

NOVEMBER 1985 \$1.50

Popular Mechanics

PM's
**MUSCLECAR
SHOOTOUT**



'80s Technology vs.
'60s Horsepower

**Giant 58-Page
Woodworking Guide**

Everything You Need
To Know To

MAKE BEAUTIFUL FURNITURE

- Selecting Wood
- Plans for 4 Projects
- 14 Fantastic Finishes

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Than Ever This Season

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POWERBOAT
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On The
Space Shuttle

AMERICA'S

JEEP: Upstart To
Upscale In 45 Years

B-1: BOMBER OR BOMB?

Can It Keep
Us Strong?



...Ford's tough 4-wheelers.

(It's our middle name!)

Ford Ranger

Ford introduces Ranger SuperCab. It gives you over 22 cu. ft. of space behind the front seat. Or, add optional center-facing jump seats for seating up to five.



Sporty Ranger STX.

The 4x4 with everything on it...to go! The exuberant Ranger STX has over a dozen extra features, from unique paint to bucket seats, at a special package price. STX won the West, now it's offered nationwide.

New 2.9L V-6 Power.

The STX boasts Ranger's new bigger, more powerful 2.9L V-6. Electronically fuel injected, it hands you the reins to 140 horses.* (Ranger standard trim models also offer 2.3L EFI Four.)

New "Touch-Drive" System.

Presto! Just touch a button in the overhead console to shift from 2WD to 4WD high at any speed. Shift back to 2WD the same way. Ford's new "Touch-Drive" is that simple! (Manual locking hubs are still standard for you traditional off-roaders.)

Ford Bronco II

This tough number shares most of Ranger's good news. Like slick "Touch-Drive." Ford's remarkable new option brings push-button ease to 4-wheeling. You never have to wrestle a reluctant 2WD/4WD shift lever. You always have the assurance of 4-wheel drive high instantly.

New Powerhouse V-6.

Bronco II has the dash and drive of Ford's new fuel-injected 2.9L V-6. It's the one for power. For bashing through the brush with tighter turns than S-10 Blazer or Jeep CJ's. And for turning heads in town, too.

Eddie Bauer Broncos.

Both Bronco II and Bronco are offered in luxurious Eddie Bauer editions. They feature unique paint and special trim. High-styled interiors with Captain's Chairs. Plus Eddie Bauer tote and garment bags. And Ford's Extended Maintenance and Limited Warranty coverage. Ask to see this warranty when you visit your dealer.



Ford Bronco

Bronco's a winner... the strapping 4-wheeler that outsells every other full-size sport utility.**

Bronco starts with Ford's husky 4.9L Six, standard. And you go up from there, with the 5.0L V-8 with multiport electronic fuel injection - and 185 surging horsepower.* Or Ford's 5.8L High Output V-8 with 4-barrel carb.



Nothing in its class can match Bronco for power!

Unique Suspension.

Of all the big 4-wheelers, only Bronco has independent front suspension. To smooth your on-road ride. And to help keep wheels glued to the ground for maximum traction off the road. Your choice: manual front hubs or optional automatic front locking hubs.

Tow almost 4 tons!

The strong, powerful Ford Bronco can be equipped to tow 7,900 lbs. That's nearly a ton more than competitors—giving Bronco extra value and versatility nobody else offers!

Ford F-Series

They're too tough to top: America's best sellers 8 years straight.†

This year, Ford 4x4's pour on the power. With the biggest standard Six, plus the most powerful lineup of V-8's—big as 7.5L and 245 horsepower.*

They're the only big 4x4's with independent front suspension (Mono-Beam on F-350). The only ones with your pick of three cab sizes.

With Ford's rugged 4-wheelers, even the choice is tough!

Best-Built American Trucks.

At Ford, Quality is Job 1. A 1985 survey established that Ford makes the best-built American trucks. This is based on an average of problems reported by owners in the prior six months on 1981-1984 models designed and built in the U.S.

Lifetime Service Guarantee.

Participating Ford Dealers stand behind their work, in writing, with a free Lifetime Service Guarantee for as long as you own your Ford car or light truck. Ask to see this guarantee when you visit your participating Ford Dealer.

Buckle up—together we can save lives.

*Horsepower based on SAE Standard J1349 7.5L engine horsepower lower in California.

**Based on 1985 model year manufacturers' reported retail deliveries through July, 1985.

†Based on 1978 through July 1985 model year manufacturers' reported retail deliveries.

BEST-BUILT 
AMERICAN TRUCKS



Ford F-Series



Ford Bronco



Ford Ranger



Ford Bronco II

This One

K1S7-C6Z-08UW



America's



Ford Bronco II

tough tradition...



Ford Ranger

Ford Bronco

Ford F-Series



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Editorial offices: 224 West 57th St., New York, N.Y. 10019. We cannot be responsible for loss of unsolicited queries, manuscripts, or photos. For return, they must be accompanied by adequate postage.

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Published by The Hearst Corporation

President: Frank A. Bennack Jr.

Chairman: Randolph A. Hearst

President, Magazines Division: Gilbert C. Maurer

Publisher, Popular Mechanics: Daniel J. Coleman

Publishing Consultant: Richard E. Deems

POPULAR MECHANICS IS PUBLISHED MONTHLY by the Hearst Corporation, 959 Eighth Avenue, New York, N.Y. 10019. U.S.A. Frank A. Bennack Jr., President; Randolph A. Hearst, Chairman; Harvey L. Lipton, Vice-President and Secretary; Edwin A. Lewis, Vice-President and Treasurer; Hearst Magazines Division: Gilbert C. Maurer, President; K. Robert Bink, Executive Vice-President; George J. Green, Executive Vice-President; Mark F. Miller, Executive Vice-President; General Manager; Raymond J. Petersen, Executive Vice-President; Thomas J. Hughes, Vice-President & Resident Controller; William S. Campbell, Vice-President, Director of Circulation; Daniel J. Coleman, Vice-President for Popular Mechanics.

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ON THE COVER
Doing it all yourself—that's the real attraction of fine furniture making. In our special Woodworking Guide, learn how to buy hardwood lumber, and how to finish it beautifully. And use our tools and tips to build four fine furniture pieces. The special section begins on page 97.

—PM photo by Bill Dolce

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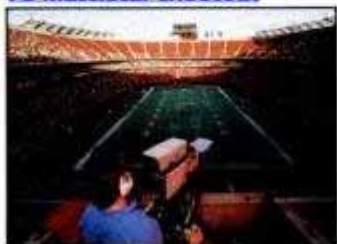
POPULAR MECHANICS (ISSN 0032-4558) is published monthly by The Hearst Corporation, 224 West 57th Street, New York, N.Y. 10019, U.S.A. Subscription prices: United States and possessions, \$13.97 for one year; \$23.97 for two years. Canada and all other countries, add \$16.00 for each year. Second-class postage paid at New York, N.Y. and additional mailing offices. Authorized second class mailing-in-Canada privileges by Canada Post, Windsor, Ont. Registered as second-class matter at the Post Office at Mexico D.F., Mexico, June 20, 1950. © 1985 by The Hearst Corporation. All rights reserved. Printed in U.S.A.

POSTMASTER: Please send address changes to Popular Mechanics, P.O. Box 10064, Des Moines, Iowa 50350. SUBSCRIPTION SERVICE: Popular Mechanics Magazine will, upon receipt from its reader of a complete new or renewal subscription order, undertake fulfillment of that order so as to provide the first-copy delivery either to the Postal Service or alternate carriers within six to twelve weeks. If for some reason this cannot be done, you will be promptly notified of the issue date that will begin your subscription, with a request for any further instructions you may have concerning your order. Please address all such orders to us at Popular Mechanics, P.O. Box 10064, Des Moines, Iowa 50350. • Should you have any problem with your subscription, please write: Joan Harris, Customer Service Department, Popular Mechanics, P.O. Box 10064, Des Moines, Iowa 50350 or call toll-free 1-800-247-5470; Iowa residents call 1-800-532-1272. Please enclose your mailing label when writing to us or renewing your subscription. • Renewal orders must be received at least eight weeks prior to expiration to assure continued service.

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8⁸⁸



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VALUE
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4⁹⁹

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EDITOR'S NOTES



Art Directors have all the fun. First of all, they're never in the office. They're always out at some exotic location, supervising a photo shoot, or "scouting" photo locations for future use. Also, they get to pick all the models for photo shoots, which means they have to interview gorgeous girls constantly. Bryan Canniff, our Graphics Director, fits neatly into this stereotype. To supervise the photography for our article on exotic superexpensive boats (page 80), Canniff spent several days in Florida, interviewing models, riding around on hundred-thousand-dollar boats, and generally having a good time. And there's Outdoor Editor Tim Cole having a good old time, too. Then Canniff was off to Michigan International Speedway, where our 45th birthday tribute to the Jeep was photographed. And while no one would classify Brooklyn, Michigan, as an exotic location, thrashing around the boonies for a couple of days with Jeeps old and new (page 94) isn't exactly boring. And there's Cole again, sharing all the fun. Cole came back to the office after the Jeep article, but Canniff went on to supervise the photography for our musclecar shootout (page 76). He was forced to spend another hum-drum day, blasting 12 cars around a skidpad and down a dragstrip. But that's not all. When John Johaneck of our art staff was assigned to the how-TV-covers-football article (page 73), he immediately decided that he needed to spend lots of time in Giants Stadium watching the New Jersey Generals play all their home games, plus monitor workouts. Luckily, cooler heads prevailed, although Johaneck did spend considerable time with Herschel Walker, Doug Flutie and the gang. By the way, how does one become an art director? . . .



Canniff and Cole having fun on the powerboat shoot.

With the NFL in full swing, you may have noticed that ABC, CBS and ESPN are all bringing you closer than ever to the action. You're practically right on the field with the football players this year, thanks in no small part to the latest video technology. Noted ABC sportscaster and famous author Dick Schaap takes you behind the scenes this issue and puts you right on the 50-yard line as he explains not only why you're seeing more action, but how the networks are working their magic. . . . **All's quiet now** in our Home and Shop Department. But you should have seen it a few days ago. Steve Willson, Joe Truini, Art Rooze, Roy Berendsohn and Lynne Abbate were then in the midst of controlled chaos as they put the finishing touches on our annual *Woodworking Guide* (page 97). The 58-page special has a new look that we hope you'll find attractive and easier to read and use. We also focused more sharply on a theme—furniture making. Hope you like it.



Canniff and Cole having fun on the Jeep photo shoot.



Johaneck (right) having fun at Giants Stadium with Dick Schaap (left) and photographer Brian Wolff.

'Til next month.

Guess which national anti-freeze brand contains Alugard?



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LETTERS TO THE EDITOR



Sound and fury

Your August '85 cover is offensive and garish. We live in an area where ATVs are very popular, but we think they are dangerous, loud and destructive.

GORDON AND NANCY SPRING
SALISBURY CENTER, NY

The peace and quiet of nature are destroyed by the noise and stink of motorized machinery. The natural environment is disappearing fast enough without the promotion of these obnoxious machines.

A.B. ZIMMERSCHIED
RENTON, WA

Your article on ATVs does not warn that they lack rollover protection.

W. WILL
CRESCENT CITY, CA

Okay, ATVs lack rollover protection. So do bicycles. So what? The fact is, all-terrain vehicles are extremely popular and there are millions of them in use. As far as usage, let's let majorities rule. For instance, on some lakes, you can use a



ATVs on our August cover brought out some controversial remarks from PM readers.

powerboat. On others, you can't. If most people in an area want to use ATVs for recreational purposes, they should be allowed to do so.

Old-time icebox

In your December '84 issue, you published plans for building an icebox (*Build An Old-Time Icebox For Your Home Bar*, page 102.) The dimensions given made the bar a bit low for mixing drinks, so I increased the height and width by 1 inch per 6 inches. This change also allowed me to include a 3-inch-deep inside drawer on the right

side for bar tools. In addition, I made a 1/4-inch plastic glass rack to hang small brandy and cocktail glasses in the upper left compartment. I love it!

T.J. ALBRECHT JR.
SAN RAMON, CA

Your icebox bar looks great. Congratulations on a job well done. To order plans, send \$10.50 to Icebox Bar, No. PL-1284, Popular Mechanics, Box 1014, Radio City Station, New York, NY 10101.



Returned to sender

Having read *Sport Planes You Can Build* (page 86, July '85), I became interested in getting information on the V-8 Special. However, my letter was returned and stamped "Moved, Not Forwardable."

EDWIN S. FITCH
N. MYRTLE BEACH, SC

Sorry for the inconvenience. Chris Beachner's new address is P.O. Box 971, Eloy, AZ 85231.

Nuclear cleanup

As a 10-year veteran of the nuclear waste business, I enjoyed reading *The (Slightly) Glowing Future Of Nuclear Waste* (page 91, May '85). A couple of statements, however, are misleading.

The U.S. government is not really spending billions of dollars searching for a safe method to get rid of nuclear waste. Millions of dollars are being spent for research, but not billions. Once the search is over, the costs of actually getting on with the job are indeed high. Also, high-level waste remains "lethal" for only a couple of hundred years after it's produced, not for 250,000. In fact, after 1000 years it will have decayed to about the same level as the uranium ore which was originally mined to begin with.

The radioactive tritium used in the lanterns described in the article does not glow with "an unearthly blue-green light you might see around a witch's brew." This color is characteristic of the phosphorescent coating used in the lanterns. This was stated correctly later in the article, but the casual reader might miss it.

JOHN R. WILEY
INTERNATIONAL ATOMIC ENERGY AGENCY
AIKEN, SC

Your otherwise excellent article contains a mistake on page 214 that cannot go uncorrected by New Mexico State University Aggies. The error refers to biological (animal feeding) studies conducted by scientists at the University of New Mexico. The biological support work has been conducted at New Mexico State University, not UNM. People interested in our work can contact me at the Department of Crop and Soil Sciences, Box 3Q, Las Cruces, NM 88003.

GEORGE O'CONNOR
SLUDGE PROJECT MANAGER—NMSU
LAS CRUCES, NM



Marlboro

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**SURGEON GENERAL'S WARNING: Cigarette
Smoke Contains Carbon Monoxide.**

16 mg "tar," 1.0 mg nicotine
av. per cigarette, FTC Report Feb '85

IMPORTS & MOTORSPORTS



Toyota Celica for '86

GT-S Liftback, now with fwd, gets a new 2-liter, 16-valve, twin-cam Four.



Let's hear it for a true sport, one that's come on stronger every year since its first appearance in 1971. The fourth-generation Celica is a tidy package in either Sport Coupe or Liftback body style. Slightly downsized from last year, it's now front-wheel drive with a transverse engine layout that results in more front and rear legroom and headroom. The re-engineering, restyled and rounded-off Celicas come in three series—ST, GT and GT-S. The ST and GT use the Camry's 1995-cc, 97-hp ohc Four, but the GT-S has a brand-new, 1998-cc, 16-valve, twin-cam Four that puts out 135 bhp at 6000 rpm. Few pieces interchange between this new engine and Toyota's similar MR2/Corolla GT-S 1.6-liter motor. Like the 1.6, the 2.0 twin-cam uses Toyota's T-VIS intake butterfly, which opens at the same 4350 rpm.

The Celica GT-S also comes with 4-wheel disc brakes, an 8-way driver's seat, tilt/telescoping steering column,

alloy wheels, and 205/60R14 Michelin steel-belted radials.

All models have 4-wheel independent suspension, variable-assist rack and pinion power steering and 5-speed manual transaxles. Analog gauges are standard but digital instruments are available optionally in the GT only.



Sport Coupe is other Celica body style; three series are ST, GT (shown) and GT-S.

Other major options include a 4-speed overdrive automatic transaxle, automatic air conditioning, power windows and locks, power sunroof and several Fujitsu Ten sound systems.

Benz birthday car?

The 380 SL Coupe/Roadster is the Mercedes-Benz that's next up for a redo. But whether a successor will be a 100th anniversary-year model for introduction sometime during 1986 remains to be seen. A rough-edged prototype, an obvious evolution of the long-lived 380



SL carries the M-B pinch-tail treatment.



New M-B sports car spotted in the rough.

SL body, has already been spotted. But 1987 may be the car's model year. You can be sure that a new SL will offer the latest M-B technology, including as a likely option 4-wheel drive. Like its predecessors, the SL's convertible top can be operated once the hardtop is removed.

'86 Indy 500—live!

It's time to readjust your schedule for next year's Memorial Day weekend. Now, the '86 Indy 500 will be broadcast as it happens. No more same-night, after-the-fact telecasts; no more hiding from the news all day; no more pretending that you're watching along with the quarter-million fans who are at the speedway.

ABC's live coverage is a 3-year contract that comes after 15 years of same-



The 1985 Indy 500 winner, Danny Sullivan, tests a videocamera mount on his car.

night broadcasts, so you can be sure of some fancy camerawork from the network—at least at trackside. It's something else to carry a videocamera in an Indy car during the 500. With a NASCAR stocker it's easy; there's plenty of room for a vidcam "passenger" inside the sedans.

We explored the difficulty in shooting from an Indy car recently, during a visit to Roger Penske's racing shops in Reading, Pennsylvania. Danny Sullivan showed us some of the mounts used for



PM Art Director John Johaneck (left) talks with Sullivan during visit to Penske shop.

cameras that take viewers on fast laps before a race. But, so far, during the race there's only room for one pair of eyes in an Indy car cockpit. **PM**

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Then imagine finding one with your name on it.

Pure Joy is a PASSPORT of your very own

PASSPORT has exactly what the discerning driver needs, superheterodyne performance in a low-profile package. It's about the size of a cassette tape, the smallest detector ever made. This miniaturization is possible only with SMDs (Surface Mounted Devices), micro-electronics common in satellites but unprecedented in radar detectors. The result is Pure Joy. Others may put it differently. "In a word, the PASSPORT is a winner," said the experts at *Car and Driver*. But you get the idea.



PASSPORT comes complete with all accessories.

PASSPORT is packaged for presentation with the same care that went into its engineering. Everything is included: visor clip, windshield mount, straight cord, coiled cord – even a leather travel case. Each item is positioned in its own foam-padded compartment to assure safe arrival. Rather like traveling first class, we think. And this will be the impression when the box is opened.

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* Pure Joy is our commitment to you. If PASSPORT doesn't live up to your highest hopes – for any reason – within 30 days, just send it back. We'll refund all of your money and your return shipping costs. No exceptions. No hidden charges. Just a straight commitment.

Pure Joy is the gift you'll save till last

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TRUCK**

HOMEOWNERS' CLINIC



Waterlogged expansion tank

Our home has an older gas-fired hot water boiler, with a pressure regulator and a relief valve to maintain the proper water pressure. A 30-gallon cylindrical tank is slung horizontally from the ceiling over the boiler, and connected to the main hot-water line.

A small amount of water leaked from the relief valve drain on each heating cycle. The overhead tank was waterlogged, and assuming that it was intended for expansion of the heated water, I pumped air into it. This stopped the leaking from the relief valve, but resulted in several airbound radiators. Is this tank an expansion tank, or an emergency source of water to the boiler?—Lester L. Meyers, Fort Wayne, IN

The tank is an expansion tank and not an emergency water source. The water feed line to the boiler, with its pressure-reducing valve, will automatically feed water at the required pressure (12-15 psi) whenever makeup water is needed.

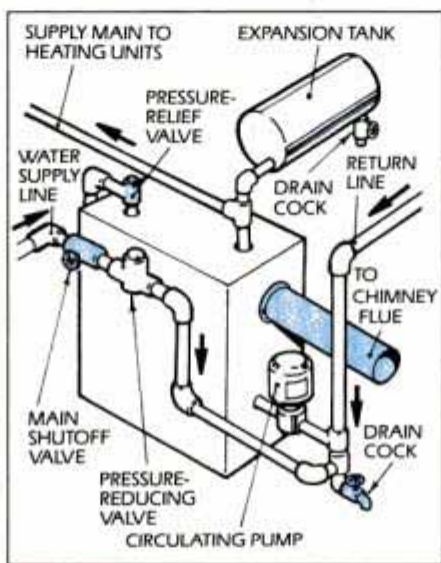
In a hot-water heating system the distribution pipes, radiators and boiler are a closed circuit completely filled with water. When the water heats up, it expands.

The additional volume of water flows into the expansion tank where it presses against a cushion of air—or in newer systems, against a diaphragm. Without an expansion tank in the system, expanding water would cause the pressure-relief valve to discharge.

When an expansion tank becomes waterlogged the system acts as if there is no expansion tank, and the relief valve constantly discharges. To correct this, you have to drain the tank. In the process, an air cushion will be re-

established. If you have an older-style tank without a diaphragm, it should be drained completely. A diaphragm-style tank needs to be only about two-thirds drained. If there is a shutoff valve in the line between the tank and boiler, be sure to leave it in a fully open position after draining the tank.

Your airbound radiators are caused by pockets of air trapped in the system. To release this air, you have to bleed the



Drain a waterlogged expansion tank to re-establish a compressible cushion of air. If airbound radiators result, bleed radiators with circulating pump running.

system. All or some of your radiators should have small key-operated valves for this purpose. After the boiler has been operating for several hours, hold a cup under each valve and open it to release the air until you get a steady stream of water.

Foggy thermal panes

My daughter's home in Michigan has double-glazed windows. Almost all of them have developed leaks in the vacuum seals and are clouded between the panes. Somewhere I read this fog could be eliminated or alleviated with the injection of a gas. Any help you can give me will be appreciated.—F.W. Robertson, Fort Myers, FL

I know of no method for correcting clouded double-glazed windows short of taking them apart, cleaning the panes and resealing the edges. Injecting a dry gas or drawing a vacuum (both extremely difficult procedures) in the space between the panes may temporarily minimize the condition. But unless the seal failure is located and corrected, the condition will recur. Usually, the failure is just a tiny hole or crack in the perimeter joint, and difficult to find. Often when there is repeated condensation and drying, a residue forms on the inner surfaces that is almost impossible to clean.

Most insulated panes are made with a hollow spacer around the edge that has an open end facing the space between the panes. The spacer is filled with a desiccant to absorb residual moisture. When there is a seal failure the desiccant becomes saturated, and moisture condenses on the panes.

To repair a faulty window you would have to remove the existing seal, clean out the edge joints so that a new seal can be applied, replace the desiccant in the spacer, clean the panes and reassemble the window unit. It's really not a do-it-yourself project.

Your best bet would be to contact the manufacturer of the windows. Most of them have a warranty—usually from 5 to 10 years—against product failure caused by a faulty seal. They will replace a pane at no cost within the first five years, and at a prorated cost for the next five years. Some manufacturers have longer warranties. Anderson Company, for example, has a full 20-year warranty. **PM**

Do you have a home-maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$2.45 postpaid. Send your order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

Painting over paneling

Several years ago, I paneled three rooms with a dark shade, low-priced paneling. Now, I would like to paint the paneling a lighter color to brighten up the rooms. Will this require a special paint? What treatment, if any, should I give the paneling prior to painting? Should I use brush or roller?—Marvin Johnson, Oak Hill, WV

Prior to painting, the walls should be covered with an oil-base primer—one that will not allow the stain on the panels to bleed through. Some stains

use a dye that can be dissolved by paint or primer. Before priming, try out a small obscure area to see if the stain bleeds through. If it doesn't, then prime all the walls using either brush or roller. Once the walls are sealed with primer, put on the finish coat of your choice.

If the stain does bleed through the primer, you will have to use a stain-suppressing primer. There are several brands of these. One such primer is called Under Cover, manufactured by Parks Corp. (1-800-225-8543). It costs about \$17 per gallon.

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SCIENCE WORLDWIDE



Escapist traits

Psychologists often study the higher primates for clues about the nature of human behavior. But at Rutgers University in New Jersey, where Michael D'Amato studies the lower *Cebus apella*, or organ grinder monkey, something unexpected was discovered recently. An organ grinder named Roscoe managed to get out of his cage after lab hours several nights. D'Amato thought it might be the fault of a careless assistant. But when a video tape was left on one night, it showed that Roscoe had discovered how to get out of the cage himself. He pounded a cage wall until one of two latches lifted from the vibrations, then pounded it again more gently to lift the other latch. D'Amato says the escape shows that the monkey had a goal in mind. Now, further studies are under way.



Roscoe, an organ grinder monkey, unexpectedly broke out of his lab cage by working on an outside lock with human wit.

Goal to go

Retired football star Rocky Bleir, interviewed for the journal of the Pain Information Center, says chronic sufferers of pain can overcome it. And the statement is backed up by papers delivered at an American Association for the Advancement of Science seminar. Bleir was severely wounded in Vietnam and told he would never walk again. Despite enormous pain, Bleir lifted weights with his toes to get back into action with the Pittsburgh Steelers. He started out lifting marbles and wound up doing toe raises with 300-pound weights. Bleir says to overcome pain of injury, arthritis or any other source you have to establish a big training goal and break it down to smaller progressive goals, as in going from marbles to heavy weights. The researchers reported that arthritic patients who went on similar programs were able to recover the use of limbs beyond all medical predictions.

Space training

Last month, I told you that I was starting a self-preparation program to improve my chances of getting the first journalist's ticket on the Space Shuttle. NASA says it won't do anything to help a candidate—there are too many of us. But the space agency is cooperating with me on a number of upcoming stories whose coverage will, I hope, add weight to my resume.

As part of the research for the stories, I am going to take a dive in a space suit inside the neutral buoyancy tank at Marshall Spaceflight Center in Huntsville, Alabama. The 60-foot tank is filled with water and astronauts go inside before a mission to simulate the weightlessness of space. For the honor of clunking around the water in a space suit, I first have to get a scuba diving license, which I am working on qualifying for this month.

I also have started taking the extension courses given to all Shuttle candidates. It familiarizes the user with the various parts of the Shuttle. If you're a regular reader, you'll recall that I flew the Space Shuttle Simulator (page 83, Nov. '82). NASA says I was the last journalist to fly the simulator; only two other journalists have tried their hands at operating the mockup. The simulator mission has already made me very familiar with the controls.

Left-hand compliment

The left and right sides of the brain have long been considered mirror images of one another. But psychologists at McMaster University in Ontario have found evidence that the two sides are not mirror images.

Sandra Witelson, who studied autopsies of lefties and righties, has found that left-handed and ambidextrous people tend to have larger *corpus callosum* areas. The *corpus callosum* is a network of nerves that collects the two sides of the brain. If the connection for lefties is larger, do left-handed people have an intellectual advantage? Witelson, who is a righty, says she'll have to do more thinking about that.

Soviet shakeout

The official American position on verifying atomic test ban treaties with Russia is that seismographs are not accurate enough and on-site inspection is necessary. Now, Columbia University geologist Lynn Sykes is taking Washington to task. He says differences in seismograph readings taken from blasts in Nevada and the Soviet Union can be explained by differences in the way the earth formed in the two separate continents. He says by taking that into account, seismographs can be extremely accurate. Washington has not yet replied.

Knock, knock . . .

Sandia National Laboratory scientists are studying a special research engine to try pinpointing the cause of engine knock. So far, the researchers report, they have identified four chemical groups as playing a major role in knock. The studies, using an engine with a constant compression ratio, are expected to lead to the creation of new additives for a true knockless gasoline.

New moon

When a distant planet passes in front of a star, astronomers train their telescopes on the planet. It should form a disc that blocks out the starlight in a circle. On several occasions in the past six years, Neptune passed in front of a star and a slight fleck was seen on the outer edge of the disc.

At first the fleck was thought to be a moon, but repeated observations now have scientists wondering if they may have discovered a ring around Neptune. That's because the little fleck appears at intervals suggesting that it is more than one body in the same orbital path. Computer studies of the phenomenon have further complicated the issue, since the ring doesn't seem to be going all around Neptune. It may be a new moon beginning to form. Further studies are under way.

PM

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CAR CLINIC



GM gasket leak update

Shortly after purchasing a 1981 Chevrolet Malibu Classic, its V6 engine started leaking oil. After several attempts by various mechanics to fix the problem, at 35,000 miles the engine is now leaking worse than ever. One mechanic told me he can't stop a leak in his 1983 Pontiac, so he certainly won't guarantee he'll be able to stop mine. This is frustrating. Is there any solution?—R. Kenneth Apgar, Sun City, AZ

The latest thinking concerning this situation is that formed-in-place gaskets aren't holding up. These are silicone RTV (room temperature vulcanizing) materials that were used in place of conventional gaskets. In recent years, they have accounted for about 65 percent of gaskets put into new engines. Now, it appears that GM is reverting to traditional solid gaskets.

For example, if there's an oil leak from rocker covers of 90° V6 engines, GM recommends installing Viton gaskets (part No. 14082319) and reinforcements (part No. 14085816). The part number of Viton gaskets for small-block V8 engines is 14082322.

Recently, molded silicone gaskets have been developed for oil pans, rocker covers and manifolds. These new solid seals supposedly withstand heat better than other materials, so you may want to try them.

Aftermarket gasket manufacturers provide conventional gaskets, as well, that can be used in place of RTV. Don't overlook the possibility that oil leaking from your engine could be a result of damaged or warped components. All mating surfaces should be checked before new gaskets are installed.

Caddy—my driver, please

Some time ago in *Car Clinic*, a "PM Car Care Tip" (Dec. '83, page 24) referred to a Pozidriv tool. I've asked at several auto stores, but no one's heard of this. Are you sure it exists?—John Karl, New Brunswick, NJ

I'm sure. A parts store can order Pozidriv drivers from a Snap-On Tool Co. distributor. These drivers are available in seven sizes, but a set of the five most popular sizes is available for \$49.25. Its stock number is SSD250.

No sympathy necessary

My 1985 Ford F150 pickup has a black, oily film inside the coolant recovery tank. The stuff is also floating around in the radiator. What has me worried is that the vehicle used two quarts of oil the first 2500 miles. The dealer says this amount of oil loss is normal, but he can't explain the black stuff. I want him to disassemble the engine to see if there's an oil leak. He refuses. I need help.—Les Hubbard, Las Vegas, NV

No you don't, Les. Using two quarts of oil the first 2500 miles in the life of a new engine is not unusual or abnormal, and has nothing to do with the black oily film you're asking about. The substance in the coolant recovery tank and radiator is undoubtedly oil deposited in the engine at the assembly plant when the engine was hot-tested. The coolant used during the hot-test procedure con-

tains a soluble oil. If there's excess oil in the hot-test coolant, it leaves a film in the engine cooling system, but it will not damage that cooling system or the engine. Stop worrying!

Embroidered in oil

In past months, you've addressed the subject of changes in engine oil recommendations by GM in particular. Would you give us Nissan owners a break and clarify that company's present thinking about engine oil?—William Roberts, Camp Hill, PA

Sure. An owner of a Nissan-built vehicle should use one of three kinds of oil, depending on whether the car or pickup truck has a nonturbocharged or turbocharged gasoline engine, or a diesel engine.

If it's a nonturbo gas engine, use oil designated SF by the American Petroleum Institute (API). Notice I said SF—not SF/CC or SF/CD.

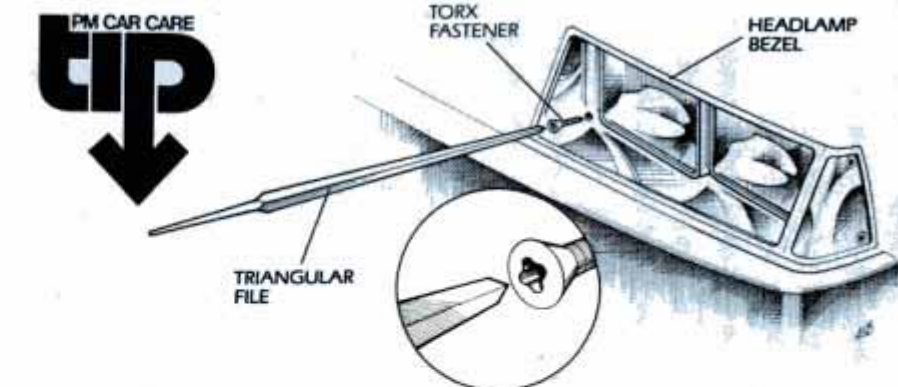
If it's a turbocharged engine, use oil designated SF/CC or SF/CD.

If the vehicle has a diesel engine, use oil designated SF/CC, SF/CD, SE/CC, SE/CD or just CD.

Concerning viscosity ratings, follow these guidelines:

■ If ambient temperature ranges between 60° F to below 0°, use oil having an SAE (Society of Automotive Engineers) viscosity of 5W-30. If 5W-30 is

(Please turn to page 20)



File this under 'stopgap measure'

Roy Zolesky of Milwaukee, Wisconsin, found himself in a bind recently while changing a burned-out headlamp in his 1984 Buick Century station wagon. The screws holding the bezel are Torx fasteners, but Roy didn't have a Torx drive in his tool kit. Tell them what you did, Roy:

"I scrounged around my workshop looking for something that would fit the fastener and picked up a small triangular file. It fit like a glove and worked like a charm."

A tip of a triangular file can be used to remove and reinstall a Torx fastener it fits. But the only way to have all size Torx fasteners covered is with a kit that contains a variety of Torx bit sizes and a drive unit. A kit like this costs about \$23 and up.

Like Pozidriv tools, Torx drivers used to be hard to get, but now Sears has them in their *Power And Hand Tools Catalog*. Torx bits with 1/4- or 3/8-in. drive cost \$5 each, a set of seven is \$30.

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Stores Flat



Pennzoil-The Choice.

CAR CLINIC

(Continued from page 18)

not available, use SAE 10W-30. This advice holds for both gasoline and diesel engines.

■ With a gasoline engine, use oil having an SAE viscosity rating of 10W-30 if the ambient temperature ranges between 0° F to over 100°. Nissan says you may use 10W-40 instead of 10W-30 if you wish. Furthermore, if the ambient temperature is above 50° F throughout the year, you may use 20W-40 or 20W-50 if you want. The preferred oil for this ambient temperature range, however, is 10W-30.

■ With a diesel engine, use oil having an SAE viscosity rating of 10W-30 if the ambient temperature ranges between 0° F to over 100°. Alternatives are SAE 15W-40 for an ambient temperature range of 20° F to over 100°, and SAE 30 for an ambient temperature range of 32° F to over 100°.

One other tip: When switching from one oil to another having a different viscosity, replace the oil filter.

DO YOU HAVE A CAR PROBLEM?

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



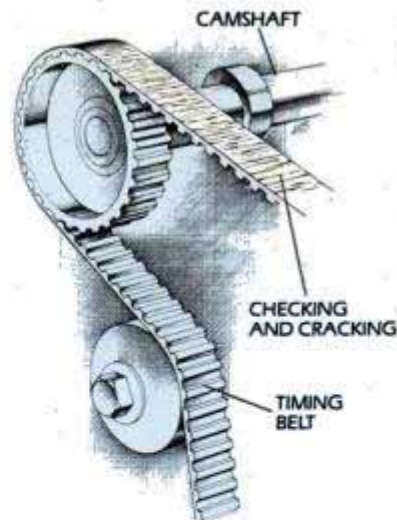
Pelts belts

The following communication from Robert Lendy (address not given) should make it obvious why it appears here as a PM Car Care Tip:

"I've just read your article in the July 1985 issue (page 42) about the fellow with a 1979 Ford Fairmont who was wondering if he should change the timing belt of the Ford 2.3-liter engine at 60,000 miles. You said he should and indicated that Ford may give you flack because of your recommendation. Well, you get no argument from me.

"My son has a '79 Fairmont with the same four-banger. Two weeks before I read your article, his engine stopped dead on the toll road at 1:30 a.m., and the car had to be towed home. Next day, we found a busted timing belt, which I'm sending along with this letter (illustration). We bought a new belt for \$15 and put it on.

"Luckily, the engine suffered no damage,



but while reading an article about the new AMC 1.7-liter engine in *Super Service Station*, this statement caught my eye: 'The 1.7-liter is not free-wheeling, so severe damage to the engine could result if the timing belt breaks.' AMC, like Ford and other manufacturers now using rubber timing belts, does not give a maintenance recommendation for the belt."

Amen, Mr. Lendy. But as long as they don't we will. Replace the belt every 50,000 miles. (Yes, I chopped it 10,000 miles from my recommendation in the July *Car Clinic*.) This just may be one of the most important steps you take in owning the car.



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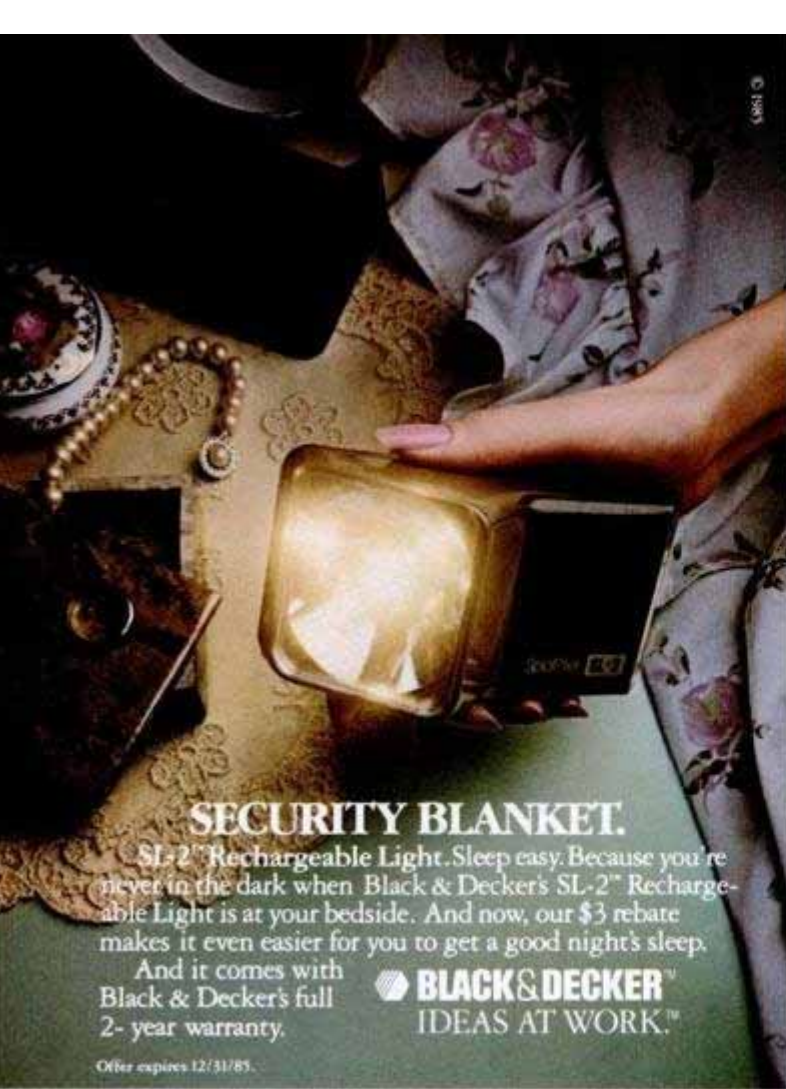
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Foreign aid

Sludge builds up in the crankcase hose and air cleaner housing of my 1982 Plymouth Reliant, and beads of condensation form on the oil dipstick. The humidity in this area is very high. I tell you this because it may help you make a diagnosis. I would appreciate any help. There is no dealer in this area I can take my car to.—Sam Nickels, Lajesfield Air Base, Azores, Portugal

Some 1981 and 1982 Chrysler K-cars had a problem with the 195° cooling system thermostat. Because the thermostat wouldn't close, the engine couldn't warm up and condensation couldn't burn off. Your '82 may be one of these, so I suggest you replace the thermostat. Maybe the PX at your base can order the thermostat for you.

If condensation isn't the result of a faulty thermostat, get the car on the highway at least once a week and drive it as fast as the law permits for at least 15 minutes, or change oil every few weeks.

In the 'altogether'

In the April 1985 Car Clinic, (page 28), John Bowden of Carson City, Nevada, requested a fix for the shuddering, chattering condition in his 1984 Toyota Tercel as he clutched and declutched at slow speeds. His Toyota service department found the clutch to be within specification. I answered that the problem was common to this vehicle and that increasing engine speed as he shifted gears would alleviate this. A new clutch disc and clutch cover are available that do away with the chatter. The part number of the disc is 31250-16030; the cover is 31210-16050.

Back to black

While working on my 1983 Mazda GLC, I accidentally got some wax on the black rubber strip of the front bumper.

POPULAR MECHANICS • NOVEMBER 1985

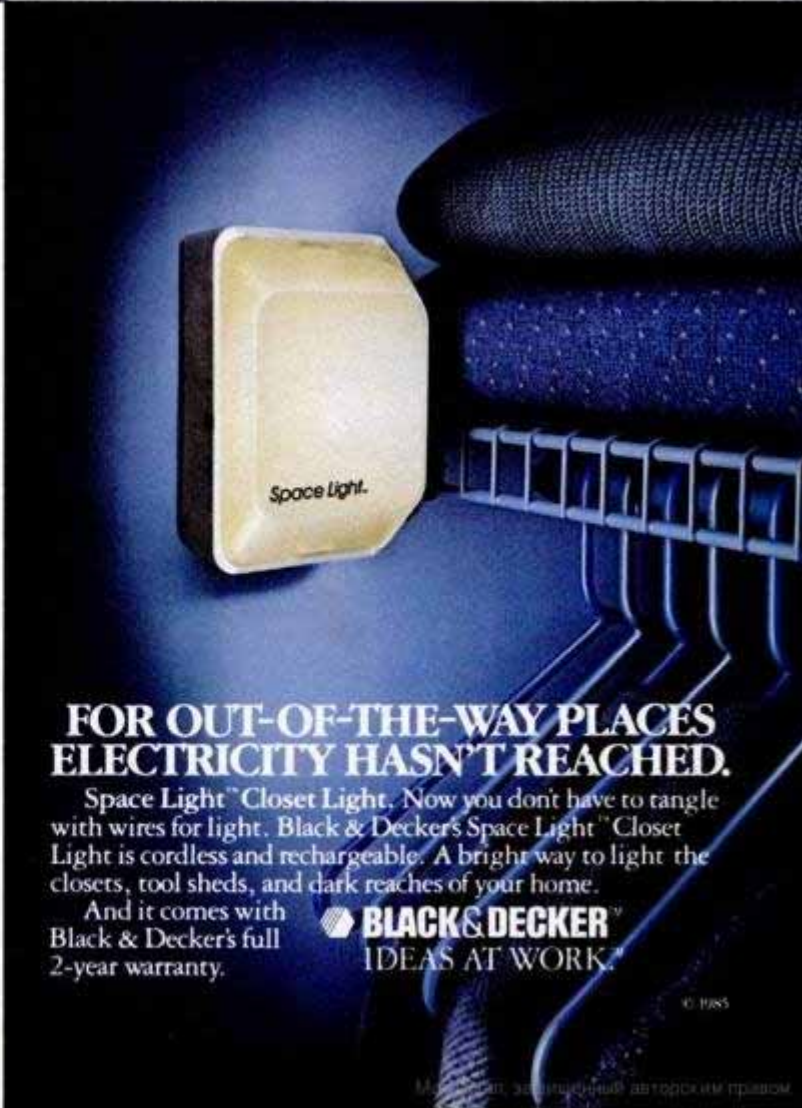
The spot has turned white. I've tried several products, but I can't get it back to black. Can you suggest something?—Ernie Baldwin, Burlington, NC

When wax gets on the flat enamel or lacquer finish of a rubber bumper strip and eats into the paint turning it white, you have to refinish the strip to get it back to black. Use flat black auto paint in a spray can after washing the strip with Prep-Sol or a similar product.

