of masking tape on the top and bottom will keep the foil in place, helping you avoid a juggling act later when you attach panels to the door.

On the door, mark a parallel line $\frac{1}{2}$ in. above the old panel top edges. Place the cut, foiled panels along this line and, using the holes bored previously in the hardboard, mark for the screw holes in the door. Press the new panel firmly against the door and set the four screws. Use a hot-glue gun to seal the panel edges. Hot glue is ideal because it sets rapidly, work progresses quickly and the seal is tight.

Because of the added weight, manually operated doors may now require more effort to lift. If adjustment of the tension spring is required, don't attempt it yourself unless you have experience. Sudden release of the spring can cause a serious accident. Although a little heavier, my manual door required no adjustment.—Joseph E. Riley



Trim heavy-duty foil a bit smaller than hardboard panel. With shiny side down, attach foil to top and bottom with masking tape.



If your panels appear square, but are really slightly rectangular, mark the front and top with chalk as shown to avoid confusion.



After all hardboard panels have been attached with screws, a hot adhesive sealant is applied with gun to seal edges.



Unsightly mildew like this on single panels will be eliminated because moisture won't condense on insulated double panels.

1981 U.S. Gov't Report:

THE COMMERCIAL APPEAL MEMPHIS, TENN.

Carlton Scores Best In Cigarette Testing

WASHINGTON (UPI) — The Carlton king-size filter cigarette sold in a hard pack had the lowest tar, nicotine and... rating of any cigarette tested in... Trade

CARLTON IS LOWEST.

Today's Carlton has even less tar than the version tested for the Government's 1981 Report. Despite new low tar brands introduced since—Carlton still lowest.

Box—less than 0.01 mg. tar, 0.002 mg. nicotine.

Box: Less than 0.01 mg. "tar", 0.002 mg. nicotine av. per cigarette by FTC method.
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Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

FIRSTHAND REPORT: MERCEDES

(Continued from page 105)

were going to buy the very best luxury sedan extant, what would you choose? An XJ6, a 733i, a Seville? Mercedes has been able to convince the doormen and the board chairmen of the world that a Mercedes is the only car which deserves respect.

I like the 300D. It's hard not to like a car which does wonderful things for your ego and can go fast, besides. But I don't love it the way I love the 300SD. And, ultimately, you must be

before major revamping. If that is to be the case with the 300D, then we should expect to see it until 1986.

All this simply leads me to wonder what purpose the W123-series (the chassis designation for the 300D body) cars serve. The big 300SD (designated as W126) has virtually identical economy, but the chassis is far superior.

According to Mercedes-Benz, the 300D is meant to appeal to people who want to move up from a 240D, or



Once up to speed, the three-liter, fuel-injected, turbodiesel Five can propel the 300D at elevated speeds and still return respectable mileage. The EPA highway cycle is 30 mpg.

drawn into a head-to-head comparison with the SD simply because the two cars are so close in price—\$28,483 for the D compared to \$35,268 for the SD—but so different in many other respects.

The 300D body, for instance, has been around since 1976, and, while it may have looked fine then, it immediately became dated when the aerodynamically restyled 300SD was introduced. Traditionally, Mercedes freezes body styles for about 10 years

can't afford a 300SD, or who can't find a 300SD to buy, since demand of the SD is far greater than supply. But surely, if you can afford \$28,483 for a 300D, you should easily be able to make the stretch to \$35,268 for the SD, and get much more car.

Personally, if I were in that position, I'd spend the extra money and wait as long as it takes to get my hands on a 300SD. When it comes to buying the best car in the world, I say: "Accept no substitutes." **PM**

MERCEDES-BENZ TURBODIESEL PASSENGER VEHICLES FOR 1982*				
	300D SEDAN	300CD COUPE	300SD SEDAN	300TD WAGON
Wheelbase (in.)	110.0	106.7	115.6	110.0
Track F/R (in.)	58.6/56.9	58.6/56.9	60.8/59.7	58.6/57.2
Length (in.)	190.0	187.5	202.6	190.9
Width (in.)	70.3	70.3	71.7	70.3
Curb weight (lbs.)	3,585	3,585	3,780	3,740
Fuel-tank capacity	21.1	21.1	20.3	18.5
EPA mpg rating	26 city 30 highway	26 city 30 highway	26 city 30 highway	27 city 33 highway

*The five-cylinder turbodiesel, rapidly becoming Mercedes-Benz's standard powerplant, is an in-line, fuel-injection Five displacing 183 cu. in. (2,998 cc) with a 21.5 to 1 compression ratio. It produces 120 hp at 4,350 rpm and 170 ft.-lb. of torque at 2,400 rpm. The rear-axle ratio for all of the cars listed above is 3.07 to 1.

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7 NEW SHAPES IN STEREO

(Continued from page 104)

tet" for its five component parts. These snap together in a package only slightly larger than a full-size portable radio/cassette recorder, to provide sound at home, on the beach or on the road with a minimum of packing fuss. The ensemble can be set up five different ways: as a complete, portable hi-fi, or in any of four configurations to suit the dimensions of a room. The 14-watt-per-channel system runs on house current, eight D-size batteries, or a car battery, when it's equipped with optional battery adapter and rechargeable battery pack. Suggested retail price is \$650.

■ **Sharp M95** is an example of audio married to video. Priced at \$430, it's the first 9-inch TV screen coupled with an AM/FM stereo radio/cassette recorder/player and twin speakers. Features of the TV include electronic varactor tuner, rapid-on picture and sound, solid-state energy-saving chassis, tone control and headphone jack. The stereo cassette recorder has an LED level meter, auto stop and two built-in microphones. The combo has a built-in carrying handle.

■ **Toshiba KFR2** updates the portable micro-size stereo cassette player by adding recording capability. Then it goes a step farther with an optional, slip-in AM radio tuner module, which matches an included FM tuner module. The recorder features easy access to musical selections, a "Talk Line" button that allows the user to tune in on a conversation without removing the headphones, automatic stop that shuts off power when the tape ends and two headphone jacks for double listening pleasure with friends. The recorder with FM module and headphones is \$219.95. The AM module is \$29.95.

■ **Sharp's VZ-3000** is a revolutionary new audio component system, designed to fit shallow shelf space. The slender system, only 6 3/4 inches deep and 14 1/4 inches high, features a microprocessor-controlled, vertically mounted, linear-tracking turntable with two tone arms that can play both sides of a record without turning it over. The other components are an AM/FM stereo tuner, a 20-watt-per-channel amplifier section, a cassette deck with metal-tape capability and matching, two-way speakers. The turntable allows continuous play of both sides of a record (one side at a time, of course), random play of either side and endless repeat of a selected side. Suggested retail price is \$750. **FPM**

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It's Uncle Henry's* smallest lockback. But don't let size fool you. This Cub is tiny, but tough. Schrade cutlery hone the 1 3/8" blade of Schrade + Steel® to a razor's edge. The stainless steel lockbar and pivot pin insure that the blade locks firmly in place. Nickel silver bolsters and linings mean The Cub™ is rust resistant throughout. It comes gift boxed and best of all, this little lockback is guaranteed against loss for one year from registration.