PM

SERVICE TIPS

- A Ford 1985 model with a 3.8- or 5-liter engine which has a low-oil-level light that flickers (although the oil level is okay) may be equipped with an oil-level sensor that doesn't have adequate resistance. A new sensor (part No. E4AZ-6C624-A) is available from Ford.
- Toyota warns that having a front-end alignment performed to stop abnormal tire wear, drifting or pulling is often not enough. "The new breed of independent rear suspension vehicles requires extremely accurate alignment of all four wheels," the company states. This requirement necessitates finding an alignment shop that has equipment that simultaneously measures and displays all of the angles relative to all four wheels.
- A 1985 Chevy Camaro or Pontiac Firebird that hesitates, sags, stumbles and stalls may have an internally shorted high-output ignition coil. If the usual service procedures fail to remedy the problem, replace the high-output coil with a standard coil (part No. 19854731) and the module in the distributor with one having part number 1976908.
- Chrysler recently made a production switch that can put you in a pickle. Since mid-June, 11-mm head bolts have been used in 1985 2.2-liter engines. All 1986 2.2s will also use them. Older engines have 10-mm bolts. The two different bolts should never be mixed in an engine. Use one or the other—if you do mix them you stand a chance of cracking the block. The bolts can be identified by the numerals stamped on their heads.



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THE PM GARAGE



Soft garage

I knew that sooner or later my car would get bumped out of its garage. The squeeze had been on for years. By the time the car rolled out for the last time, bikes were hanging from hooks all around it, and the car itself had become the storage shelf for outdoor furniture cushions. The last straw was adding a table saw to the garage workshop. At least the exile coincided with the availability of a good car cover. A cover is only as good as its fabric and we found the right stuff at Reliable Motoring Accessories. Reliable's DuraShield is made of Evolution 3 fabric, a 3-layer design from Kimberly-Clark. The polypropylene outer layer stops bird strafings, soot and sap; the middle layer is a moisture barrier that allows air to circulate; and the inner layer caresses your paint finish.

Durashield is fitted, won't shrink, rot or mildew and is washable. The Saab-size cover is \$129.95. Storage bag and



Theftguard cable lock are also available. The \$3 for the 44-page color catalog is refundable with first purchase. Reliable is at 1751 Spruce St., Riverside, CA 92507.—B.H.

Special-fabric car cover is designed to fit specific models. Cable lock secures it.



Detecting alcohol



Test kit detects alcohol level in gasoline.

Gasoline containing more than 5 percent methanol or 10 percent ethanol can cause engines to hesitate, buck and stall. Alcohol may also affect fuel economy and damage fuel-system components. This alcohol-detection kit allows you to check for adulterated fuel.

Make the test by drawing 3cc of water and 9cc of gasoline into one of the kit's syringes. Shake vigorously for one minute; then, hold the syringe nozzle up for one minute. Any alcohol in the gas will mix with the water, and the water-alcohol mixture will fall to the plunger end of the syringe.

Take a reading at the point on the syringe where the water-alcohol mixture and gasoline meet to determine the amount of alcohol.

The Alcohol Detection Kit (part No. J

34353) is available for \$9.85 from Kent-Moore Allied Div., Sealed Power Corp., 29784 Little Mack, Roseville, MI 48066.—Mort Schultz

Red alert

Now there's no excuse for driving around with underinflated tires. With a quick walk around the car you can instantly tell if any tire has dropped below its set pressure.

The Red Alert is a valve that installs from inside the wheel. With the tire inflated and the pin set to the desired pressure, all you'll see is the clear plastic cap. If pressure drops, a bright red pin snaps up as a warning. Pressure can still be checked with standard equipment. Made by Schrader Automotive Group, 2000 Richard Jones Rd., Nashville, TN 37215, they're sold at auto parts stores.—W.H.



Indicator gives warning of low pressure.

Dual tools

Owning both an American car and a foreign motorcycle, I'm forever rummaging through the toolbox in search of the right size socket. No more, though. Now there's a Metrinch tool set in my garage.

The idea is so simple I wonder why

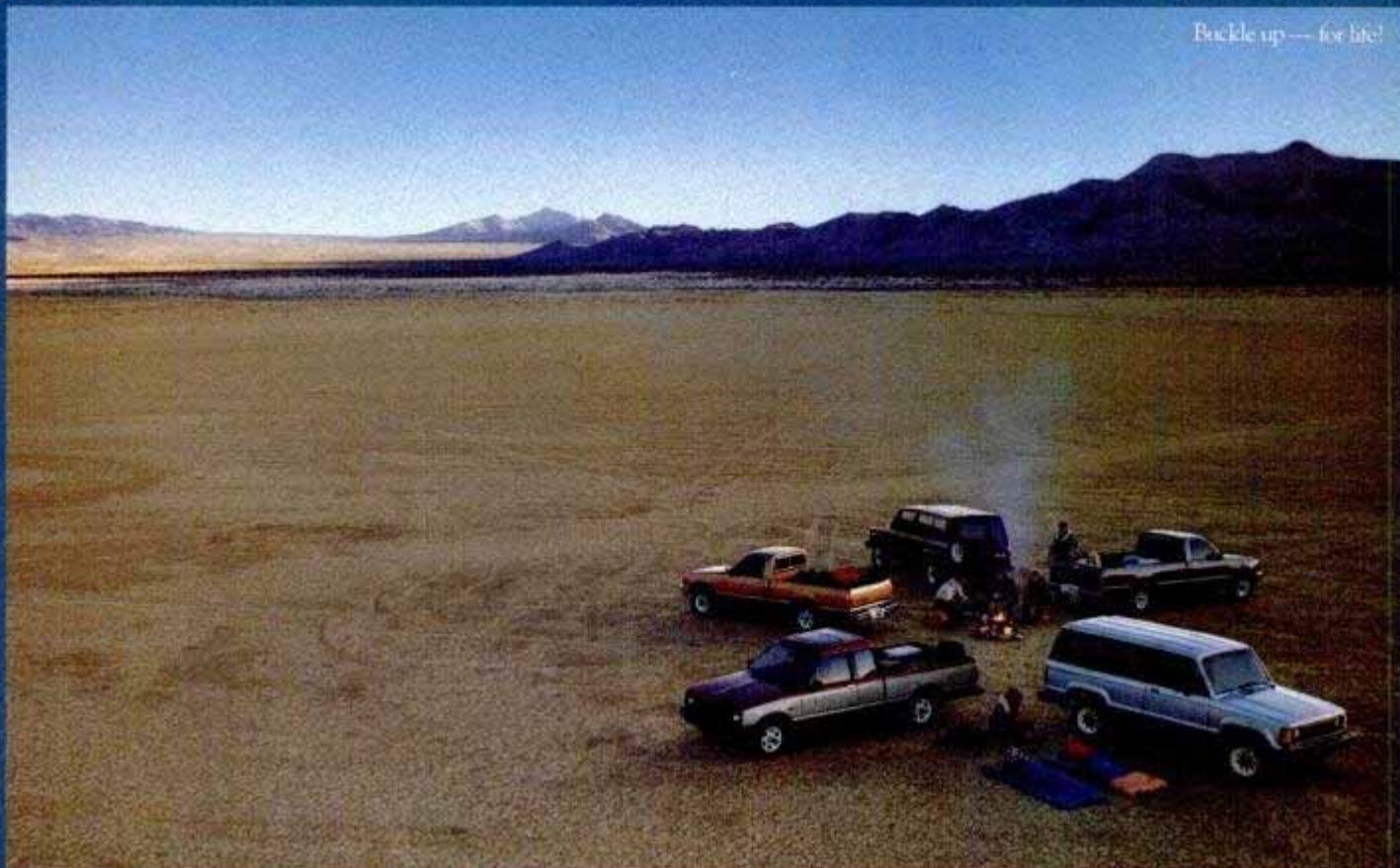


Metrinch tools combine SAE and metric fit.

no one has done it before. Both SAE and metric sizes are combined in each of the 12-point sockets; for instance, on one socket half the points are $\frac{3}{8}$ inch, and the other six points accept 16-mm hexheads. If one set of points doesn't quite fit, you simply have to rotate the socket and try again. Available in a variety of sets and sizes, the Metrinch tool set is sold by Testrite Products Corp., 395 Allwood Road, Clifton, NJ 07012.—N.S.M.

THERE ARE PLACES ON EARTH WHERE NO LIFE EXISTS
EXCEPT SMALL COLONIES OF ISUZUS.

Buckle up — for life!



In some of the farthest corners of the earth, you'll find the only form of transportation is an Isuzu. Or a donkey.

Take the small colony of Isuzus you see here. Clockwise, you'll see our new Spacecab,* standard bed pickup, Trooper II, longbed pickup and another Trooper II. Five versions of high adventure powered this year by an all new 2.3-liter gas engine. (An optional turbo-diesel engine is available for the pickups and the Trooper II.**)

The Trooper II is a go anywhere, do anything, four-wheel drive that thinks it's a utility truck. With its huge 21.9-gallon fuel tank, you can leave civilization and go up to 613 miles without refueling.*** The versatile Trooper II was voted "4x4 of the Year" by *4 Wheel & Off-Road* magazine. And still, it's the least expensive 4x4 in its class!



Then there's our Spacecab. In its cab, there's room for up to four people, with the optional jumpseats. Plus, there's extra storage space for your equipment, with a built-in tonneau cover for security. There's even a sunroof standard on the LS model.

And now our most popular Isuzus. Our longbed and standard bed. No other truck in its class has a larger bed than our longbed; it also has the largest standard fuel tank in the field. And our standard bed just won the stock mini-pickup class in the toughest off-road race in the world—the Baja 1000. Isuzu trucks. You'll find a small colony right at your Isuzu dealer. Ready to go. Anyplace.

*Spacecab available summer of 1985. **Turbo-diesel not available in California. Turbo-diesel trucks available summer of 1985. ***Turbo-diesel Trooper II, 28 estimated MPG. Use estimated MPG for comparison. Actual mileage may vary.

THE FIRST CAR BUILDERS OF JAPAN.

ISUZU

Исuzu — это эксклюзивный авторский проект.

ALL OUTDOORS



Fishing/skiing compromise



Ranger's Forrest Wood designed his boat's windshield so his hat wouldn't blow off.

The boat skitters across the Arizona lake with all the verve and sass you'd expect from a bass machine. And, with fore and aft pedestal seating, stowage lockers, trolling motor on the bow and aerator-equipped live wells, it has all the accoutrements a discriminating bass fisherman normally demands. In fact, from the gunwales down it doesn't look much different. But the topsides are a radical departure from the conventional—a compromise, to be sure, between non-angling recreation and fishing functionality.

So far, Performance, Stratos, Kingfisher and Ranger (hull No. 1 of their ski/bass boat pictured here) have devel-

oped these multipurpose platforms for general lakeland utility. And to bass fishermen who are accustomed to split stern seating for enhanced unobstructed deck space, I can report that this compromise in layout does not constitute a compromise in performance. There appears to be little limitation on casting space fore and aft and plenty of room amidships.

In profile, this style bass boat looks very much like a low-freeboard bowrider, and while it lacks that wind-in-your-face vivacity, she handles smartly across all levels of the speed range. See these new designs at the fall and early winter boat shows.

Riding the BMW K100RS

We broke the story on the BMW K100 two years ago when it was in its concept stage, promising a road report at the earliest opportunity. Following a recent 2-week test conducted by PM's Outdoors and Automotive departments, we can state confidently BMW's reputation for building a gentleman's motorcycle remains intact. But this latest Bimmer, particularly the sport model RS, boasts some significant, hot-shot refinements.

The RS literally wraps itself around curves, for instance, aided and abetted by a low CG longitudinally mounted in-



The K100RS offers the kind of civilized motorcycling that made BMW famous.

line Four that delivers power directly to the port-side shaft drive. The 90-hp liquid-cooled engine is actually a stress-bearing member of the frame. Weight is thereby reduced to 474 pounds dry, which, when combined with a monoshock and full-front fairing, helps the RS achieve its spritely characteristics.

You'll also find the swiftness and touring comfort so typical of a BMW on the straightaways. Bosch fuel injection—though irritatingly audible at idle—contributes to instantaneous throttle response and fuel economy. BMW has apparently solved a muffler bracket and foot-peg vibration problem with a retrofit kit. On the down side, BMW separates the left and right turn indicators on each handlebar which is a little bothersome.

So what does it cost to be a gentleman motorcyclist these days? Around \$7200. And what's next in 2-wheeling from BMW? The 3-cylinder K75, due on these shores soon. Contact BMW of North America, BMW Plaza, Montvale, NJ 07645.

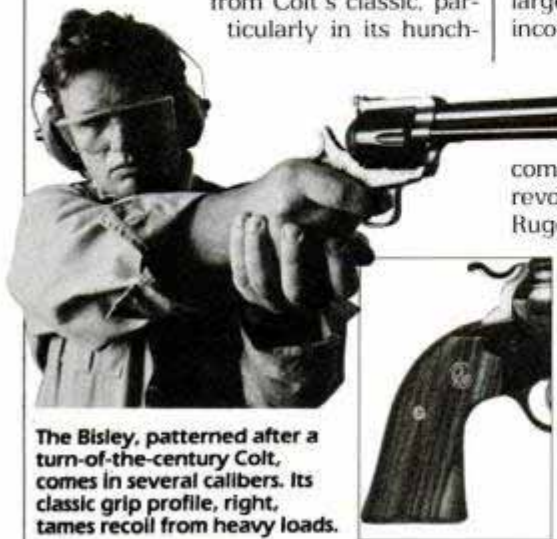
PM

Bisley handgun revival

The new Ruger Bisley is modeled after the 1896 Colt single-action six-gun of the same name. In profile, the Ruger is virtually indistinguishable from Colt's classic, particularly in its hunch-

back "Peacemaker" style grip strap that flows naturally into the frame. Ruger's Bisley design has a lower profile in the hammer spur, however, and a wider, smoother trigger surface. The large-frame Bisleys in larger calibers incorporate components from Ruger's Blackhawk line. Small-frame Bisleys, in .32 and .22 long, use

components from Ruger's Single-Six revolver. I fired 42 rounds through Ruger's largest Bisley, the .44 Magnum. The grip accommodates the hand well, and with no thumb-crushing recurve, recoil is forgiving. A distinct "roll-up" on firing dissipates the kick. As one observer put it, "The .44 Magnum cartridge has finally been tamed." Prices range from \$258 for the 11½" .22 long to \$307 for the 13" .44 magnum. Contact Sturm, Ruger, Southport, CT 06490.



The Bisley, patterned after a turn-of-the-century Colt, comes in several calibers. Its classic grip profile, right, tames recoil from heavy loads.

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Are you a regular user of any moist smokeless tobacco? Yes _____ No _____
 If yes, what brand? _____



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Great taste.**

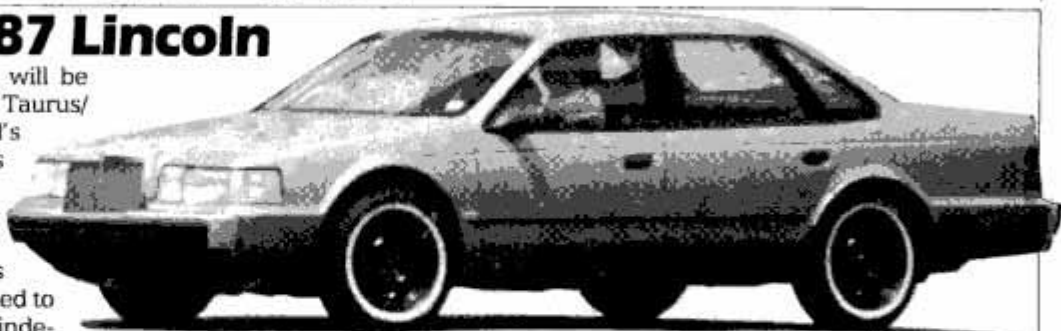
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DETROIT LISTENING POST

Front-drive '87 Lincoln

The 1987 Lincoln Continental will be built on the front-drive Ford Taurus/Mercury Sable platform. Ford's slick aero school of design is apparent, with faired-in headlights and a gentle notchback roofline reminiscent of the bigger BMW coupes. Lincoln's first front-drive model is expected to carry over the Taurus/Sable independent rear suspension, but the 1987 Continental should feature a bigger 3.8-liter V6 engine, as opposed to the 3-liter, 140-hp unit in the less expensive Fords and Mercurys.

The 3.8 engine will be used with an



Sleek, fwd '87 Lincoln Continental is a far cry from the boxy looks of its competitors.

Eaton supercharger on the rear-drive '87 T-Bird, and you can expect the power pump on high-performance versions of the Continental, too.

Four-wheel ABS disc brakes and speed-sensitive power steering (with more boost at low speed) also are expected on the future Lincoln.

Chevy pick-'em-ups

Chevrolet will begin to revise its entire line of full-size pickups in the 1988 model year. The new styling will give better aero numbers than the old, but overall the trucks will look practical and conventional. No flush headlights or



New line of full-size Chevy L-10 pickups will feature the usual choices of cab and bed sizes, plus new V6 engines.

aero droop snoots for GM's workhorses. Code-named GMT-400, the new trucks will carry L-10 and L-20 designations, replacing the current C-10 and C-20 model numbers. Suburbans, big Blazers, crew cabs and heavy-duty C-30 models will carry over until they are replaced in 1989. Available with both 2- and 4-wheel drive, the new GMT-400 line will include short (6½-ft.) and long (8-ft.) beds; a standard cab, stretch cab with jump seats, and 4-door crew cab; plus a heavy-hauling, dual-rear-wheel rig. Power will include the 4.3-liter 4-barrel V6 now in the Astro vans. Grille on upmarket versions will have a wide horizontal chrome bar.

Rear-wheelers to stay

GM and Ford are apparently consulting the same psychic on the future of their rear-wheel-drive cars when front-drive replacements are ready in 1988/89. GM will keep at least two rear-drivers—Buick Regal and Olds Cutlass—in production for a year or two after the front-drive successor cars come out. Ford will retain rear-wheel drive on the Lincoln Town Car and Mark when the Continental goes to front-drive next year. All of these cars will stay rear-drive at least until 1990, and possibly beyond that.

Design your own car

Four or five years from now you'll be able to walk into a GM dealer, sit at a TV screen, design your own car (within limits) and place the order to put it into production. Once you've decided on the make and model you want, the TV display will list every available choice—engine, axle, transmission, options, accessories, tires, upholstery, colors, along with information on prices and the pros and cons of this versus that. Point a finger at the item on the screen and it becomes part of the order. If you decide you can't handle it financially when the total comes up on the screen, you'll be able to backtrack and delete items to reduce the price.

At the end of the selection process, the dealer will hand you a printout of the order. The car should be ready in two weeks. No excuses that the dealer had to take a 4-cylinder because the V6 wasn't available, or the factory added extras you didn't want.

(Please turn to page 28)

Minivan mania

The longer Pontiac delays in putting its "people van" into production, the more likely it is to run into heavy competition. Pontiac disclosed last year that it would like to produce a companion vehicle to Chevrolet's Astro. But where Astro is aimed primarily at commercial users hauling cargo, the Pontiac product would be a people carrier. Pontiac's still working on the idea, but hasn't received approval from GM management to put the piece in production.

Chrysler, meanwhile, is looking at both upsized and downsized versions of its popular minivan. The upsizer is expected in late 1987, as soon as the

company can tool up for a second production line in St. Louis. The downsizer is still in the talking stage and won't be ready before 1989, if Chrysler decides to go with it.

GM was actually the first company to design a modern hybrid between a station wagon and full-size van. That was five or six years ago. PM saw a styling mockup of it. But for reasons that have never been explained, GM backed off and didn't revive the project until Chrysler came out with Dodge Caravan and Plymouth Voyager. GM must be kicking itself for this decision in light of Chrysler's success with the compact vans.

IF YOU CAN DRIVE IT, AUTOLITE MAKES A COPPER PLUG FOR IT.

England is a country renowned for building unusual cars.

But, even there, this one raises a few eyebrows.

It's the Aston Martin Lagonda Bulldog, and it's propelled by an extremely modern, highly-efficient engine. Which, like all modern, high-revving engines, whether British, Japanese, or German, can develop a problem. If you use the wrong kind of spark plug.

When you do a lot of short trips, ordinary plugs can develop something called "carbon fouling." This means that carbon can build up at the spark plug tips and cause misfiring, or even prevent the engine from starting at all. The answer? Autolite *copper* spark plugs. Autolite makes plugs for today's smaller engines that not only have copper in the center electrode, but they also have a longer insulator, to help burn off carbon fast.

And they also have something no other major American-made plug has.

Copper either in the seal or the gasket, because it does a great job of conducting heat and electricity.

The result is a plug that helps cars like this Aston Martin perform as beautifully and efficiently as they were designed to.

A plug that will perform equally well in your car.

Autolite *copper* spark plug.

Autolite Division, Providence, Rhode Island 02916.



IF AUTOLITE'S ON IT, THERE'S COPPER IN IT.



 **ALLIED** Automotive

DETROIT LISTENING POST

(Continued from page 26)

The specs on the car will also be entered into a computer in the service department that will provide mechanics with specific instructions on what to do when you come in for service.

GM is developing this system with its new electronics and computer division, Electronic Data Systems.

High-buck test drive

You say you've always wanted to drive on a Detroit test track? Cadillac has a deal for you. When the Caddy-Pininfar-

ina Allante 2-seat convertible is ready next year, you'll be invited to pick it up in Detroit (actually Hamtramck) and take a couple of turns around the track with a Cadillac engineer. But bring lots of money. The car will carry the highest sticker price ever for a GM product—something in the \$50,000 range.

Performance contest

There's a quiet power struggle going on between Ford and Chrysler. Quiet because they don't want trouble with the Drive-55 crowd. Chrysler will add a turbo to its 2.5-liter Four in the '87 model year. Ford will come back in '89

with a super-charger for its 3.8-liter V6. Chrysler will likely counter with a high-performance version of the V6 it is buying from Mitsubishi. Chrysler's also mulling the idea of producing a V6.

Catching car crooks

Ford and Buick are installing computers in dealer service departments that put the mechanic in direct contact with the factory if he has a question about repairing a car. Punch in the question and a reply comes back in a few seconds, telling the mechanic what to do. The Buick version will eventually be used by other divisions of GM.

To get an answer to a question, the mechanic must first describe the car, including the vehicle identification number (VIN). As more manufacturers develop service information systems and more dealers acquire the equipment to tap into factory databanks, this could be a highly effective tool for recovering stolen cars. Carmakers say it would be easy to program VINs of stolen cars into factory computers.

One flaw in this is that the crook would have to take the car to a dealer to have it repaired. But companies that make equipment for nondealer shops are working on devices similar to the Ford and Buick equipment.

Chrysler's new 4-speed

Chrysler will have a new 4-speed automatic for its '89 cars. The company makes transmissions at Kokomo, Indiana, and is putting \$350 million into the plant to build the new 4-speed.

Ready, set, wait

On several occasions in recent years, GM and Ford have been caught in the embarrassing position of announcing on-sale dates for new cars and then not being able to deliver. So the date is moved forward. And sometimes moved forward again. This is actually to the credit of the car companies. In the bad old days, the sales and ad departments determined when a car would go on sale. Once a date was set, there was no changing it, even if it resulted in rushing out a bum product. Release dates are now set by the manufacturing and quality control groups, and if they decide a car isn't ready to roll, it's held back until the problem is corrected.

More U.S. Hondas

Honda is spending \$40 million to expand its engine factory in Marysville, Ohio. The factory, which now builds engines for Honda's big Gold Wing motorcycles, will produce the 1.5-liter Civic 4-cylinder at a rate of 250 per day. That will allow Honda to assemble Civics as well as Accords in Ohio. It's getting so you can't tell the imports without a scorecard. **PM**

When you pick up a Husqvarna you expect to get the best chain saw. Now you can expect even more—saving up to forty bucks* on a new Husqvarna weekend pro chain saw and getting a \$50.00 retail value woodcutter's kit FREE.

The woodcutter's kit is packed with a waterproof nylon saw carrying case, a log carrier, a pair of leather work gloves, file, file handle and file guide. It's everything you need to do the job—beginning to end.

If you've been waiting for a windfall before buying a new chain saw, you're in luck. It's at your participating Husqvarna dealer's.

*off manufacturer's suggested retail price on models 35, 37, 40, 44, 50, 61 through 12/31/85.



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I've helped Dad take care of the old convertible ever since it was new. Always with Quaker State. I learned early about Quaker State's unique formula—it starts with Pennsylvania Grade Crude. About its stable viscosity, and its smooth flowing, steady protection. I had a good teacher. Thanks, Dad.

Quaker State.
The Big Q stands for quality.
Always has. Always will.



RAM 50



RAM 50 SPORT

The feature that makes these Dodge imports move very fast:



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The price.

The 1986 Dodge Ram 50's come well equipped with a very impressive array of performance features.

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Our Power Ram 50 Sport, as pictured above with an owner installed sport bar, comes with a 2.6L engine and four-wheel drive. So it'll hold fast in places where there are no highways at all.

And our Ram 50 Sport boasts spoker

(Ram 50. From \$5788*)

wheels, 14" radials, sporty stripes, swing-away mirrors, a chrome

front bumper and a fully carpeted deluxe interior. So it'll look fast even standing still.

But the one thing that's guaranteed to make these Dodge imports move very fast is this feature. The right price.

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BUCKLE UP FOR SAFETY.

PM ELECTRONICS MONITOR



Low-cost workhorse computer



Bondwell 14 computer offers amber on gray display screen, two double-density disk drives and full-size keyboard.

Jewelry and custom-made clothing aren't Hong Kong's only bargains. But I was skeptical when Bondwell Industrial Co. invited PM to try its \$1100 transportable computer. The price tag and point of origin aroused boyhood memories of buying cheap baseballs when we couldn't raise two bucks for the real major-league thing. I'm happy to report that there's more than sawdust and newspaper shavings inside the plastic hide of this import item. What your \$1100 buys is an 8-bit CPM 3.0 machine with bundled software, 128K-RAM, and a pair of 5¼-in. disk drives good for 360K formatted storage each.

In English, this means the Bondwell 14 is an inexpensive workhorse. Its 8-bit microprocessor uses the same CPM operating system as the Kaypro II, Osborne I and other transportable computers—enabling it to run some 15,000

software programs written for the CPM format. Five of the most popular, including the WordStar writing program, are included in the computer's purchase price. The Bondwell's CPM 3.0 operating system, combined with its 128,000-character Random Access Memory, gives these programs plenty of room to perform complex tasks quickly. The 360,000 characters of storage in each disk drive would hold nearly 50 pages of this magazine.

The Bondwell 14 is a very usable machine. The 9-inch amber on gray screen displays 25 lines of 80 characters and is easy on the eyes. The keyboard is large and comfortable, and has 16 keys you can program for specific functions, instead of having to type frequently used commands. Three ports let you connect printers and peripherals—even another computer.

Now what don't you get for \$1100? You don't get to use IBM software: The CPM system is not compatible with IBM's PC/DOS. And the Bondwell 14's manual should give more explicit instructions for first-time users.

Currents

■ Worried about erasing your computer's memory with a jolt of static electricity? An ounce of prevention comes from 3M, maker of Scotch-brand tapes—magnetic and sticky. The company's First Touch is a foot-long anti-static strip that attaches to your computer's keyboard in such a manner that you touch it before anything else, and discharge any static you may be carrying. A 10-foot cord runs from the anti-static strip to a suitable ground point (such as an electrical outlet) to drain the charge away. The First Touch static discharging accessory (Model 9250) costs \$20.

■ Losing your computer's random access memory is bad enough, but destroying the data stored on a floppy disk is a much greater disaster. All might not be lost if you use Polaroid-brand floppies. The company offers a free service to restore the data on damaged disks—and claims a nearly perfect success rate. If you damage a Polaroid disk, call the toll-free number on the packaging and Polaroid will ship you a special return mailer.

Two bargain-priced computer printers

If you intend to use your computer to produce written material, you'll need a printer to get the words off the floppy disk and onto paper. Most of us, though, don't need expensive, heavy-duty, high-speed printers of the sort used in business offices. For the typical home-computer user, what's wanted is a printer that can type at least as fast as you do, and produce easily readable copy.

We've encountered two under-\$300 printers that fit the bill. Juki's Model



Dot-matrix print element gives graphics ability to General Electric's new printer.



Daisywheel in Juki 6000 printer punches 10 characters a second in bidirectional mode. The printer weighs just 13 pounds.

6000 is a letter-quality daisywheel printer priced at \$300 but widely discounted for less. Its top typing speed is 10 characters per second, with the daisywheel running in both directions across the paper. It weighs just 13 pounds and is smaller than a breadbox. General Electric's \$260 Model 3-8100 uses a quieter, dot-matrix printing element to churn out 25 or 50 characters a second, depending on the type darkness desired. It's no bigger than a portable typewriter. **PM**

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PM-19

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them to fit right and work right,
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Next time your import car seems to

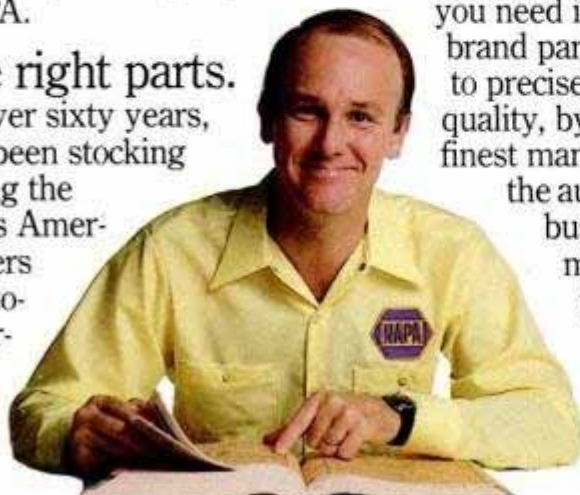


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Let's talk foreign. Parts for foreign cars, that is. Because when it comes to keeping your import car running right, nobody speaks your language like NAPA.

All the right parts.

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over 100,000 different parts and products in the NAPA inventory, odds are, your local NAPA auto parts store will have the part you need, when you need it. All NAPA brand parts are made to precise standards of quality, by some of the finest manufacturers in the automotive parts business. In fact, many NAPA parts are better than your car's original factory equipment. So, you count on

be running a little bit foreign, look for the NAPA sign of quality. We've got all the right parts in all the right places.



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APPLIANCE CLINIC



Self-cleaning oven won't

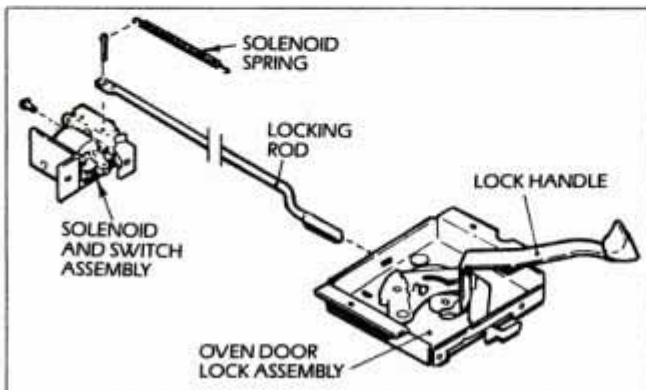
My Kenmore electric range, model No. 911.9347910, serial No. 056661, will not go into the cleaning cycle. I push in the lock/unlock switch while sliding the door lock handle to the right, but all I get is a clicking sound from the solenoid; the door lock will not engage to start the cleaning. I have removed the back panels of the range and can find no loose or burned-out wires. We've used the cycle before without difficulty.—Charles H. Sawyer, Seattle, WA

Your problem is either a faulty lock/unlock solenoid, or a malfunctioning lock assembly. When you depress the lock/unlock switch you should hear a buzz from the solenoid, not a click.

Disconnect the electrical power to the range, then lift the main top and prop it up. Remove the lock rod cover, which is a metal channel approximately 4 in. wide, located at the center of the range. The rod cover houses the linkage and lock assembly.

The lock assembly, near the front of

the range, operates the linkage rod and the solenoid. Move the linkage rod back and forth. It should move easily. Next, move the linkage rod toward the rear of the range. Hold it in this position. Lock the oven door by moving the door lock



Check an inoperative oven door lock by holding locking rod back, then swinging the handle. If the door locks, the solenoid is faulty. If it doesn't, the lock assembly is the culprit.

handle. If it fails to lock or it jams, the lock needs replacing. If the door locks easily, then the solenoid at the other end needs replacing.

The oven door lock assembly is part No. 308827 and costs approximately \$15. The solenoid and switch, which carry part No. 299629, cost \$16.50. Both are available from any Sears repair parts store.

Machine goes bang

When our Ward washing machine, Model LNC6330A80, serial No. 032135 shuts off after the rinse cycle, there is a loud bang. Could this noise be from a spring release, and can it damage the transmission? The washing machine is five years old.—Kenton Brewer, Herndon, KY

The sound you're hearing probably is the noise of the brake latch solenoid de-energizing. This causes the brake latch to hit against the brake band, which stops the wash basket from spinning. This braking sound is a normal part of operation, and you will also notice it at the end of each spin cycle.

As the machine ages, the sound might get a little louder, but I don't think it will damage the transmission. If you are still concerned about the noise, you might call a service person in to confirm my suspicion.

Rare refrigerator parts

I own a 1966 Delmonico refrigerator, model No. 8130, serial No. 159623. It needs points in the switch. I can't seem to locate the maker. Can you tell me if they are still in business and where I can find them?—Ray Larson, Minneapolis, MN

Delmonico has either gone out of business or has been bought by another company. I tried several sources, and managed to find a parts distributor who has a door gasket kit, light switches, light socket, thermostats, compressor relay and overload switch for Delmonico refrigerators.

Contact National Parts Distributor at 1-800-523-3620. When you call, give the make and model number of your refrigerator, along with a description of the part you are trying to replace and any part number stamped on it. They assured me that they can help you.

Whistles and wheezes

We have a Sears Coldspot frostless refrigerator/freezer, model No. 106.7617203, serial No. E13694054, that whistles, wheezes and hisses. Sometimes it sounds almost alive—even human-like. What do these strange sounds indicate? Is the refrigerator about to break down? Often, the refrigerator makes these noises when the door is opened.—Michael Eden Cox, Dade City, FL

Your refrigerator's strange noises are probably coming from the evaporator fan motor located on the back wall of the freezer compartment. Usually before the evaporator's motor's bearings give out, they will make chirping sounds. As the bearings continue to wear, the motor will produce other strange sounds similar to the ones you describe. Usually this means the motor is about due for a replacement.

A new fan motor kit can be purchased from any Sears parts store. Your local appliance center may have one, also. The kit's part No. is 482731 and it costs approximately \$28.

The first thing to do is empty the freezer's contents into paper bags. To provide added insulation, cover the bags with a blanket. Next, unplug the refrigerator and then remove the six screws that secure the evaporator cover to the back inside wall of the freezer compartment; remove the evaporator cover from the compartment.

As the repair progresses, you will find yourself with a lot of loose screws, so you better find a good way of organizing them so they won't get lost and to ensure they'll be re-installed in the right places.

Remove the four screws that hold the plastic fan scroll to the back wall. Next, back out the two screws which hold the fan blade to the fan motor shaft, and remove the blade. Now you should remove the two screws that fasten the fan motor in place.

Disconnect the motor's two power wires and the ground wire and remove the fan motor from the compartment. Install the replacement motor following the instructions that come with it. **PM**

If you have a problem with any appliance, send your question, along with the model and serial numbers, to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.

DRIVETRAIN

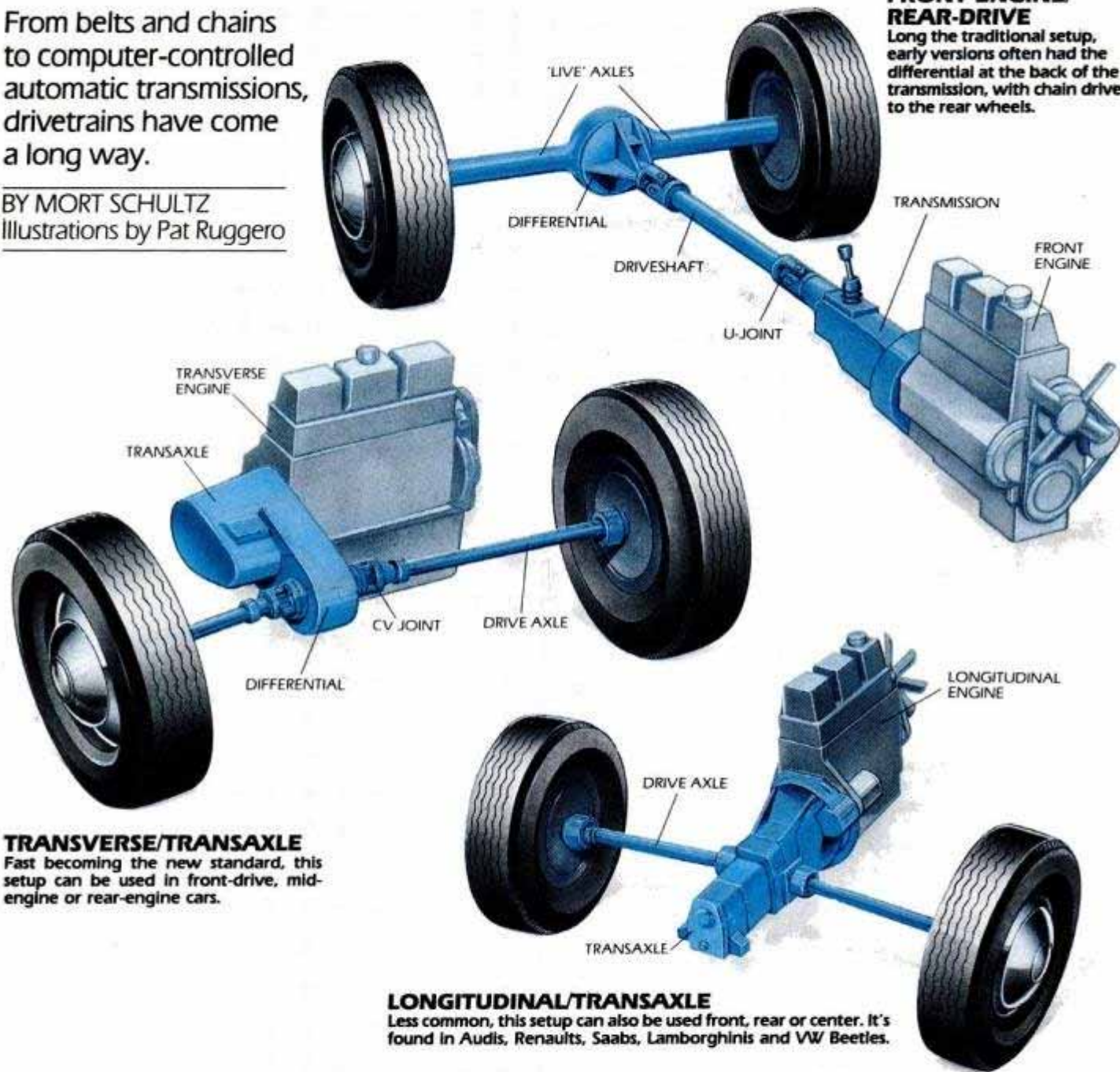
A CENTURY OF PROGRESS

100 YEARS

From belts and chains to computer-controlled automatic transmissions, drivetrains have come a long way.

BY MORT SCHULTZ
Illustrations by Pat Ruggero

**FRONT-ENGINE/
REAR-DRIVE**
Long the traditional setup, early versions often had the differential at the back of the transmission, with chain drive to the rear wheels.



TRANSVERSE/TRANSAXLE
Fast becoming the new standard, this setup can be used in front-drive, mid-engine or rear-engine cars.

LONGITUDINAL/TRANSAXLE
Less common, this setup can also be used front, rear or center. It's found in Audis, Renaults, Saabs, Lamborghinis and VW Beetles.

Getting power from the engine to the wheels of an automobile has provided a seemingly endless challenge for engineers, who have so far developed rear-wheel-drive, front-wheel-drive, 4-wheel-drive, front-engine, rear-engine and mid-engine cars, longitudinal, transverse, vertical, slant and flat engines, plus an amazing array of hardware in between. George Selden's notorious 1877 patent (see *Centennial On Wheels*, page 75, Dec. '84) was for a front-drive carriage with a transverse 3-

cylinder engine, anticipating the Chevy/Suzuki Sprint by over a century. When it comes to car designs, there are very few new ideas, just progressively successful adaptations of old concepts.

The heart of the drivetrain is the transmission. Because gasoline engines develop their torque over a very narrow speed range, several gears are needed to reach useful road speeds. (Steam engines and electric motors can be used in cars with no transmissions.)

The modern transmission was intro-

duced by a pair of Frenchmen—Louis-Rene Panhard and Emile Levassor—in 1894. The engineers had invited the press to a demonstration of "the most revolutionary advancement to date in the brief history of the motor car industry." Unfortunately, the engine in their demo vehicle died, and they were reduced to giving a chalk talk on multi-gear transmission theory to a bored press corps.

One 19th-century newsman reported

(Please turn to page 40)

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"Poly" is short for polytetrafluoroethylene (TFE), the slipperiest substance known to man. (1981 Guinness Book of World Records). Petrolon Corporation, makers of Slick 50, invented a way to permanently bind this slippery chemical to your engine with one treatment. Just one quart of Slick 50 can reduce engine friction, increase gas mileage and horsepower and reduce engine operating temperature, causing your oil and engine to last longer. . . plus it reduces metal wear, defraying costly overhauls.

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Slick 50 has been thoroughly tested in independent laboratories and out on the road:

The March/April 1982, p. 35 issue of "Consumer Digest" magazine stated, "Slick 50 does reduce engine heat and ordinary wear, and our informal tests indicate that it will improve gas mileage by about 2 or 3 miles per gallon."

One of the country's most respected research institutes reported applying a powerful ultrasonic cleaning process to a Slick 50 treated engine and were surprised at its permanence. "We actually expected the Petrolon Slick 50 TFE Resin coating to also be removed, but later found it was still there."

"Dune Buggies & Hot VWs" magazine April 1983 issue records the results of their one year testing of Slick 50. "We can indeed say scientifically that Slick 50 does work, and that it does reduce engine wear! . . . for the price of one treatment when compared to engine rebuild, we feel that you'd be money ahead using Slick 50."

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The senior engineering researcher at a leading southern California university stated, "Slick 50 does increase horsepower and decreases fuel consumption in tests done at the university."

The Space Shuttle Columbia uses the chemical "poly" in its gears and bearings because it is the only chemical lubricant which can withstand the heat and corrosive elements of space.

Perhaps most dramatic of all is a torture test overseen by the Automotive Services Council for Pennsylvania and shown on WTVE television. Three cars with 75,000 to 129,000 miles on them were treated with Slick 50. Six months later the oil was drained from each vehicle, and the cars driven without the oil plugs for about a half hour. The water temperature never rose and the engines sustained no apparent damage.



There isn't room here to tell you about the dozens of other tests proving that Slick 50 is everything we say. However, if you're still skeptical, send \$2.00 to cover printing and postage costs, and we'll send you detailed test results plus actual letters from users who report how Slick 50 saved their engines and saved them money!

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A few minutes before oil and filter change, add the engine flush you get free with each order to clean out the engine. Let the engine idle for 5 minutes. Then drain the oil, change the filter and add the proper amount of oil, less one quart. Add one quart of Slick 50, drive for 30 minutes, and leave it in the crankcase for at least 3,000 miles. As the engine operates, the oil carries the "poly" between the parts where it is burnished into the pores of the metal.

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It's permanent, so you do it only once, not each time you change oil. One quart of Slick 50 will treat all standard 4, 6 and 8-cylinder gasoline and diesel engines.

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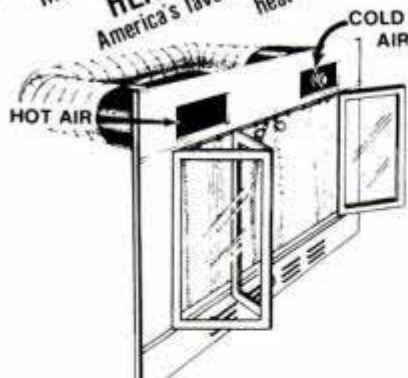
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100 YEARS

DRIVETRAIN: A CENTURY OF PROGRESS

(Continued from page 38)

their invention as "more hocus-pocus from charlatans trying to cash in on the public's fascination with the new motor car." Maybe the inventors should have skipped the tech talk and just used the description later attributed to Panhard: "It's brutal, but it works!"

Cars of the time transmitted engine power to the wheels in a simple fashion that was easy for non-engineers to visualize. The engine drove a set of bevel reduction gears that drove a shaft and pulley. Leather belts extended between the pulley and geared wheels on an axle. One wheel, the small one, got the car going by meshing with a ring gear on one of the driving wheels. The big wheel then took over to get the car to hustle along at a top speed of 20 mph. If the car encountered a hill that it didn't have the power to climb, the driver would come to a dead stop so he could engage the small wheel.

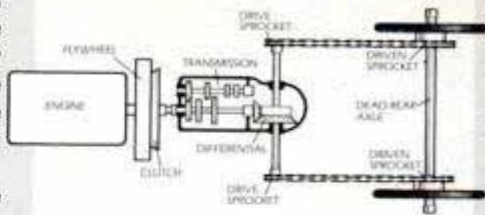
Thus did British auto pioneer F.W. Lanchester describe the transmissions in his cars: "One belt-driven HIGH gear that will go over everything and one belt-driven LOW gear in case the car had to climb a tree."

It wasn't until a year after their disastrous news conference that Panhard and Levassor regained their reputations. At this time, they had their first car ready for the press to drive. With it, they changed a lot of minds.

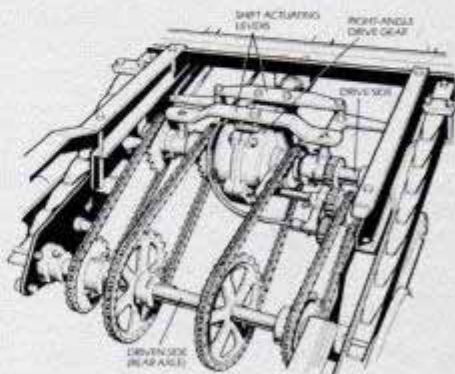
That 1895 Panhard-Levassor was revolutionary—not the transmission alone, but the whole drivetrain layout. In fact, it has served as the prototype for most vehicles built in the 90 years since then. Unlike other cars of that day, it possessed a vertically mounted engine in the front of the vehicle that drove the rear wheels through a clutch, 3-speed sliding gear transmission and chain-driven axle. The only modern features missing from the setup were a differential rear axle and driveshaft. These came along three years later, in 1898, when millionaire-turned-auto-hobbyist Louis Renault connected a vertical engine with transmission to a "live" rear axle by means of a metal shaft.

The live rear axle—which Renault adapted from an idea developed in 1893 by an American, C.E. Duryea—was called the differential rear axle. It used a number of gears to overcome the problem of rapid tire wear, which resulted on turns with the "dead" axles used by all other carmakers. "Differential" referred to the ability of the unit to turn the outer driving wheel faster than the inner driving wheel, eliminating tire scuffing in turns.

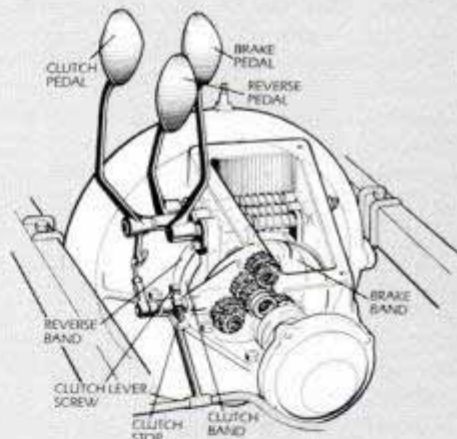
By 1904, the Panhard-Levassor sliding gear manual transmission had been adopted by most carmakers. In one



Classic turn-of-the-century drivetrain combined the transmission and differential and had chain drive to the rear axle.



Three-speed (plus reverse) Fraser Nash "chain gang" transmission used dog clutches to engage sprockets on the driveshaft.




Model T Ford planetary transmission had a separate pedal to engage reverse. The throttle lever was on the steering wheel.

form or another, it has remained in use until recent times. Obviously, there have been improvements, the most significant being the invention of a synchronizing system that permits drive and driven gears to be brought into mesh with each other smoothly without gear clashing. This system allows both sets of gears to reach the same speed before they are engaged. The first of these synchronesh transmissions was introduced by Cadillac in 1928. An improvement to the design patented by Porsche is widely used today.

Between the time the sliding gear-transmission was introduced and the perfection of the synchromesh, there

(Please turn to page 44)

 NISSAN

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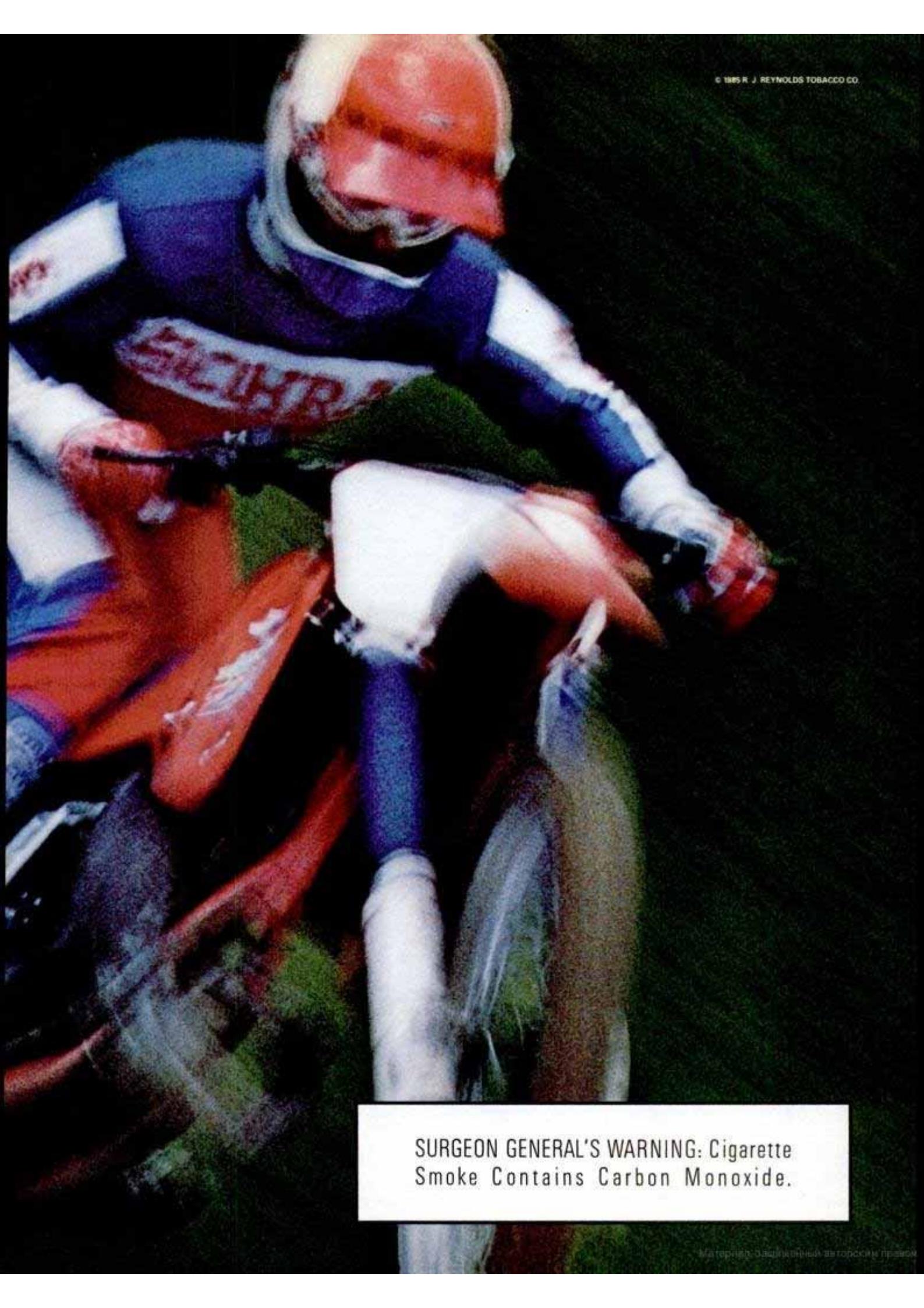
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100 YEARS

DRIVETRAIN: A CENTURY OF PROGRESS

(Continued from page 40)

were other attempts at making it easier for the driver to shift gears. One was the planetary transmission in the 1907 Model T Ford. It had a central gear, called the "sun" gear, surrounded by three "planet" gears. Today, planetary gears are more widely used in automatic transmissions than in manual.

Some pretty elaborate planetary manual transmissions did evolve, however. One was developed by Walter Wilson and was called the Wilson Preselector. It came along in 1930.

This gear system, which used four individual planetary gearsets, allowed the driver to preselect one gear ratio by moving a small lever on the steering column. The driver could then "order up" the particular preselected gear by depressing a foot pedal. This caused a camshaft to disengage one gear and simultaneously allow the preselected gearset to engage.

All transmission designs since the Panhard-Levassor unit have had one goal in common—to make shifting easier. Obviously, the easiest to shift transmission is the automatic. It's strictly an American innovation.

The first automatic was invented in 1904 by the Sturtevant brothers of Boston. It provided two forward speeds that were engaged and disengaged by the action of centrifugal weights without need for a foot-operated clutch. As engine speed increased, the weights swung out to engage bands—first the low-gear band and then the high-gear band. The unit failed because the weights often flew apart.

The next significant attempt at an automatic transmission was by Reo in 1934. Called the Reo Self-Shifter, it was actually two transmissions connected in series. For ordinary driving, one unit upshifted itself automatically in relation to car speed through the engagement of a centrifugal multiple-disc clutch—much the same idea used by the Sturtevants. The second transmission was shifted manually and was used only when a lower gear was needed.

In 1937, Buick and Oldsmobile came

out with a transmission called the Automatic Safety Transmission. It had a conventional clutch for shifting the transmission into forward or reverse. Once in forward, the transmission shifted automatically by using two hydraulically operated planetary units—one for LOW gear and one for DRIVE. This unit was the forerunner of the GM Hydra-Matic, which was born in 1938.

The Hydra-Matic consisted of three planetary gearsets that were operated hydraulically. A fluid coupling was used to connect the engine and transmission. Credit for perfecting the fluid coupling goes to Chrysler, which developed the concept in 1937. However, Chrysler didn't make use of it until 1941, when the Chrysler Fluid Drive transmission was introduced. This was not an automatic unit, but a standard transmission with a fluid coupling, not a clutch.

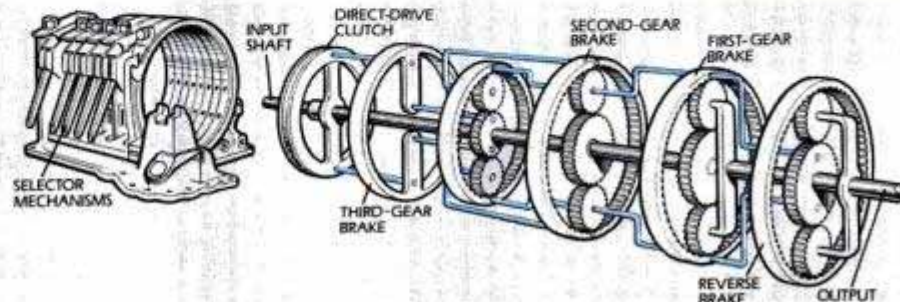
By 1948, the automatic transmission had evolved into the hydraulic torque converter that we know today coupled to a planetary gear train. The first to use the converter was Buick. The '48 Buick Dynaflo, as it was called, was the model for present-day automatic transmissions. Others soon followed with similar units—Chevrolet Powerglide, Fordomatic and Merc-O-Matic in 1950; and the Chrysler M-6 Torque Converter Automatic in 1951.

These are some other interesting developments in the history of transmissions and drive units:

- In the early days of transmissions, leather-lined, multiple-disc, oil-bathed clutches were in common use. Although the first use of a dry single-plate clutch was by Duryea in 1893, it wasn't until 1921 that a design was developed that wouldn't burn out in a few hundred miles, thanks mainly to Englishman Herbert Frood, who perfected more durable friction materials.

- Universal joints were first introduced on the 1902 Peerless. The 1908 Franklin was the first car to use roller-bearing U-joints. The 1930 Hupmobile pioneered needle-bearing U-joints, which is

(Please turn to page 46)



Wilson Preselector gearbox used a stack of planetary gearsets, very much like the modular Lenco transmission that is found in today's Pro-Stock dragsters.

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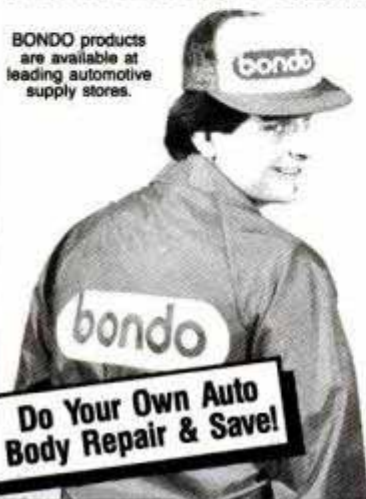
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100 YEARS

(Continued from page 44)

the point where we stand today.

■ Although differential locks were first used on a steam lorry in 1903 to provide wheel traction on slippery roads, it wasn't until 1956 that the first production limited-slip differential for a popular car was produced by Studebaker.

■ In 1909, Otto Zachow and William Besserlich of Clintonville, Wisconsin, built a car with the first successful 4-wheel-drive unit. A year later, they began a company called the Four Wheel Drive Auto Co.

■ In 1913, Packard made a milestone step in differential development with the introduction of a spiral-bevel ring and pinion set that cut the noise level produced in the rear axle. In 1926, with the introduction by Packard of the hypoid gear rear axle, noise ceased to be a problem altogether, unless the differential was going bad.

■ In 1934, automatic overdrive was introduced on the Chrysler and DeSoto Airflow.

■ The latest development in transmission seems to be the continuously variable automatic transmission, or CVT (see *Get Ready For A New Kind Of Automatic Transmission*, page 70, June '84). The CVT is driven by a metal link belt. We've come full circle in 100 years, back to the belt-drive! **PM**

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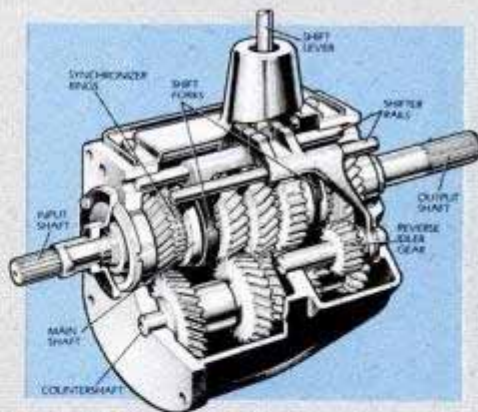
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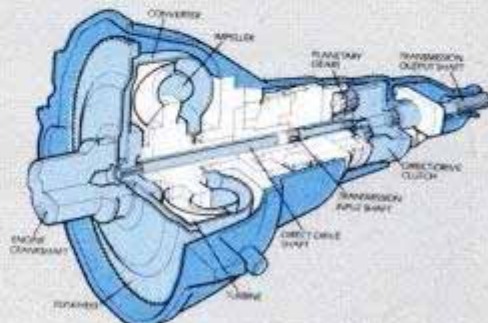
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Modern 4-speed manual transmission is very much like the sliding gear unit introduced in 1894 by Panhard and LeVassor.



Modern "lockup" automatic transmission has a fluid coupling/torque converter, planetary gears and a clutch that eliminates torque converter slippage at cruising speed.

Amazing New Third Brake Light Can Save Your Life

Introducing the biggest safety breakthrough in the history of the National Highway Traffic Safety Administration (NHTSA).

Gov't approved Mandatory for 1986

Stringent government tests prove that the third brake light mounted at eye level reduces rear-end accidents by over 53%. The government is so amazed with these test results they are demanding all 1986 cars be equipped with this new third brake light. (These cars will be introduced in September of 1985.)

The NHTSA estimates predict that this light will prevent 900,000 rear-end collisions a year and 40,000 personal injuries a year. And when accidents do occur, tests show that personal injuries are reduced. Car damage and repairs are also reduced by almost 60%.

Here's why it works

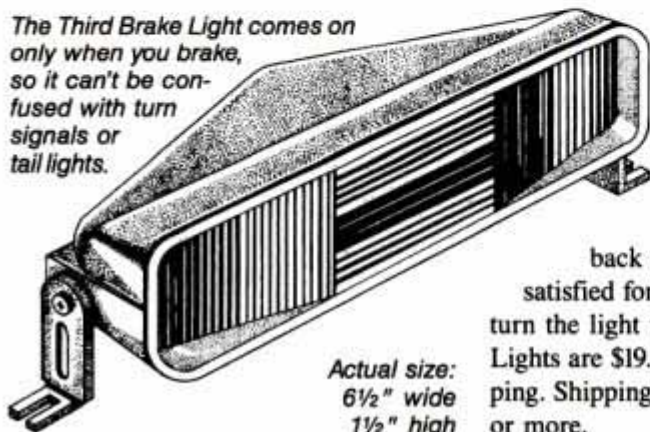
Mounted at eye level, the brake light is bright and easy to see because it shines directly into the eyes of the drivers in the second and third cars behind you. Also, since the light comes on only when you brake, it can't be confused with turn signals or tail lights.

Reduce rear-enders

The third brake light can prevent painful whiplash injuries, remind tail-gaters to back off, and gives the driver behind you better depth perception, day or night.

Many insurance companies are offering discounts for these lights.

The Third Brake Light comes on only when you brake, so it can't be confused with turn signals or tail lights.



Actual size:
6½" wide
1½" high



Amazing results — your chance of a rear-end accident is reduced by over 53%.

Exclusive Design

The versatile design of our light comes complete with everything you need — so it fits every kind of car. The patented bulb assembly snaps out for easy bulb replacement. The contemporary style has a low profile — so it looks good on all vehicles.

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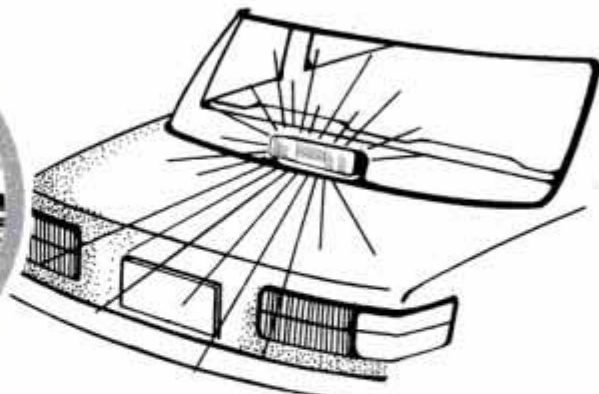
It's easy to install

The eye level brake light mounts inside your rear window — like the new cars, where it is protected from weather, car washes, body damage and theft.

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Our lights are backed by a one year manufacturer's warranty and our own 60-day money-back guarantee. If you are not satisfied for any reason, you may return the light for a prompt full refund. Lights are \$19.95 each, plus \$3.00 shipping. Shipping is FREE with orders of 2 or more.



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Mazda RX-7

Under the all-new skin of the second-generation RX-7 is a hotter rotary, and a turbo is on the way.

TEXT AND PHOTOS BY RICH TAYLOR

In 1978, Toyo Kogyo was almost bankrupt. Then it introduced the RX-7 in what was very nearly a last-ditch effort to stay alive. Since then, Mazda has sold 360,000 RX-7s, the company is in strong financial shape, and Kenichi Yamamoto, creator of the RX-7, is now the president of the renamed Mazda Motor Corp.

All this is another way of saying that the RX-7 is the most important vehicle Mazda makes. But it's also getting long in the tooth. When the original RX-7 was introduced, it cost \$5995 and competed with cars like the TR 7 and MGB. It's a lot to expect that same car—seven years later—to compete with not only the CRX and MR2, but everything from the Camaro Z28 to the Porsche 944.

For 1986, Mazda has an all new RX-7. It's better than the original in every way, yet it also accomplishes the almost impossible task of being both completely different and remarkably similar to the car it replaces. You know immedi-

ately that it's an RX-7, yet the new car doesn't look anything at all like the old one. Remarkable.

What the new RX-7 *does* look like is a lot of other cars. The nose, fender treatments and wheel openings are obviously borrowed from Porsche's 944. The side windows and doors are similar to those on the Chrysler Laser/Dodge Daytona. And the compound curve rear hatch window, taillights and rear contour might have come right off Chevy's Camaro. The original RX-7 was just that—*original*. Everyone is already predicting it'll be a timeless classic. The new RX-7 is a safe pastiche of themes from other cars, made to work together pleasantly, if not brilliantly. It's a great-looking car, no question, but not a breakthrough design.

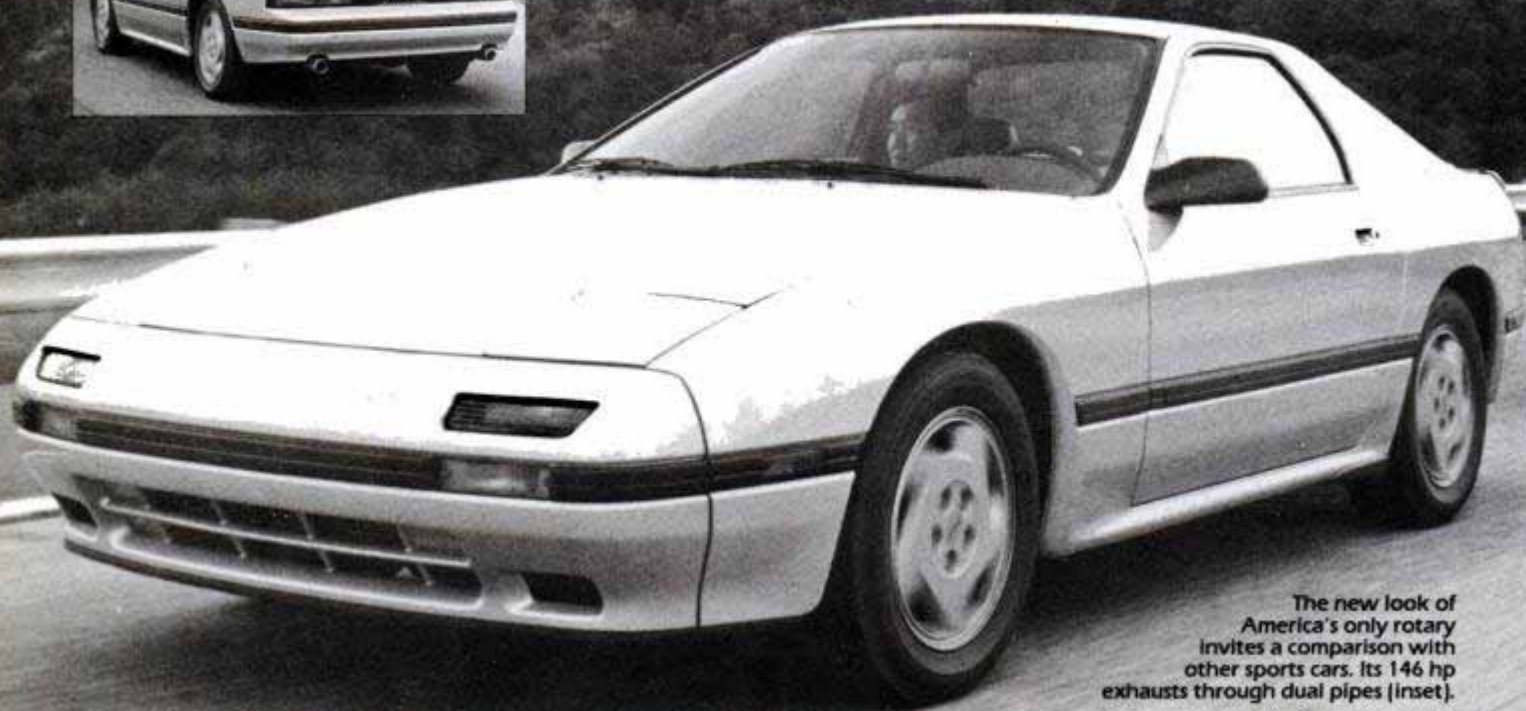
Under that softly rounded body, the new RX-7 is equally conventional—at least by Mazda standards. The only powerplant currently available is a refined version of the 13B Rotary. The

most important changes are a new 6-part induction system and an intake manifold with a "dynamic effect chamber," which uses a compression wave from one rotary chamber to "supercharge" the other chamber on each intake cycle.

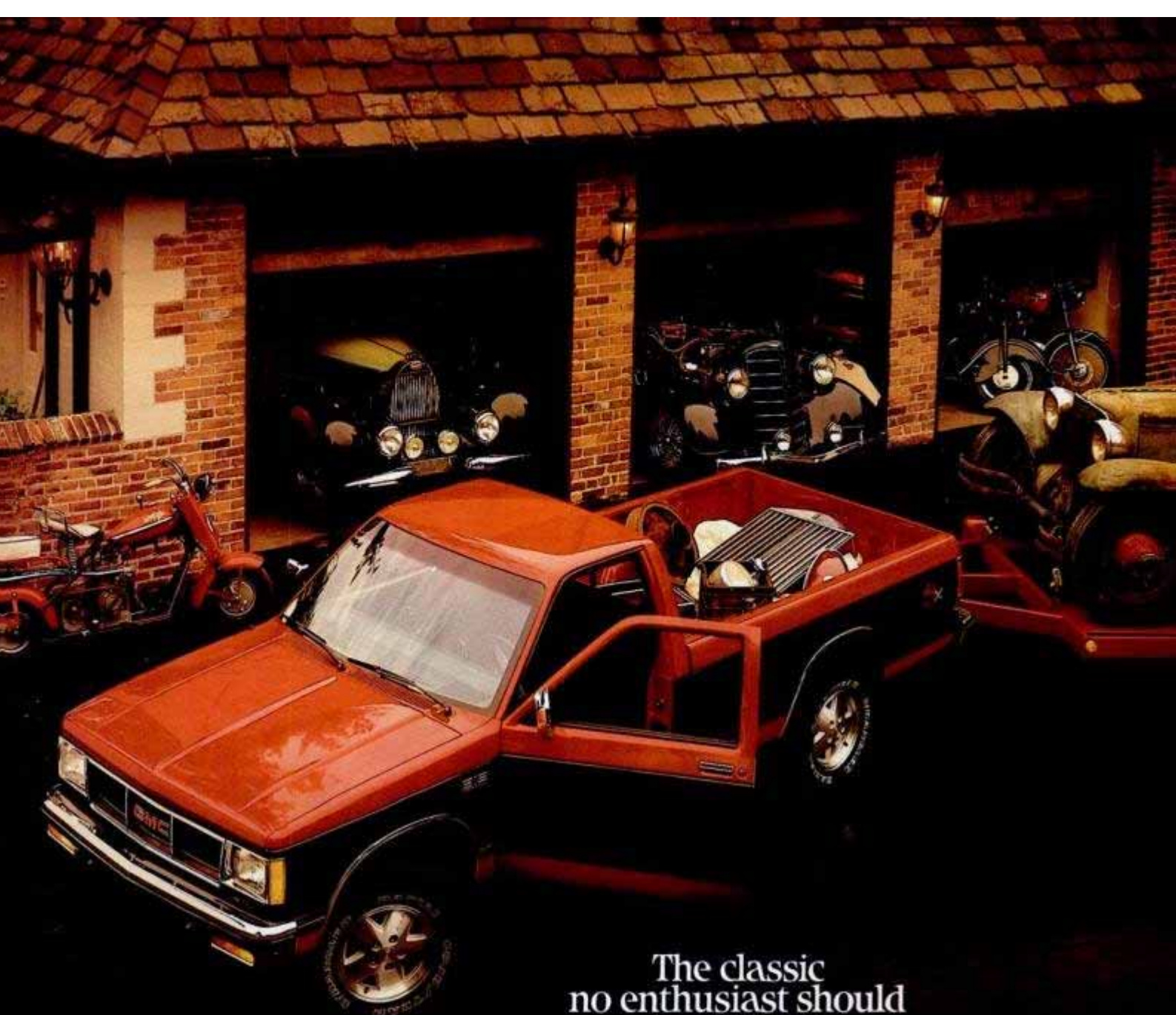
A new 16-byte microprocessor, fuel injection (two injectors for each rotor), lighter weight rotors and new smaller, more effective rotor seals give 146 hp at 6500 rpm, a useful increase of 11 hp over the 13B engine in the '85 GSL SE, and 45 hp more than the 12A Rotary in low-line '85 RX-7s. All '86 RX-7s will have the new 13B EGI.

Starting in January, you'll also be able to buy a Turbo II. After driving it back-to-back with the normally aspirated 13B, I'd guess the Turbo II will be rated about 180 hp using about 8 psi boost pressure (Mazda hasn't released specs yet). The performance difference is remarkable. The turbo makes the RX-

(Please turn to page 58)



The new look of America's only rotary invites a comparison with other sports cars. Its 146 hp exhausts through dual pipes (inset).



The classic no enthusiast should be without.

A classic truck? Well, sure.

The pickup is a classic of sorts, with over five decades of service to mankind to its credit. But the GMC S-15 4X4 Pickup is a classic departure from trucks as they are commonly perceived.

Its rakish looks and sophisticated comforts allow this GMC truck to do virtually anything a car can do. And its Insta-Trac four-wheel drive, double-wall cargo box and optional V-6 engine allow our pickup to do a lot of things a car could never do.

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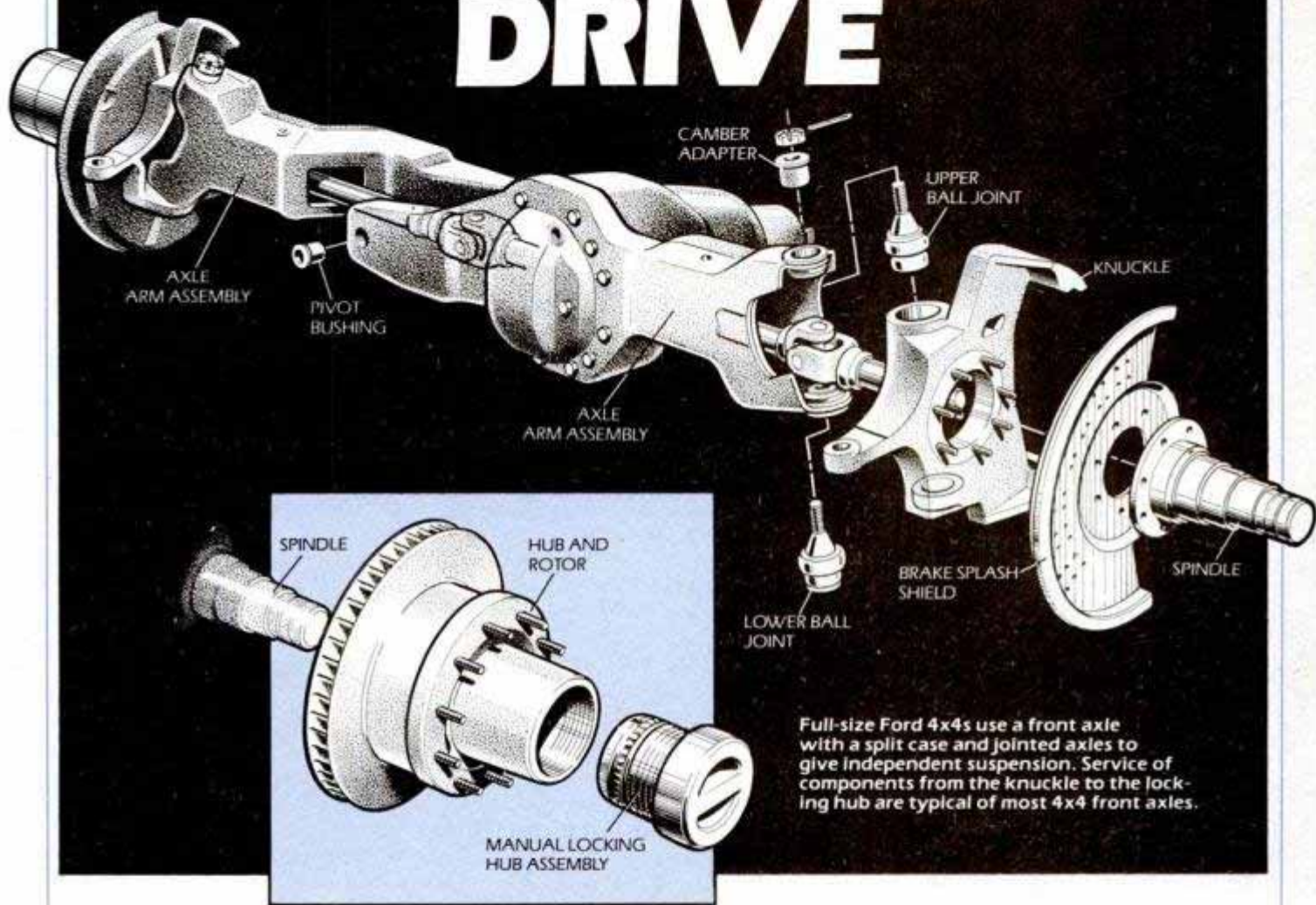
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How To Maintain And Repair **FOUR-WHEEL DRIVE**



Full-size Ford 4x4s use a front axle with a split case and jointed axles to give independent suspension. Service of components from the knuckle to the locking hub are typical of most 4x4 front axles.

BY PAUL STENQUIST

Over hill, over dale—until you bend a wheel, bust a ball joint or fry a wheel bearing.

Four-wheel-drive trucks are a lot of fun because they can take you places a car can't. But there's a price to pay in increased maintenance and repair, especially if you spend a lot of time sloshing through mud or pounding over rocks. Dirt and moisture are natural enemies of all bearings and joints, and you have to keep them clean and well-lubricated if you want to keep rolling.

In addition to the wear and tear of off-road use, many 4x4 owners who have

installed different wheels, tires or suspension parts are plagued with steering shimmy problems.

In the following sections, we'll explain how to repair or install a steering damper for shimmy control, how to check for bent rims and how to service 4x4 ball joints and wheel bearings.

Shimmy control

Every time you drive over a small bump in the road, the tire involved gives the steering linkage a good smack. When a 4x4 is equipped with large wheels and tires, road shock forces may be multiplied. These forces cause motion in the steering linkage—shimmy, which is a frightening shaking

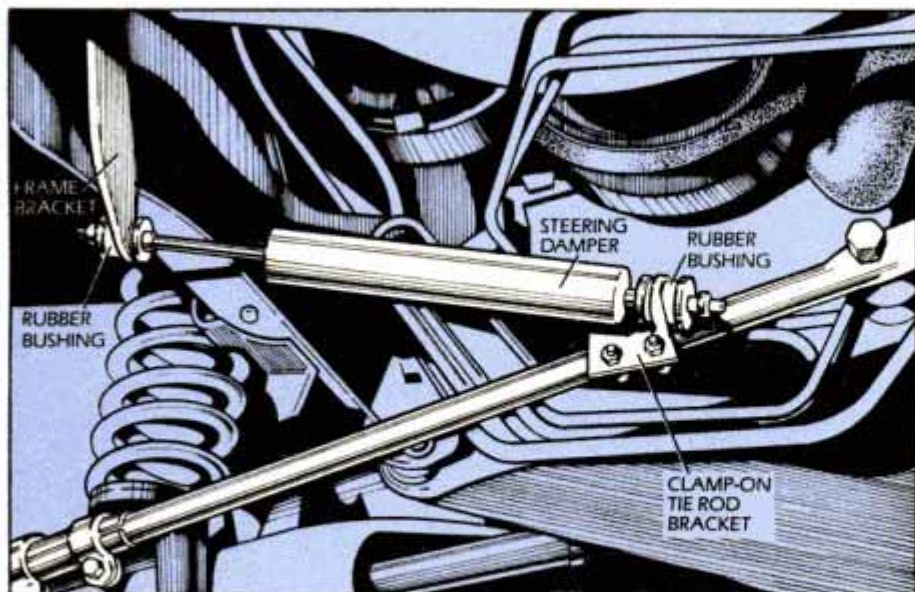
of the tires and steering wheel.

A steering damper, attached to the tie rod on one end and the frame or front axle housing on the other, can greatly reduce the abuse (Fig. 1). Nothing more than a shock absorber, the steering damper arrests the motion that feels like you're losing control.

Checking and replacing a steering damper

Many 4x4s come factory-equipped with a steering damper. Because of its importance and because of the constant abuse to which it is subjected, check damper condition on a regular basis.

Each time you lube your front end, inspect the damper mountings. At each



1 Steering shimmy problems, often exaggerated by oversize tire installation, can be brought under control by installing a hydraulic steering damper on the linkage.

end of the damper, you'll find rubber bushings. If the bushings are worn or deteriorating, they must be replaced.

Check the damper for signs of fluid leakage or a bent shaft. A light film of fluid near the shaft seal is sometimes normal, but the damper should not drip fluid. A leaking damper or one with a bent shaft must be replaced. If the damper is old and you're not sure about its condition, or if shimmy is a problem, install a new one.

Upgrading a steering damper

If you've outfitted your rig with big mud tires, you probably need some help hanging onto the steering wheel.

Retrofit steering dampers are available from a number of companies. One principal supplier is Moog Automotive (P.O. Box 7224, St. Louis, MO 63177).

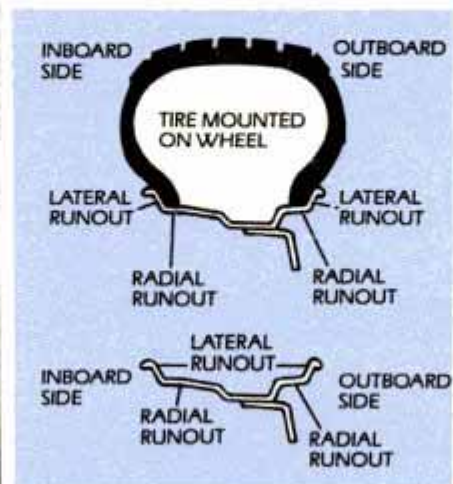
To install the steering damper, loosely attach the mounting brackets in the spots indicated in the instructions. Extend the damper and assemble the mounting bushings, washers and nuts. The damper should be almost horizontal, with the shaft end slightly higher than the cylinder end. Make sure the damper has adequate clearance in respect to chassis parts, hoses and so on. Tighten the mounting bolts, then turn the wheels to make sure the shock doesn't prevent full wheel movement.

Checking for bent wheels

For those who really beat on their 4x4s, bent wheels are a common problem. If you experience a roughness or vibration immediately after an off-road trip, chances are you've smacked up a

wheel. If you manage to cut a tire while bouncing around off-road, you should always check the wheel for damage.

Measure wheel runout with a dial indicator. If possible, radial and lateral runout should be measured on both inboard and outboard sides of the wheel (Fig. 2). If the wheel design makes the outboard measurement impossible, check inboard runout only. Check lateral runout with the indicator positioned perpendicular to the face of the wheel, against the smooth surface on the far edge of the rim. Check radial runout with the indicator mounted parallel to the wheel, against the flat part of the inner rim. Replace steel wheels if radial runout exceeds 0.040 inch or if lateral runout exceeds 0.045 inch. Replace aluminum wheels if either radial or lateral runout exceeds 0.030 inch.



2 Checking wheel radial and lateral runout is done best with a dial indicator and the tire dismounted from the wheel.

Ball Joint Inspection

Most manufacturers recommend that you check ball joints on a regular basis. For serious off-road use, check them every time you lube the steering and suspension parts. Some trucks, including Toyotas, do not have ball joints. Instead, the steering knuckle is mounted on cone-type bearings. If lubed on a regular basis, these should not require adjustment.