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AIR TRAFFIC CONTROL

(Continued from page 98)

chant of doom," Kerr told us, "but I have a gut feeling that we're in for a 'biggie'—a major air disaster in the New York area any day now."

Kerr is, of course, a union man arguing that the job of air traffic controller can turn the best of men into burnt-up pensioners before their 40th birthdays. On the other hand, Owens is management, trying to make what he manages appear as efficient as possible.

Not surprisingly, our investiga-

tion reveals that truth lies between these two opposing viewpoints. Under the present system, you don't take your life in your hands when you board an airliner—but neither can we report that you are flying on the wings of angels.

The air traffic control system fails almost every day at its weakest link: the massive computer systems that support each center's operation. Controllers watch monitor scopes where each of the aircraft under their control is labeled with computer-generated numbers called "tags." But when the computer malfunc-

tions, these tags disappear or become unreliable. The computer, according to both controllers and FAA people we interviewed, "often" goes down.

"When the computer goes," one controller said, "you don't know if it's going to be out for three seconds, three hours or three days. You just scramble like hell and hope it comes back on soon. It's a gut-tightening feeling."

Alphabet soup

When the system is working—as it does the vast majority of the time—it is a wonder to behold.

The pilot of an aircraft files a flight plan with the FAA. Then, the plane takes off from an airport under the guidance of the tower. As it leaves the ground, it's guided by the controllers in the regional centers or in the TRACON (Terminal Radar Approach Control) facilities that surround some of our busier cities. (The TRACON facilities will guide aircraft for three miles or so before the regional centers pick them up.)

The controllers sit at monitor scopes and watch "tags" drift like lighted banners being towed by dim, green smudges that are the aircraft themselves. But most of the controllers we saw depended more on their own sense of three-dimensionality than on computer displays.

Time after time, we heard the expression, "Watch the blip, not the tag." We heard it repeated so often, it almost became a technological chant: "Watch the blip, not the tag." Why? Because many controllers believe the tags are simply too unreliable.

Occasionally, the central computer updates the tags with erroneous information. We watched two tags that—for just a few seconds—showed the wrong data. If such misinformation were displayed at a critical time, and if the controller on duty were watching only the tags and not the blips of the aircraft, such a computer error could spell disaster. Or in Kerr's word—a "biggie."

While we saw new equipment that offset the labels automatically, much of the older equipment still in use around the country places tags on top of each other. This can make the tags harder to read than Sanskrit.

Near crash in New York

On Feb. 20, 1981, an Argentinian airliner came within two minutes of crashing directly into the towering, crowded World Trade Center. At the time, the plane was under the control of the New York City "Common

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Eye" (for common instrument flight procedures) room.

The airliner descended from 2,700 to 1,500 feet without authorization. (Due to confusion in transmission, the pilot thought he did have authorization.) At the altitude the plane was flying, a crash was imminent.

As the plane descended, its on-board transponders automatically alerted the air-traffic computer which "likely" displayed the information on the plane's tag.

But many controllers turn off all the tags for most of a craft's journey through the area of guidance. Others "watch the blip and not the tag." And there is no way to fault them for this, since the tag can be misleading.

But whether or not the controller was watching the tag, the computer system, this time, came through.

As the plane entered the boundary of no return, the Minimum Safe Altitude Warning (MSAW) buzzer was triggered by the computer. This audible signal alerted the controller: He acted with dispatch and the collision was avoided.

The "new" computers

Since the Argentinian incident, the Common Eye room has been closed and operations moved to a brand-new TRACON facility on Long Island—at least, the impressive-looking building is brand-new. We visited the TRACON shortly after it opened. We expected to be shown a new computer system. Instead, we saw a "new" system which had been purchased nine years ago, prior to the building's opening. New York City's air traffic control had moved from an outrageously outmoded computer system to one that was simply dated.

Norbert Owens, the FAA official, blames this on government purchasing policies. By the time you write, argue about, approve, pay for, and fill the order, nine years have passed.

A report from the transportation subcommittee of the Senate Appropriations Committee called the situation of outmoded and overworked air-traffic computers throughout the country a "nightmare." The report accused the FAA of not recording computer breakdowns and said that the FAA has no real way to tell if near misses or even crashes can be directly related to computer failures.

As of this writing, George Kerr and his controller's union are out of work. We wonder if he sits watching the sky for the disaster he said he expected. But even Norbert Owens of the FAA agrees with him that the

system—the computers—must be improved. The FAA's most recent request to Congress calls for \$2.8 billion to replace the present computers.

But the FAA has also announced that it is developing on-board collision-avoidance systems that may return full control of the aircraft to the pilot. J. Lynn Helms, new head of the FAA, has proclaimed this new anticollision device as the wave of the future. He would like to see the system operational as early as 1984. Aircraft with these new devices would receive warnings of approach-

ing craft, separate from any ground-control warnings.

Newer, more sophisticated computers, capable of running more complex software, will also add more flexibility to any ground control. And with more money invested in backup systems, the FAA hopes to cut down on the frequency of the computer outages.

For now, the problem with air traffic control is that it is safe *almost* all the time. But there have been times when the machines have failed. And then, it was up to the men to step in and set things right. **PM**

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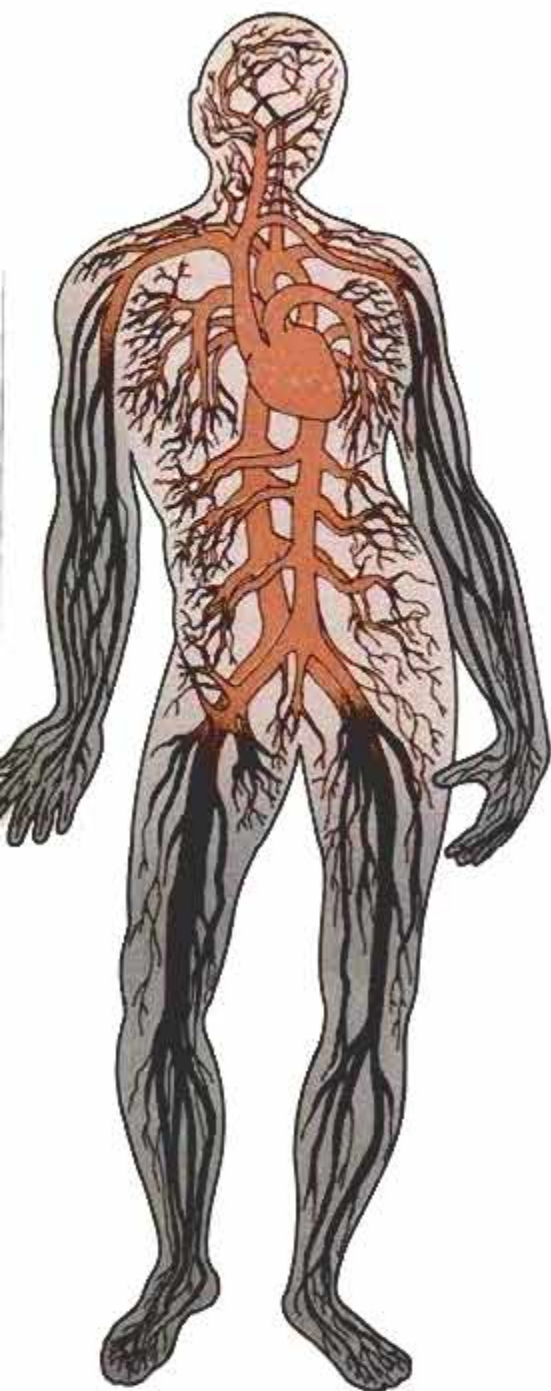
I plan to build: _____ (date)

MPM12

New ways to fight the chill that kills

Now, improved clothing, techniques and treatments can save your life in the cold.

by Bill McKeown OUTDOORS EDITOR



Crucial for keeping you alive, veins and arteries of body core can withdraw blood from extremities to warm vital organs.

It was a sunny, windy day of late fall when the two brothers started their hike. The temperature was a brisk 48° F.—the kind of weather that might be found almost anywhere in the country this time of year—and the boys worked up a sweat as they followed a trail uphill through the woods. They were sliding down the far side of a mossy ledge, four hours out and ready to turn and head back, when Pete, 17, fell and twisted his leg under him. They couldn't tell if it was a sprained or broken ankle, but it was obvious that he wouldn't be able to make it back home. Younger brother Fred left Pete his cotton jacket and started downhill to get help.

Night brought a driving wind with rain squalls, and there was no sign of Pete when four friends with a folding stretcher came looking for him several hours later. Apparently, Pete had headed down to look for shelter and had fallen in a shallow, but icy stream in the dark. Their flashlights showed where he had crawled out on the far side, but then his trail seemed to wander and they lost it. During the night, as they searched, the temperature never dropped below freezing, but by

morning, when Pete was finally found, his body was stiff and lifeless. His grieving friends recognized it as another case of death from "exposure" as they carried him back down.

That was four years ago, but the added tragedy is that, from what we now know, Pete's life might have been saved.

Doctors call it hypothermia, and the diagnosis is made when a low-reading thermometer, preferably rectal, goes down to 94° F. or below. Death comes when the body cools below about 80° F.—the temperature of a mild summer day. Well before that, the body may become stiff, the pulse disappear, and the skin appear gray. Proper and rapid treatment, in a hospital, if at all possible, is essential.

The condition of hypothermia, we now know, can occur almost anywhere at almost any time—to an athletic mountain climber caught in a rainstorm, a sailor who falls overboard in water under 70° F., or an alcoholic passed out on the cold sidewalk of a city.

Symptoms may start with shivering and drowsiness. Lack of coordi-

(Please turn to page 166)

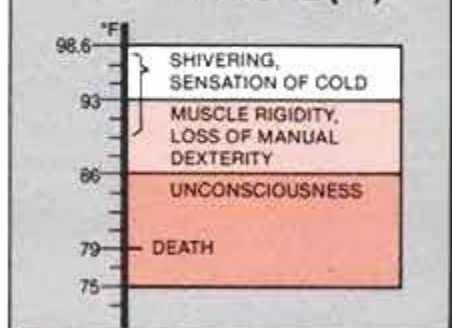
WIND-CHILL CHART

WIND SPEED	ACTUAL TEMPERATURE (°F)					
	40	20	0	-20	-40	-60
	EQUIVALENT TEMPERATURE (°F)					
CALM	40	20	0	-20	-40	-60
10	26	4	-24	-46	-70	-95
20	18	-10	-39	-67	-96	-124
30	13	-18	-48	-79	-109	-140
40	10	-21	-53	-85	-116	-148

LITTLE DANGER
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With wind lowering the effective temperature, body-core cooling can occur well above the freezing point and induce hypothermia or frostbite at any time of the year.

BODY TEMPERATURE (°F)



As body temperature drops, significant symptoms may indicate critical cooling. Hypothermia begins below 94° F. At temperatures below 80° F., the victim dies.

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- 3/8" - 1/2"
- 1/2" - 9/16"
- 9/16" - 5/8"
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NEW WAYS TO FIGHT THE CHILL THAT KILLS (Continued from page 164)

nation, irrational actions, slurred speech, and finally unconsciousness may follow. It's very important to watch for these subtle signs before they can advance.

A clever reflex action of the body pulls blood away from the hands and feet, so that the more important vital organs in the central body core can be kept warm. Quilted vests are popular because they help maintain heat in this core region and seem to make the entire body feel warm. New survival life jackets have a bottom panel to pull up and help retain heat in the groin area. A knit cap on the head, where more than half the body's heat is sometimes radiated and lost, frees blood to return to the extremities and helps keep hands and feet warm.

Careless warming of a hypothermia victim's hands and feet is dangerous, however—warm core blood may be attracted to the extremities, while the cold blood from them is displaced back to the core, shocking the heart into failure. Proper first aid for someone suffering from exposure can be critical. Hospitals frequently warm only the core in a 100° to 110° F. bath, while leaving hands and feet out of the water and carefully monitoring vital signs. Expert medical treatment is now saving cold-condition victims who previously were lost.

Army-developed clothing

The most extensive study of new methods and equipment to combat the cold has been done by the U.S. Army Research Institute of Environmental Medicine at Natick, Mass. Here they have tested, and in some cases created, the clothing designed to keep GIs comfortable anywhere in the world, and they have worked out the rules for using it properly. Even a warmth measurement has been devised: One CLO equals the body-heat retention of one standard suit of clothes; the Army-issue of layered uniform for cold conditions provides up to 4.6 CLO.

Dr. Murray Hamlet, Natick's director of experimental pathology and lecturer on survival techniques, points out that Army gear must serve in colder and more rugged conditions than most civilian equipment, but that there is no substitute for quality, in or out of the military. An afternoon on a ski slope is not as grueling as all-night guard duty in the arctic, but the Army does test new civilian sport materials. Often they don't prove durable enough to stand up to field conditions.