To check conventional ball joint suspensions, raise the truck with a jack positioned under the front differential housing. Chock the wheels and place jack stands under the axle, just inside the springs or in the positions recommended in your service or owner's manual. Rock the tires in and out and watch for side-to-side movement of the ball joint studs. Check for vertical looseness by attempting to raise each tire with a pry bar while watching the studs. Any easily noticeable movement is excessive.

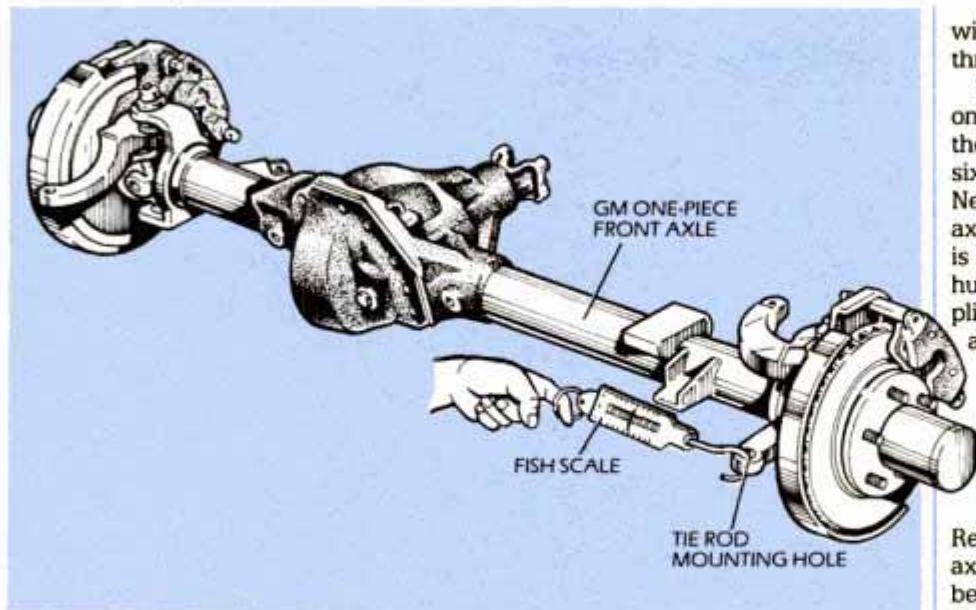
On Ford minitrucks, check for side-to-side movement only. Watch the gap between the spindle and axle jaw while checking. More than 1/32-inch movement is excessive.

You'll need a fish scale to check the joints of full-size Chevy or GMC light trucks for binding (Fig. 3). Remove the wheels, then disengage the connecting rod and tie rod so that each knuckle assembly can be rotated independent of the other. Attach the scale's hook to the tie rod mounting hole of one of the steering knuckles. Then, with the knuckle assembly in the straight-ahead position, pull the scale toward the differential center section. Watch the scale to see how much force is needed to keep the knuckle turning after break-away. For most trucks, it should not exceed 25 pounds.

Ball Joint replacement

To replace a ball joint on trucks with a 1-piece or Ford-type front axle, you have to remove the locking hubs, the hub/rotor and the spindles before you can disengage the knuckle and ball joint from the front axle. For many trucks, including full-size Chevy, Ford and Dodge and the Ford minitrucks, you'll need a ball-joint press to remove the joints from the knuckle. Before you can get close to the ball joints, you'll need a special spanner wrench to remove the wheel bearing outer locknut and a large socket for the adjusting nut. A torque wrench is needed to adjust the wheel bearing.

The replacement of the joint is the same as on a passenger car. See the



3 To check for binding in ball joints, measure the turning effort with a fish scale hooked to a tie rod mounting hole. The fish scale reading should not exceed 25 pounds.

July '85 *Saturday Mechanic* (page 53) for more on the use of a press and the removal of joints.

Hub removal, inspection

The removal of either automatic or manual-locking hubs is fairly easy and is necessary for ball joint service or wheel bearing lube. A few examples follow. The procedures for other trucks are very similar, but there are quite a few different types of hubs that have been used over the last 15 years. Even within one model year, different type hubs were used on some vehicles.

Disassembly of automatic locking hubs is somewhat complex, and there are too many steps and too many different procedures for us to cover them here. But it's a job you should be able to do if you have the factory

service manual for your truck. Automatic locking hubs should be disassembled and lubed with automatic trans fluid, or as recommended, every 24,000 miles. When disassembling an automatic hub, never remove the brake band from the drag sleeve and detent.

Disassembly of manual hubs is easy, and it's a good idea to pull them apart, clean the parts, check for galling, chips or excessive wear and reassemble them whenever you have them off for wheel bearing or ball joint service. Lube the parts with a coating of automatic transmission fluid or multipurpose grease, depending on manufacturer recommendation. Use a multipurpose grease or white lithium grease on the O-ring seals.

To remove the automatic locking hub used on most late-model Dodge trucks, unscrew the five cover screws, using a Torx T-25 driver. Remove the cover, along with the bearing race spring assembly, the sealing ring, the seal bridge retainer and the bearing components. Locate the wire retaining ring on the outer edge of the hub clutch housing, squeeze it together with needle-nose pliers and pull the remaining parts from the spindle (Fig. 4).

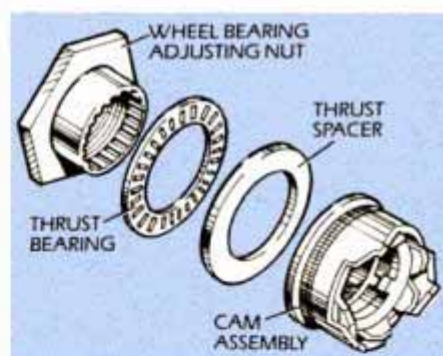
To remove the automatic locking hubs used on Ford Bronco II and Ranger, unscrew the retainer washers from the lug nut studs, then pull the hub assembly off of the spindle. Remove the snap ring from the end of the spindle shaft, then remove the axle shaft spacer, needle thrust bearing and the bearing spacer. Being careful not to damage it, pull the cam assembly off the wheel bearing adjusting nut along

with the thrust spacer and needle thrust bearing (Fig. 5).

To service the Ford manual hub used on Bronco, F-150 and F-250, disengage the cap from the hub by unscrewing the six socket head capscrews (Fig. 6). Next, remove the snap ring from the axle shaft. Then locate the lock ring that is seated in the groove of the wheel hub, and use a pair of needle-nose pliers to remove this ring. The body assembly should then slide out of the wheel hub. You may have to use a puller to remove the body assembly. To service the manual hubs used on Jeep CJ and Scrambler, remove the hub bolts and tabbed lockwashers along with the hub body and gasket. Remove the retaining ring from the axle shaft, then the hub clutch and bearing assembly. When reinstalling the hub, use a new gasket. Do not turn the hub dial until it has been reinstalled.

Wheel bearing service

If you keep your truck out of the mud and water, a wheel bearing and spindle bearing lube job every 12,000 miles is adequate, but if you're continuously blasting through the muck, you should

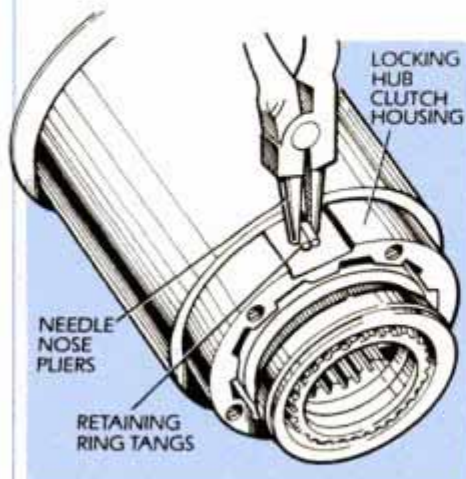


5 Take extra care not to damage the cam assembly when removing automatic locking hubs from Ford Bronco II/Ranger axles.

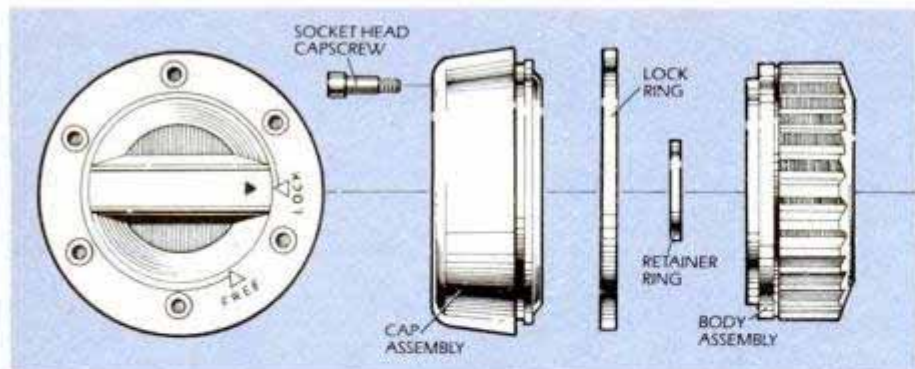
do it at least twice as often. As noted previously, you'll need a special tool—a spanner wrench for the wheel bearing outer locknut—to service the wheel bearings on most trucks (Fig. 7). You'll also need a gigantic hex socket (2 $\frac{3}{8}$ inch for many types) to remove the wheel bearing adjusting nut, and a torque wrench.

T-Trucks have permanently lubed, sealed wheel bearings. These bearings are part of a 1-piece hub and bearing assembly that bolts right up to the steering knuckle. If they fail, the entire unit is replaced.

To service the wheel bearings on most other 4x4s, remove the locking hubs as described above, then remove



4 Removal of most locking hubs requires disengagement of hub retaining ring. Use needle-nose pliers to compress ring tangs.

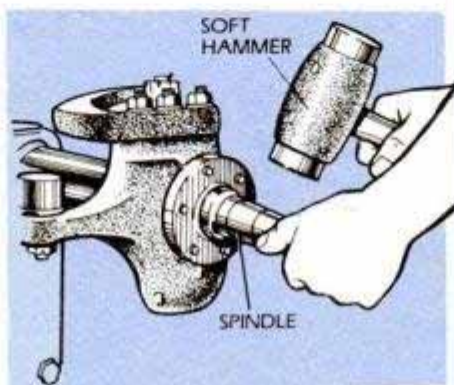


6 To remove Ford manual locking hubs, the lock ring located in the groove of the wheel hub must first be taken out with needle-nose pliers. Then you can slide the hub off.

the brake caliper and hang it out of the way. Next, remove the wheel bearing locknut, lock ring and adjusting nut. Pull the hub and disc assembly from the spindle. The outer wheel bearing cone and roller assembly will slide out as the hub is removed.

Unscrew the spindle retaining nuts. Then, remove the spindle from the knuckle studs and axle shaft. You may have to tap the end of the spindle lightly with a soft hammer to disengage it (Fig. 8). If there's a thrust washer behind the spindle, note its position and mark one stud and washer hole, so the washer can be reinstalled in the same position.

Clean any old grease from the needle bearings inside the spindle and from the spindle bore seal. If the bearing is in good condition, thoroughly lubricate the needle bearing and pack the spindle face that mates with the spindle bore



8 A soft hammer may be needed to disengage front spindle from knuckle studs.

ed, you should drive the bearing cups out of the hub and replace them as well. In most cases you should be able to knock them out with a long brass dowel rod and a hammer, but for some hubs you may need a slide hammer and puller device to yank them out.

Lube the bearings with multipurpose bearing grease after cleaning all old grease from the bearings and hub. Pack the cones and rollers with the grease. If you don't have a bearing packer, work as much lubricant as possible between the rollers and the cages. Then, position the inner bearing cone and roller in the inner cup and install a new grease seal, carefully tapping it into place with a large socket or cup that fits just within its perimeter. Position the hub and disc assembly on the spindle, install the outer bearing assembly and the adjusting nut.

Wheel bearing adjustment

Before reinstalling the locking hubs, you have to adjust the wheel bearings. Using the spanner wrench socket and a torque wrench, tighten the bearing inner adjusting nut to 50 ft.-lb. while rotating the wheel back and forth. Loosen the nut and retighten to the same spec. With GM automatic hubs, retighten to 35 ft.-lb. Back off the adjust-

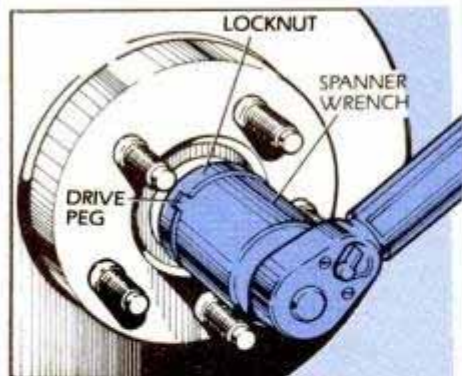
ing nut 45°, then install the lockwasher by turning the inner adjusting nut until the lock pin slips into the nearest hole in the lockwasher (Fig. 9). Install the outer locknut and tighten it to 150 ft.-lb. (160 ft.-lb. on GM). If you want to make sure you've got it right, check wheel end play with a dial indicator. It should be less than 0.006 inch.

Locking hub installation

To reinstall Ford and Jeep manual locking hubs, assemble parts in the reverse order of the procedure found above in the section "Hub removal and inspection." After installing Jeep hubs, raise the front of the truck, turn the hub dials to "4x2" and rotate the wheels. If the wheels don't rotate freely, check the hub installation and make sure the dials are fully in "4x2" position.

To reinstall Dodge automatic locking hubs, check to see that the drag sleeve retainer washer is in position between the wheel bearing adjusting nut and the lock nut. Make sure that the spacer and retaining ring are in position on the axle shaft, then install the automatic locking hub into the wheel hub, aligning the drag sleeve slots with the tabs on the drag sleeve retainer washer. Align the outer clutch housing splines with the splines of the wheel hub. Then, loosen the cover screws three or four turns and push in on the cover to allow the retaining ring to expand into the rotor hub groove. Using your Torx T-25 driver, tighten the cover screws to 40 to 50 in.-lb.

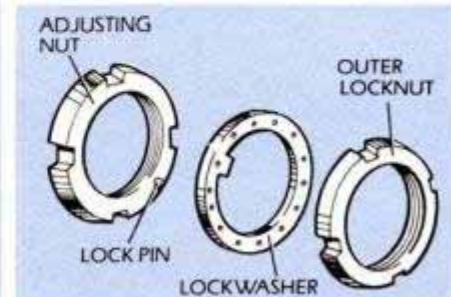
To reassemble Ford minitruck automatic hubs, install the locknut needle bearing and thrust washer in the order of removal and push the cam assembly onto the locknut by lining up the key in the fixed cam with the spindle keyway. Install bearing thrust washer, needle thrust bearing and axle shaft spacer. Attach the snap ring to the end of the spindle, then install the locking hub assembly over the spindle by lining up the three legs in the hub assembly with the pockets in the cam assembly. **PM**



7 A 4-prong spanner wrench helps to remove the outer wheel bearing locknut.

seal using a high quality multipurpose bearing grease. Reinstall the spindle over the axle and torque the retaining nuts to spec (20 to 30 ft.-lb. for most Ford and Dodge light trucks, 65 ft.-lb. for Chevy and GMC trucks).

Pry the grease seal out of the back of the hub and discard it. Remove the inner bearing cone. If the bearings have to be replaced rather than just repack-



9 Wheel bearing locknut peg fits into spindle groove. Hole in washer engages pin.

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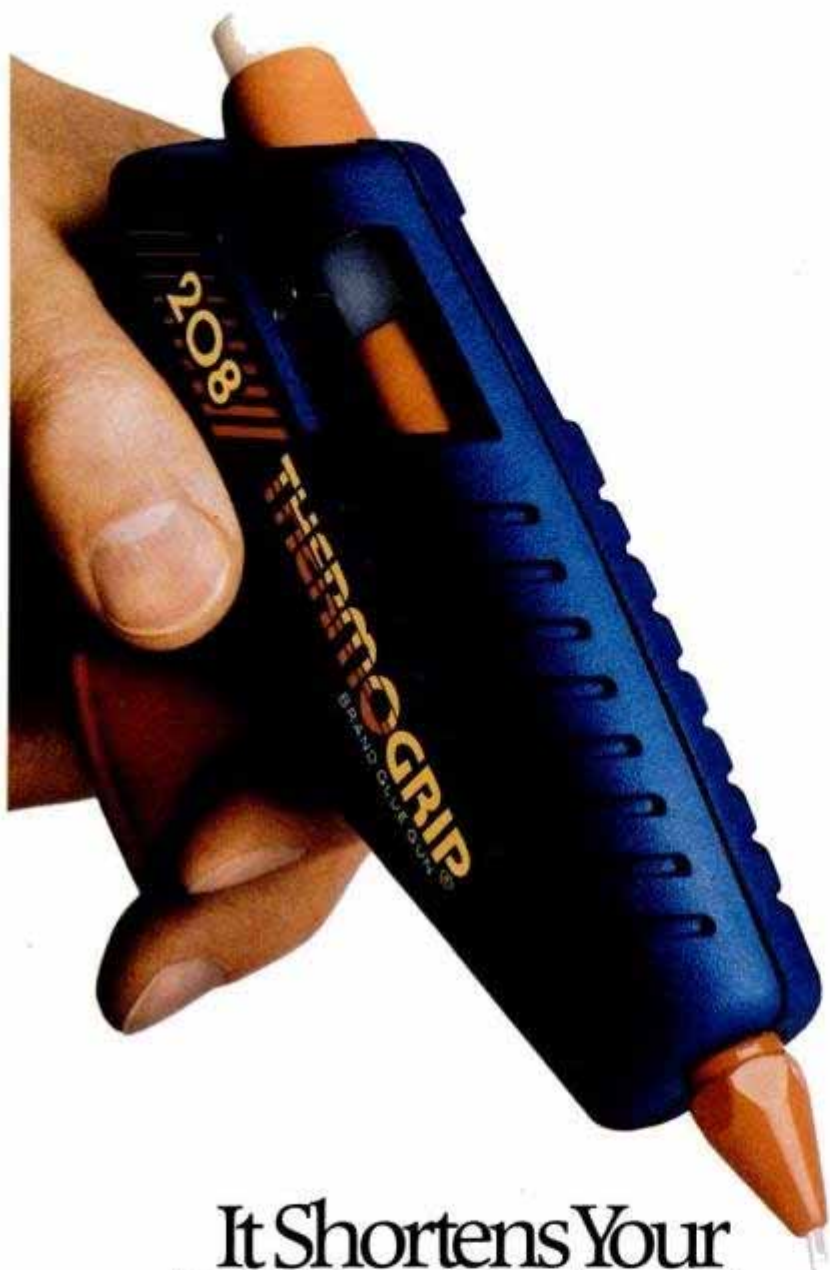
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MAZDA RX-7

(Continued from page 48)

7 quicker in all speed ranges, particularly at high speed.

On the half-mile front straight at Seattle International Raceway, where Mazda let us drive the new RX-7s, an '85 GSL SE was barely able to accelerate to 100 mph before it was time to brake for the corner at the end of the straight. The new 13B EGI could touch



Turbocharged 13B Rotary should be good for approximately 180 hp. Acceleration from 0 to 60 mph will clock under 7 seconds.

110 mph; the Turbo II was going 125. Maximum speed of the new normally aspirated car is about 125 mph, with 0-to-60 acceleration in 8 seconds. The Turbo II should hit 140 mph, and do 0 to 60 in under 7 seconds.

Handling at all speeds is impeccable, a quantum leap over the old RX-7. Weight distribution remains an almost perfect 50/50, with MacPherson strut front suspension. Aluminum A-arms and wheel hubs are new, as is electronically variable power steering, which becomes progressively firmer as speeds increase. Pulling out of a parking space is one-finger light; but by the time you reach 110 mph, it's as stiff as a manual steering box.

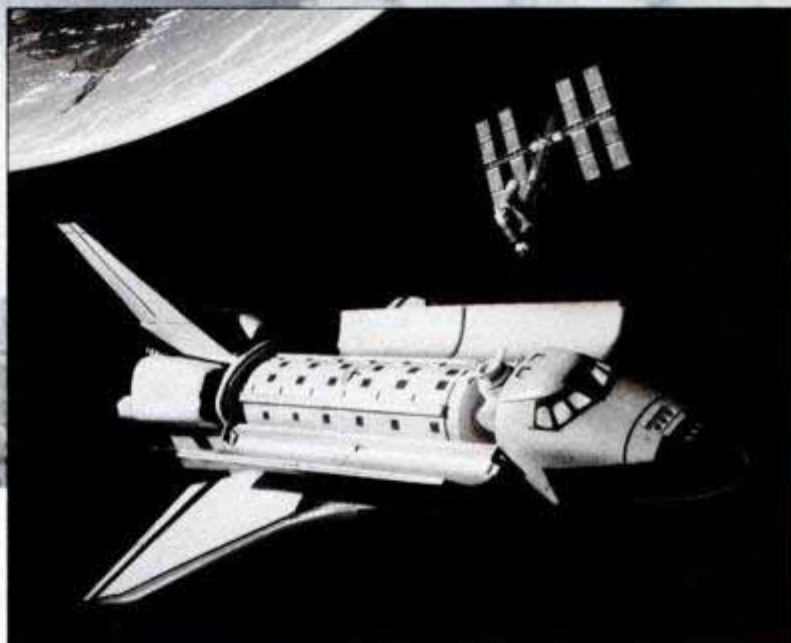
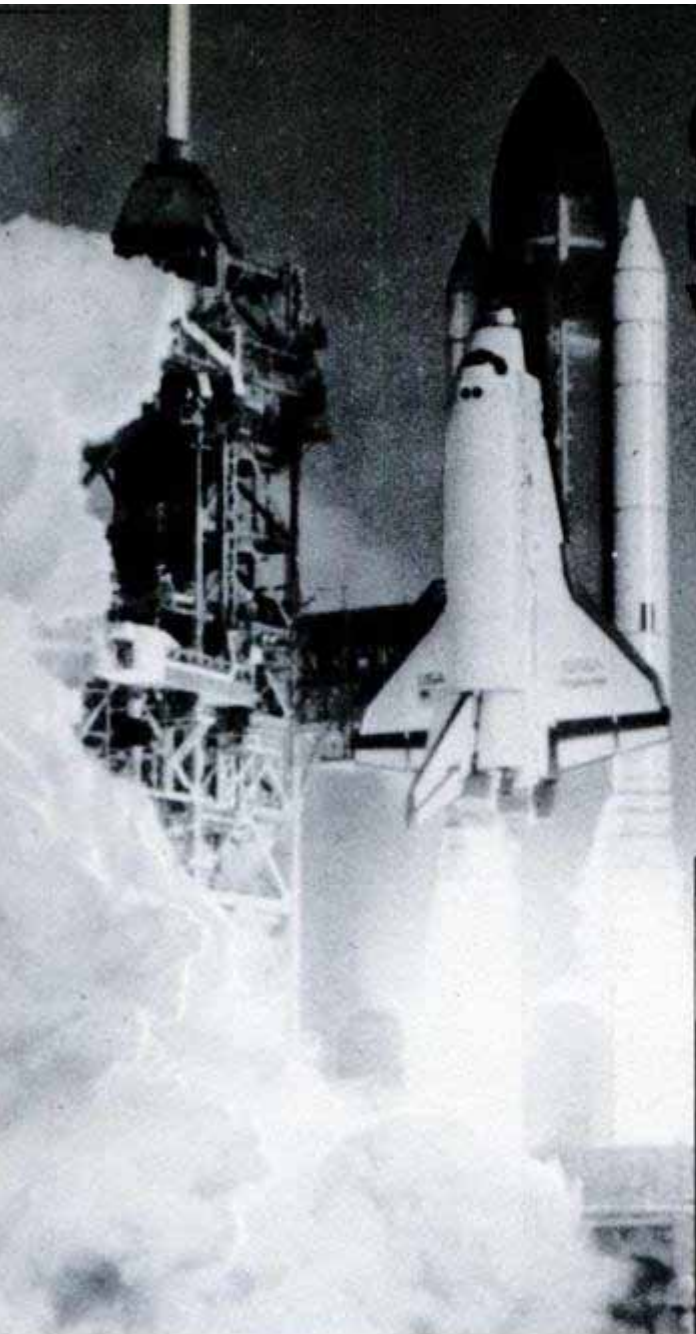
Even more innovative is the RX-7 rear suspension. A development of the 323/626 independent rear suspension—and a major improvement over the rigid axle of the original RX-7—this is one of the cleverest rear suspension designs yet produced. Mazda calls it Dynamic Tracking Suspension System. The idea is that under straight-ahead normal driving, the rear wheels run with 0° toe-in. When you put a cornering load of up to .5g on the suspension,

(Please turn to page 180)

SPACE VACATION 1995

If you've already vacationed everywhere on earth, consider a 3-day cruise to nowhere in space. Cost? \$1 million!

BY DENNIS ESKOW, Science Editor



PM ILLUSTRATION BY BRIAN SULLIVAN

The Space Shuttle cargo bay will open as vessel enters orbit, allowing passengers to view earth, space and possibly the Space Station from their seats.

"I've traveled around the world three times. On my next vacation, I'm going somewhere else."

—Groucho Marx

A generation ago, a vacation in space was strictly fantasy. But with the Space Shuttle program running closer and closer to its 24-launch-per-year goal, and amid growing interest in space business, the notion of a space vacation has become real. So real, in fact, that a Seattle-based travel company that specializes in the exotic this year began offering applications for the first Space Shuttle voyage to nowhere. If you want to buy a seat you have to be in good physical condition, be available for a 2-day flight preparation and a 3-day flight, and be able to spend \$1 million.

"Typical clients of Society Expeditions are experienced travelers who desire something different," explains Coke Mead, spokesperson for the company that in the past has run tours to such exotic places as Antarctica and Easter Island. Company officials say they expect to start taking well-heeled tourists into space by 1995. And they aren't the only ones.

"NASA has been approached by a British group that wants to use the Space Shuttle to go to the Space Station

and then on to Mars," says NASA public affairs officer William J. O'Donnell. A West German group wants to buy a Shuttle to use for tourism. And several aerospace companies have shown plans for a tourist module that can be flown in the Shuttle cargo bay.

McDonnell Douglas, Rockwell and Lockheed have in the past two years released plans for Space Shuttle interiors obviously designed for pleasure travelers. One plan calls for an exercise unit, seating for 40 passengers, a bar and an astronomy bridge where amateurs can point their scopes to get glimpses of heavenly bodies they could never have seen through earth's atmosphere.

The Shuttle cargo bay is 60 feet long and 15 feet wide. By inserting a tubular passenger section into the bay, NASA officials say there would be plenty of room for 24 passen-

(Please turn to page 62)

The Promise.

Renault Alliance's European technology will give you superior room, riding comfort and driving ease.



The Proof.

100 new car shoppers compared Renault Alliance to Toyota Corolla, 76 chose Renault superior overall.



	Comfort/ Convenience	Riding Comfort	Driving Ease	Styling		Overall Superiority
				Interior	Exterior	
Renault Alliance	85	82	70	89	72	76
Toyota Corolla	15	18	30	11	28	24

Nationwide Consumer Testing Institute asked new car shoppers¹ to compare Toyota Corolla Dlx with 1.6 litre to Renault Alliance DL with 1.7 litre in 30 categories, including room, riding comfort and driving ease.

The results: 76% of the shoppers voted Alliance superior overall, winning 29 out of 30 categories. But there's more. The 1986 Alliance has improved mileage ratings,² **41 MPG HWY, 35 MPG CITY.** Redesigned and improved struts, sway bars and shocks for a smooth ride. And America's best small car protection—5 years or 50,000 miles, Plus free required maintenance,

5/50 PLUS

parts and labor; you pay only for fluids.³ All this European technology in the Alliance DL (shown) for **\$7245.*** Now available with Accusound by Jensen, a premium 6-speaker system.

2-door prices start at only **\$5895.*** Renault Alliance. **Built in America.** See your Renault dealer for test details. Then drive an Alliance for yourself. Because if you're like the small car shoppers we know, your preference for European technology will prove our promise.

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PM ILLUSTRATION BY ED VALIGURSKY

Inside the 24-passenger cabin, you'll be able to rest, exercise, walk on the wall and ceiling or stand at the bar for down-to-earth refreshment.

gers, the number projected for the first tourist voyage.

The first tourist voyages on the shuttle would begin two days before launch. Passengers would have to present the results of a physical examination that certifies they are in excellent health and psychologically capable of spending three days in space.

In the months before the trip, a passenger would have to register at an approved adult education center for physical conditioning that includes scuba diving, aerobics, muscle toning and, if necessary, weight reduction. The medical forms, signed by an approved doctor, will have to testify that the prospective tourist has no disease, injury or impairment that could interfere with flight training or the flight itself.

Excellent physical condition does not mean superhuman. For instance, a passenger's blood pressure will have to register under 160/100, in the higher range of normal. All told, preparation for your first flight into space would take about eight weeks.

In the two days before launch, passengers would be briefed and would have time to ask questions about the mission they're joining. In some cases, NASA says it might even permit future passengers on this or another tour to help perform minor experiments.

Society Expeditions has prepared a detailed schedule for the first passengers. On the first day, you'll enter the Shuttle, receive a briefing from the expedition leader, await the countdown and take off. The passenger cabin will have a video screen to monitor the launch and follow flight trajectory. The

video screen will also display shots of earth as the boosters separate.

Once in orbit, passengers will be permitted out of their seats to get accustomed to weightlessness in space. The cabin will have an overhead walkway to allow you to stroll parallel to the floor or even upside down. The first few hours after launch will be taken up with learning to eat, drink, relax in your chair and use the toilet.

After mission control is assured that all passengers are comfortably battened down, the TV screen will go off and the cargo bay doors will open to provide your first direct views of space and the earth below.

The Shuttle will orbit earth 16 times a day, giving tourists plenty of chances to take photographs, enjoy recorded lectures and watch for points of interest on earth and in space. Once America's Space Station is finished—and it is scheduled for operations in the mid-1990s—the trip into space may also include a docking maneuver and a visit to the station.

On the third day of the tourist mission, passengers will batten down and go back to the video monitor as the cargo bay doors close for re-entry. After touchdown, passengers will have a 1-day debriefing and head for home in a more conventional craft.

If plans for the first space tour seem somewhat flighty, consider the vision of a British group called Mars Flight. The group was organized in 1983 by a panel of British aerospace engineers and scientists. They want to organize the first nongovernmental expedition to Mars. NASA is currently trying to sort out the

possibilities of sending an official government manned expedition to Mars in the late 1990s. But Mars Flight wants to go just after the year 2000.

"Exploration of space should not be confined to quasi-military government agencies," says British astronomer Malcolm Ebersol. "Some of the best explorers on earth have been adventurers and tradesmen. They had a certain naiveté that let them go beyond dangers and unknowns into new worlds such as the Himalayas and the poles."

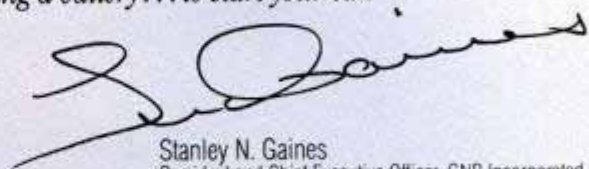
Of course, Columbus was backed by the Spanish Court and the early polar explorers included admirals with backing from government. Ebersol allows that the Mars flight will need financial support from some governments or international corporations. But, he believes, the planning and execution of the 21st century Mars expedition should be in private hands.

Mars Flight already has held two international meetings attended by American and European space enthusiasts. The general plan is to launch by Shuttle four small spacecraft that could carry enough supplies and fuel for a 14-month flight from the Space Station to Mars and a 12-month return trip. In between, a group of from six to eight private explorers would land on Mars and spend a minimum of three weeks on the red planet.

Why? Ebersol laughs, "Because it's there." In a more serious tone, Ebersol notes that no one can say with any precision what we can eventually accomplish on Mars.

At one recent scientific meeting, a
(Please turn to page 168)

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Do you have to pay the high price of synthetic motor oils like Mobil 1 or Amoco Ultimate to get the engine protection your car needs?

Check out these facts.

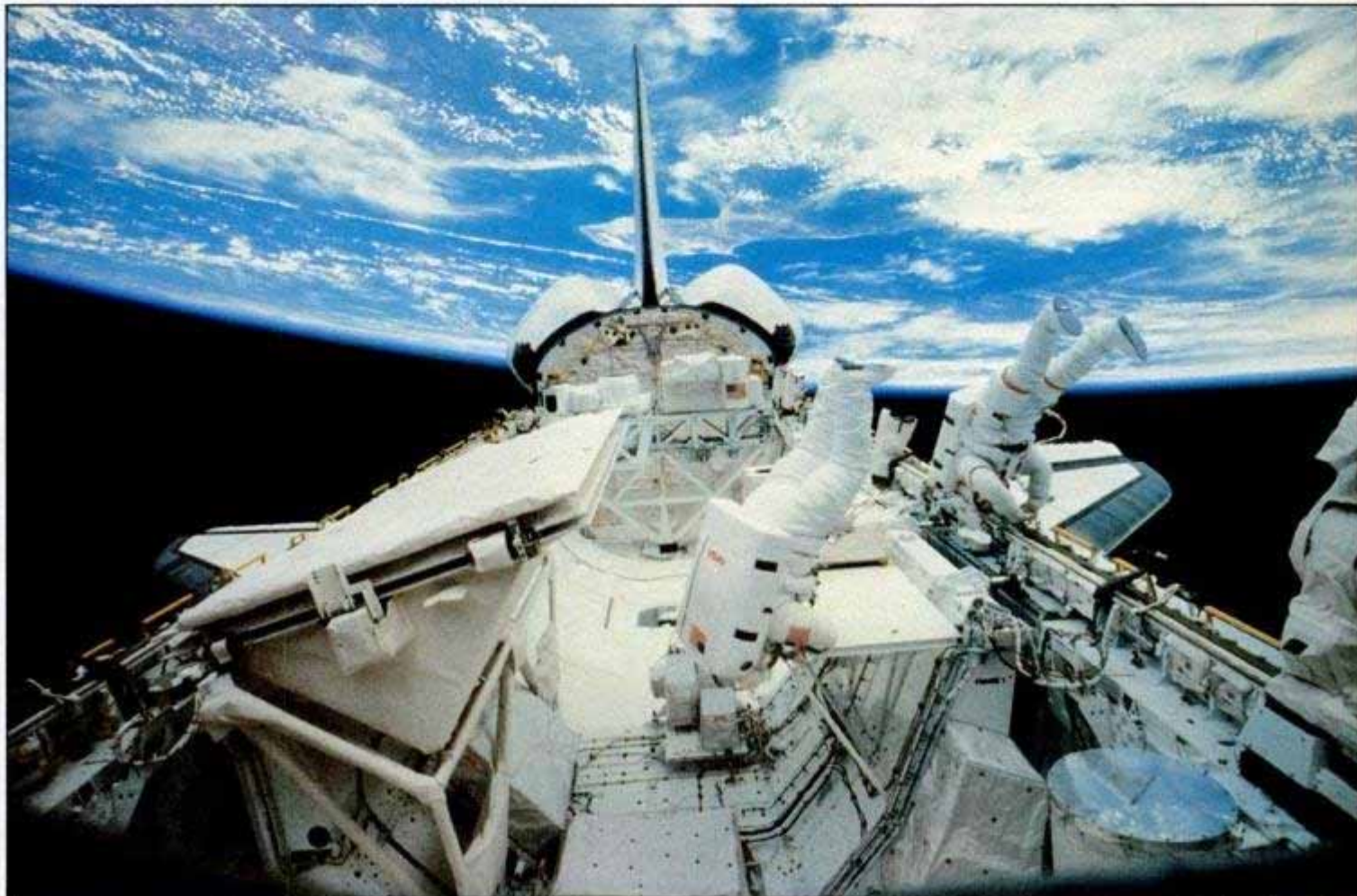
Both the expensive synthetics and Texaco's Havoline Supreme 10W-30 give you the quality protection demanded by these industry yardsticks:

Both exceed carmakers' warranty requirements for virtually all gasoline-powered cars. Both meet or exceed industry standards in helping prevent wear, keeping engines clean, saving gasoline, and protecting against rust.

But only Havoline comes without the high price. And that you can check out wherever Havoline is sold.

HAVOLINE SUPREME. HIGH QUALITY PROTECTION WITHOUT THE HIGH PRICE.

PM TECHNOLOGY UPDATE 11/85



'Spacetacle' just like being there

Experienced astronauts describe the IMAX/OMNIMAX film "The Dream Is Alive" as the closest thing to being there. "Dream" contains stunning scenes of Shuttle launches and landings as well as breathtaking footage of astronauts James van Hoften and George D. Nelson working in the Shuttle bay (above). That sense of being there is produced with a screen almost five stories tall and 66 feet wide. The roar of the Shuttle's engines are realistically recreated with a 6-chan-

nel surround-sound system pumped through nine speakers. IMAX's 70-mm frames are three times as large as conventional 70-mm film and 10 times larger than 35-mm. Specially designed projectors are used to give viewers a dizzying sense of floating weightless in zero gravity. "Dream" can be seen at 40 locations across the country during 1985-86. The film not only advances photographic technology, but we can join in one of the century's greatest adventures.

Outer space interiors

When crews man the proposed Space Station in the 1990s, their habitats and working areas will be designed for extended but comfortable residence. Grumman is crafting interiors (photo) that give crewmen a feeling of "this is the floor and this is the ceiling." Crewmembers will use resistant surfaces to push off or slow down. A habitat module would house the station's recreation and exercise

facilities. The crew would meet and eat together next to a microwave-equipped galley. Grumman hopes to make habitable modules.



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TECHNOLOGY UPDATE

SOLAR POWER

Sun shines on a utility

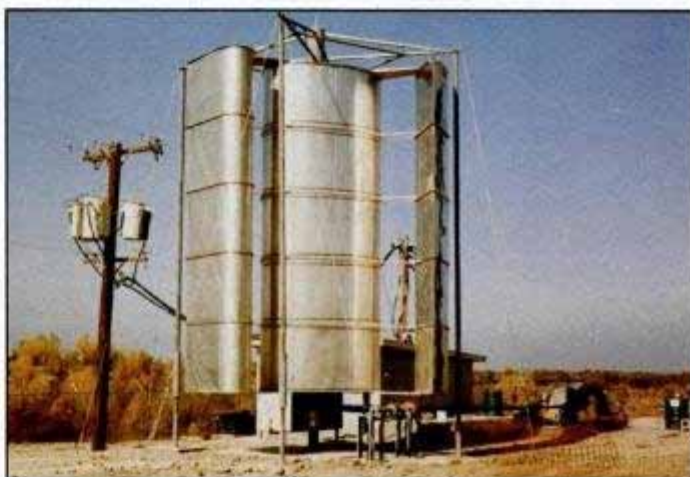
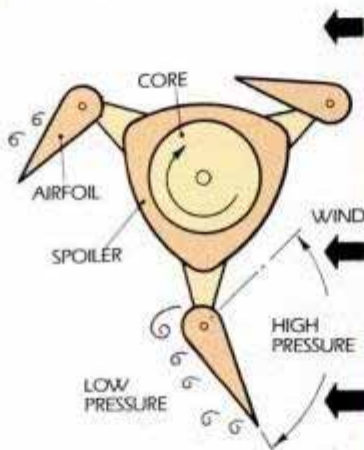
The world's first commercial central station photovoltaic powerplant, located at the base of the Rancho Seco nuclear plant, is producing enough electricity for 300 to 400 homes. The Sacramento Municipal Utility District's solar panels rotate with the sun's position. The arrays are programmed to maximize sunlight reaching them. Further expansion is expected to produce enough power for some 30,000 homes.



WIND POWER

Wind wings

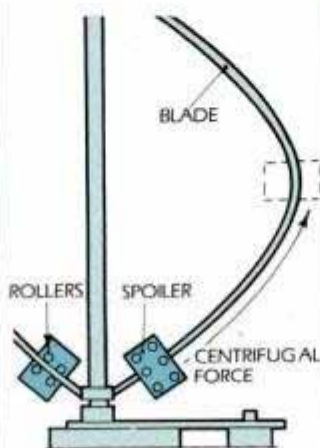
The Venturi Rotor System (photo at right) utilizes what essentially is a series of airfoils and spoilers to generate power. The central spoiler (drawing) directs the wind to the airfoils. The swing-wing foils act as sails, capturing the wind and turning the core. The hinged airfoils fold inward in the low-pressure area. This type of wind power-generating system is planned for the top of a Chicago building.



Spoiled eggbeater

Sandia Labs has added a spoiler to its successful "eggbeater" design (below). The airfoil shaped blades are

slowed by 4-foot-square spoilers which rest at the blades' base. As wind speeds increase, centrifugal force drives the spoiler (below right) to the blade's center. Drag created by spoilers slows and eventually stops the blades.



Capturing a slice of fury

The Survivor windmill (above) can operate safely in winds up to hurricane force and wafts of air as little as 6 mph. A hinged system, patented by a Taiwanese firm, permits the rotors to shift position, offering less rotor surface in high winds and more in low winds. Survivor eliminates the bane of most windmills: destructive stress in high winds.



Windy garden party harvest

Vespa's wind turbines (above) employ airfoil-type blades in California's windswept Tehachapi Mountain windmill garden. Turbines reach 95 percent efficiency and begin producing power in 9-mph winds. A microprocessor applies brakes to stop rotors. California expects the equivalent energy of a nuclear plant from the garden this year.

AVIATION

A Viking gets tough

Quieter, faster Soviet submarines have led Lockheed to update nearly the entire suite of avionics in its Viking S-3A antisubmarine planes. The new S-3B has improved radar detection, tracking and classification; improved countermeasures; superior sonobuoy data processor systems; and improved communications systems. The S-3B is expected to be effective against current and projected surface and subsurface threats.



The sub-chasing Viking now has offensive standoff capability against surfaced submarines with the addition of under-wing Harpoon missiles.



Quick hops by a master

Fokker Aircraft, acknowledged master of short and middle distance routes, has a new plane for the ever-evolving market. The Fokker 100 jet airliner (above) is especially designed for profitable opera-

tions in the competitive short-to medium-haul market. The 100 employs advanced avionics, noise abatement, lightweight composite structures and a highly efficient wing. Fokker hopes the craft will be as popular as its F-27, which is still the most successful airliner in the air.



One engine is enough

Cessna is ready to begin delivering its new Caravan I single-engine turboprop (above). Powered by a Pratt & Whitney PT6a-114 engine, Caravan I cruises at 210 mph with a 604-

statute-mile range and is the largest single-engine plane in production. A sturdy nose wheel structure, expanded cargo area and reduced fuel burn has made it Federal Express's choice to expand its overnight delivery service to smaller cities.