With recruits from city and country, snowbelt and tropics, the Army teaches them to remember the acronym COLD. C stands for cleanliness of clothing. It is important to wash garments to remove the grease and grime that clogs fabric airspaces and reduces insulation. O is a reminder to avoid the overheating that causes sweating, damp clothes and chills that follow as moisture lowers skin temperature. Clothing should be opened before sweating begins, or removed layer by layer. Several light garments are better than one heavy one.

L means loose clothing, with space for insulating air layers between. D refers to the importance of keeping dry. (Wet cold, according to the Army, is usually defined as temperatures above freezing during the day and down to 14° F. at night.) Snow should be brushed off—not rubbed into the fabric—to avoid dampness. Clothing should be aired and dried whenever possible.

Synthetics for warmth

New synthetic polypropylene underwear has been found to be particularly effective in wicking away warmth-stealing sweat from the body. One civilian equivalent is the Lifa brand from Helly-Hanson, originally tested by Norwegian fishermen. Wool clothing, unlike fabrics such as cotton denim, supplies warmth retention even when it's wet. Fiber pile, also made from synthetic yarn and now available from various sources, doesn't hold water and helps it evaporate. Mittens made of preshrunk boiled wool, such as the Dachstein type, have a tighter weave and are worn alone or under waterproof outer shells for added protection.

Feet are difficult to keep warm, so several methods can be combined. While plastic bags can be fitted over socks as vapor barriers, the wet warmth may eventually turn cold. Socks that wick away wetness are preferred by many outdoorsmen. Foot powder can also be used to keep feet dry. Boots should be loose enough to fit comfortably (European lasts often taper too much and cramp the toes).

To keep the cold ground under boots from robbing foot warmth, plastic inserts can be fitted inside, beneath your socks, as added insulation. Remember that body thermostats in the head and neck control temperatures throughout the entire body. Put on a warm cap and added blood to the feet will make them feel warmer as well.

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When pushed hard, the Alfa's suspension is designed to understeer initially, then balance out with throttle to bring the rear in line.

Every so often, someone creates a truly remarkable car—remarkable because it's exceptionally beautiful, powerful, well engineered, exciting to drive, or has some other combination of virtues. And sometimes, this label may be applied because a car is unique in a world that is overpopulated with look-alike, drive-alike transportation appliances.

The Alfa Romeo GTV6 2.5 is a truly remarkable car. It's beautiful, powerful, well engineered, exciting and, boy, is it unique!

Long known for its flashy sports cars (usually red) and sports sedans, Alfa took a stab at the luxury market two years ago with a larger, Mercedes-like sedan. The heart of that \$20,000 sedan was a marvelous new, 2.5-liter V6 engine. Unfortunately, Alfa's V6 sedan is produced in very small quantities, and was never certified for U.S. import.

On the other hand, the Alfa GT, a sleek and lovely sport coupe in the Toyota Celica/Datsun 200-SX class, has been imported here for several years with only mild sales success. It was a bit more expensive than the competition, and its desmogged four-cylinder engine was lacking in performance and fuel economy.

But one day, someone at Alfa Romeo came up with a brilliant idea: Why not combine our best and most beautiful car with our best, most modern and most powerful engine? Presto!

Like proud parents, the Alfa folks invited us over to see their new baby, and we got to drive on the sorts of roads it was created for: narrow, twisty two-lanes in the hills and fast, freeway-type motorways in the valleys near Rome. "The *polizia*

FIRSTHAND REPORT

Driving the Alfa Romeo GT V6

An Italian exotic with a hot-rodder's muscle.

by Gary Witzenburg

DETROIT AUTO EDITOR

have agreed to look the other way," they told us.

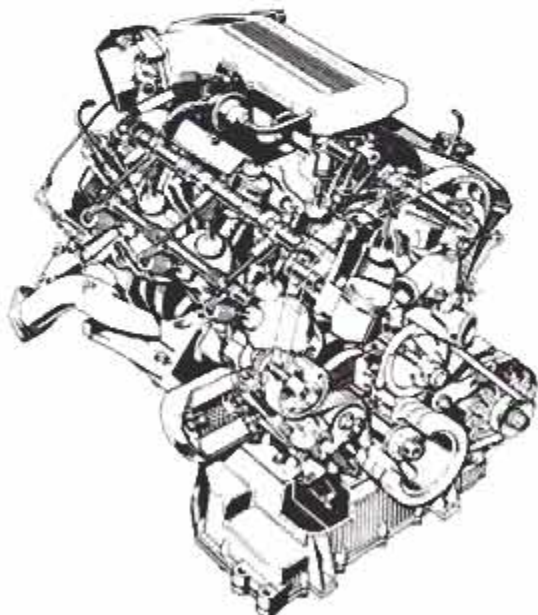
Our test car was bright red (of course) and looked like an effective blend of European sport coupe and American muscle car. There's a functional-looking, flat-black front spoiler with twin grilles for cooling, a menacing "power bump" on the hood (necessitated by the V6's bulk), 195/60 HR 15 Pirelli P6 tires on magnesium alloy wheels and a subtle aerodynamic lip on the hatch door above the taillamps. Window frames, mirrors, rear-quarter vents, bumpers, rocker moldings and other exterior trim pieces are also black to complete the effect.

The GTV6 offers stunning performance from its electronically fuel-injected, 160-hp, 2.5-liter engine. The two banks of three cylinders are joined in a narrow 60° V (like GM's X-car V6) for

compactness, and there is one overhead camshaft per bank. Alfa says the smog-certified American version puts out an impressive 154 hp. The transmission is a smooth-shifting, five-speed manual, which is located just ahead

(Please turn to page 170)

The 2.5-liter V6 fuel-injected powerplant develops 154 hp. It uses a single overhead camshaft per bank to activate the intake and exhaust valves.



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The GT V6 sits on a fairly trim 94.5-in. wheelbase, but weighs in at a chubby 2,800 lbs.

DRIVING THE ALFA ROMEO GT V6 (Continued from page 168)

of the rear axle for optimum weight distribution (Alfa doesn't have automatic transmission in the GT V6).

The front suspension uses torsion-bar springs and progressive-rate shocks; rear suspension is a highly sophisticated De Dion design, which keeps the rear wheels perpendicular to the road at all times. There are sway bars at both ends to control body roll during hard cornering. All four brakes are discs.

A better cockpit

Inside accommodations are much improved compared to the last (four-cylinder) Alfa GT we drove. The new dashboard incorporates a large, round speedometer, a tachometer and clock faces in individual shaded pods. Auxiliary gauges and switches are located just to the right for easy view and reach. The attractive, three-spoke sport steering wheel can be adjusted for height, and its rim thickness, diameter and soft-foam covering seemed just right.

We covered the 178-kilometer test route in 2½ hours, including a half-hour rest and snack stop, and we found the GT V6 an absolute ball to drive. It accelerates, darts, weaves, corners and brakes with amazing agility in city traffic and mountain switchbacks, then cruises on the Italian motorway with sure-footed stability at well over twice our national speed limit.

The engine comes on with a Porsche-like throaty roar when accelerating. At speed, there's a bit of wind noise around the outside mirrors, but otherwise, the cockpit seems as quiet as it is comfortable. On the other hand, the brakes squeal unmercifully, the steering-wheel position (adjusted so we could see the dials) is still too high and angled for us, the shifter throws are fairly long and there isn't much headroom in the back seat. But then, this Italian stallion isn't intended for hauling more than its driver and one thrilled passenger, anyway.

At about \$17,000, the price in-

cludes airconditioning and most everything else you could want.

The Alfa's engine is one of the most refreshing powerplants that we've seen in a long time. It lives in an engine box that's mercifully free of miles of smog tubing and hoses.

A single overhead camshaft activates the valves in each of the two cylinder banks. The cylinder heads are a cross-flow design, with the intake charge delivered through ram-tuned passages and the exhaust gases expelled through tubular headers.

The valve activation mechanism is as exotic as the rest of the car. The intake valves are activated directly by the camshafts, as in a conventional overhead design. The exhaust valves, however, are operated through a sideways-mounted lifter and a short pushrod, connected to a rocker arm attached to the exhaust-valve stem. It's a curious arrangement, but it makes sense. A dual overhead camshaft per bank would require a wider engine to accommodate beefing up of that side of the head. As it is, the rocker-arm shaft sits beside the exhaust valves.

Both camshafts are driven by a single-toothed rubber belt versus a timing chain mounted at the front of the engine.

On the road, this awesome-looking wedge spins out lots of power and revs so freely you'd think you had a two-stroke under the hood.

Unfortunately, Alfa is a tiny company, and will import only about 4,000 of these road burners this year—it's a rare jewel, indeed. **PM**

SPECIFICATIONS—ALFA GT V6

Wheelbase: 94.5 in.
Overall length: 167.7 in.
Overall width: 65.5 in.
Overall height: 52.4 in.
Approximate curb weight: 2,800 lbs.
Engine displacement: 2,492 cc
Engine horsepower (estimated): 154 @ 5,500 rpm
Transmission: five-speed manual
Rear-axle ratio: 4.10:1
Fuel capacity: 20.4 gal.
Cargo volume: 6.5 cu. ft.
EPA economy estimates: 17 mpg city/28 mpg hwy.

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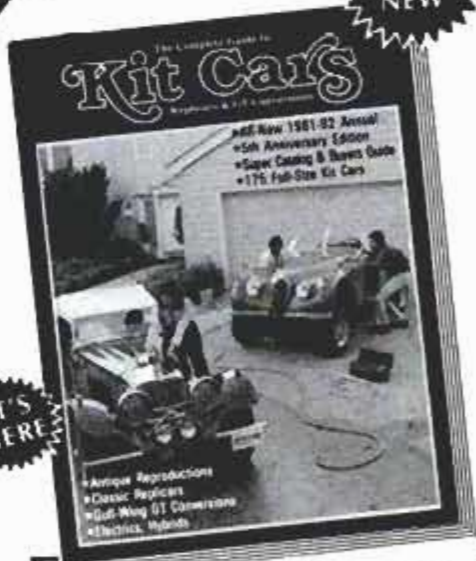
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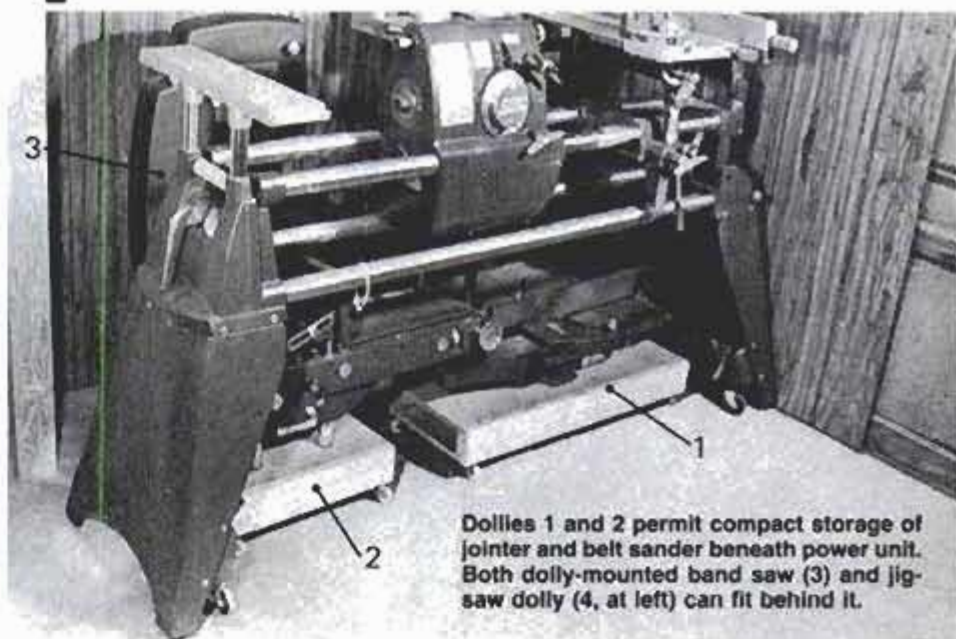
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These versatile dollies are good for mounting other lightweight shop equipment, too.

For storing Shopsmith attachments, these dollies are hard to beat. They're inexpensive, simple to build and provide the mobility and space-saving virtues that are so appealing in the Shopsmith itself.

Begin assembly by cutting the 2x4s to the required length and then cutting the $\frac{3}{8}$ x $\frac{1}{2}$ -in. rabbets as shown. The chart in the drawing

gives appropriate dimensions for all four dollies. (Allowance was made for different centers of gravity.) Use numbers for the lettered measurements: A, B, C, and D.