Simulator aids in design

NASA is testing the latest in cockpit design with its desktop flight station simulator (below). The new simulator em-

plies cathode-ray tubes instead of meters and slide-stick controllers in lieu of column/wheels. NASA hopes a pilot will be able to touch the CRT screens and vocally tell the craft to skirt bad weather.



RESEARCH

In the spirit of research

Eschewing slower crafts, Island Research & Development Corp. has acquired a unique Boeing Jetfoil, *Spirit Of Discovery* (above). The 50-

mph ship is geared for high-speed transmission of data gleaned from bottom mapping and oil exploration. The craft will be outfitted with four prototypes, including sub-bottom analysis and obstacle avoidance sonar systems. *Spirit* will provide high-speed acoustical research.



TECHNOLOGY UPDATE



COMMUNICATIONS

Stopping busy signals

It is predicted that by the end of the 1990s satellite communications channels will be overloaded. In response, NASA is preparing for a 1989

launch of its Advanced Communications Technology Satellite (ACTS). ACTS (above) will demonstrate frequency reuse through two narrow spot beams. Fixed spot beams will be focused on areas that have heavy communications needs. Scanning spot beams will rapidly "hop" around an assigned sector.

Hi-tech pal for live-alones

Telepal's special emergency features are designed for anyone home alone. Telepal's automatic emergency dialer can be activated with a special panic button pendant. Telepal will dial four friends repeatedly until one is reached and its

prerecorded emergency message delivered.



ENGINEERING

Cool accelerator

The Argonne Tandem Linear Accelerator (ATLAS) is the world's first heavy-ion superconducting accelerator, producing high-precision heavy-ion beams. Key are 42 split-ring, helium-cooled resonators (right), which eliminate electrical resistance along the ion pathway. The superconducting resonators, enclosed in the tubular cryostat (far right) are cooled to -460° . The ATLAS studies forces that hold atomic nuclei together.



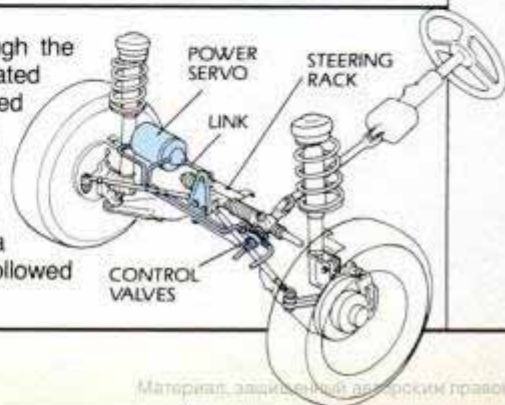
AUTOMOTIVE

Air-powered steering

An air-powered steering system costing and weighing significantly less than a hydraulic system has been developed by Birfield Transmission of It-

aly. The system operates on manifold vacuum. The absence of hydraulic fluid permits use of simple plastic or rubber hoses and couplings. The design is said to be precise, with quick response. Powered assistance is directly proportional to torque applied to the wheel, so road feel is

retained. Airflow through the control valve is regulated according to applied steering torque. The power servo mounts directly on the steering rack. The first application—on a Lancia racing car—could be followed by a Ferrari model.





MILITARY

Jet takes on choppers

A new wrinkle in the Army's LHX (light helicopter experimental) competition is Phalanx Organization's prototype Dragon, a Harrier-type jet

which its designers say can meet Army LHX specs. The rotorless, swivel-nozzle Dragon will do almost everything Bell's SCAT (at left) will do,

plus fly at Mach 2. Bell is sticking to conventional bearingless rotor systems, lightweight airframes and reduced pilot workload cockpits.

Cub grows up

Israel Aircraft Industries is completing work on one of six prototypes of its Lavi (Lion) jet fighter. Based on combat experience, the Lavi (below) will have a center-mounted con-

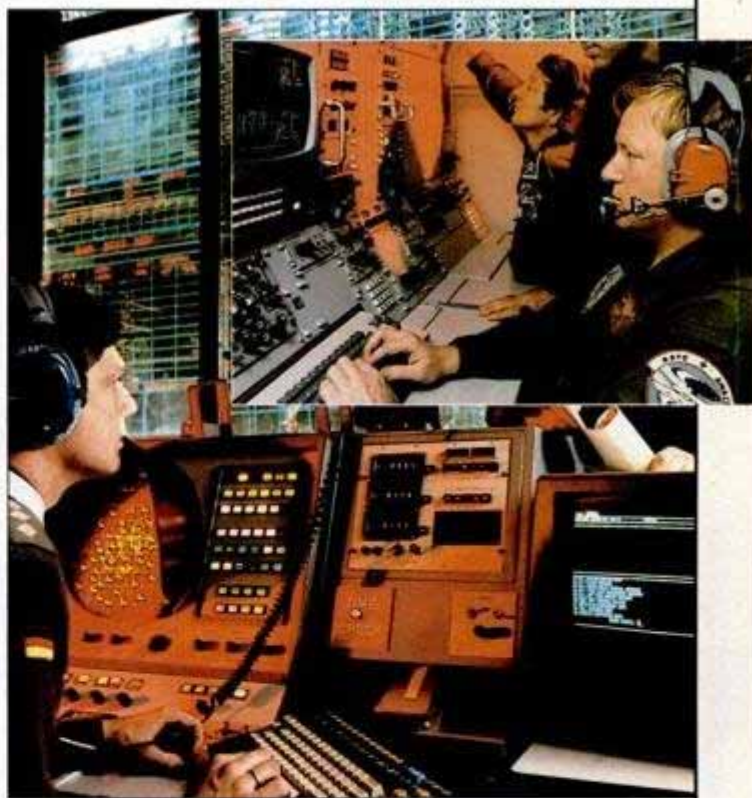
trol stick, Hughes wide-angle holographic head-up display and two CRT data displays. The Lavi program ushers Israel into the elite fraternity of aircraft designers such as the U.S. and Russia.



Boots 'n' saddles '85

The Army and Marines use the latest in cold-weather gear. The Extended Cold/Wet Clothing System is comprised

of (left to right) polypropylene underwear; polyester fiber-pile jacket and pants; quilted polyester jacket and pants; and parka and trousers. They keep heat in and water and cold out.



No-sneak radar

Hughes AEGIS (Airborne Early Warning/Ground Environment Integration Segment) radar system (above) installed at 36 stations in eight NATO countries couples AWACS

aircraft's 60-mile radius radar (inset) with NATO ground-based radar complexes. Computer links give an overall view of air defenses. The system prevents missiles and bombers from escaping radar detection.

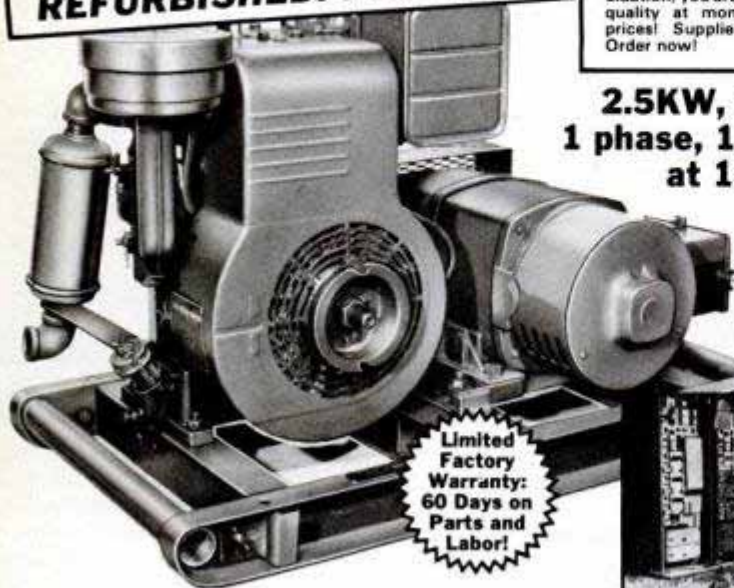


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PM PHOTO HINTS

Boots for tripods



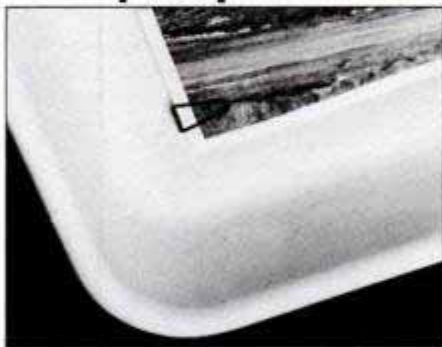
Water, sand, snow and mud can foul the threads and joints of collapsible tripods. Make protective boots from PVC tubing and endcaps welded with PVC glue. An elastic cord looped through a hole in each pipe fastens the boot to each leg.—C. Boyd Pfeiffer

Soda suds

Stock processing solutions can deposit residues in storage containers. To clean, fill with warm water, add 8 ounces of baking soda for each gallon, let stand overnight, then brush and rinse.—Kenn Oberrecht



Quick pickup



Resin-coated paper is prized for its flatness, but difficult to lift from a tray of processing solution. A plastic paper clip fastened to an edge of print allows fast pickup with tongs.—William J. Frazier

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by Richard Kruger

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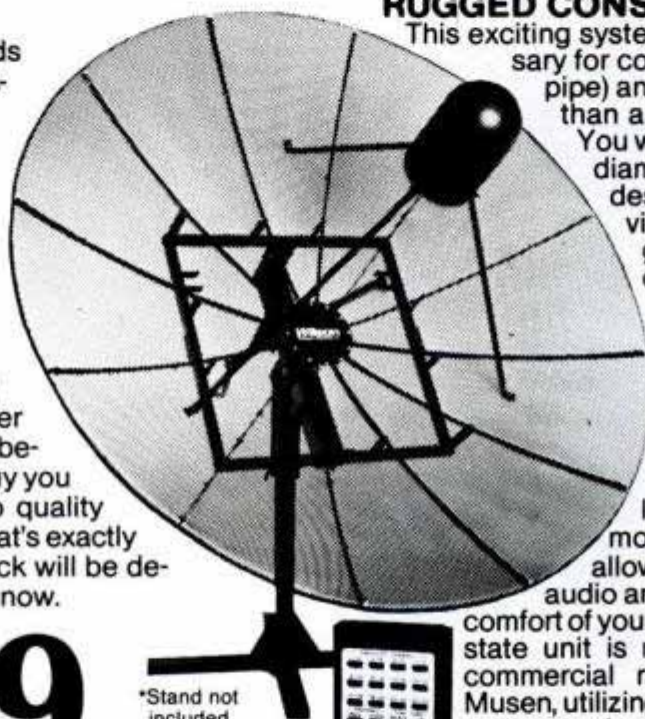
Thousands of these Wilson systems have been sold nationwide at over \$2400 per system. Now because of my excellent buy you can have this same top quality system at only \$1199! That's exactly 1/2 off. At this price, stock will be depleted quickly, so order now.

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NEW KOOL BOX

SURGEON GENERAL'S WARNING: Smoking Causes Lung Cancer, Heart Disease, Emphysema, And May Complicate Pregnancy.

16 mg. "tar", 1.1 mg. nicotine av. per cigarette, FTC Report Feb. '85.

TELEVISION TOUCHDOWNS

Popular
Mechanics
NOVEMBER 1985

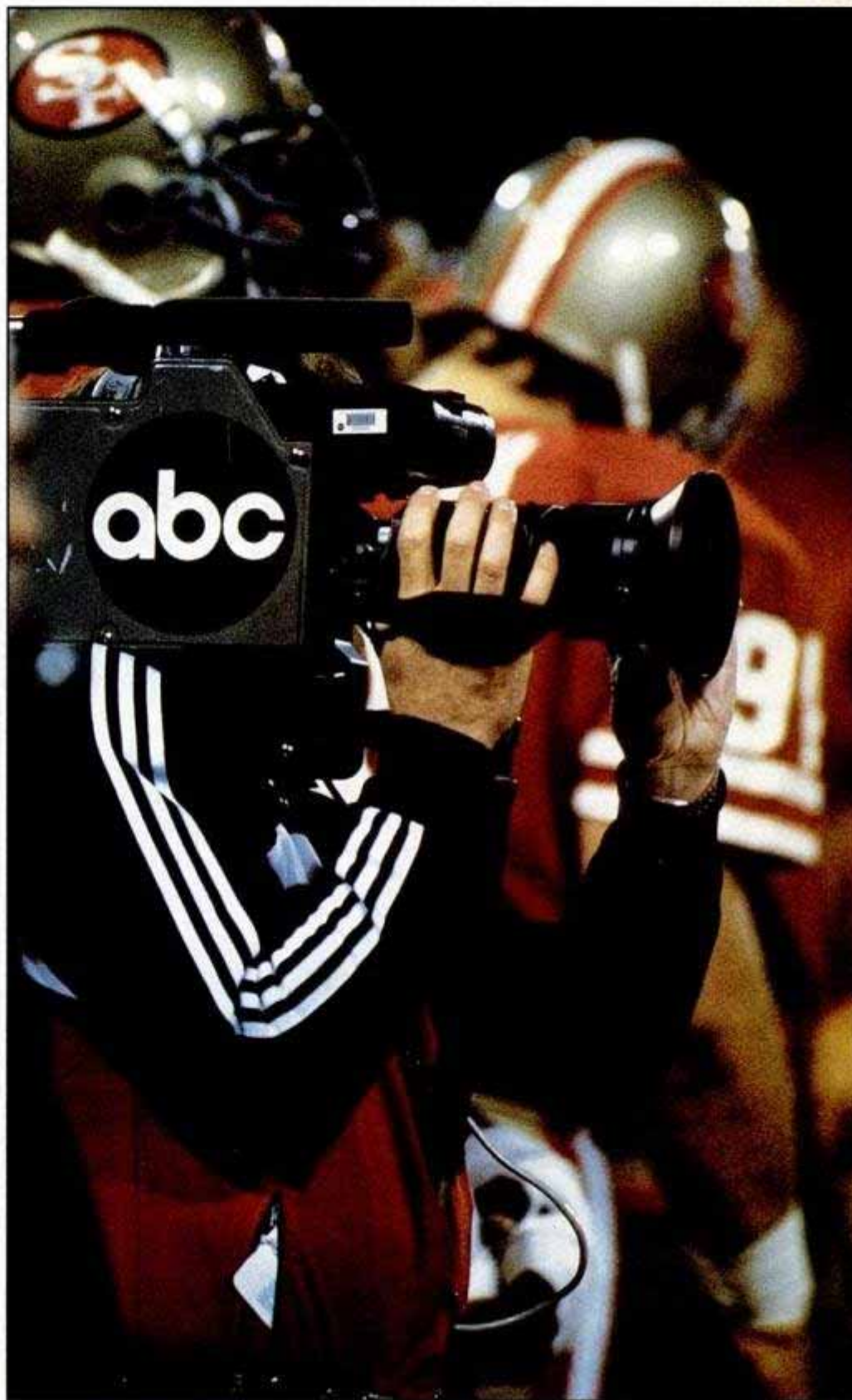
With a crew of over 50 technicians and an array of computerized equipment, television is better than any 50-yard-line seat.

BY DICK SCHAAP

The kickoff is still more than two hours away, and the producer is thinking about Herschel Walker and talking to the Red Hat. The Red Hat is a moonlighting physiotherapist who has never been a Red Hat before. The producer tells the Red Hat not to worry, the \$50-a-game job is easy. All he has to do is stand on the sidelines and listen to the producer over the earphones. When the producer says he wants a timeout for a commercial, the Red Hat folds his arms across his chest until the referee notices and calls the timeout. Then, the Red Hat keeps one arm across his chest until the commercial break ends. When the producer says, "OK, let 'em play," the Red Hat drops both arms to his sides. The producer warns the Red Hat he will have to be aggressive if the referee tries to resume play before the commercial break is over. "Grab the ball," John Wildhack, who is the producer, suggests, half-kidding. "They can't play without the ball."

Wildhack is surprisingly relaxed and easygoing. He is only 26 years old, five years out of Syracuse University, and he is producing a Monday night football game. This isn't ABC's Monday Night Football, and this isn't a National Football League game, but it is, essentially, the same thing, in microcosm. Wildhack is producing a United States Football League game for ESPN, a game between the New Jersey Generals and the Jacksonville Bulls. It is a significant game because Herschel Walker of New Jersey is within reach of the pro football single-season rushing record, set only six months earlier by Eric Dickerson of the NFL's Los Angeles Rams.

The producer oversees a crew of 27, ranging from the director to play-by-play commentators to cameramen to Red Hat to spotters. He deploys five cameras: four Hitachi SK-70s—two at the 25-yard lines, one at midfield and one in the end zone—plus an Ikegami



TV TOUCHDOWNS

mounted on a blimp that roams up and down the sidelines.

ABC Sports, which assigned more than 175 people and 29 cameras to the most recent Super Bowl game, uses more than 50 people and 10 cameras to cover a regular-season NFL game on *Monday Night Football*. ESPN, obviously, manages on a smaller budget.

Covering a network football game these days involves hundreds of miles of wiring, banks of televisions and computers, wireless mikes for the refs, and sometimes for the players, and an assortment of specialized gear to make watching the game at home often more exciting and more informative than watching it from the 50-yard line.

In recent years, the specialized equipment has come to include a multi-range, multiangle camera suspended from the Goodyear Blimp. The camera can get sweeping shots of the entire ballpark or zoom in for an overhead shot of the play action.

Last year the networks added a new kind of camera, the Skycam. Suspended from high wires strung to payout drums, the motorized camera races above the field from 20 to 70 feet off the ground. By paying out the cables to different tensions, the crew can bank and steer the camera around a play, putting the viewer right into the action as if he were a 12th player. The computerized Skycam can swivel a full 360° on its axial motor, or bank a full 90° when wires are played out right. A 3-man crew runs the camera.

On the night of the Generals' game, ESPN's Wildhack reviews the signals with the Red Hat, then goes to his command post, the nerve center of the

telecast, the van that is camped within Giants Stadium in Rutherford, New Jersey, next to the tunnel leading from the locker rooms to the playing field. He takes his seat in the front row of the front section of the crowded van, a 27-foot mobile unit divided into three sections. A driver and an engineer, and the five cameras, travel with the van.

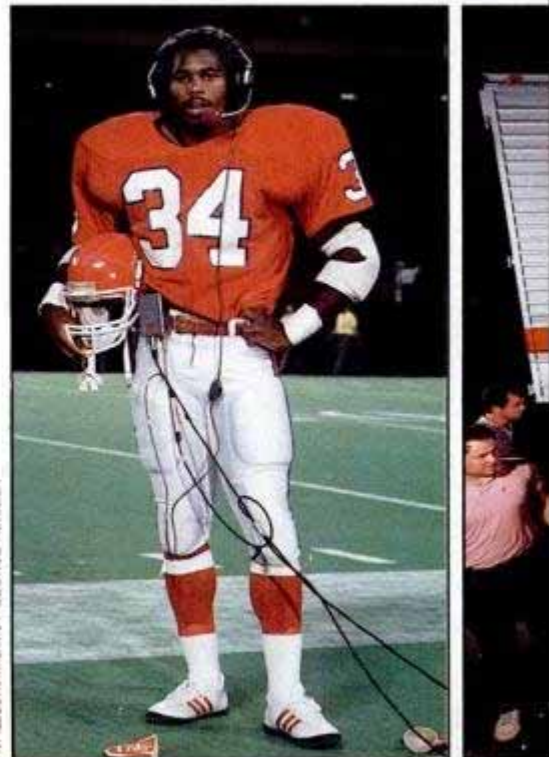
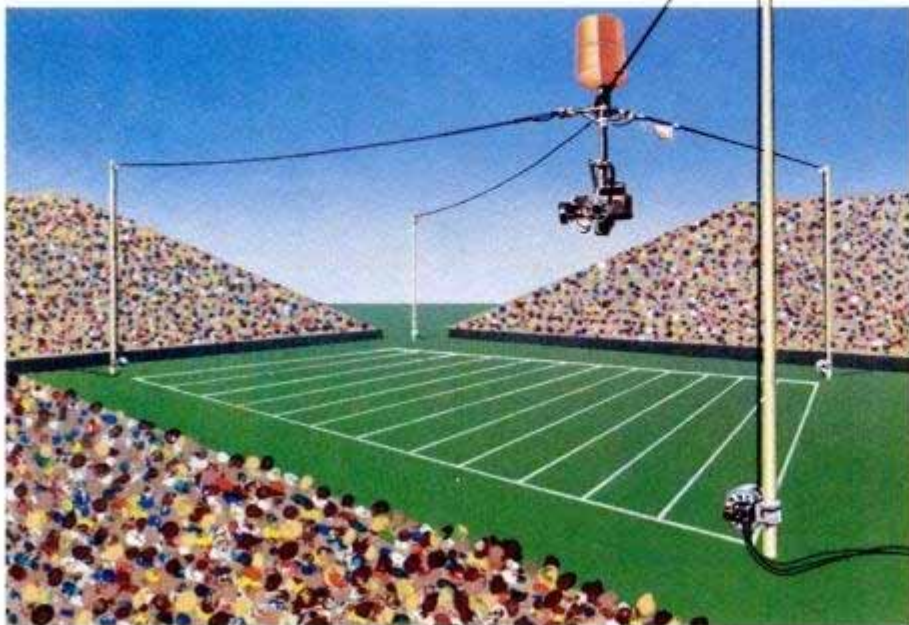
The director, Ralph Mole, sits between Wildhack and the technical director, Frank Gilbuena, in the front row. The three of them face a wall of television screens, 25 of varying sizes. The largest, in the center, shows what the viewers see. Some of the others show the shots available on each of the five cameras. The director *calls* the shots. The technical director *executes* them on a board equipped with more than 100 buttons and levers. By pushing a button or pressing a lever, the technical director can insert graphics, perform visual effects, frame the game clock, initiate a slow-motion replay, change the shot on air—perpetrate whatever technical wizardry the director desires.

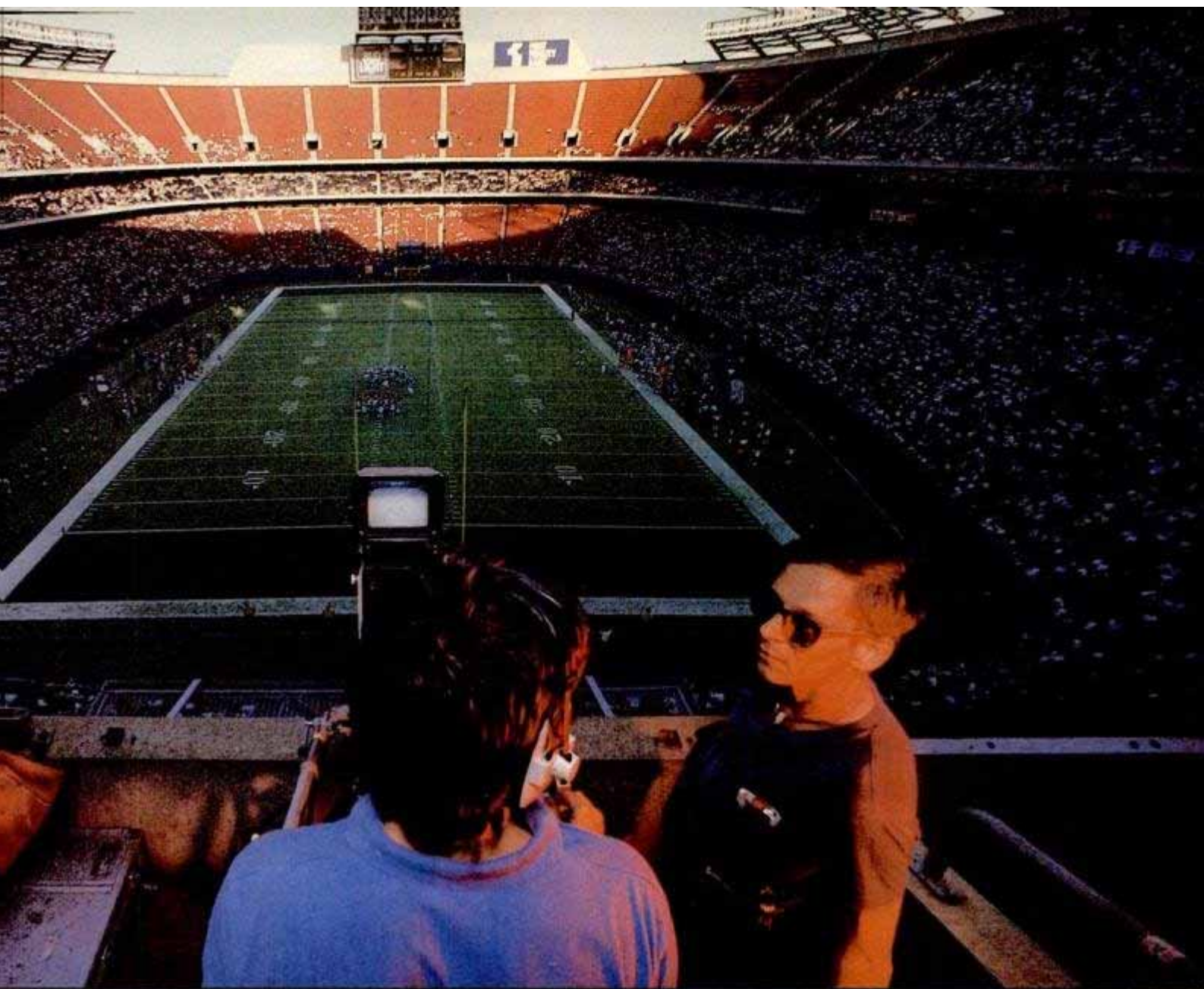
In a second row, directly behind the producer, director and technical director, are the associate producer and chyron operator. The chyron, or character generator, stores some 2500 characters and prints out those statistic captions that frequently appear on your television screen.

The associate director stays on the telephone while the pictures are fed via land line from Giants Stadium to ESPN headquarters in Bristol, Connecticut, then broadcast by satellite throughout the country.

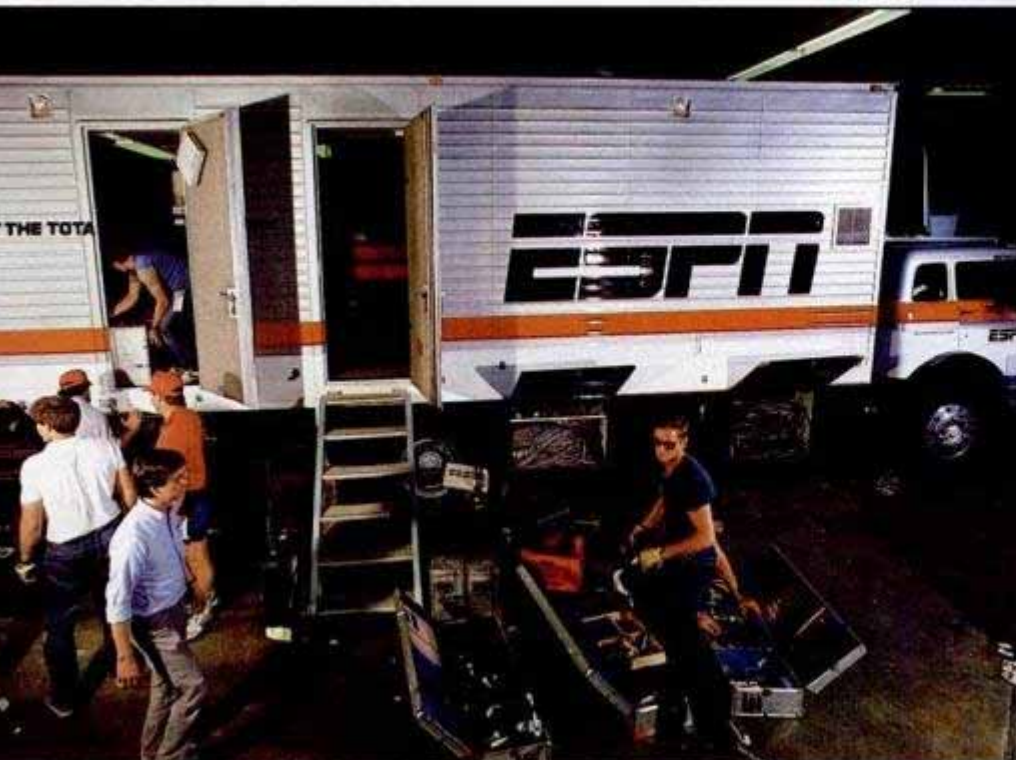
In the center section of the van, the
(Please turn to page 159)

The Skycam, suspended above the play action, travels at up to 50 mph, its altitude adjusted by a cable system.





© BRVAN R. WOLFF 1985



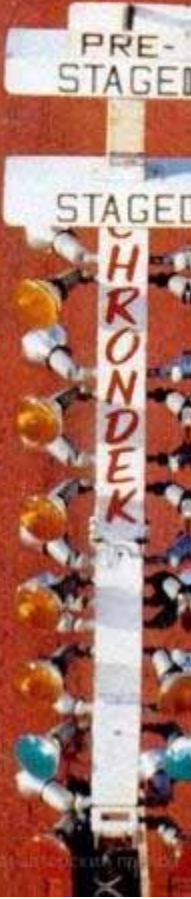
At one of a dozen camera locations around Giant Stadium, cameraman and director (top) take orders from a van standing inside the park. Inside van (above), technicians watch banks of screens and take their orders from a studio. It takes a crew of 10 to offload miles of cable and equipment from the van (left). With remote miking technologies, New Jersey Generals rushing star Herschel Walker (facing page) can do a live post-game commentary.

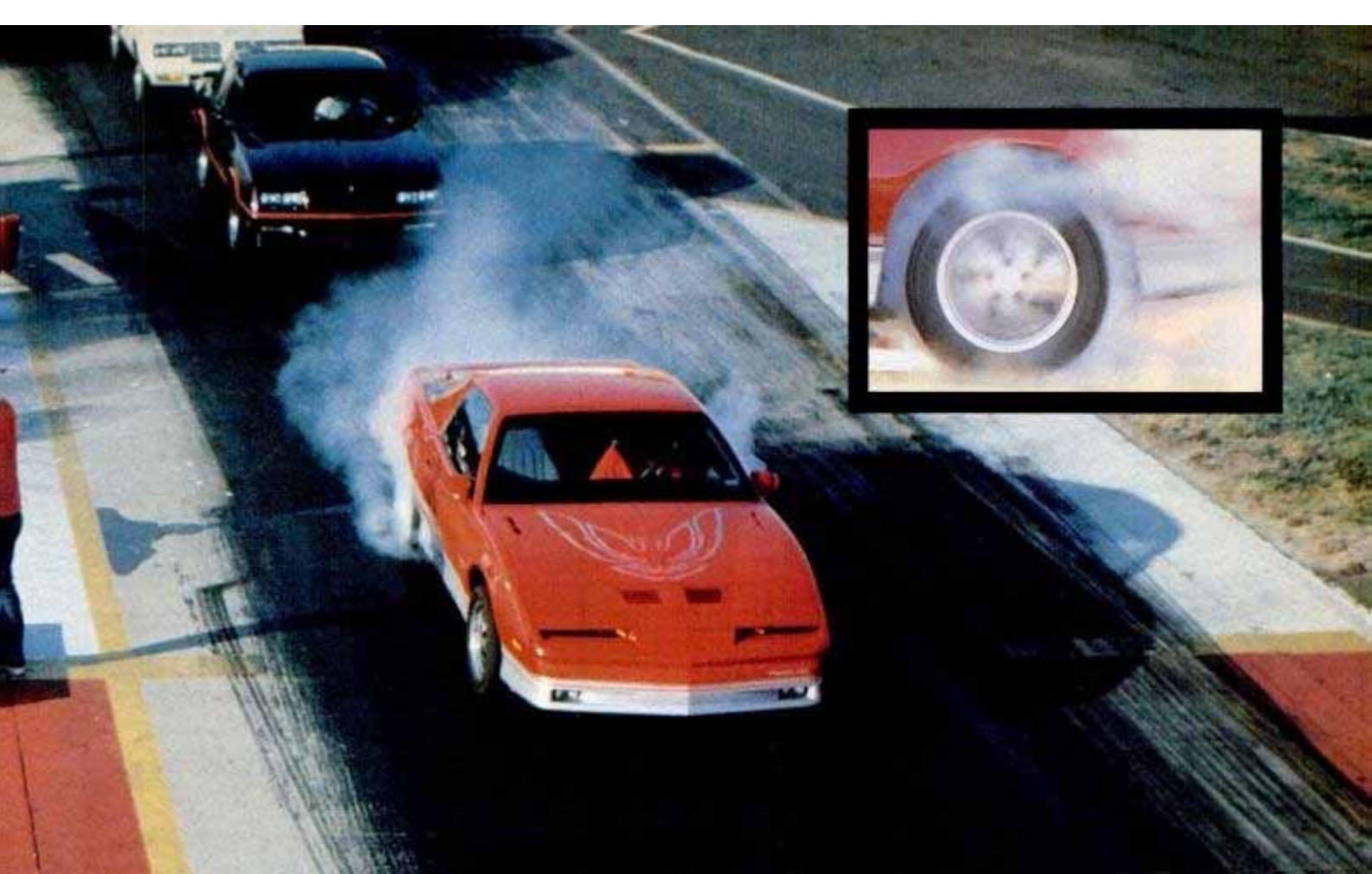


PM COMPARISON TEST:

Muscle

THEN AND NOW





Cars

Are they still making 'em like they used to?
Two dozen tires go up in smoke to find out.

Remember Dr. Oldsmobile and Elephant Engine Ernie? Remember the Dodge Scat Pack and Chrysler's Rapid Transit System? Remember shaker hoods, air-grabber induction, SixPack carburetors and "Here comes The Judge?" Remember flat-black hoods, Wedges, Hemis and Wide Oval tires? Remember twin black streaks of rubber that went down a hundred yards? Remember... *musclecars?*

The musclecar was invented in 1964 by a madcap Pontiac ad guy named Jim Wangers. Wangers figured that if he sold a cheap, lightweight car with a big V8 and tire-melting acceleration, teenagers all over America would happily work overtime mowing lawns and packing groceries to earn the down-payment. He was right beyond his wildest dreams.

Wangers took the smallest car Pontiac built—the 3200-pound Tempest—and swapped-in the 389-cu.-in. V8 from the full-size Catalina. He added a few suspension and interior upgrades, but not enough to push the price over \$3000. And then, in a brazen masterstroke, he stole the name of the fastest Ferrari race car, and called his lowly hot rod Tempest a GTO. The rest, as they say, is history.

Of course, every other car company had to have its own musclecar, most of them built from the GTO pattern—a lightweight intermediate with the biggest engine available. The zenith of the musclecar was 1970, when any kid with \$3000 could buy 13-second quarter-miles right off a dozen different showroom floors, no skill required.

Amazingly, by 1972, the musclecar was



BRUTE FORCE



Dodge Charger R/T
426-cu.-in. Hemi V8, two
4-barrel carburetors, 425 hp



Pontiac GTO
389-cu.-in. V8, three
2-barrel carburetors, 360 hp



Chevy Chevelle SS 454
454-cu.-in. V8, 4-barrel
carburetor, 450 hp



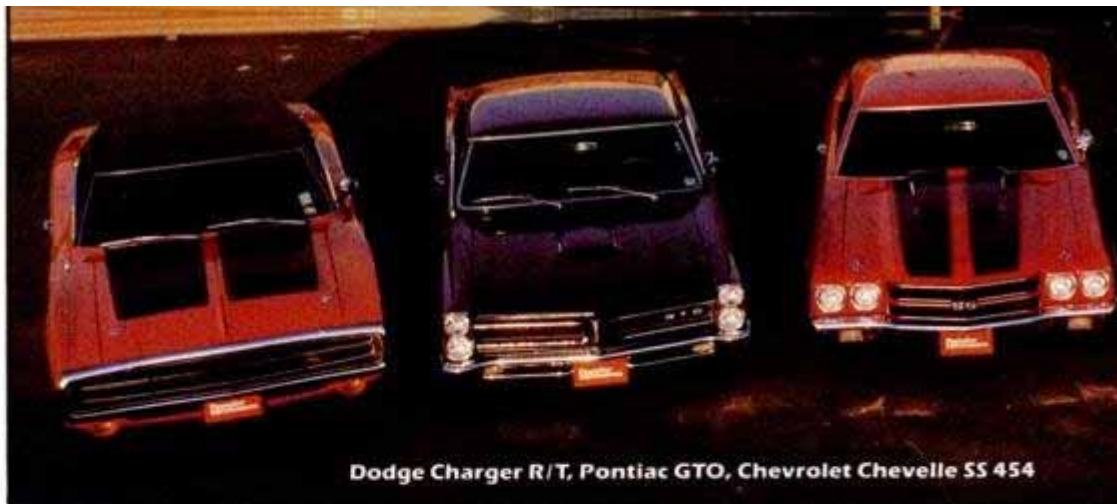
Buick GSX Stage 1
455-cu.-in. V8, 4-barrel
carburetor, 360 hp



Ford Cobra Talladega
428-cu.-in. V8, 4-barrel
carburetor, 335 hp



Olds 442 W-30
455-cu.-in. V8, 4-barrel
carburetor, 370 hp



Dodge Charger R/T, Pontiac GTO, Chevrolet Chevelle SS 454

TEST RESULTS: OLD-FASHIONED HORSEPOWER

CAR	GAS MILEAGE*	¼-MILE (sec. @ mph)	SLALOM ¹ (mph)	SKIDPAD ² (cw/ccw)	BRAKING (ft.) (60-0 mph)
1970 Buick GSX	12	14.95 @ 93.55	54.07	.74/.73	199
1970 Chevelle SS 454	12	14.22 @ 101.69	54.76	.75/.76	143
1970 Dodge Charger R/T	10	14.12 @ 103.44	56.50	.73/.74	152
1969 Ford Cobra Talladega	12	14.79 @ 95.59	55.32	.74/.75	163
1970 Oldsmobile 442 W-30	12	13.93 @ 99.33	52.99	.77/.74	177
1965 Pontiac GTO	14	14.84 @ 96.56	49.89	.70/.72	201

1. Best speed achieved while weaving through seven cones placed 100 feet apart; the higher the speed, the better the transient handling.
2. G-forces generated during steady-state cornering around a 200-foot-diameter circle; cw = clockwise, ccw = counterclockwise.
Bold numbers indicate best performance. *From published sources.



Buick Regal Grand National, Ford Mustang GT, Chevrolet Monte Carlo SS

dead—a victim of emissions regulations, fuel shortages and escalating insurance premiums. Gone, but not forgotten. Musclecars have always been our favorites, the greatest thumping performance bargains ever offered the speed-crazed thrill-seekers of America.

Now, 20 years after Jim Wangers had his first pavement-shaking idea for the GTO, performance is back in vogue. People are calling things like the Shelby Charger and Mustang GT New Wave musclecars, able to do everything well. Then they start talking about how the old musclecars were totally one-dimensional, able to be driven only in a straight line.

That's not the way we remember it. We remember musclecars as pretty competent machines, some of the most spectacular performance cars ever built, all things considered. The way we figure it, the only thing they lacked was a good set of tires.

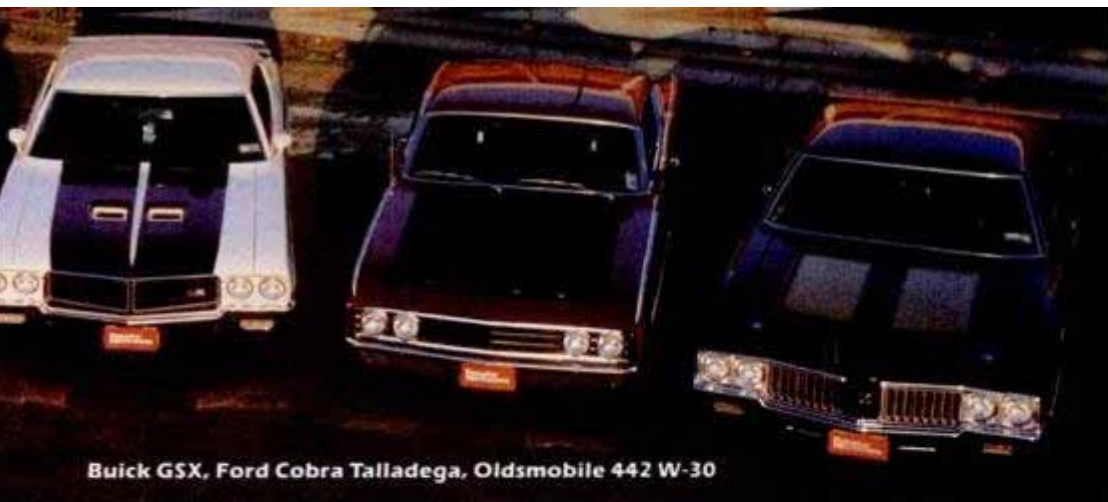
But rather than sit around and endlessly

speculate, we decided to find out for sure. And that meant a giant comparison in which we invited a representative group of old-time musclecars to go up against the New Wave.

We had to have the car that started it all, the original GTO. Tom Dalton, of Dalton's Auto Repair in Clifton Heights, Pennsylvania, brought his '65 GTO Tri-Power—as clean and original a GTO as you could hope for. Then we had to have a Hemi. Paul Malone of Hartsdale, New York, offered us our choice from his four Hemi-powered Chrysler products. We opted for a fabulous 1970 Dodge Charger R/T painted Hemi Orange. From Ford, we wanted a Torino Talladega with the 428 Cobra Jet motor. Steve Staffieri of Philadelphia gave us a choice of five. We took his hot '69.

The high point of musclecar development

Produced by the PM Auto Dept.
Text by Rich Taylor
Photos by John Paul Endress



Buick GSX, Ford Cobra Talladega, Oldsmobile 442 W-30

VS. NEW-FANGLED SOPHISTICATION

CAR	GAS MILEAGE* (EPA city)	1/4-MILE (sec. @ mph)	SLALOM ¹ (mph)	SKIDPAD ² (cw/ccw)	BRAKING (ft.) (60-0 mph)
1985 Buick Regal GN	17	16.43 @ 83.37	58.66	.79/.87	143
1985 Chevrolet Monte Carlo SS	16	16.24 @ 83.41	59.02	.81/.85	138
1985 Dodge Shelby Charger	19	15.90 @ 85.02	58.15	.80/.83	126
1985 Ford Mustang GT	16	14.87 @ 92.59	57.73	.80/.83	146
1985 Oldsmobile 442	17	18.23 @ 79.51	56.84	.76/.76	121
1985 Pontiac Firebird Trans Am	15	16.01 @ 85.83	56.18	.83/.86	140

1. Best speed achieved while weaving through seven cones placed 100 feet apart; the higher the speed, the better the transient handling.
2. G-forces generated during steady-state cornering around a 200-foot-diameter circle; cw - clockwise, ccw - counterclockwise.
Bold numbers indicate best performance.