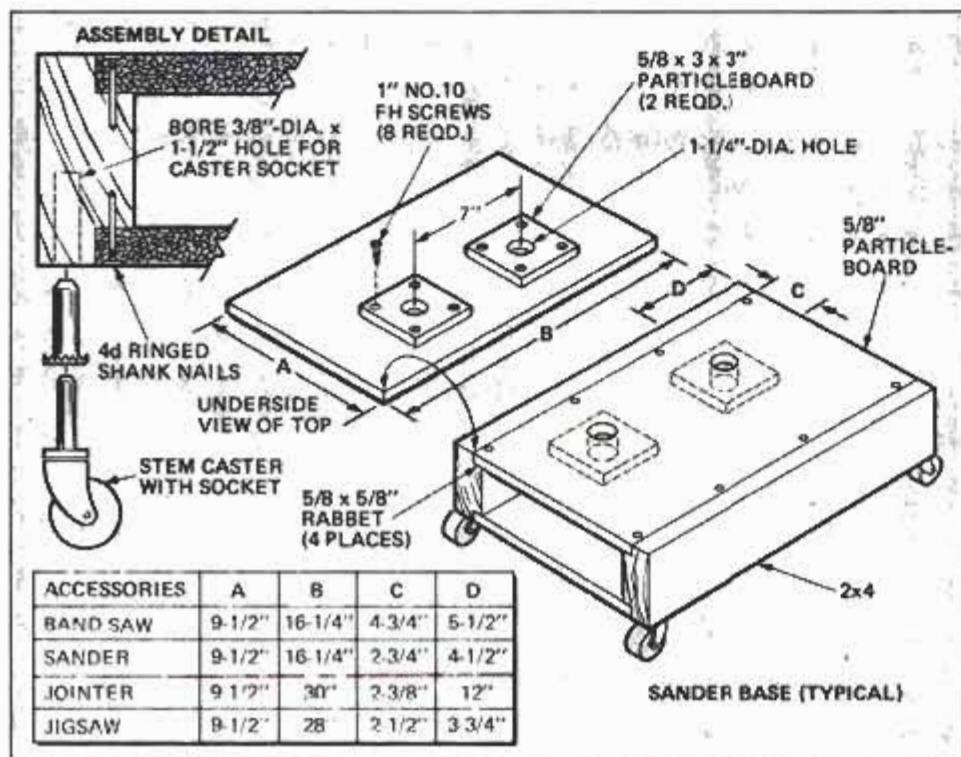
Next, cut the reinforcing collars and bore the $\frac{1}{4}$ -in.-dia. hole in the middle of each. Lay out the underside of the top and locate the first collar, using dimensions C and D as reference. Attach this collar, using white glue and ringed shank nails.

Position the other collar, using the saw extension table from the Shopsmith as a guide. Even though the distance between the mounting prongs (7 in.) has been supplied, using the extension table will prevent the possibility of error. Attach the second collar in the same way as the first. Using a hole saw, preferably in a drill press, bore the holes through the top with the collars as guides. Next, glue and nail the top and bottom to the 2x4s.

Finally, bore the $\frac{3}{8}$ x $\frac{1}{2}$ -in. socket holes in the 2x4s—not the particleboard—and insert the casters. We used the Bassick Caster model No. 11531, a ball-bearing, stem-type caster with sockets. But flat plate-type casters can be substituted.

Once the dollies are complete, the accessories can be easily rolled to the Shopsmith bed and lifted into place. The same dolly design can be used for other shop equipment.

—John E. Gaynor



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Buying the materials

The backing for the three mirrors is $\frac{1}{2}$ -in. plywood. The wings and the center panel are hinged together with 2-in. brass hinges.

When purchasing a mirror, make certain that it's free of distortion. To check for distortion, stand as far

Easier to build than it appears, this mirror is guaranteed to please the 'star' in your family.

by Robert C. Barnes

away from the mirror as you will stand when the mirror is in your home. Watch your reflection as you move back and forth, stoop down and rise up. If ripples of distortion are noticeable in your reflection, or if straight lines appear to have waves in them, the mirror is of poor quali-

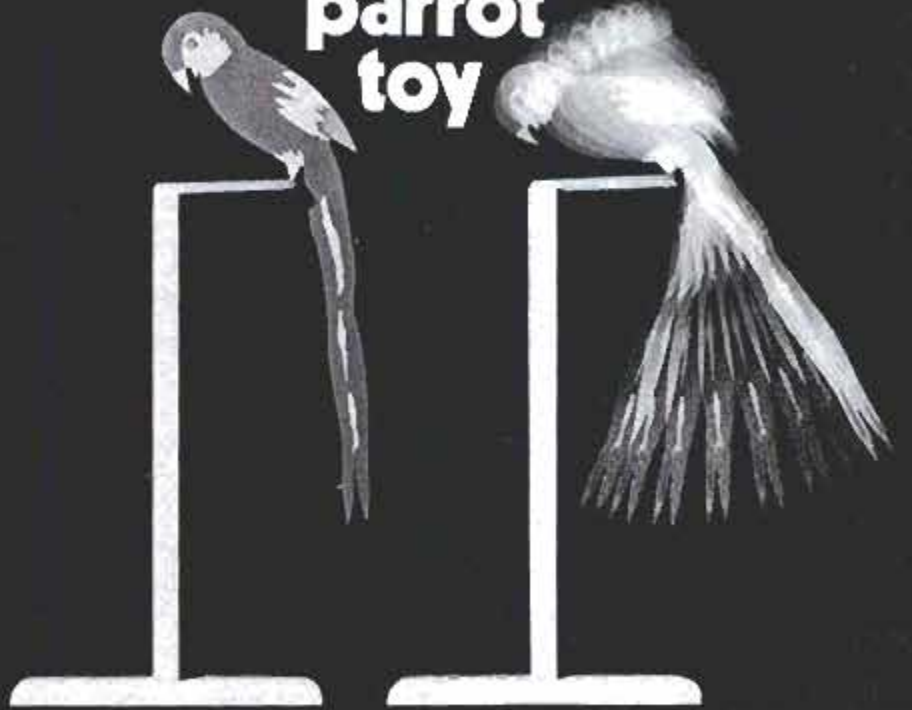
ty. Remember to ask the glazier to seam all of the edges (round them over slightly with a carborundum stone).

The light-bulb socket covers are made of 24-ga. sheet metal. If you haven't worked with sheet metal before, don't let this part of the project stop you. For just a nominal charge, you can have a local sheet-metal shop cut all of the socket covers to size and form them to shape. The drawing on page 58 makes the metal work easy, whether you have it done or do it yourself.

After the plywood backs are cut to size, attach the wings to the center

(Please turn to page 176)

Make this old-time parrot toy



Parrot balances on any ledge, but you can make a simple perch with pieces of scrap wood.

Here is a toy that will delight any youngster. Designed to remain balanced, it rocks when nudged gently with a finger.

Use a grid to recreate the pattern. Check your bird for balance before painting. Adjust balance by sanding away weight in the head or tail to produce a stable at-rest position. Balance can also be adjusted by filing either side of the fulcrum.

—Alexander Hess



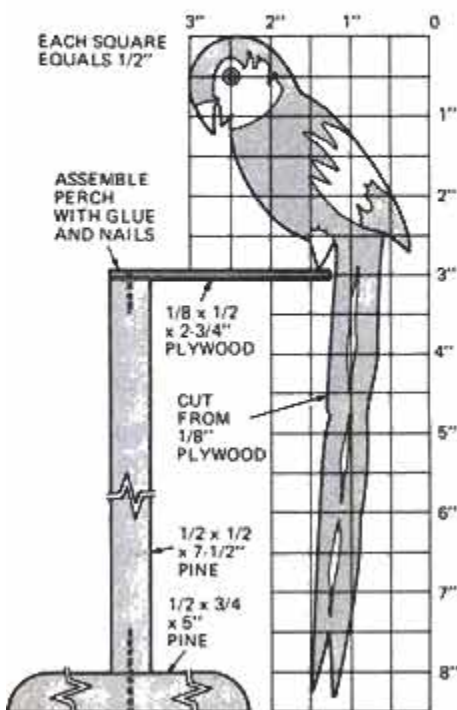
Coping saw does a quick, neat job on 1/8-in. plywood. Use a bench pin for support.



If you are planning to make several parrot toys, you'd be wise to use a cardboard template in order to trace the outlines.



Paint the overall color first, then fill in the detail colors. Use nontoxic paint.



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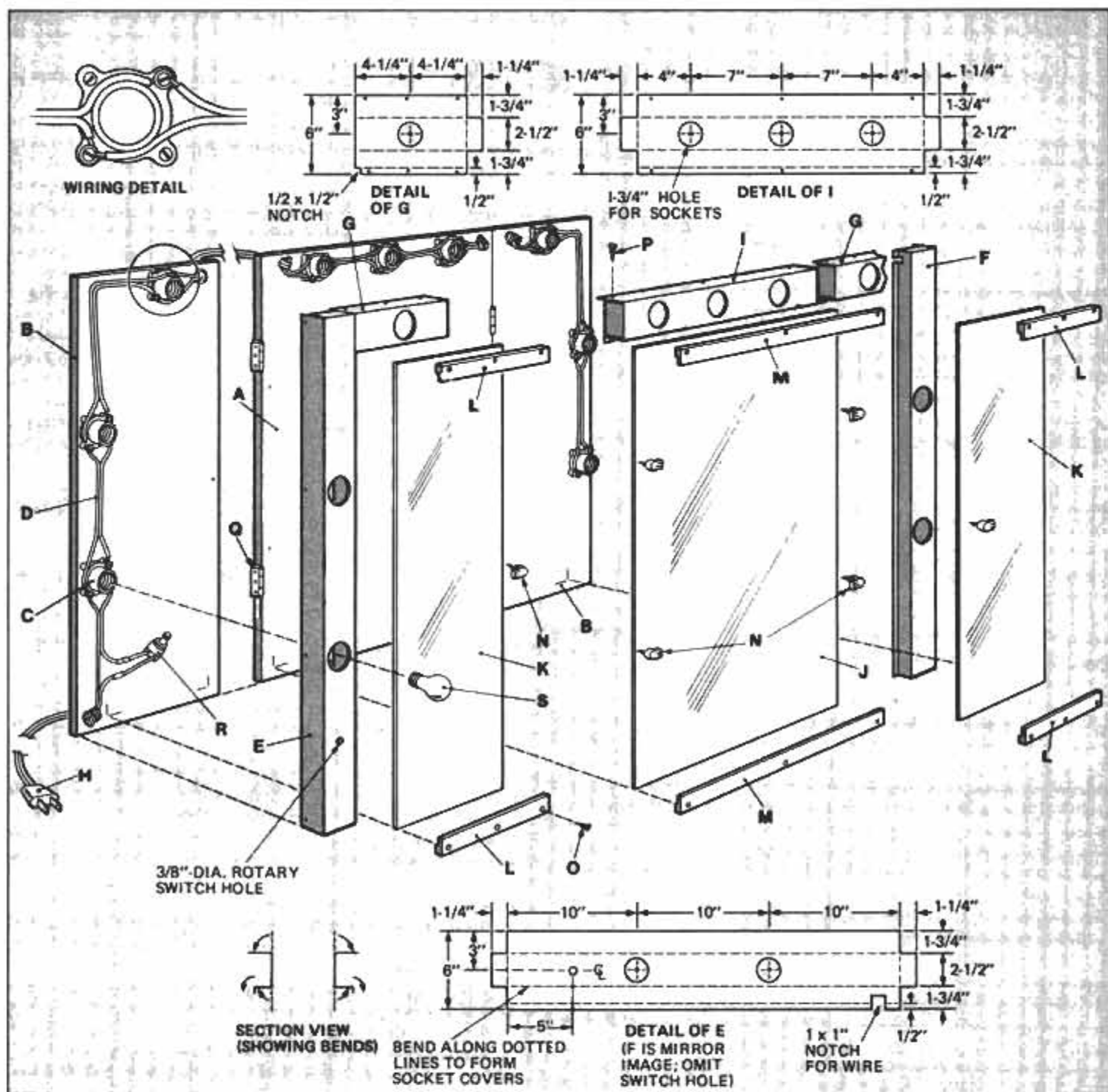
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MAKE THIS THREE-WAY MIRROR

(Continued from page 174)

panel and mortise for the hinges. Then bore the holes for the electrical cord.

When the sheet-metal socket covers have been cut and formed to shape, use them to position the sockets. Place each socket in its relative position, then lower the cover over the sockets. Center the sockets in their respective holes and remove the covers carefully. Attach the sockets with $\frac{1}{4}$ -in., No. 8 roundhead screws.

Electrical work

The drawing shows the sockets wired in parallel and operated by a

rotary switch. Even if you have some experience in basic wiring, exercise caution when doing electrical work.

In the wiring detail above, note that the insulation is stripped from the wire for a length of about $\frac{1}{4}$ in. Then the stripped section is looped once around the socket terminal screw before the screw is tightened. This procedure ensures good contact and a continuous flow of electricity. When following this procedure, be careful not to cut any of the individual copper threads in the bundle.

Begin the electrical work by using plenty of wire. Work backward from the last socket to the plug. There is no need to use staples, but don't pull

(Please turn to page 178)

MATERIALS LIST—THREE-WAY MIRROR

Key	No.	Size and description (use)
A	1	$\frac{1}{2} \times 24 \times 30'$ plywood (back)
B	2	$\frac{1}{2} \times 12 \times 30'$ plywood (wing backs)
C	9	porcelain or plastic light-bulb socket
D	1	16-ft., 16-ga. flexible electrical cord
E	1	$6 \times 32\frac{1}{2}'$, 24-ga. sheet metal (left socket cover)
F	1	$6 \times 32\frac{1}{2}'$, 24-ga. sheet metal (right socket cover)
G	2	$6 \times 9\frac{3}{4}'$, 24-ga. sheet metal (top wing socket cover)
H	1	electrical plug
I	1	$6 \times 24\frac{1}{2}'$, 24-ga. sheet metal (top socket cover)
J	1	$\frac{1}{8} \times 22 \times 26\frac{1}{2}'$ center mirror
K	2	$\frac{1}{8} \times 8\frac{1}{2} \times 26\frac{1}{2}'$ mirror
L	4	$\frac{1}{2} \times 1 \times 8\frac{1}{2}'$ wood molding with $\frac{1}{8} \times \frac{1}{2}'$ rabbet (mirror retainer)
M	2	$\frac{1}{2} \times 1 \times 22'$ wood molding with $\frac{1}{8} \times \frac{1}{2}'$ rabbet (center mirror retainer)
N	6	plastic mirror clips
O	38	$\frac{3}{4}$ in., No. 8 rh wood screws
P	17	$\frac{1}{2}$ in., No. 8 panhead, sheet-metal screws
Q	4	$1 \times 2'$ brass hinge
R	1	rotary switch (on/off)
S	9	15-w. light bulbs

Misc.: paint, solderless connectors or electrical tape.