Pontiac Firebird, Dodge Shelby Charger, Oldsmobile 442

was offered by General Motors in 1970. Built from the same intermediate coupe, Buick, Olds, Pontiac and Chevy all offered similar machines. We borrowed a Buick GSX Stage I from John Csordas of the Bronx, New York, an Olds 442 W-30 from Charles Dunn of Maybrook, New York, and an extremely rare Chevelle SS 454 LS-6 from Ron Banach of Toms River, New Jersey.

To represent the performance cars of 1985, we had the lineal descendants of those GM hot rods—the Buick Regal Grand National, Oldsmobile 442 and Chevrolet Monte Carlo SS. Pontiac doesn't really have a modern-day musclecar, so we settled on the sporty Firebird Trans Am, nowadays the hottest performing Poncho. From Ford we borrowed a Mustang GT, and from Dodge, the turbocharged Shelby Charger, the 1985 version of high performance at Chrysler.

All the new cars came equipped with Goodyear Eagle GT radials, one of the best

all-around street performance tires on the market. To make everything as even as possible, we replaced the tires on all six golden oldies with the appropriate size of Eagle GT, thanks to the generosity of Dave Hederich at Goodyear, who turned out to be a closet musclecar fan, too.

And then, there we were at Englishtown, New Jersey, on a hot morning, surrounded by enough horsepower to move the QE2. Our concept was simple enough. We'd run each of the 12 cars, new and old, through our full battery of performance tests: quarter-mile acceleration, 60 to 0 braking, 700-foot slalom and 200-foot skidpad.

As far as we know, this is a first—the first time anybody, anywhere, has run musclecars from the '60s fitted with modern high-performance radial tires through instrumented handling tests. Twenty years ago, even racing engineers weren't using skidpad and

(Please turn to page 165)

HIGH-TECH



Dodge Shelby Charger
135-cu.-in. ohc Four, fuel injection, turbo, 146 hp



Pontiac Firebird Trans Am
305-cu.-in. V8, tuned port fuel injection, 205 hp



Chevy Monte Carlo SS
305-cu.-in. V8, 4-barrel carburetor, 190 hp



Buick Regal Grand National
305-cu.-in. V8, multiport fuel injection, turbo, 200 hp



Ford Mustang GT
302-cu.-in. V8, 4-barrel carburetor, 210 hp



Olds 442
307-cu.-in. V8, 4-barrel carburetor, 190 hp



DREAM BOATS

High speed on the high seas for a cool hundred grand!

BY TIM COLE, Boating/Outdoors Editor; Photos by Skip Gandy

Let's just say our inside look at high-performance powerboating began on a high note.

As we cruised south inside Boca Grande on Florida's west coast, we encountered a 60-foot Hatteras cabin cruiser kicking up a 5-foot wake. Tempted, I asked Wellcraft marketing chief Bill Erickson if the 30-foot Scarab I was piloting could jump the advancing wall of water. "Only one way to find out," he replied.

So I gunned the Scarab's twin 370 Mercs and the sedate blatting from the through-transom exhaust turned into a steady whine. We sank into the first swell and roared off the wave top behind it. With that, the Scarab reached escape velocity and blasted off. The props screamed as they broke

free of the water and the tachs leaped for the red line.

"This is how you break boats," I mused, "and we haven't even landed yet." I gripped the wheel and winced. But the Scarab alighted with a firm yet delicate bounce and sketched a gradual arc in the cobalt-blue waters of Charlotte Harbor.

Welcome to the muscle and glitz of modern speed boating, I thought. High rollers need only apply.

Actually, this excursion to the charm and quietude of Useppa Island just north of Captiva offered only a foretaste of what this brawny, beautiful sport is all about. Wellcraft was kind enough to loan us a Wellcraft 42 Excalibur, a broad powerful bomber, and its spritely 30-foot sibling, the Scarab



II. But the field of high-performance boats is populated by all manner of sportsters in every conceivable size, shape, power and accommodation plan. Length overall is the most obvious variable, with high-performance boats from Donzi, Formula and Sutphen populating the smaller size ranges. Wellcraft, Fountain, Chris-Craft and the benchmark Cigarette dominate the 30- to 45-foot range. Magnum and Riva make million-dollar monsters that stretch the measuring tape to around 60 feet. Most manufacturers, principally Chris-Craft, Maxon and U.S.A. Racing Team, are now developing high-speed catamarans that ride a cushion of air at speeds approaching 100 mph. And they are all very real blendings of speed, engineering and comfort. Average price? For smaller models, start between 50 to 100 grand. For some of the big boats, don't stop until you've reached seven figures.

But the variety in the field of high-performance powerboats is unique in that nearly all designs are descended

Compressing Time And Space

At 50 knots, class meets comfort aboard this collection of high performers.



PHOTO BY CHRIS-CRAFT

CHRIS-CRAFT 357

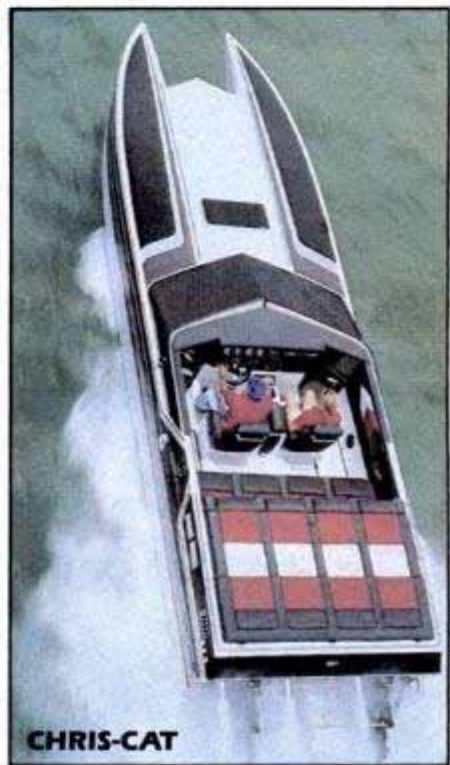


CIGARETTE 38

PHOTO BY R.D. FRIESE

Most recreational boats in the high-performance category have racing roots. But only one, *Cigarette*, can claim the role of benchmark. Ever since Don Aronow developed the *Cigarette* concept in 1970, builders have been creating deep-vee variations on the theme. Recently, however, the recreational *Chris-Cat* has developed benchmark status of its own among high-speed cats. Its racing alter ego is a key contender in the modified class on the offshore competition circuit. This boat is built for speed and speed alone—up to 100 mph. The racing heritage lurks subsurface in the *Fountain 12 Meter*, which sports twin 330 engines for spritely performance. She's also known for her plush below-deck accommodation. The *Formula 357* edges more to the recreational side in a manageable size range with plenty of cockpit volume. But standard twin 330s in a compact hull form mean she'll top out at 60 mph. The *Chris-Craft 390X* sprouts the fashionable if not superfluous radar arch. Like the Wellcraft *Excalibur 42*, the 390X incor-

...ated in this sound recreational design.—T.C.



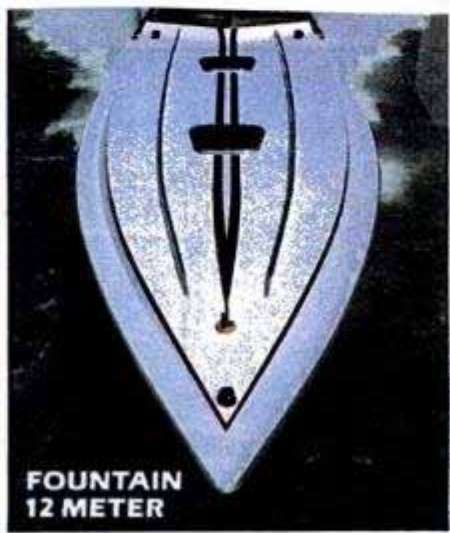
CHRIS-CAT

PHOTO BY CHRIS-CRAFT



FORMULA 357

PHOTO BY CARTER ALLEN



FOUNTAIN 12 METER

PHOTO BY BOY ATAWAY



from forebears in the racing fraternity. Many design elements may coalesce in the average bowrider, center-console skiff or coastal fisherman, but high-performance sport boats all derived solely from the gutbusting crucible of offshore competition.

The sport took hold in the Roaring Twenties when wealthy sportsmen dropped 12- and 16-cylinder aircraft engines into wooden planing hulls. True ocean powerboat racing was born when Ray Hunt designed the deep-vee hull in the late '50s, later improved by racing legends Richard Bertram and Don Aronow, the originator of today's Cigarette-type hull. The deep-vee, now the standard hull form, is able to leap ocean swells and shatter chop at speeds exceeding 90 mph. On the ocean, *that is fast*—very fast.

Limits of mechanical, human endurance

The Allison and Libertys that powered those early flat-water speedboats have been replaced by hopped-up Mercruisers, Lamborghinis, even Caterpillar diesels. And hull materials have progressed in the never-ending quest for lightness and strength from wood to fiberglass to special, space-age laminates of Kevlar and carbon fiber. Nearly coincident with the arrival of cat hulls was the advent of "surface-piercing" stern drives and tricked-out props. Rather than position the propeller on a gear case at the end of a conventional outdrive, surface drives from Second Effort and Kaama turn specially designed and built props at the air-water boundary. The result is less friction, higher rpm and a much faster ride—for the price of hyper-skittish low-speed control while maneuvering dockside. But these beasts have no burdens other than to run at the limits of

Deck gear on the 42 includes grab rails up forward and centerline vent hatches. Close-up of arch (below) shows radome mount.



ocean in these things. You get so knocked around you can't believe it. Most of these guys get sore knees, necks, not to mention kidneys."

In spite of the brutalizing effects of high wind and big water, powerboat racing drivers must steer precisely over the waves. Concentration is critical. At the same time, a throttle man must chop power when the boat leaves the water to prevent over-revving the engines. Too many rpm can literally blow a \$30,000 powerplant to tiny pieces. A



The 42 below: galley to port; eating and sleeping areas forward.

All of these developments in powerboat racing have devolved to the racers' recreational brethren, improving the current breed. You get all the thrills and none of the discomforts when you're aboard this crop of sport boats.

As far as amenities go, Wellcraft's 42 Excalibur keeps pace with the field below decks as well as when she's flat out. Standard models—starting at \$136,995—come with fully equipped (and spacious) head and galley areas to port and starboard as you descend the off-center companionway. Living area is comprised of a circular "conversation pit" which can easily seat the defensive backfield of your average NFL team. Beyond this communal area is the queen-size berth.

Deck space has its utilitarian aspects. Aft, the 42 boasts a sizeable swim platform for deploying a Windsurfer or retrieving a skin diver. Moving forward, you arrive at the cushioned sun pad (vitaly important if you're into competition tanning) and the bench athwartship seating for keeping

(Please turn to page 169)

SNOW MOTION



TALE OF THE TAPE: VIDEOCAMERA DO'S AND DON'TS



This TV photo from our videotape shows that with camcorder placed at finish line, skier's too distant for tight zoom shot.



Skier is in tighter focus, but backlit by sun facing camera. Spectators, lower right, spoil otherwise good composition.



A winner! Zooming puts skier in center. Colors pop and composition improves with sun and crowds behind camera.

Winter sports provide plenty of action for camera-toting videophiles. Here's how to get great videos when the mercury drops.

BY FRANK VIZARD

When you hit the slopes to videotape world-class skiing, you're taking on one of the toughest challenges for an amateur moviemaker. The terrific speed of the pros makes it difficult enough to follow the action. But the environment itself can sabotage your efforts and your equipment, too.

To get a handle on the problems involved, POPULAR MECHANICS flew to Heavenly Valley, Nevada, where top-ranked athletes such as Cindy Nelson of the United States and Luxembourg's Marc Ghiradelli were competing in the 1985 Alpine Ski World Cup Finals. Conditions on the slopes were about the best the skiers had seen all season—a well-groomed, powdery course with bright, clear skies overhead. This combination would test our video equipment to the limits.

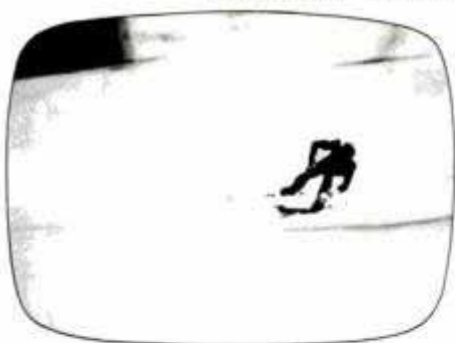
The skiers, of course, had chosen their gear long before they arrived. So had PM: a Zenith VideoMovie camcorder that combines videocamera and recording deck in a 5-pound package. Contributing to the camcorder's compactness is the VHS-C cassette it uses, good for recording 20 minutes at a time. These down-sized VHS tapes measure 3½ inches long by 2¼ inches wide—a lot smaller than standard VHS and Beta cassettes, and easy to stuff in a jacket pocket.

Compared to the combined weight of the very lightest conventional camera and portable recorder we could find, the camcorder netted a savings of at least 2 pounds. This might not sound like much, but if you intend to shoot action at the start, middle and finish of the course, lugging any extra weight all over the side of a mountain becomes burdensome very quickly. Skiing is not the most accommodating of

PM PHOTO BY IMRE DE POZSGAY



TALE OF THE TAPE: VIDEOCAMERA DO'S AND DON'TS



Tighter zooming would improve composition of this frame, and reduce underexposure of skier against white background.



Framing's improved, but glare made iris contract, underexposing skier to featureless silhouette. Fixing iris on skier would help.



Picture-perfect finish: Tight zooming centers skier. White balance yields true color. Iris keyed to skier gives right exposure.

SNOW MOTION

spectator sports. With the exception of stands at the finish line, spectators at a skiing competition must use skis or hike through knee-deep snow to view the action from the sidelines.

Given these conditions, a 1-piece camcorder is more convenient to transport than a shoulder-slung recorder and separate camera. In fact, we found portability to be a more important asset than the lighter weight. Accordingly, a slightly heavier but standard-size Beta or VHS camcorder (or even the new 8-mm machines) would have served as well as our VideoMovie model, and offered longer recording time per cassette.

Although we chose the convenience of a camcorder for this assignment, much of what we learned about taping winter sports applies equally to conventional videocamera and portable recorder rigs.

Optically, camcorders are on a par with most popularly priced videocameras: You can't switch lenses, and the one supplied is a 6X telephoto zoom. This means that if you're positioned at the finish line, these lenses won't enlarge skiers at the starting gate enough to fill the entire viewfinder frame. They become effective at just about the point where the skiers post their intermediate time.

Note that some videocameras on the market have C-mount lenses that are interchangeable with specialty lenses used for film cameras. And given the right adapter rings, most vidcams can be fitted with add-on lens attachments for enhanced telephoto or wide-angle effects. Be careful, though: These substitute lenses and attachments might interfere with your vidcam's autofocus and auto-iris operation. Consult the owner's manual for your particular model.

Necessities—not accessories

Extra batteries are a necessity when you head outdoors to

VIDEO POWER SUPPLIES TO GO

If you understand how your camera/recorder combo works and know the power options available to you, you'll avoid the frustration of finding yourself powerless in the great outdoors.

To save weight, most camcorders and portable VCRs use nickel-cadmium (Nicaid) slab batteries. With luck and lots of babying, they'll power camera and recorder for up to one hour. Autofocus cameras consume more juice.

Nicaid slabs can be recharged. Most VCR manufacturers sell optional rechargers that use household electricity. Trouble is, you're not likely to find an

electrical outlet on the slopes.

You could, of course, carry a few extra batteries with you—but this is an expensive precaution. Nicaid slabs can cost as much as \$75. The ideal solution is a heavy-duty power belt.

Typically, these use efficient gel-electrolyte power cells and come with an AC recharger that prevents overcharging. A variety of models offers three to 16 hours of camera/VCR operation; belt weight is about 1 pound per amp hour. They're sold by accessories suppliers such as Ambico and VDO-Pak. The latter even offers a rechargeable, 7-

pound Nicaid belt good for seven to nine hours of camera/VCR operation.

One source of emergency power is your car's battery. Run your VCR from the car's cigaret lighter whenever possible and conserve your portable batteries. There's a wide variety of adapter/extension cords for this purpose. It's best to have the car's engine running to tap the alternator and avoid draining the battery. But if this causes electrical noise interference on your videotape, use straight battery power for short periods of time, with pauses to restart and rev the engine.—*Carl Caiati*



Adapter cord (left) plugs into lighter to tap car battery. Rechargeable Nicaid belt (above) gives 7 to 9 hours of power.

videotape. You'll understand why if you familiarize yourself with your video gear.

Any power option, such as autofocus or power zoom, consumes precious juice. And don't let that PAUSE button fool you. Unless your gear is turned off, it's draining power. If you're using conventional slab batteries to operate your equipment, be sure to take extras along (see *Video Power Supplies To Go* on the facing page). In our experience, it's wise to carry 50 percent more power than the amount of tape you intend to record. This means 90 minutes of battery capacity for every hour's worth of videotape.

How much tape should you bring? Ask yourself how much footage you're willing to sit through. You could shoot an entire day and edit it later, but this means you'll have to lug lots of tape and heavy batteries. If you prep up on the day's events, you can determine beforehand what it is you wish to capture on tape. Shooting selectively, you'll get by on two hours' worth of cassettes.

Another necessary accessory for taping fast-action sports is a support for your camera. This is because a telephoto lens will magnify any unsteadiness of handling. For our purposes, a unipod (or monopod) proved more practical than a tripod. It's lighter to carry, more quickly deployed (especially on uneven terrain), and requires less space in crowded surroundings. A convenient alternative—especially if you're on skis and carrying poles—is a shoulder pod. This device straps around your back and chest with a harness. Its adjustable mounting tube braces the camera's weight against your shoulder.

The smallest but most important accessory for taping winter sports is a neutral-density filter for your camera's lens. This is available from photographic supply stores.

Handling light

The neutral-density filter, combined with judicious use of your vidcam's white-balance and iris controls, will help you overcome the tough lighting conditions that snowscapes present.

The intense brightness that is generated by sunlight reflecting off a gleaming white surface will tax the upper limits of your vidcam's light-handling circuitry. This snow blindness occurs not only on the slopes, but also at indoor winter sporting events such as ice skating and hockey. A neutral-density filter, gray in appearance, reduces the amount of light reaching the camera without altering the natural tones of colors. (You might also want to experiment with your vidcam by shooting with a moderate blue filter. A blue filter will make objects more distinct against snowy backgrounds, especially when overcast skies create a bright but washed-out appearance.)

Besides creating difficult light-handling conditions for your vidcam, bright snowscapes compound the typical photographic problems of backlighting and glare. These can be held in check by proper adjustment of your vidcam's filter, sensitivity, white-balance and iris controls.

Set the filter control for natural light (sun), not electrical lighting. Sensitivity should be set to normal—there's no need to boost light intake. Adjusting white-balance (also called color temperature) takes a bit more work.

White-balance measures the composition of ambient light and makes compensations in order to render colors accurately. Your vidcam will have two settings: STANDARD (or NORMAL) and ADJUST. The standard setting is preset at the factory and will get you by in most situations. For special

(Please turn to page 172)



Miniature VHS-format cassettes used in 5-pound camcorder record for 20 minutes.

A BACKPACK STUDIO YOU BUILD

A portable VCR and separate video-camera will capture outdoors activities as well as any camcorder. But transporting bulky equipment and supplies can be a problem.

By fitting the camera, recorder, high-capacity battery and accessories in a custom-padded pack, your gear is protected and easily carried—on your back. Customize strong, aluminum-frame backpacks with foamboard, which provides lightweight protection for VCR and camera and is easily cut and formed.

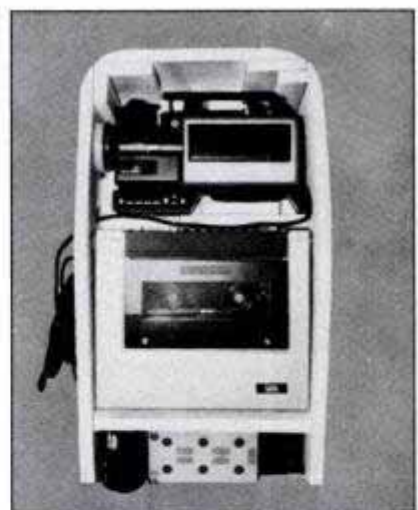
Attach a 1/8-inch hardboard sheet to the frame with screws or rivets. This will provide a base for cementing the foamboard. To the hardboard, attach a small shelf to support the backpack contents when they're in a vertical position on your back. Then, in preparation for assembly, lay out the battery pack, recorder and camera in various configurations to determine the measurements needed. Try to distribute the weight evenly. The battery is best placed at the bottom.

Use a small, thin-bladed knife to cut the 3/4-inch foamboard. Start at the base of the pack and work to the top,



Foam-filled backpack studio cushions gear and protects it from elements.

cementing foam pieces to the hardboard for spacers and padding while positioning the recorder and camera components. Finish by adding side and end pieces. Reinforce the corners and, after the cement dries, shape the corners to fit the backpack. Cut holes as necessary to route cables. When everything's cut and dry, place the assembly in the pack,



Battery and VCR at bottom of backpack keep center of gravity low.

install the electronics components in their slots and route the cables. A side pocket may be used for access to cable connections, and to store the camera cable.

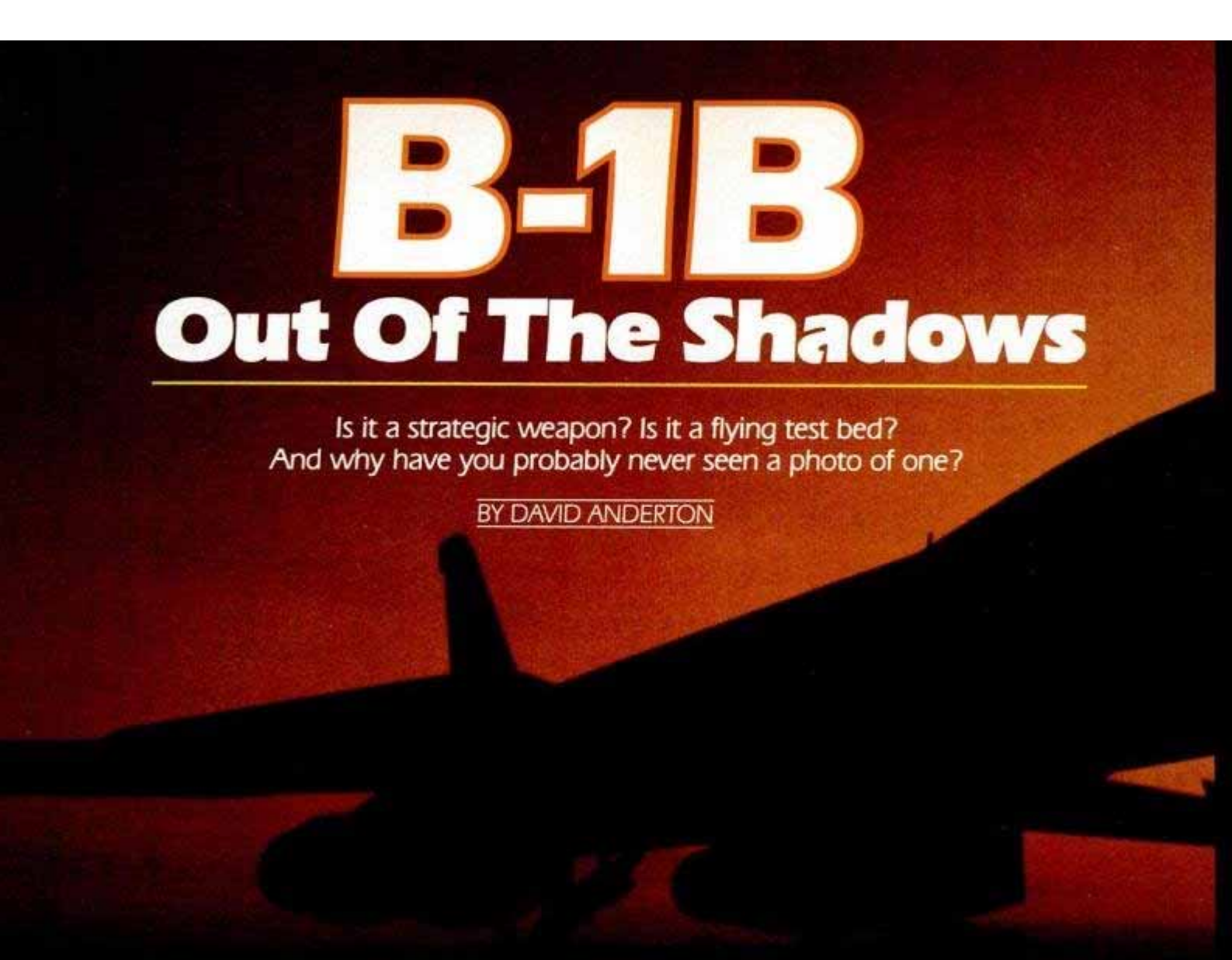
Add a sheet of foamboard to cover the components. Straps for attaching a tripod or monopod may be added to the pack.—*Bob Imsand*

B-1B

Out Of The Shadows

Is it a strategic weapon? Is it a flying test bed?
And why have you probably never seen a photo of one?

BY DAVID ANDERTON



Controversial is always the first word in a story about the B-1 bomber. Some call it the defender of the future. Some insist it is doomed to failure as a military aircraft. The Defense Department pictures it as a limited-production interim bomber between the B-52 and the upcoming Advanced Technology Bomber (ATB). Despite the constant barrage of news stories on the B-1, the public has never taken a close look at the insides of this amazing high-technology bomber, largely because the discussion has taken place in the halls of Congress rather than on the runway tarmac.

To take a flight on the B-1 is to enter a world of roller-coaster maneuvers and split-second decisions. The tops of trees rush by at 600 mph, a green peripheral blur. The valley floor lies 200 feet below. A range of hills fills the horizon ahead. You're flying low and fast, penetrating enemy territory. Electronic sensors "see" the hills, and move the controls to fly you safely through a gap below the peaks. The big bomber banks between menacing rocky ledges and outcroppings, and eases down into the valley below, using terrain features to mask itself from enemy radar. Air currents rising off the uneven land would buffet a lesser air-

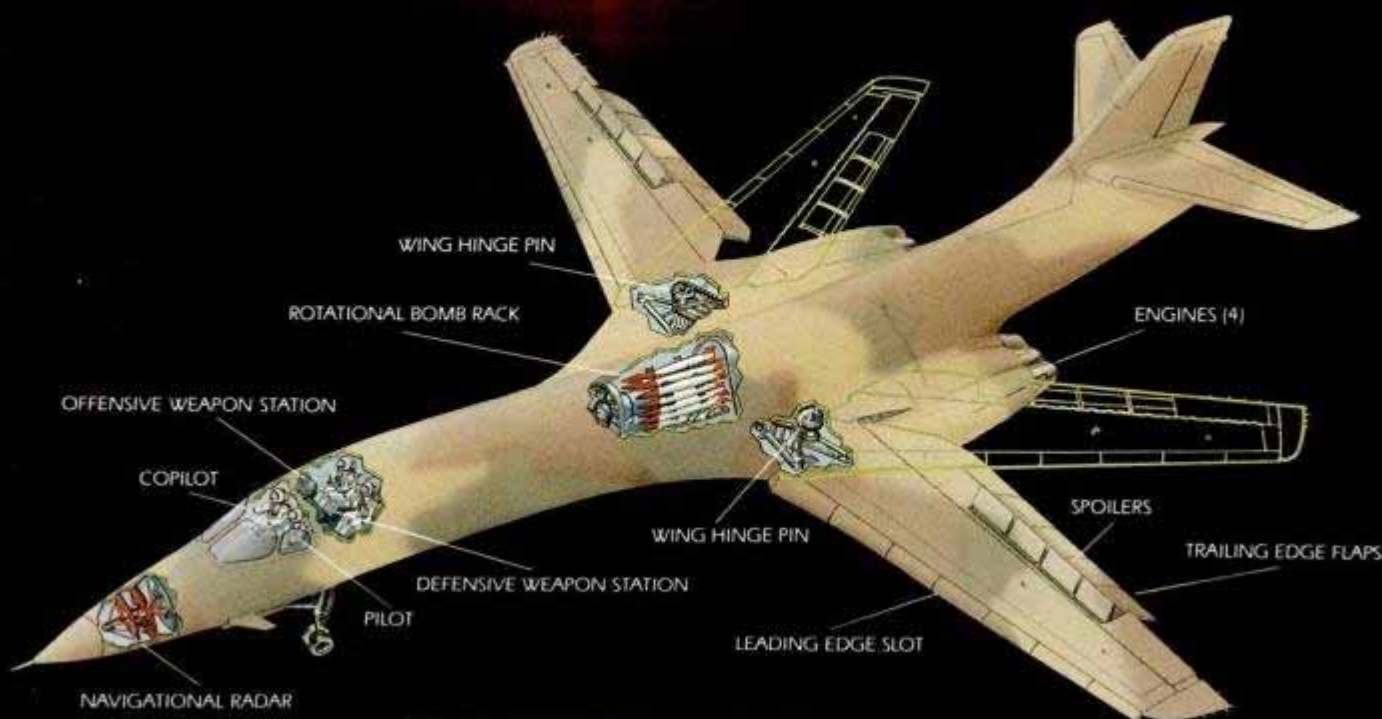
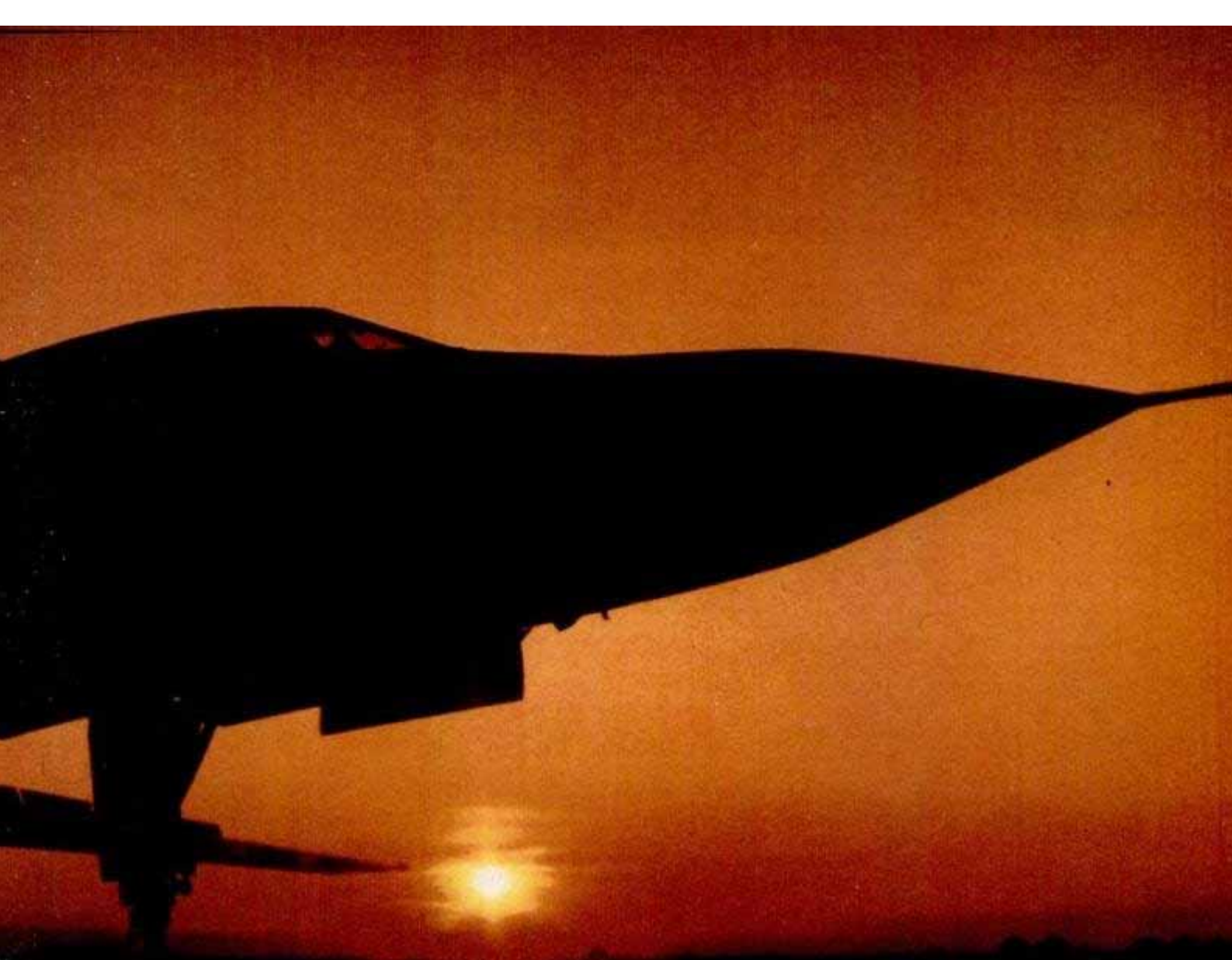
plane. The B-1B has ride control: horizontal forward vanes and a rudder segment to sense rough air. An automatic control system compensates for every bump with lightning-fast responses.

Behind you and your copilot, the two operators of the electronic warfare system blind and deafen enemy communications, and deceive interceptors with false targets.

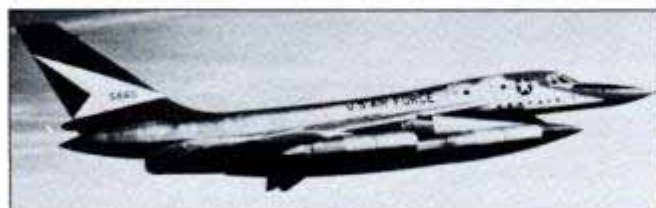
The B-1B is the long-range penetrating derivative of the original B-1 design. It can launch attack and cruise missiles, drop conventional bombs, lay mines, patrol the seas, and hunt and kill submarines. It's smaller than the B-52 it will supplement (see *B-52: Holding The Fort*, on the following page), but almost as heavy. And it requires four crewmen instead of the B-52's six.

It's also expensive: The 100 production airplanes represent research, development, test, design and production investments of \$205 million each. Critics think the B-1B will be detected and destroyed easily by tomorrow's defense systems. Others question the need for a manned bomber mission. Some want to bypass the B-1B in favor of Northrop's ATB with the latest stealth techniques. Northrop's ATB is in the testing phase now.

The B-1B's most conspicuous feature is its variable-



B-1B has sophisticated navigational radar and advanced electronics, and the wings sweep back for combat flight.



Combat-ready B-1B (above) began service this year. It will serve along with the B-52, which was first produced in the 1950s.

The B-58 Hustler (left) was built as a replacement for the B-52. However, the Hustler couldn't outrun anti-aircraft missiles.

geometry (VG) wing, blended into the fuselage for best aerodynamic performance. Its outer panels are pivoted on huge titanium-alloy pins, nearly 20 inches in diameter. For takeoff, climb, cruise and landing, the wing swings forward to 15° of sweep-back angle. For low-level, high-subsonic speeds, and supersonic flights, the wings sweep to their 67° maximum. The wing design is responsible for reducing takeoff distance and time dramatically, compared to the B-52.

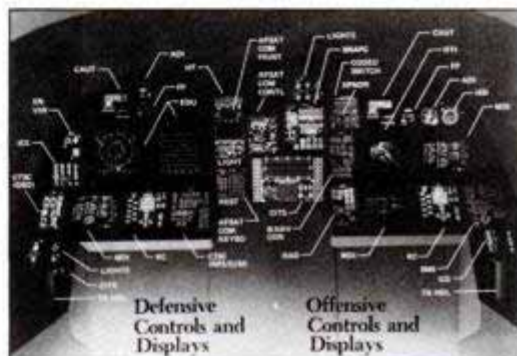
Added low-speed lift comes from 7-segment, full-span leading-edge slats, deflecting 20° for takeoff and landing to direct airflow over the wing at the high angles of attack of slow flight. The trailing edge carries 6-segment, single-slotted flaps, their maximum deflection of 40° adding lift for landing. There are no ailerons; 4-segment airbrakes and spoilers provide lateral control.

The four General Electric F101-GE-102 augmented turbofans deliver more than 30,000 pounds of thrust each. Developed over 14 years, they have been tested for the equivalent of 10 years' service in the B-1B.

JP-4 fuel is stored in eight integral tanks, six in the fuselage and one in

each outer wing panel. The two main tanks are in the massive titanium-alloy wing carry-through structure. Additional fuel for long-range flight can be carried in weapons-bay tanks, and there is provision for six underwing pylon-mounted drop tanks. A fuel management system automatically balances the airplane as the wings sweep by pumping fuel between the tanks and always maintaining full main tanks. Unrefueled range is approximately 7,500 miles, and the B-1B can be refueled from either the Boeing KC-135A or McDonnell Douglas KC-10A airborne tankers. Powerplant inlet design masks the engine faces to reduce radar reflections. That concept, one of the uses of stealth techniques in the B-1B, plus anti-radar coatings, has made the radar cross-section 1/100th that of the B-52.

The B-1B can load 125,000 pounds of weaponry in three bays: Long- and short-range air-to-surface nuclear-warhead missiles such as 24 SRAM (short-range attack missiles), or free-fall bombs, either nuclear or conventional (up to 84 Mk. 82 iron bombs, for



The B-1B has a 2-seat electronics section behind cockpit (above). The defensive station controls jamming and offensive station runs weaponry.

example). Also, 14 cruise missiles can be carried on belly stations.

The B-1B is crammed with the black boxes of modular, self-checking offensive and defensive avionics systems, each system operated by a single crew member. The Boeing offensive avionics system—providing navigational information, and data for alignment and launching of weapons—includes terrain-following, Doppler, and altimeter radars and a highly accurate inertial navigation system. Defensive electron-

(Please turn to page 174)

B-52: Holding The Fort

Early in the Vietnam War the 10-year-old B-52 Stratofortress was slated to become obsolete. It would be replaced by the B-58

Hustler, a high-tech bomber that could outrun anything the enemy could throw at it. Except missiles. The B-58 never got off the ground, and the B-52 became the mainstay of the Vietnam air war. Now that B-1B's are coming on line, the Air Force is hedging its bets with the B-52. The old standby will continue in service



probably into the 1990s or beyond. The Strategic Air Command has almost 270 B-52s in service. The latest model B-52s (B-52G and B-52H) can perform a wide variety of functions at speeds over Mach .5 and altitudes above 55,000 feet. The B-52 can fly under radar and over most anti-air-

craft weapons. The G model can carry cruise missiles, while the H model carries a variety of conventional and nuclear bombs.

The biggest trouble with the B-52 is it puts out a large radar signature. But, so far, no aircraft has come along that could be called truly stealthy. So the B-52 continues to hold the fort.—D.E.

SUPER SCOPES

They do everything but squeeze the trigger.

BY ANGUS LAIDLAW; Photos by Bill Dolce

The day may come when you have only to fix your gaze on the target to hit it every time. But right now, you can aim better than ever with a wider selection of affordable telescopic sights, reflector sights—even laser aiming devices.

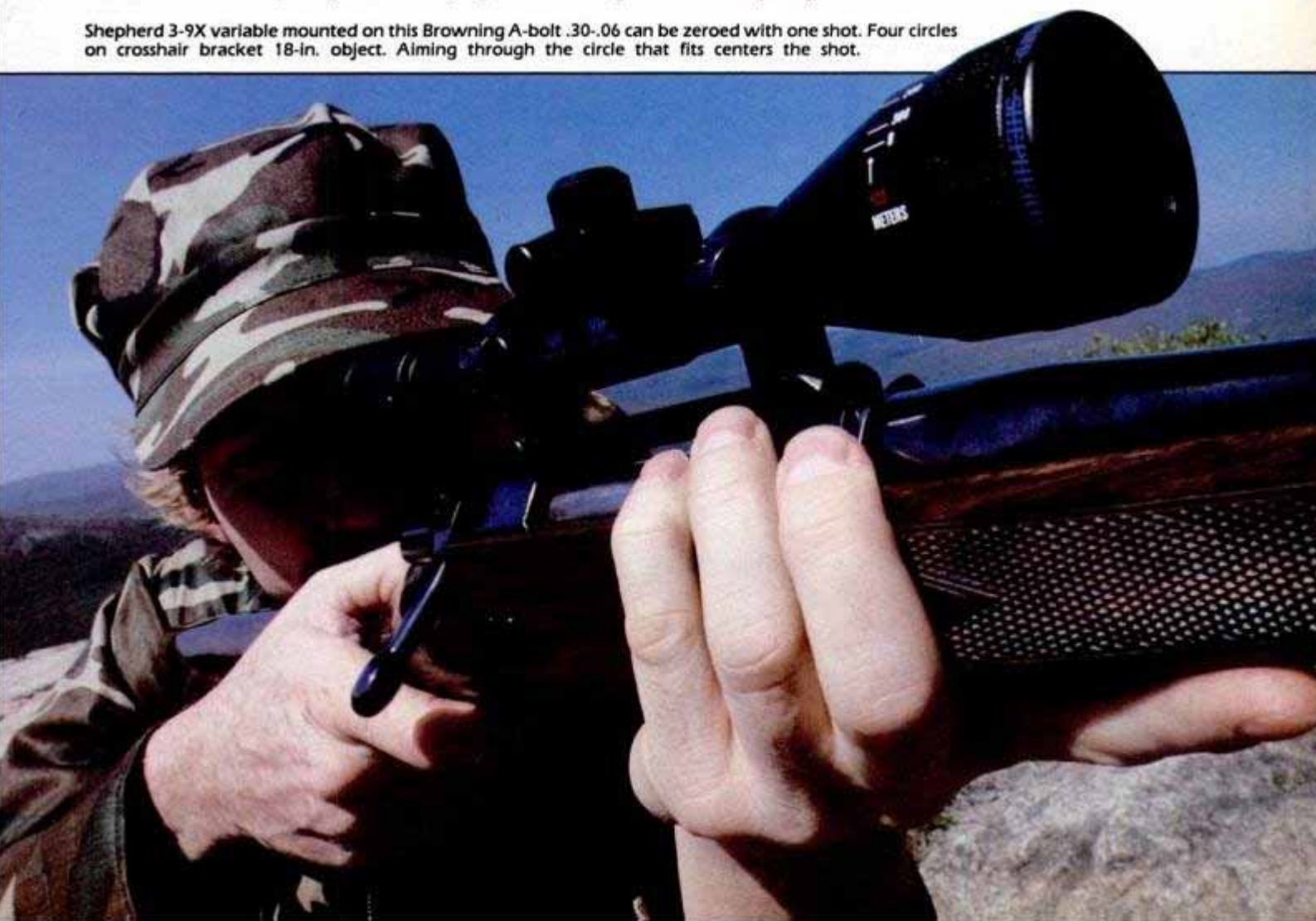
A wide assortment of improved and newly developed aiming aids include telescopic sights with zoom lenses, low-light capabilities, illuminated reticles, range-finding reticles and bullet-drop compensators. And electronic aiming devices like the Aimpoint reflector sight, with or without battery-illuminated aiming points, make it easier to line up on fast-moving targets.

There are two ways to go when scoping a firearm. Big

game and relatively short-range hunting rifles work best with smaller, lighter, low-powered scopes with wide fields of view and good light-gathering ability. Target, silhouette and varmint hunting rifles, as well as long-range hunting rifles for game like antelope, call for higher powers, which means larger scopes.

Whichever scope matches your hunting needs, be advised that the most visible changes in rifle scopes are showing up on the outside. Rubber armor is becoming increasingly popular and available. It cuts down on reflections and helps protect the scope. Matte finishes are increasingly common on both serious hunting rifles and their scope sights.

Shepherd 3-9X variable mounted on this Browning A-bolt .30-.06 can be zeroed with one shot. Four circles on crosshair bracket 18-in. object. Aiming through the circle that fits centers the shot.



The current craze in hunting is lightweight mountain rifles, like the Browning A-bolt, which chops the weight to just over 6 pounds from 8 pounds plus. A good part of the weight saved can be lost if you equip your lightweight rifle with a heavyweight scope, however. This need is giving birth to a whole crop of small-size lightweight scopes. Improved optics help these new, lighter scopes to perform as well as many older, larger models.

Some, like Beeman's SS-1, -2 and -3 were originally designed for military assault rifles, where small size and weight really count. To stand up to the full-automatic recoil and rough handling a military rifle gets, these have to be strong. This makes them good light-hunting rifle scopes.

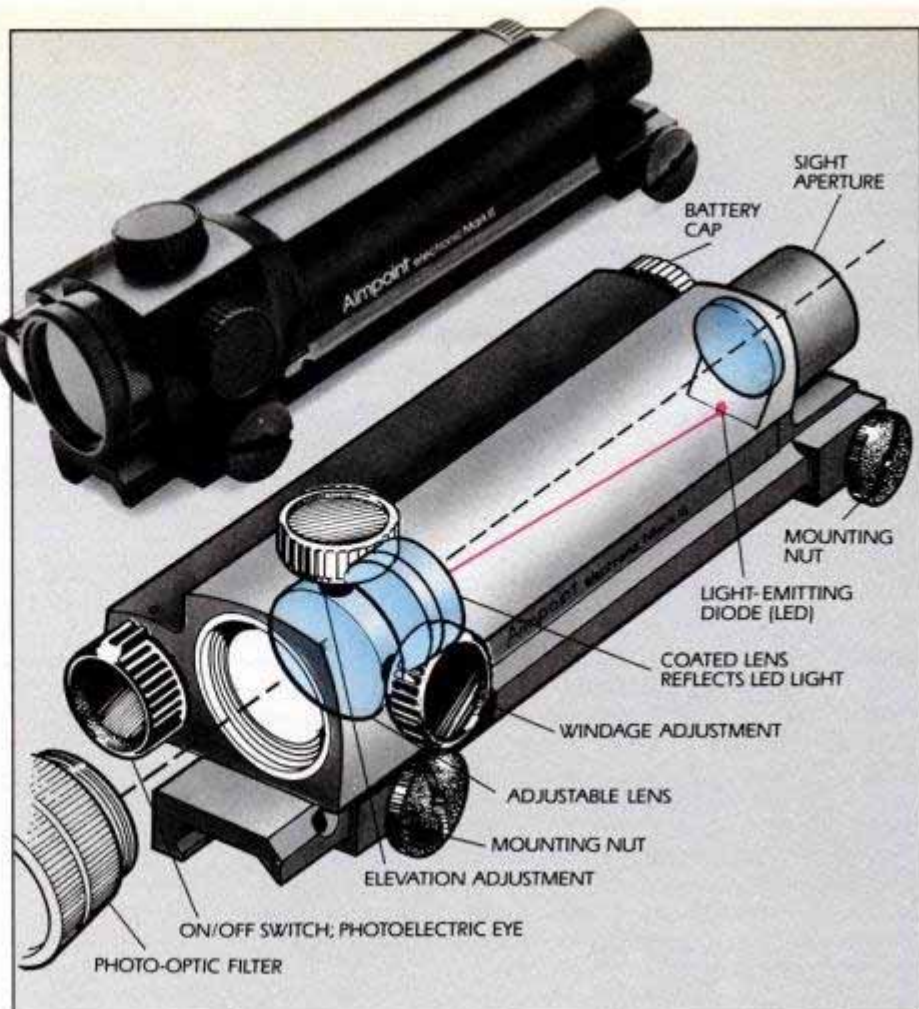
Besides Beeman, nearly all the scope sight makers offer a selection of smaller and lighter scope models. Leupold, Burris and Redfield have all recently introduced quality compacts.

Variables out in front

But the real scope innovations these days are on the inside. To increase versatility, rifle scopes are increasingly being offered with variable powers. Like zoom camera lenses, these make it possible for one rifle with one scope to handle many different types of hunting or target shooting. Probably the 2-to-7 zoom is the most popular, but serious hunters often find the bottom-end variables, the 1.5-to-5 range, more useful on big game rifles. The lower the power, the greater the field of view, the more light available for dawn or dusk shooting, and the better the scope performs on moving targets. While slightly larger than a fixed-power 4X scope, the 1.5-to-5 does a lot more. The drawbacks are somewhat greater weight, increased fragility and a greater price tag.

Once you have the variable-power feature built into a rifle scope, however, it can then be taught to do useful tricks—tricks like making a reasonably accurate estimation of the distance to a target of known size and even allowing for bullet drop at long range.

Different makes use differing systems for range finding. However, all are based on matching the size of the target to a known-reference point in the reticle of the scope. Most use a second-horizontal crosshair called a stadia wire. As



Aimpoint reflector sight projects an illuminated red dot on a see-through mirror to indicate bullet strike. This sight is widely used on pistols as well as rifles.

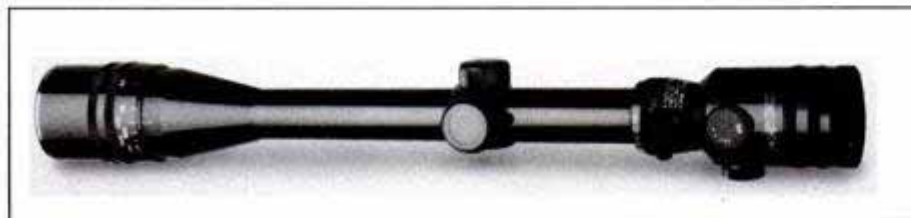
you zoom the scope, the distance between the stadia wire and the horizontal crosshair (or a second horizontal crosshair down near the bottom of the field) changes. Knowing that an adult woodchuck stands about 18 inches high, or that the shoulder-to-brisket dimension of most full-grown whitetail bucks is 18 inches, bracketing the animal between the crosshairs by zooming the scope then tells you how far away it is. These range-finding scopes have a scale to read the distance.

One particularly clever design, the Shepherd scope, has a series of small circles on the vertical crosshair which decrease in size as they come lower in the field. Bracket your 18-inch object with the big circle and your shot is centered at 200 yards. Bracket your target with one of the smaller circles

farther down the scale and your shot is centered at a greater distance.

Most other range-finding scopes require that you turn the zoom ring to move the stadia wires to estimate the range. Some then require that you turn an elevation turret to compensate for bullet drop or trajectory. This system works well for target shooting at unknown ranges, but few game animals will wait around while you fiddle with the scope unless they really are too far away for a sporting shot. The military-derived ART-IV gets around this by turning the zoom ring into a cam that changes the elevation of the scope to coincide with the bullet trajectory. It's a neat system, but the Shepherd system does it all without zooming or making any adjustments while aiming the shot.

Accuracy and mechanical repeatability make a good variable useful, and their lack turns a lesser model into an overpriced, under-accurate fixed-power scope. The whole point of having a variable is to be able to change the image size for different shooting conditions and targets. Many of the less expensive models change the point of bullet impact when you change the power. Some even change again when you return to the original power. The



Tasco's top 6-18x variable light reticle for dim-light shooting, finds range by stadia wire and allows for bullet drop by setting the distance on the vertical turret.

only way to tell for sure is to mount the scope on your rifle and shoot it at different settings. Then you must either learn to know where it hits at each setting so you can allow for it, or get a more precise scope.

That's why many serious shooters still prefer the fixed-power scope. Without the monkey-motion of the zoom feature, a fixed scope can be both cheaper and better than a zoom. Once zeroed-in on the rifle, and all fasteners firmly tightened with thread-locking compound to keep them from shifting, a fixed-power scope is less apt to get knocked out of whack by a fall off a horse or other unplanned impact.

Scopes that light up in the dark

Gathering more light than the unaided human eye has always been a scope sight strong point. The extra quarter-hour of accurate shooting time gained at dawn or dusk can spell the difference between a trophy and coming home empty-handed.

Until recently, dim-light scopes had to rely on bigger lenses with superior light-transmitting coatings and reticles with heavy posts or broad crosshairs. Some offered posts which flipped out of the way for brighter conditions. Now,

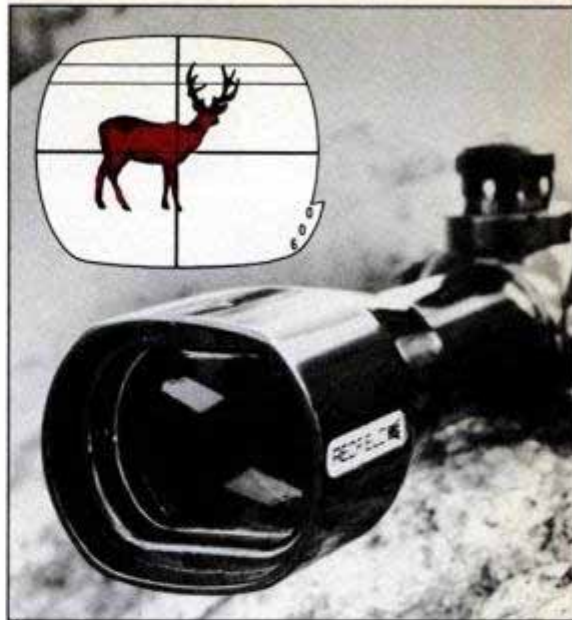
the LED (light-emitting diode) makes it possible to project an illuminated dot onto the intersection of the crosshairs, or to light them up so the aiming point stands out against the dark target.

To make the glowing red dot visible in dim light, some early models made it too light for darker shooting conditions. Variable-intensity illumination helps keep the aiming point from blotting out the view through the scope. Some models project a single dot. Others illuminate the crosshairs instead of projecting a single dot. This makes it easier to avoid tilting the rifle, which could throw off your shot.

Bushnell, Tasco, Thompson Center and others offer illuminated reticle scopes. These models may cost a little more than similar scopes without this feature, but for the serious hunter, they could be well worth it.

Reflector sights for quick shots

By reflecting an aiming point on a see-through one-way mirror, a reflector sight combines the virtues of a scope with the quickness of good iron sights. The shooter's eye sees the aiming dot or other reticle in the same plane as the target so it doesn't have to go through the impossible gymnastics of focusing

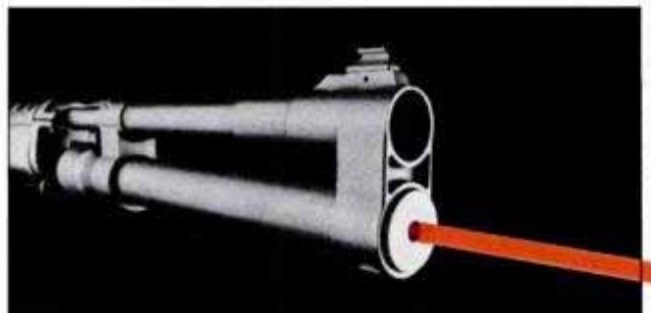


Redfield Widefield scope gives TV-shaped view of the target, measures range by stadia wire and reads yardage.

on a close-up rear sight, nearby front sight and a target many yards away. And the aiming point can be illuminated as it is on the Swedish Aimpoint sight so you can see it clearly under

(Please turn to page 176)

SETTING SIGHTS ON THE FUTURE



Laser 14A on Ruger Mini 14 rifle projects a 3-in. dot on the target at 50 yards. The laser is preferred by police units and can be fired effectively from the hip.

Almost all of the fanciest military small-arms sights are currently offered on the civilian market as well. All you have to do is to come up with the price. Serviceable and rebuilt see-in-the-dark sighting devices, laser sights and other exotica start at about \$1000 and work up. Plain, super-tough military rifle scope sights run about half that; they're usually not a whole lot more than the \$200 to \$300 good civilian scopes cost.

Among the military-surplus items, you can get first-generation image intensifiers which combine fiber optics with a photosensitive electron-emitting film on a TV-like screen. Stacking three stages together make the early, so-called "starlight" scopes effective but bulky.

The first quantity-produced military model, the AN/PVS-1, weighed 6 pounds, was 18½ inches long and 5½ inches high. The next generation of scopes, the AN/PVS-2, was only an inch shorter than the first, with slightly improved definition. The more recent AN/PVS-3 version cut weight in

half and length to 14 inches, making the scope more usable mounted on a rifle.

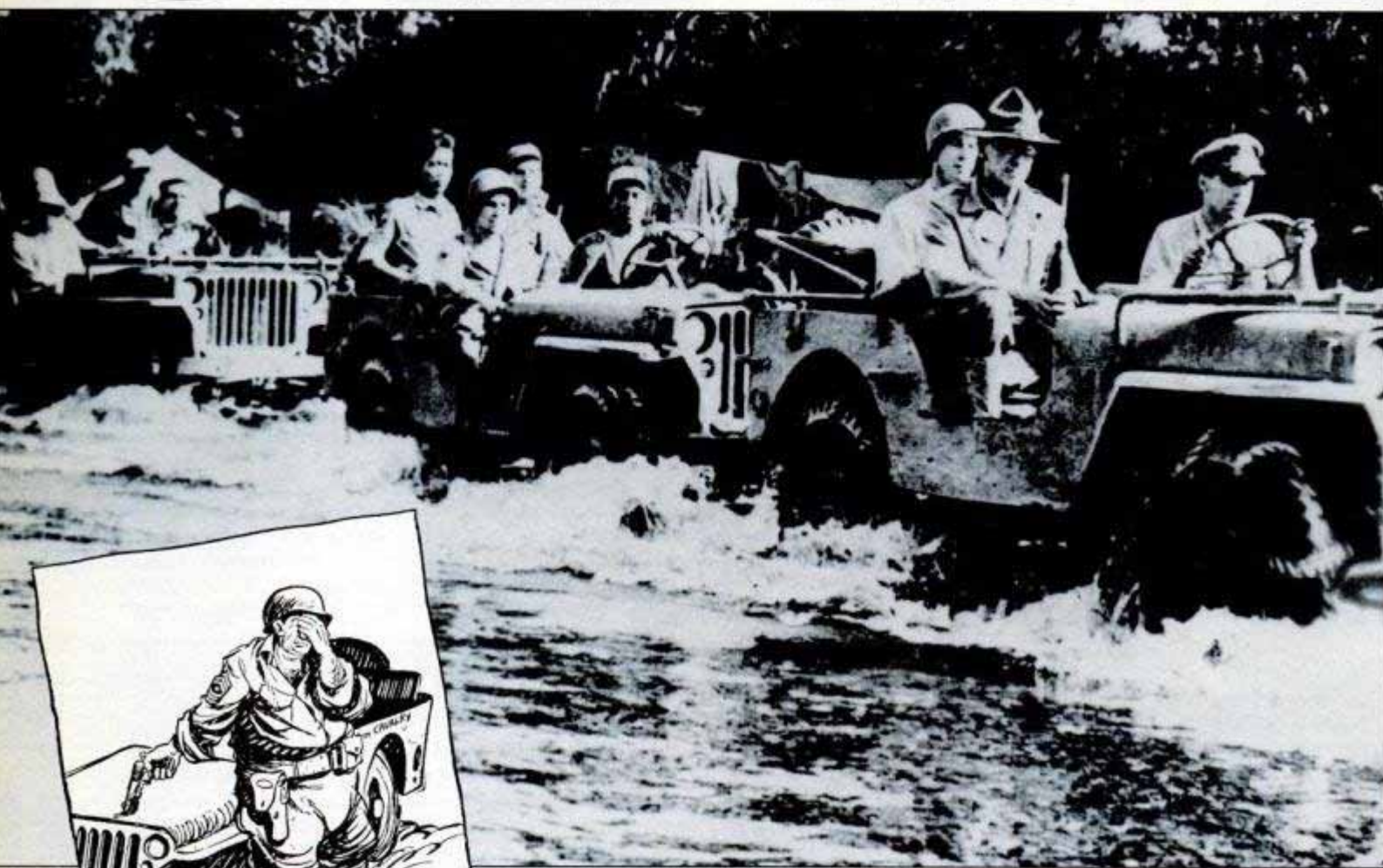
Excalibur Enterprises, Emmaus, Pennsylvania, now offers AN/PVS-4 second-generation devices with all new parts except reconditioned image tubes for \$2850 and with a new tube for \$3895 at 9½ inches long and 3¾ pounds. Excalibur also offers the older and larger AN/PVS-3 for \$1495 and there are other sources.

Infrared-powered scopes require no ambient light at all to function, unlike image-intensifiers which amplify existing light. Nite Hawk Inc., Madison, Alabama, produces the MV-500 3X with a 75-mm lens for \$1095 and the MV 560S with an 82-mm objective for \$1295. They weigh about 3 pounds on the gun and require a separate 3-pound, belt-hung battery pack. With one of these, you can see a target up to 225 yards and recognize it clearly at 150.

Some of the latest laser sights project a brilliant red aiming point that appears on the target right where the bullet will hit. The Laser Products (Fountain Valley, California) Model 14A for the Ruger Mini 14 rifle mounts the laser tube under the barrel ahead of the fore-end with the battery pack in the buttstock. The Model 15A for the Colt AR-15 (M16) replaces the whole upper receiver and barrel with parts integrated with the laser assembly. Both of these project an almost invisible beam when seen from the side. It produces a 3-inch spot at 50 yards and a 6-incher at 100 yards. Prices range from about \$1000 to \$2400, depending on the model, with the 15A pegged at \$1600.

But, for most shooters, the current crop of optical telescopic sights offers a wide range of precision aiming devices that are more suitable, less bulky and a lot less expensive than these exotic scopes. However, if you wait just a minute, there's sure to be something new and still better coming around the corner.—A.L.

ONLY IN A



Happy 45th to America's quintessential four-by.

BY TIM COLE, *Outdoors Editor*; Photos by George Nagher

No doubt about it—each of these Jeeps has got an attitude. The beautifully restored World War II Jeep MB creaks over the hummocks and eases out of the sandpits like a spry old Gramps. It's shooing away the nurses, you see, and making its way up the stairs unassisted.

The 1986 CJ-7, the latest Jeep variant following 45 years of steady improvement, acts every bit the impetuous teenager, romping along on its steel-belted radials, its 2.5-liter in-line Four delivering a kind of don't-give-a-hoot abandon.

Well, what did you expect from a vintage World War II Willys? It was manufactured in Toledo, Ohio, in June 1943, just one of more than 600,000

Jeeps built during the war. Its original 4-cylinder "Go-Devil" engine continues to send 65 horses to its four, narrow all-terrain tires through a museum-piece Spicer transfer case. Did we have any expectations before we got behind the wheel? None to speak of.

But what we got was a chance to take a close look at the vehicle that won the war and compare its characteristics to the '86 Jeep, a fascinating meander across time. More importantly, we learned without a doubt why the popularity of the homely little Jeep, proved on the battlefield and perfected in peacetime, remains undiminished.

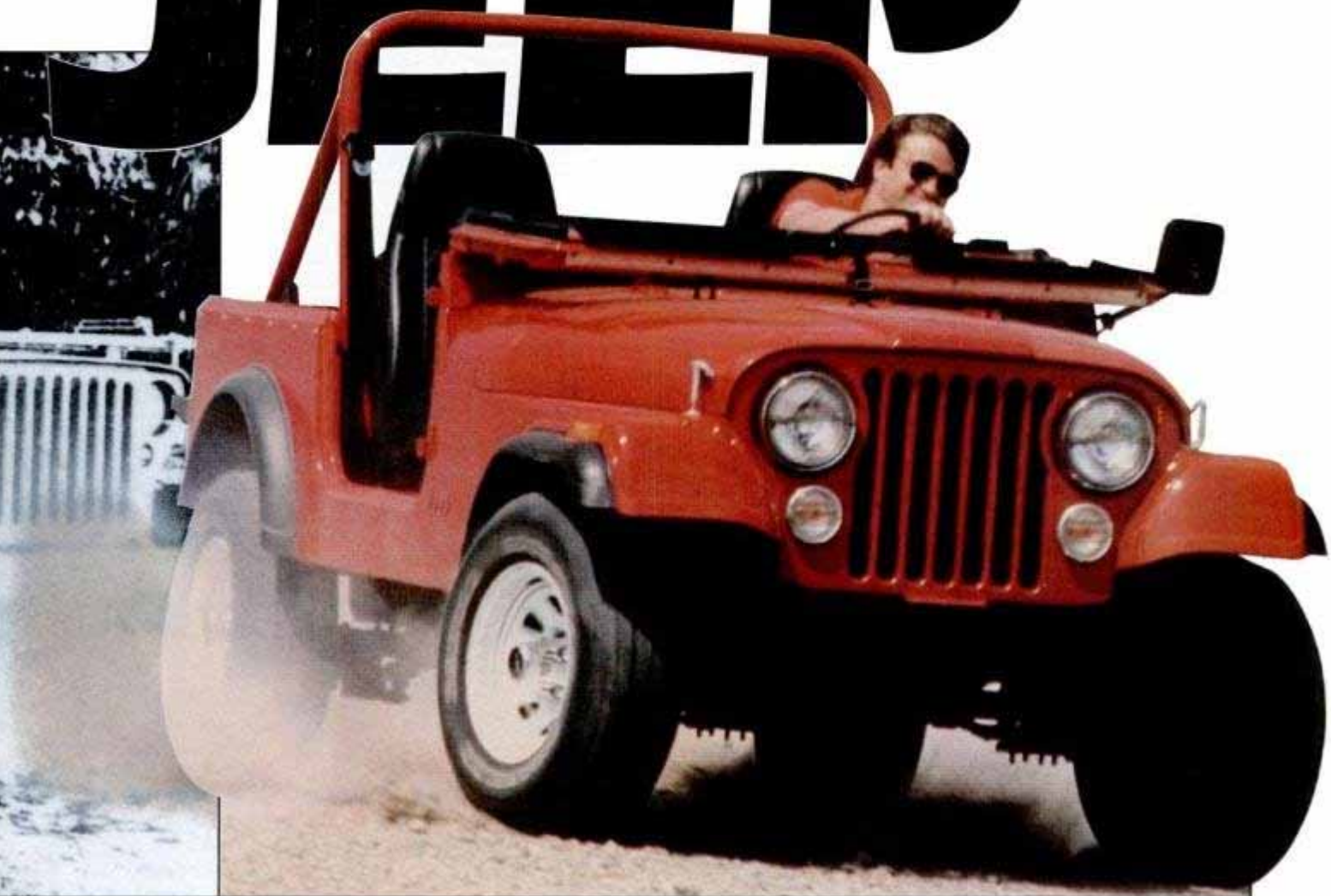
As it turns out, the birthing of America's favorite four-by was not without some protracted labor pains. A historical sketch of the Jeep's nativity cleaves

along these somewhat convoluted lines:

The Army Quartermaster Corps (QMC) spent much of the 1930s developing modern mechanized transports, reconnaissance vehicles and weapons carriers for both land and air. Four-wheel-drive technology had appeared in the waning days of World War I in the Nash Quad truck, and the Army experimented in the mid-30s with 4x4 conversions of the Ford 1½-ton truck.

The Army's real objective, contrary to these early gargantuan four-bys, was a light, low-profile scouting vehicle. The Howie-Wiley machine-gun carrier of 1937 was an early prototype. The 1000-pound, 2-man runabout had a 75-inch wheelbase and a top speed of 28 mph. Its occupants lay prone face forward and steered with a lever. Possess-

JEEP



ing no visible means of suspension, the contraption quickly assumed the nickname "bellyflopper." Two were built before the project was scuttled.

In May 1940, the American Bantam Co. (previously the American Austin Co.) invited members of the Quartermaster Corp's Ordnance Technical Committee to inspect reconnaissance cars adapted from its Bantam roadster. Based on its impressions of the Bantam, the committee drew up specs for bidding, developing parameters that closely describe the Jeep of today. A driving front axle powered through a 2-speed transfer unit would be mandatory, for instance. Also, the vehicle would need a mount for a machine gun, rectangular body design, folding windshield and low profile to avoid hostile fire.

ONLY IN A JEEP

One hundred thirty-five manufacturers were invited to bid on the project in July 1940. Bantam Chief Designer Karl Probst finished his design, including complete drawings and specs, over a weekend at the Bantam plant in Butler, Pennsylvania. The Bantam concept car was delivered for testing to Holabird Army Camp near Baltimore in Septem-

ber 1940. Soon thereafter, Bantam won the bid to build a preproduction series of 70 cars, including eight with all-wheel steering as well as all-wheel drive (a true contortionist, as it turned out, that turned with such alacrity it jettisoned occupants around corners).

Willys and Ford never made the deadline and only began working on designs after strong encouragement from the Quartermaster's office, which

began showing signs of favoring big-capacity automakers. Designers from Willys and Ford also showed up at Holabird to make sketches and take notes as testers from QMC put the Bantam through her paces.

Willys came up with its prototype in November 1940. Its Quad (pictured on page 178) looked suspiciously similar to the Bantam test car, particularly in the rather un-Jeeplike front end. Ford also delivered a prototype military vehicle at this point. It named the vehicle, which had a nose most similar to Willy's later production design, the G.P., for general purpose. QMC placed orders for 1500 vehicles with all three manufacturers, still hesitant to rely on a single source.

Confusing history

The history of the Jeep gets pretty blurry between November 1940 and March 1941. The period is characterized by protests over the "split contracts" and delayed deliveries due to a strike at the Spicer gear works. Bantam and Ford started delivering Jeeps in March 1941, while Willys, stung by Quartermaster Corps' criticism that its model was overweight, submitted a redesign.

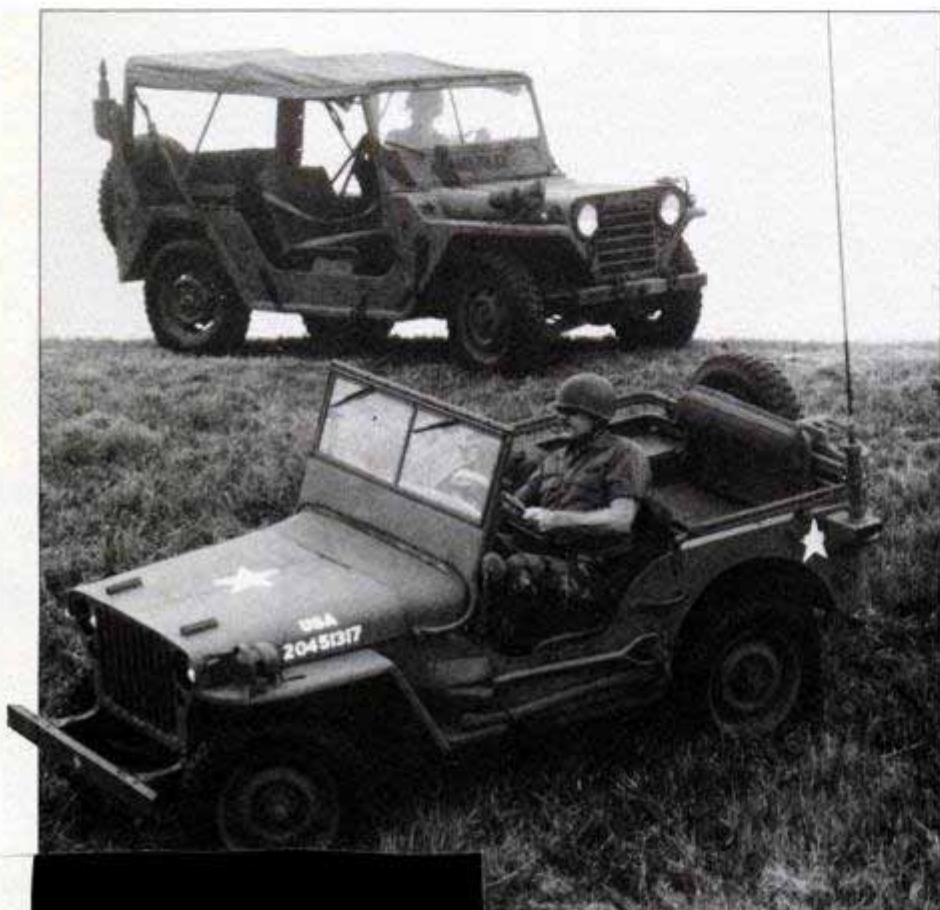
In June of '41, while some of the original 3000 Jeeps from Ford and Bantam were making their way to Britain and the Soviet Union as part of the Lend-Lease Act, the Army announced a bid for 16,000 additional Jeeps from a single source. Ford bid high and lost. Tiny Bantam, after much toil and trouble, bid middle, protested the result and wound up manufacturing Jeep trailers for the duration. And as we all know, Willys bid low and won. A year later, Ford agreed to build Jeeps to Willys specifications to help the war effort and their model also hit the beaches.

It is generally thought, yet bitterly disputed, that the name Jeep resulted from the slurring of the letters G and P, as in general purpose. Other sources credit cartoonist Elzie Segar, who introduced readers of the Popeye comic strip to Eugene the Jeep in 1936, "a wonderful animal who could do most anything." Others credit an anonymous sergeant at the Holabird testing facility, who transposed the word "Jeep" for a more colorful expletive.

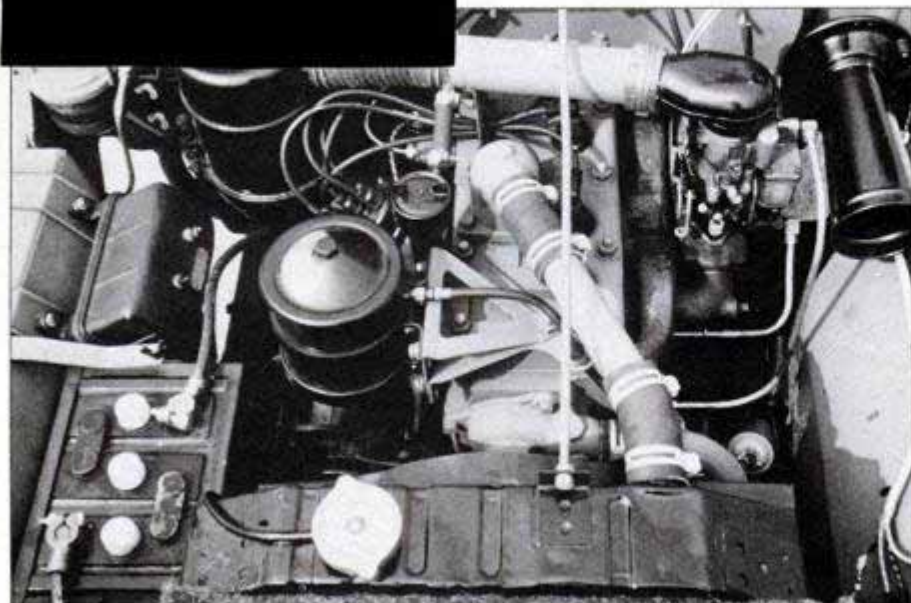
Regardless of the source, the name stuck. Who designed this musclebound little creature? In reality, the consensus that emerged between Army planners and all three manufacturers—spurred by the inspirations of Bantam's Karl Probst—gave birth to the Jeep and its line of descendants.

The list of Jeep models is a long one, and each entry adheres at least in spirit to the Jeep's same stubby lines. The Willys Quad became the Jeep MA. Its offshoot, the MB, served in World War

(Please turn to page 178)



Following in the footsteps of the original Jeep, the Bantam, will be replaced by the larger Hummer.



The 4-cylinder "Go-Devil" engine in the Willys MB delivered 65 hp to four wheels through a Spicer transfer case. Note the oil-bath air cleaner and brick-like generator, left.

**Popular
Mechanics**

Woodworking Guide



PM PHOTO BY BILL DOLCE

GUIDE TO COMMON HARDWOODS

How To Choose And Buy Hardwood Stock

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VERSATILE ARMOIRE • BLACK LACQUER TABLE

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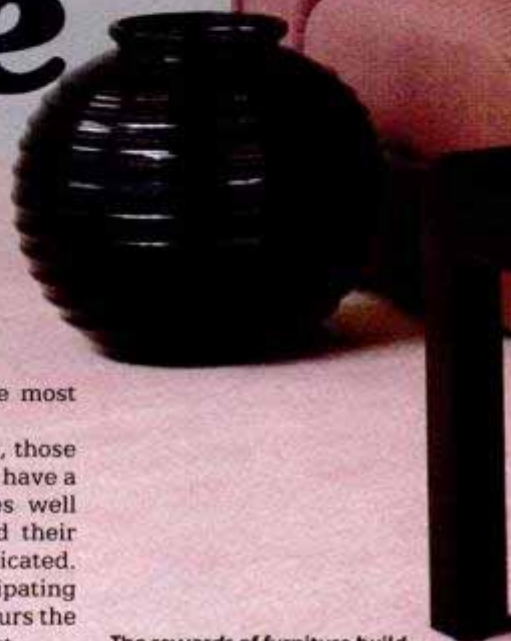
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Plus:

NEW TOOLS

OLD TRICKS OF THE TRADE

The Joy Of Fine Furniture Building



I have an old friend, who is still a young man, who is a furniture maker. He's made his living at it for years now, in both good times and bad. When I once asked him directly what he thought about his work, he just smiled and said, "It has its moments." I'm sure it does.

I've seen him work for days carving a decorative panel for a Victorian desk, and spend just a few hours selecting, joining and scraping stock for a huge tabletop. I've seen him turn a chair leg in less time than many would need to mount the blank, and I've watched him spend countless hours hand-sanding column flutes when others would have called "close" good enough. And on several occasions, I've seen him stand back and quietly stare—for what seemed an immodest length of time—at one of his finished creations.

He seems to approach each task as if time had changed its complexion and was no longer so strongly joined to commerce. He acts as if the work itself demands a certain devotion and therefore has a value that transcends dollars and cents. It is, in the best sense of the word, an old idea.

He chose the occupation, and the joys and frustrations that came with it, of his own free will. But many times I've thought the occupation might well have chosen him. He has the right temperament for it. He's thoughtful and patient, and he understands the nature of compromise that all people who work with wood must know. It is not a static material; it is changeable and unpredictable. It moves in a dance of bends, bows and cups. And the same volatile elements—water and light—that can transform a seed

into a tree, can buckle and split the most well-wrought piece.

The fine furniture makers of today, those who build one-of-a-kind pieces, often have a sense of style and design that goes well beyond that of their forebears. And their construction skills are equally sophisticated. These people, in essence, are participating in an age-old approach to craft that blurs the distinction between worker and artist.

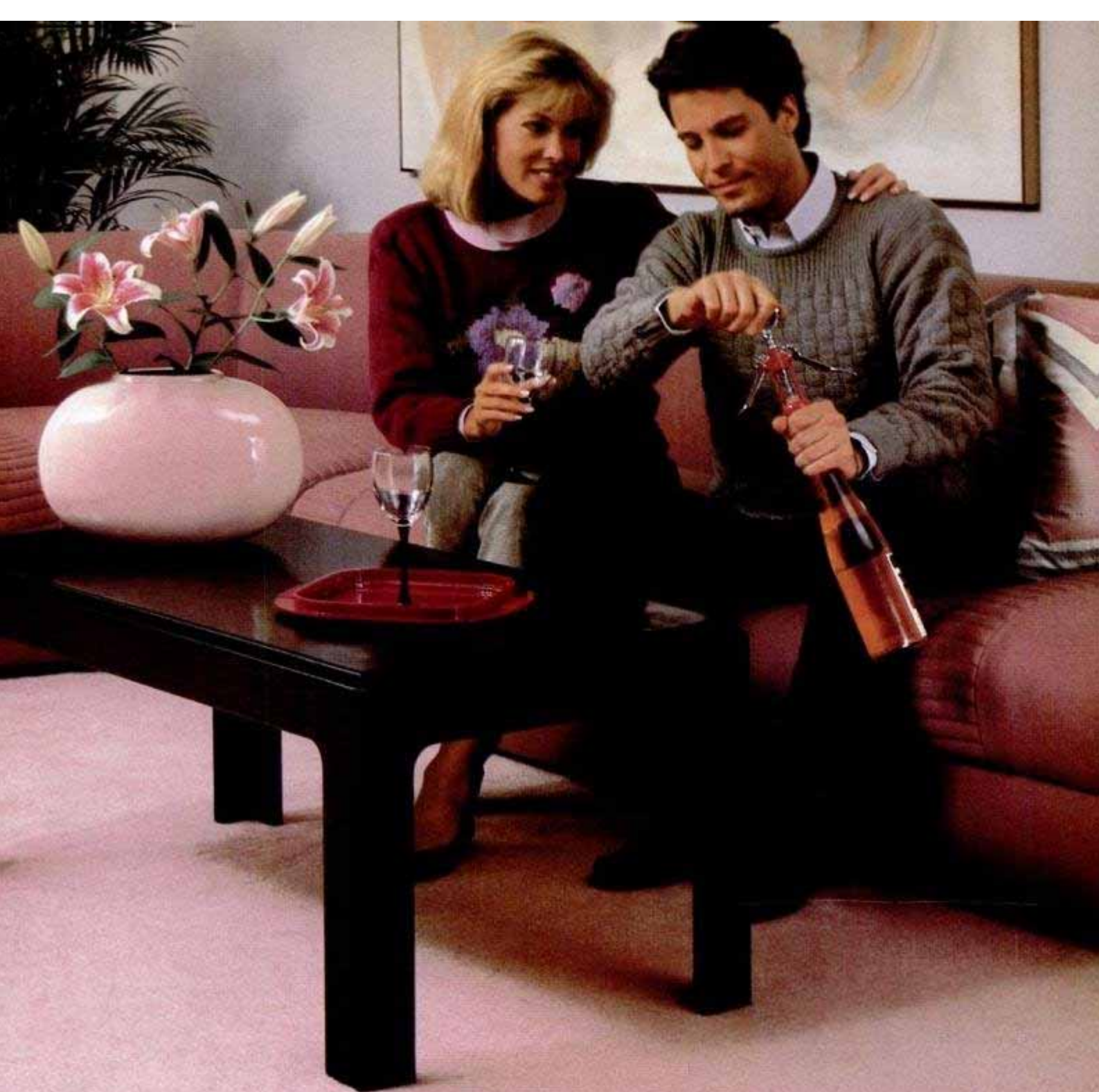
While such skills can take years to master, the basics are there for all to see: design, material selection, joinery and finishing. Each step requires its proper due for the piece to succeed, and because of this the vocation takes on a kind of integration frequently missing in other modern pursuits.

In the past this "organic" approach to work—following something through from beginning to end—was enjoyed by many people. When my grandfather built houses in the '30s and '40s, he drew the plans, laid the foundation, framed the walls and roof, then sided, plumbed, plastered and electrified every house he touched. In the '70s, when I was a contractor, I just framed the houses, moving from one foundation to the next in barren tracts that had no amenities and no imagination. The system was, and still is, called division of labor. It should be called alienation of labor.

In contrast, the real attraction to furniture making, especially when pursued as an avocation, is doing it all yourself, participating in the design, execution and ultimate enjoyment of the product. By doing so, the piece becomes an extension of the person who builds it. Pride can be taken in the strong points, humility in the weak ones.

The rewards of furniture building go well beyond the enjoyment of the finished piece. The process also encourages the virtues of curiosity, self-reliance and creativity.

PHOTO BY MARK KOZLOWSKI



The piece is understood in its own context and as such teaches a valuable lesson in how to maintain perspective. It is truly a creative endeavor.

This process also encourages the virtues of curiosity and independence. To build something from scratch represents a desire to learn how things work, it's a commitment to the idea that through effort the obscure will become known. By pursuing this course—with the knowledge that there will be drawbacks and pitfalls—the individual takes a giant step toward self-reliance.

In the larger sense, furniture making is no different than many other practical pursuits like fixing your car,

maintaining your house or tending your garden. The reward of each is essentially the same: the joy of participating. Along the way, you may save some money, though often you won't, and you may well do a better job than money can buy, but too often you can't. It is the sincere desire to learn more about the world in which one lives that is unquestionably worthwhile.

What we have tried to do in this special *Woodworking Guide* is to encourage this pursuit, to make knowable some of the mysteries that confront beginning woodworkers. We have presented stories on how to buy hardwood lumber, and how to finish it

once your project is built. We have shown some tools that can help you along the way and tips that can enliven, if not shorten, the journey. We have also tried to supply some dreams in the form of four furniture pieces that you can build from our drawings and instructions.

But what we most hope you will find in the following pages is the willingness to approach the field, to become involved, to become excited about the way furniture works. Our hope is that you can take the basics shown here and begin making your own creations that will be every bit as durable, attractive and compelling as the trees from which they came.—S.W.

Guide To Common Hardwoods

Going With The Grain

An introduction to the world of hardwoods for the beginning woodworker.

BY WILLIAM W. RICE

Wood is man's oldest building material, used for everything from rough construction to finely finished works of art. Most amateur woodworkers get their first whiff of sawdust using softwoods, because they're cheaper, easier to work with and more readily available. But the strength, beauty and versatility of hardwoods eventually entices anyone who becomes serious about woodworking.