HINTS FROM READERS

Handy ruler



Make it easy to measure small items at your workbench without getting out a rule each time. To do it, glue or screw-fasten an aluminum or wooden yardstick to the leading edge of your workbench.—*C. Boyd Pfeiffer*

Knurling a rod



To make a rod fit snugly in an oversized hole, knurl it in a metal lathe. Then measure the knurled section to make certain the diameter is right.—*Bob Berger*

Jigsaw handles



Don't discard a broken file or hacksaw blade. Grind the tang (or ends) to square them for use in a jigsaw to power file or to do heavy-duty metal cutting. You can break them for this use by gripping the wanted part in a vise and striking a sharp blow with a hammer at the free end, close to the vise. Wear goggles when you make the break.

—*Rosario Capotosto*

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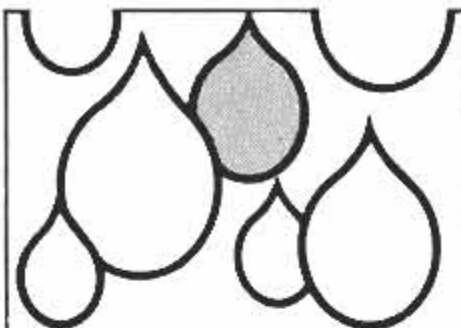
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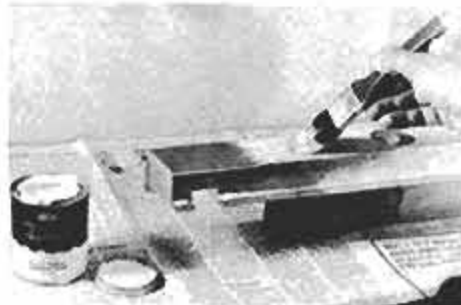
(Continued from page 176)

the wire tight. Tie stop-knots and be sure to leave plenty of slack between panels. You can screw in bulbs to check the switch and your electrical wiring.

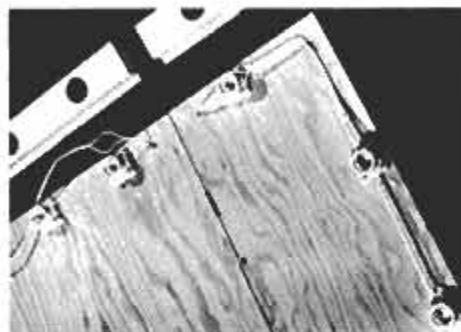
Remove the test bulbs, secure the



Position socket covers on the plywood backs for a good fit. Use covers to position sockets on center in cover holes. Remove covers and attach sockets to backs.



Paint the socket covers white or an off-white color. Other colors may cast hues on faces in the reflected light of the bulbs. Paint all parts before assembling the unit.



Begin wiring with the last socket and work backward. Strip insulation carefully without cutting the wire. Loop wire around terminal screw once and tighten the screw.

switch to its socket cover and attach all covers to the back edges with sheet-metal screws. Attach the mirrors using mirror clips. Then, with top moldings placed over top cover flanges, attach all moldings with roundhead screws which go through the cover flanges. You don't have to use screws in the vertical cover flanges. These flanges are concealed under the wing mirrors.

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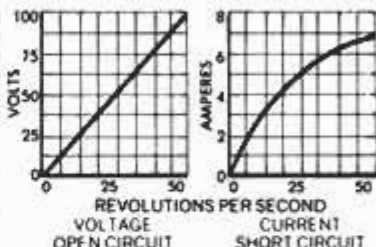
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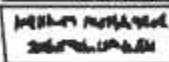
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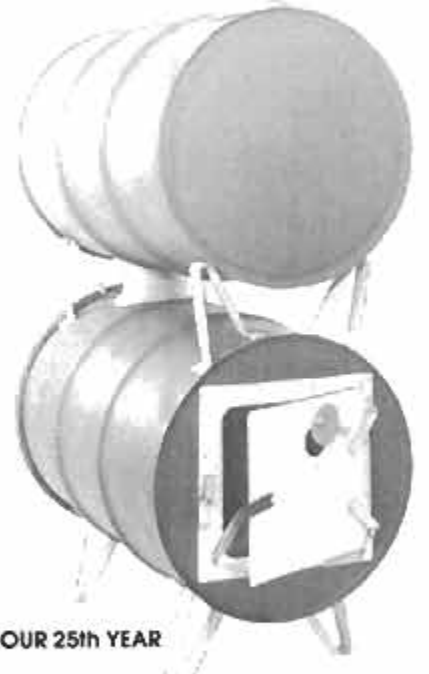
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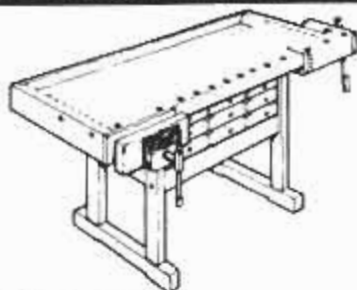
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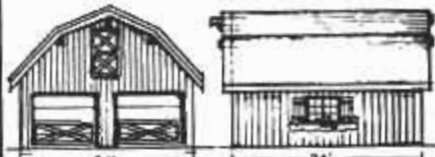
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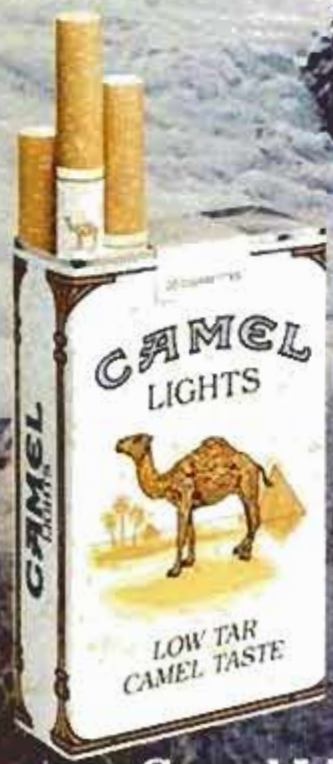
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