Hardwoods—especially oak, cherry, walnut and mahogany—have interesting color and grain variations that give both craftsman and viewer a sense of warmth and substance. The coffee table made from quartersawn oak, polished to a satin finish, has a truly individualistic pattern. And a solid cherry hutch develops a mellow patina as it ages, further enhancing the family treasures it stores.

If you're looking for a new challenge to your growing skills, you'll find it with hardwoods. But working with them will require some changes in operating procedures. To begin with, you will need greater patience because the harder wood will cut slower than softwoods, sanding will take longer and you will have to take more precautions to prevent splitting.

Working with hardwoods will also require better equipment. The 1-hp, 8-in. table or radial-arm saw you may have been using should be upgraded to a 10-in. saw with 2 hp to prevent stalling or burning the wood. And, other machines such as routers, shapers, sanders and jointers should also have more power to produce satisfactory results.

But perhaps most important is the quality of your cutting edges. Ordinary steel saw blades and router bits just won't cut well or last long

working with hardwood. Carbide-tipped blades and bits are a necessity. And while they are more expensive to buy, they require far less frequent sharpening and yield flawless edges on even the hardest wood.

Where to buy

Buying hardwood lumber may, at first glance, seem difficult since many lumberyards and home centers don't carry it. Where do you look for it? First, try local lumberyards that do a considerable wholesale business. Often, they stock hardwoods for nearby manufacturers and are willing to sell small quantities at retail prices.

Next, check with any furniture plants, architectural millwork houses or cabinet manufacturers in your area. You may be able to obtain short pieces that are waste to them, but very useful to you. Take your materials list with you when you visit these sources, and make sure any scrap you buy has been stored indoors, not out in the weather.

If you live or travel in rural areas, you may locate a sawmill that cuts hardwoods. This can be an excellent source, but many small mills do not kiln-dry their lumber, and therefore anything you buy will be too wet for building furniture or cabinetry. You can, however, air-dry it yourself in six to eight months, depending on the species and thickness. To do this, stack the green boards neatly with $\frac{1}{4}$ x $1\frac{1}{2}$ -in. spacers (stickers) separating each layer. These stickers should be spaced 12 in. apart and aligned directly over each other. Also, both ends of each board should be supported.

Protect the stack from rain, snow and sun, but allow for some air movement.

William W. Rice is a professor of wood technology at the University of Massachusetts.





HARDWOOD GUIDE

SPECIES	COST PER BD. FT.*	TYPE OF GRAIN	RESISTANCE TO SPLITTING	SUITABILITY FOR CARVING
1. Maple	\$1.90	Closed	Good	Good
2. White Oak	2.60	Open	Good	Good
3. Birch	2.10	Closed	Fair	Good
4. Poplar	1.60	Closed	Excellent	Excellent
5. Ash	2.55	Open	Good	Good
6. Cherry	2.65	Closed	Fair	Excellent
7. Walnut	4.60	Semi-open	Good	Excellent
8. Mahogany	3.50	Semi-open	Good	Excellent
9. Red Oak	2.70	Open	Good	Good
10. Hickory	2.40	Open	Fair	Fair
11. Beech	1.50	Closed	Fair	Fair

*Average retail prices, August 1985, for 4/4 stock, FAS, surfaced on two sides.

PHOTO BY BILL DOLCE

Woodworking Guide

After six months or longer, restack the wood inside in a dry location for a few months to reach an indoor equilibrium moisture content of 6 to 8 percent.

If drying your own lumber appeals to you, you might also consider using "found wood"—that walnut, maple or oak tree in your backyard or your neighbor's—that needs to be cut down. Getting the logs sawn into boards can be a problem, since many sawmillers don't want to risk expensive saw blades hitting nails or other hardware often buried in residential trees.

But if you can get the logs cut, the boards will be ideal for any building project and also provide that feeling of pride that comes with making something literally from scratch.

One practical source of hardwood lumber is the mail-order suppliers that specialize in selling small quantities of well-dried, high-quality wood, usually milled smooth on at least two sides. These companies are found nationwide, often near large cities, but also in areas where hobbyists and artisans are concentrated. Many are located in the Northeast, in Florida and in the Far West (a list of names and addresses appears at the end of this article). Many have catalogs and price lists available

on request. All will ship if you can't get there in person.

The advantages of buying wood from these suppliers is that generally the pieces will be small in size and therefore more nearly what you need, without excessive waste. Also, the stock will have minimum defects such as knots, splits or warp. Many suppliers carry a wide assortment of species, including exotics, and a full range of thicknesses.

The disadvantages of buying from specialty firms are a generally higher price per board foot, and buying stock sight unseen. Doing so, you risk receiving material with a knot or some other natural defect where it will adversely affect your project cutting procedure.

The great number of hardwood spe-

cies available to the amateur craftsman is astounding, but the most common domestic woods are ash, birch, cherry, maple, hickory, red and white oak, poplar and walnut. The most available foreign species is mahogany, either African or Caribbean.

For the woodworker using hardwood for the first time, it's probably advisable to start with poplar, birch, maple or oak, since they are plentiful and somewhat less expensive to replace if you make a drastic mistake. The mahoganies and walnut are very attractive, and easily worked, but they cost two or three times as much as the more common species. (See the Hardwood Guide chart on page 101 for relative costs.)

Knowing something about lumber grades is important when selecting stock, even by mail order, because hardwood is not grade stamped like softwoods. Hardwood grades are based on the poorest appearing side of the board. The grading assumes that the board will be cut into pieces (cuttings) from 2 to 7 ft. long, and that each of these cuttings will be clear on one face. Grade is related to the yield of clear cuttings found in the board.

The two best grades, called Firsts and Seconds, are usually sold as a combined grade and designated FAS. A board graded FAS must be at least 6 in.

HARDWOOD LUMBER DIMENSIONS (Standard thicknesses)		
Rough (in.)	Nominal size	Surfaced two sides (in.)
1	(4/4)	1 ³ / ₁₆
1 ¹ / ₄	(5/4)	1 ¹ / ₁₆
1 ¹ / ₂	(6/4)	1 ³ / ₁₆
1 ³ / ₄	(7/4)	1 ¹ / ₂
2	(8/4)	1 ³ / ₄
2 ¹ / ₂	(10/4)	2 ¹ / ₄
3	(12/4)	2 ³ / ₄
3 ¹ / ₂	(14/4)	3 ¹ / ₄
4	(16/4)	3 ³ / ₄

Standard lengths: 4 ft. to 16 ft. in 1 ft. multiples in various widths
Source: National Hardwood Lumber Association

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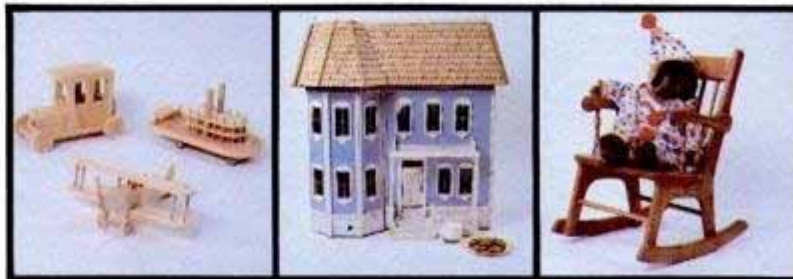
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wide, 8 to 16 ft. long and 83½ percent clear on its worst face. Lower grades, called Selects, and Number 1-, 2- and 3-Common, have proportionately less clear wood and different overall size and clear cutting requirements. For example, a Number 1 Common grade must be at least 3 in. wide, 4 to 16 ft. long and contain 66½ percent clear wood. Minimum sizes for clear cuttings (for grade determination only) are 4 in.

× 5 ft. or 3 in. × 7 ft. for FAS and Selects. For the common grades, clear cuttings must be at least 3 in. × 3 ft. or 4 in. × 2 ft.

There are other grade requirements that are specific for certain species: the amount of sapwood permitted in walnut, for example. All these grading rules are monitored by the National Hardwood Lumber Assn., and a copy of its rule book is available by sending \$3 to the association at P.O. Box 34518, Memphis, TN 38134.

In many cases, top graded lumber is the best buy for the home craftsman because of the large percentage of clear

material. However, you should remember that in most projects—including commercially made furniture—more than 80 percent of the required pieces will be shorter than 40 inches. And it's seldom necessary for a furniture part to be exposed on both faces. Using Select and Common grades will often yield all the necessary parts for less money.

The current price differential for FAS versus No. 1 Common grade oak is about 40 cents per board foot. Other species have comparable differentials in price. But besides the cost savings, there's another advantage to using the lower hardwood grades: the opportuni-

GLOSSARY

ROUGH LUMBER: Lumber that still contains the marks of the saw teeth on the surface.

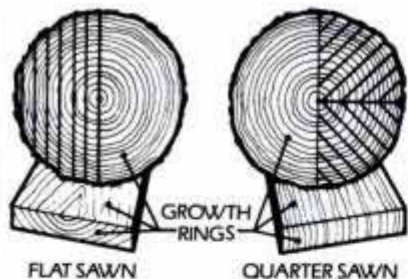
DRESSED LUMBER: Lumber that has been planed on one or more surfaces.

BOARD-FOOT: A measurement of wood that is the equivalent of 1 ft. wide by 1 ft. long by 1 in. thick.

OPEN GRAIN: Species with large pores or vessels concentrated along one edge of the growth, such as oak, hickory or ash. Surface is course-textured, with a prominent grain.

CLOSED GRAIN: Species with small pores or vessels evenly distributed along the growth ring, such as birch, maple or cherry. Surface is fine-textured and smooth.

FLAT SAWN: Lumber cut so the growth rings are tangent to the wide face of the board. Also called plain sawn.



QUARTER SAWN: Lumber cut so the growth rings intersect the wide face of the board at a greater than 45° angle.

GREEN: Lumber freshly sawn from a log, with a moisture content above 30 percent.

AIR DRIED: Lumber dried in a ventilated stack by exposure to normal temperature and humidity conditions. Moisture content is 15 to 30 percent.

KILN DRIED: Lumber dried in a closed chamber in a controlled environment. Moisture content is 6 to 15 percent, ideally 6 to 8 percent.

MOISTURE CONTENT: Ratio of the weight of the water in wood to the weight of oven-dry wood, expressed as a percentage.

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Woodworking Guide

ty to utilize a natural defect or character mark that can lend beauty and individualism to your piece.

How much do you need?

Hardwood is not only graded differently than softwood; it is also measured differently. Becoming acquainted with some of these measuring terms will help you determine how much lumber to buy for a project.

Hardwoods retailed as rough-sawn boards are usually sold by the board foot in a variety of thicknesses, and in random widths (r/w) and random lengths (r/l). A board-foot represents a piece of wood 1 ft. square and 1 in. thick. A board 1 in. thick, 12 in. wide and 5 ft. long would be 5 board-feet. A board 1 in. thick, 4 in. wide and 6 ft. long would be 2 board-feet.

If you plan to buy rough-sawn boards and plane them yourself or have them planed, you should expect 40 to 50 percent waste after trimming and ripping. Also keep in mind when calculating board-feet that any thickness 1 in. or less is counted as 1 in. thick.

To decide how much lumber you need, total the board-feet required and add your waste factor. Also be sure that at least some of the boards are long

enough to yield the longer pieces a project requires, such as a table or desk top. Board widths are not so critical, since you can edge-glue pieces to make wider stock.

Some of the specialty houses sell fully dimensioned stock—pieces cut to specific length, width and thickness, and planed on all four sides. When buying such lumber, you needn't concern yourself with board footage; simply buy dimensioned pieces that most nearly match your requirements. In fact, another "packaged" hardwood that both the specialty houses and retail lumberyards are beginning to stock is the standardized blank—glued-up, fully milled panels in various lengths. These blanks can be cut into parts, leaving you with minimal waste.

Unless you are buying dimensioned stock or blanks, you will usually find lumber with just the board surfaces milled. Planing the edges is relatively easy to do in your own shop. But if you want to save money by buying rough-sawn stock—that is, milled on neither the edges nor the surfaces—keep in mind that you will need access to a planer and that buying the proper thickness requires a little more thought. Parts that must finish 1 in. thick generally cannot be made from 4/4 rough lumber; you will need 5/4 (1 1/4-in.-thick)

rough stock for that. If you buy rough lumber you can ask the seller to plane it for you. Unless you instruct otherwise, it will be planed to standard thickness (see dimension chart on page 102).

After purchasing your hardwood, store it carefully, away from the furnace, which can cause shrinkage, and away from dampness. Hardwoods—especially denser species such as oak, maple and hickory—react to small changes in moisture content by changing dimension significantly, warping or checking. When storing wood for long periods, seal the ends with paint since they absorb proportionately more moisture than the rest of the board. **PM**

SOURCES FOR HARDWOOD LUMBER

- A Woodworker's Dream, 10 West North St., Nazareth, PA 18064
- Bob Morgan Woodworking Supplies, 1123 Bardstown Road, Louisville, KY 40204
- Constantine's, 2050 Eastchester Road, Bronx, NY 10461
- Craftsman Wood Service Co., 1735 West Cortland Court, Addison, IL 60101
- Gilmer Wood Co., 10426 Northwest Laidlaw Rd., Portland, OR 97229
- MGM Hardwood, 5344 Vineland Ave., North Hollywood, CA 91601
- Reisen-Seidel Hardwood Co., 1080 Morris Ave., Union, NJ 07083
- The Woodworkers' Store, 21801 Industrial Blvd., Rogers, MN 55374
- Unicorn Universal Woods Ltd., 4190 Steeles Avenue West, Unit 4, Woodbridge, Ont., Canada L4L3S8
- United States Mahogany Corp., 746 Lloyd Road, Matawan, NJ 07747



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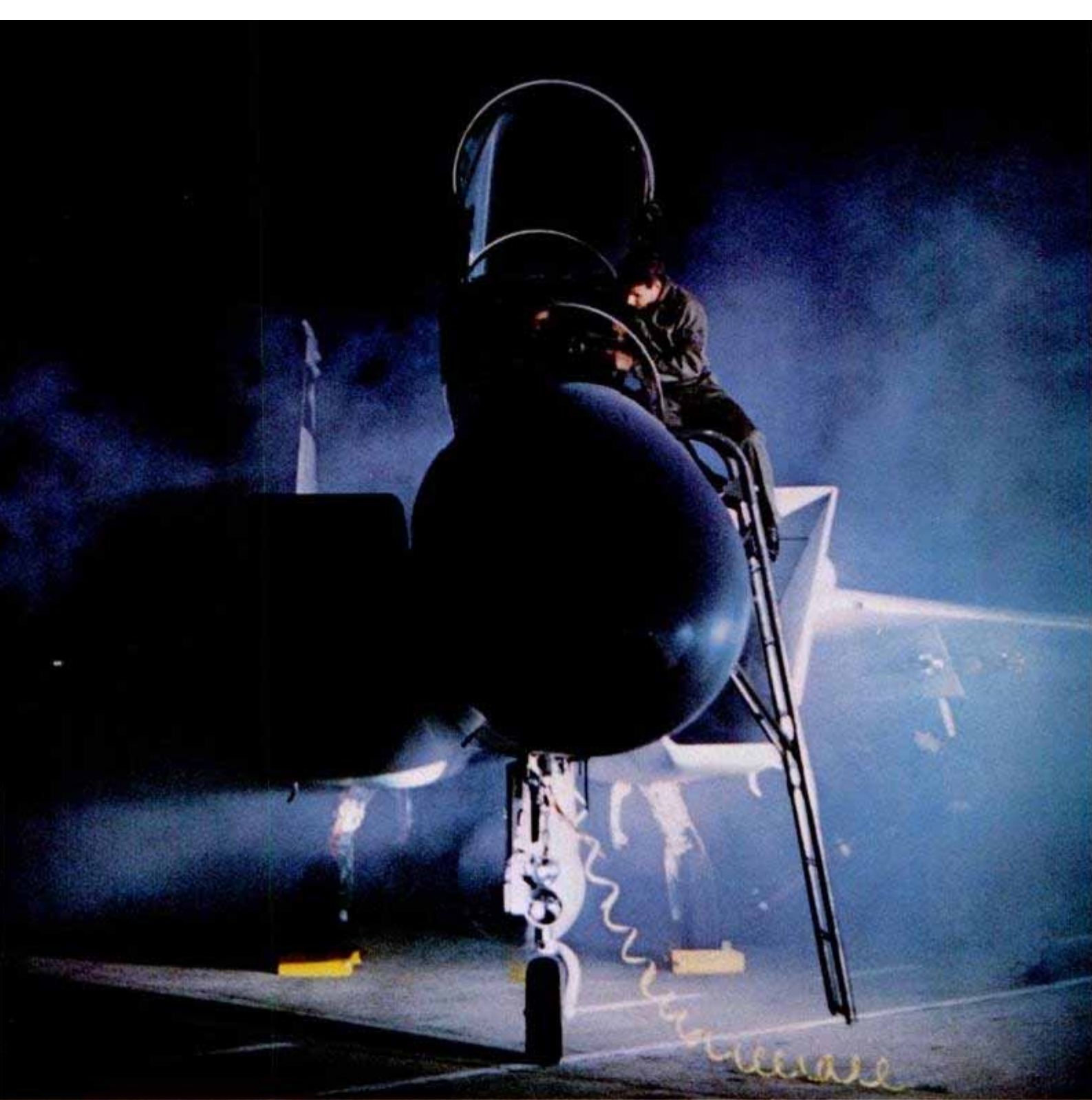
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Woodworking Guide

Terrific Tools



1 This powerful cordless saber saw operates on a 9.6-volt rechargeable battery to produce 2400 strokes per minute. It accepts 1/4-in. shank blades and features a handy blade storage compartment. The saw comes with a battery and battery charger for about \$175. An extra battery costs about \$40. Contact Black & Decker, 626 Hanover Pike, Hampstead, MD 18074.

2 Milwaukee's 3/8-in. cordless, reversible screwdriver/drill (S154) has a 6-position adjustable clutch that provides the proper torque for the job at hand. Speeds range from 100 to 600 rpm and an electronic feedback maintains a constant speed during use. The drill comes with a 7.2-volt battery and battery charger. For details, contact Milwaukee Tool Corp., 13135 West Lisbon Rd., Brookfield, WI 53005.



3 Here's a timesaving tape measure that performs four functions. First, it has a 1/2-in. x 10-ft. steel rule graduated in inches and millimeters for measuring; its flip-out pivot pin helps you draw circles easily; its top window lets you read inside measurements directly; and finally, a built-in level helps with alignments. It's \$14.80 postpaid from Garrett Wade, 161 Ave. of the Americas, New York, NY 10013.



4 The veneer hammer isn't made to drive nails; it's made to smooth out newly veneered surfaces. To use the tool, place the hammer's 3-in.-wide blade on the veneer and apply pressure by pushing down on the square head. Raise the ash handle and pull the tool across the veneer to ensure total surface contact. The veneer hammer is \$16.95 postpaid from Garrett Wade, 161 Ave. of the Americas, New York, NY 10013.

5 Use a Japanese saw rasp for shaping and sculpting wood, plastics and soft metals. The tool features a reversible 1½-in.-wide × 10¼-in. blade that has two cutting surfaces: a coarse side (11 teeth per inch) and a fine side (25 teeth per inch). Use the coarse side for fast stock removal and the fine side for smoothing. The saw rasp is from Constantine's, 2050 Eastchester Rd., Bronx, NY 10461, for \$15.10 postpaid.

6 Makita's cordless 3⅞-in. circular saw is designed for convenient, light-duty cutting of wood, plywood, plastics, concrete and glass. The lightweight tool (just 3.7 pounds) operates on a 9.6-volt battery and has a cutting depth of ¾ in. The saw comes with a battery, battery charger and combination saw blade, and it costs approximately \$165. For details, write to Makita, 12950 East Alondra Blvd., Cerritos, CA 90701.

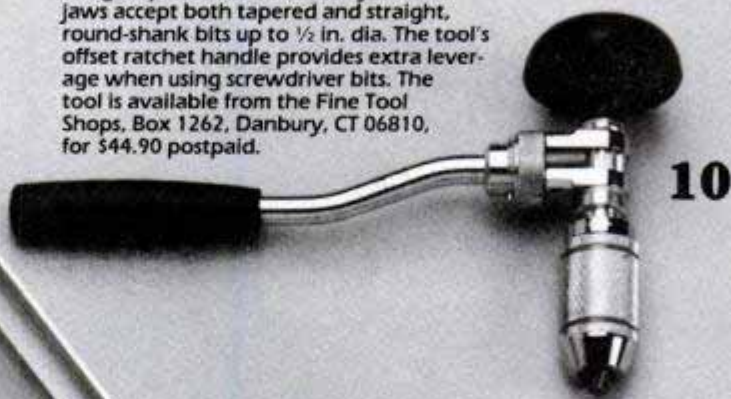
7 This Japanese marking gauge is larger and more versatile than its Western counterpart. The gauge is made of ebony with high-carbon-steel cutters and brass-plated hardware. Shift and reverse the tool's slides and it functions as a standard cutting gauge, a mortise gauge and a single-spur marking gauge. It can mark up to 5 in. from the edge of a board. The gauge costs \$32.40 postpaid from Garrett Wade, 161 Ave. of the Americas, New York, NY 10013.

8 Cut raised panels by hand using this traditional panel raising plane. The 13½-in.-long maple tool cuts a raised panel section that is 2 in. wide on its sloping face with a gentle curve at its base where the panel meets the stiles or rails. The plane iron is set at a skew to facilitate cross-grain cutting. It's from Garrett Wade, 161 Ave. of the Americas, New York, NY 10013, for \$136.90 postpaid.

9 Solve your veneer edge-trimming problems with the combination veneer stripper and trimmer. Run the beech-handled tool along a straightedge to trim off overhanging veneer neatly and quickly. Or, use the tool to cut veneer strips from ⅞ to ⅝ in. wide. The tool comes with three cutter blades and adjustable spacers. It's available from Constantine's, 2050 Eastchester Rd., Bronx, NY 10461, for \$54.70 postpaid.



10 The joist brace is designed for boring holes in tight spaces between floor joists. The jaws accept both tapered and straight, round-shank bits up to 1/2 in. dia. The tool's offset ratchet handle provides extra leverage when using screwdriver bits. The tool is available from the Fine Tool Shops, Box 1262, Danbury, CT 06810, for \$44.90 postpaid.



10

11 Use the miniature router plane to cut 1/4-in.-wide grooves for veneer inlay borders or to cut narrow, shallow dadoes and stop dadoes. The nickel-plated plane with a 1/4-in.-wide cutter (\$15.60) is from Constantine's, 2050 Eastchester Rd., Bronx, NY 10461.



11

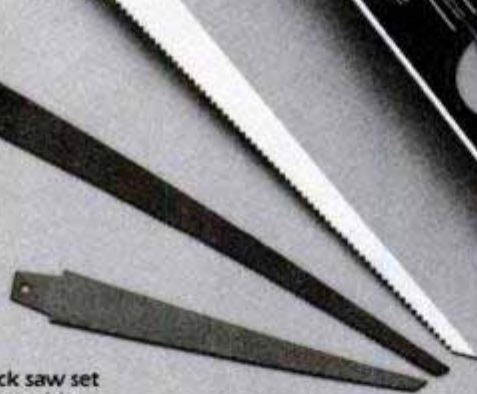
12 Here's an electronic level that uses blinking lights and an audible signal to help you find exact level, plumb, unknown angles and preselected angles. The Levelite (\$45) operates on a 9-volt battery and clips into an aluminum rail. Rails come in 2-(\$12.50), 3-(\$16.85), 4-(\$18.85) and 6-ft. (\$34) lengths. Contact Technical Designs, North 182nd St., Seattle, WA 98133.



12

13 The Disston Twist-n-Lock saw set comes with three interchangeable saw blades—wood cutting, metal cutting and multipurpose. The lightweight plastic handle has a locking collar that allows you to change blades quickly and then lock the blade securely at any angle. The saw set is available at hardware stores and home centers for about \$10. For details, contact Disston Co., Box 3000, Danville, VA 24543.

13



14 The AEG cordless reversible screwdriver has a hinged handle for working in constricted areas. The 1 7/16 x 9-in. tool accepts standard 1/4-in.-dia. hex bits and can drive up to a No. 8 screw. It features six clutch settings for selecting the proper operating torque and a maximum rpm of 190. The tool (model EZ 502) comes with a rechargeable 2.4-volt battery, battery charger, two Phillips bits and one slotted bit. It's available from AEG tool dealers for about \$98. For more information, you should write to AEG Tool Corp., Box 850, Norwich, CT 06360.



14

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15 The Freud TR-100 (\$289) table saw/radial-arm saw kit contains three 10-in. carbide-tipped saw blades and an 8-in. carbide-tipped dado set all packed in a durable plastic carrying case. The kit includes a 60-tooth finishing blade for general crosscutting and trimming, a 40-tooth combination blade for all-purpose cutting, a 24-tooth ripping blade and a 6-piece dado set. The dado set cuts grooves from $\frac{1}{4}$ to $\frac{13}{16}$ in. wide. For details, contact Freud, Box 787, 218 Feid Ave., High Point, NC 27264.

16 When cutting dovetail joints by hand, use this dovetail gauge to mark the pins and tails accurately. The body of the gauge is machined from tool-steel. The two adjustable brass templates are angled for use on hardwood (1:8) and on softwood (1:6). The gauge (No. 03P33-RZ) is available from Woodcraft Supply, 41 Atlantic Ave., Woburn, MA 01888, for \$29.95 postpaid.

17 The universal scraper is actually 12 lathe tools in one. This versatile turning tool has three interchangeable high-speed steel cutters that each have four cutting edges. Each cutter is held securely to the tool with a hex-key screw. It's available from Constantine's, 2050 Eastchester Rd., Bronx, NY 10461, for \$42.70 postpaid.



18 This hand saw is designed to cut plywood without splintering the panel's underside veneer. The 11-in.-long blade has 14 teeth per in. And the teeth on the blade's upper edge permit cutting into the center of a panel without boring a hole first. It's from Garrett Wade, 161 Ave. of the Americas, New York, NY 10013, for \$11.70 postpaid.

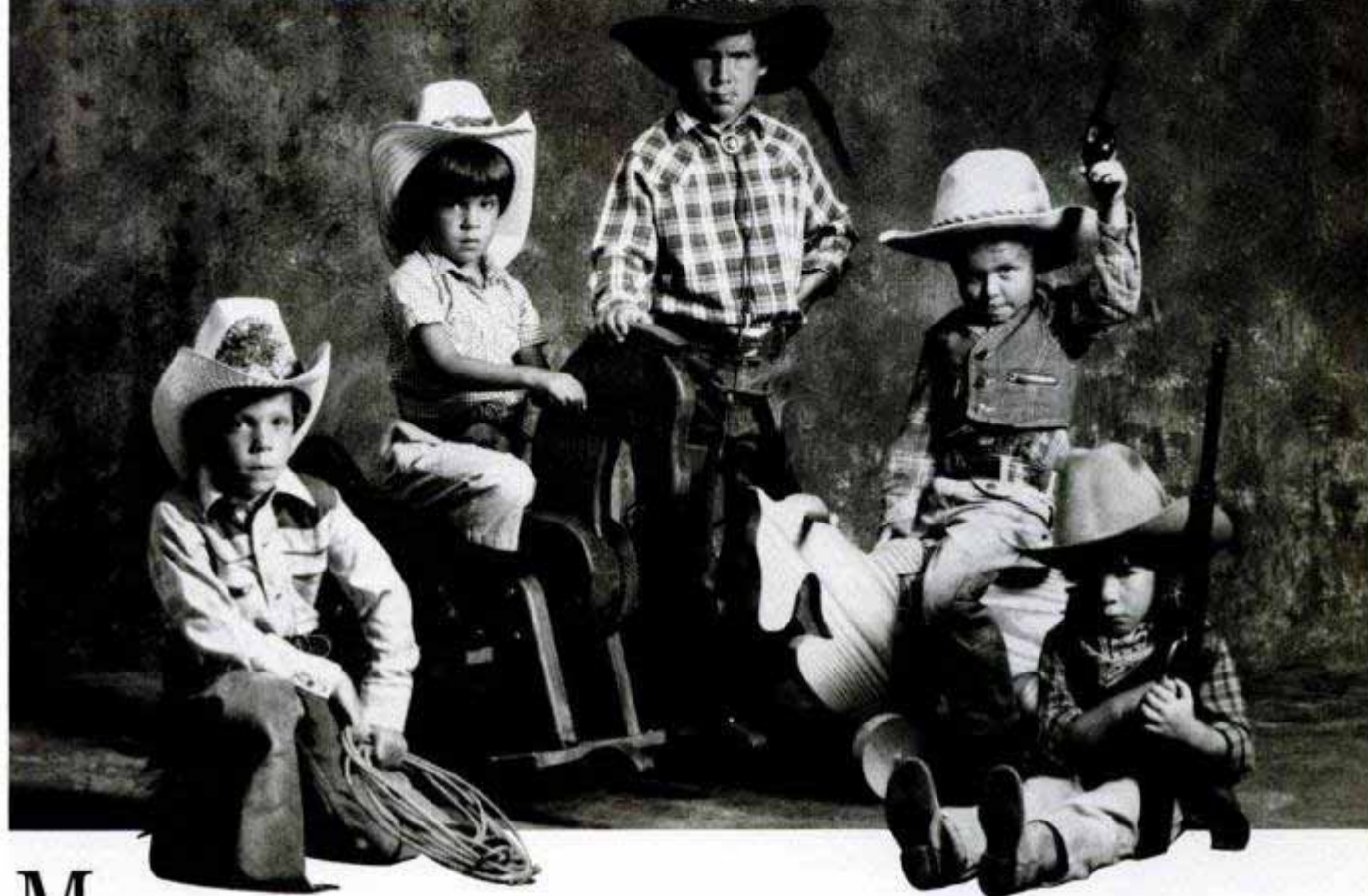


19 The Sioux $\frac{3}{8}$ -in. variable-speed drill features a 58° angled chuck for working in close quarters. The drill's unique shape and paddle switch make for easy 1-hand operation. The 3½-amp, reversible drill has a maximum no-load speed of 1300 rpm. The Model 8000 costs about \$158 and is available through Sioux dealers. For details, contact Sioux Tools, Box 507, Sioux City, IA 51102.



20 Boring holes in hard-to-reach places is an easy task with this 48-in.-long flexible shaft. Simply chuck the exposed end of the shaft into your electric drill and use the shaft's $\frac{5}{16}$ -in.-capacity chuck to hold the bit, wire brush, rotary file or buffing wheel. The flexible shaft will turn up to 6000 rpm. It's available for \$32.95 postpaid from Eastwood Co., 147 Pennsylvania Ave., Box 296-PM, Malvern, PA 19355. **PM**

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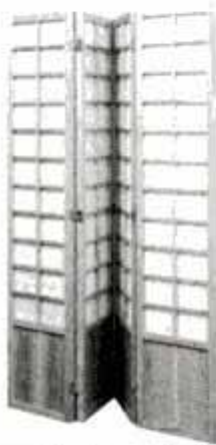
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Dept. 375Z

Private Screening

Based on a traditional Japanese design, this free-standing screen is made of solid ash and has a replaceable rice paper insert.

BY NEAL BARRETT



To provide the greatest interior design flexibility, this screen was built with double-acting hinges so each panel can fold in or out.

If you would like to divide a large room, or add a contemporary touch to a traditional one, you may want to look east instead of west, like we did. This folding screen was designed to match the graceful proportions of a traditional Japanese Shoji screen and, at the same time, be a sturdy and durable furniture piece. It features solid ash construction, rice paper panels, clear shellac finish and removable rear grids so if the paper gets damaged it can be replaced easily.

Preparing the stock

To duplicate it, begin by cutting 6/4 stock to size for all rails and stiles. Then, surface each to a 1 1/4-in. thickness. Next, cut and join stock for the solid panels at the bottom of each screen panel. One good way to form these is by resawing 6/4 stock on the band saw, then forming each panel from the two resulting boards. There are two advantages to this method. First, materials are used more economically than if 4/4 stock were planed to a 1/2-in. thickness. Second, by gluing up resawn stock, you can achieve a bookmatched panel, one that is balanced in color and has a mirror-image grain pattern.

Next, use a jointer to flatten one face of the 4/4 stock used for the panel gridwork. Then, thickness-plane the stock to 3/4 in. for the fixed grids and 1/2 in. for the removable grids. Using a table saw, rip the required pieces from these boards and cut to specified length.

Mortises

Using the drawing as a guide, lay out the location of all mortises on the stiles and top and middle rails. To speed this work, clamp all stiles together with all the ends square to the sides. Lay out mortises on one stile, then use a square to transfer the marks across the other pieces. Keep in mind that these mortises are closer to the front edge of the stiles; they are not centered.

Cutting the mortises can be done by hand

using a doweling jig, portable drill and chisel, but using a mortising attachment on a drill press is much less time consuming. If you'd like to try the latter, just follow the manufacturer's directions for setting up the attachment with a 1/2-in. hollow chisel. Test the alignment on a piece of scrap stock before beginning actual work.

Grooves and tenons

Next, using dado blades in the table saw, cut the grooves for the solid panels in the stiles and the middle and bottom rails. Note that the grooves in the stiles are stopped grooves, so you must end your dado blade cut short, and clean the remainder of the groove with a chisel. These stopped stile grooves also serve as the mortises for the bottom and middle rail tenons.

Again using the dado blades, cut the tenons on rail ends. Once the tenons are cut, tape the vertical grid parts together in one group, and the horizontal grid parts into groups of five or six, and lay out the position of the cross lap joints simultaneously. Then, cut the joints together using dado blades. This method assures precise alignment.

Next, use a 3/4-in.-dia. straight bit in a router table to cut the rabbet—for the removable grid—in the middle and top rails and the stopped rabbet in the stiles. Make the cut in two or three passes for the smoothest results. Again, the stopped rabbet cut will have to be finished with a sharp chisel. When all parts are cut, sand each with 120-grit followed by 220-grit sandpaper.

Assembly

Begin assembly by joining the fixed grids. Place a drop of glue on each cross lap joint and use a clamp to squeeze each tight. If the joints have been cut properly, they should fit snugly.

Black and white photos: Neal Barrett
Technical art: Eugene Thompson
Color photo: Harry Hartman
Photo stylist: Gabe Henick



Woodworking Guide

but if some joints are loose, you should reinforce them by driving $\frac{7}{16}$ -in. brads through the mating parts.

Next, join the top and middle rails to the fixed grid assembly with glue and, when dry, glue this assembly into the stiles as shown. Then slide the wood panel into its groove, but do not glue it in place. It should "float" to allow for seasonal wood movement. Finally, glue the remaining stile in place and draw

MATERIALS LIST—FOLDING SCREEN

Key	No.	Size and description (use)
A	8	$1\frac{1}{4} \times 1\frac{1}{4} \times 72$ " ash (stile)
B	4	$1\frac{1}{4} \times 1\frac{1}{4} \times 13\frac{1}{2}$ " ash (top rail)
C	4	$1\frac{1}{4} \times 1\frac{1}{4} \times 13\frac{1}{2}$ " ash (middle rail)
D	4	$1\frac{1}{4} \times 1\frac{1}{4} \times 13\frac{1}{2}$ " ash (bottom rail)
E	4	$\frac{1}{2} \times \frac{3}{4} \times 55\frac{1}{2}$ " ash (fixed grid vertical member)
F	40	$\frac{1}{2} \times \frac{3}{4} \times 13\frac{1}{2}$ " ash (fixed grid horizontal member)
G	12	$\frac{1}{2} \times \frac{1}{2} \times 55\frac{1}{2}$ " ash (removable grid vertical member)
H	48	$\frac{1}{2} \times \frac{1}{2} \times 13\frac{1}{2}$ " ash (removable grid horizontal member)
I	4	$\frac{1}{2} \times 13\frac{1}{2} \times 14\frac{1}{4}$ " ash (panel)
J	9	$1\frac{1}{4}$ " double-acting hinge
K	24	1" No. 6 fh brass screw
L	8	24×30 " sheet of rice paper
M	As reqd.	$\frac{7}{16}$ " brads

tight with bar clamps. Be sure to check the panel for squareness by comparing opposite diagonal measurements.

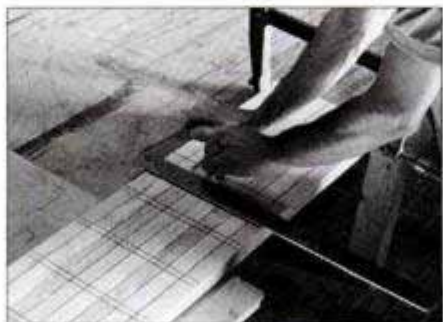
While the panels dry, assemble the removable grids in the same manner as the fixed grids. Apply glue to all joint surfaces, and use brads to pin the joints if necessary. Allow the grids to dry overnight.

Finish-sand all panels, then lay out the position of the hinges. Bore pilot holes for the screws and attach to the edges of the stiles. These hinges need not be mortised into place. They will

provide a uniform $\frac{3}{16}$ -in. space between the panels.

Remove the hinges for finishing, then spot-sand the panels as necessary to remove any scuffs resulting from assembly. Apply $\frac{3}{4}$ -in.-wide masking tape to the back side of the fixed grid. This will leave an unfinished surface to accept the glue used to attach the rice paper.

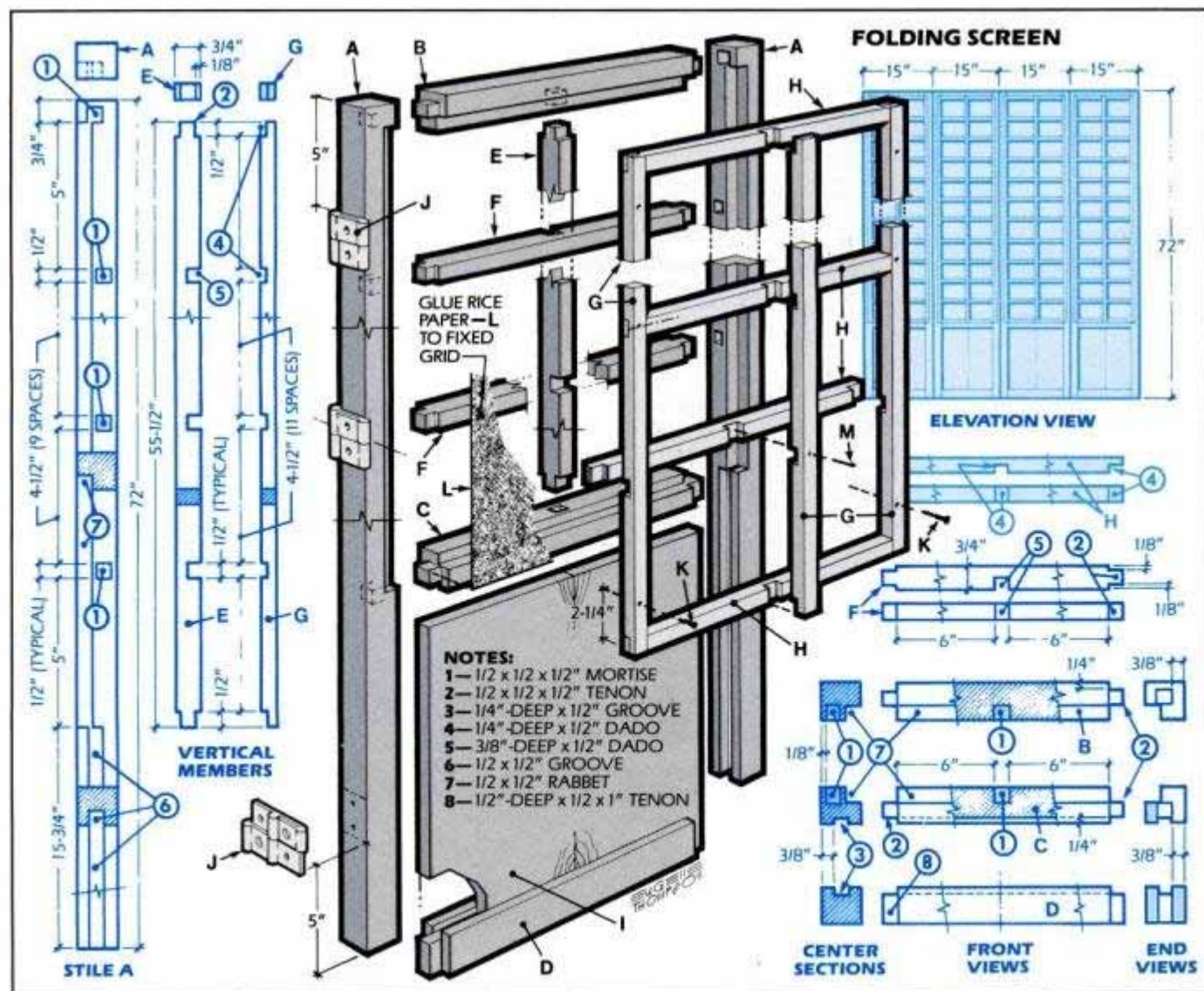
To finish, apply two coats of clear shellac. Thin the first coat to a 1-pound cut to penetrate and seal the wood. Let it dry, then sand lightly with 220-grit



1 Cut all stiles to size. Then, clamp together and lay out position of all grid mortises at the same time to ensure accuracy.



2 Cut grid mortises in rails and stiles using drill press mortising attachment (above) or doweling jig and handheld chisel.



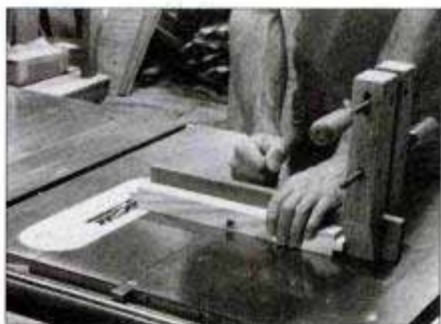
sandpaper. Wipe the work with a tack cloth and apply the second coat in a 3-pound cut.

When the second coat of shellac has dried thoroughly, rub the surface of the work with 4/0 steel wool to achieve a satin finish.

Rice paper

Next, remove the masking tape from the grids and cut the rice paper to size. Because the paper usually comes in 24-in. x 30-in. sheets, you will have at least one seam in each panel. Be sure that you cut the paper so that the seams fall over grid members. The pieces of rice paper should overlap each other by at least 1/4 in.

Use a starch-based glue, such as wallpaper paste, to attach the rice paper. This dissolves in water, which makes replacement of the paper easy if it's ever damaged. You'll just have to dampen the paper with a wet rag and pull it off.



4 Cut tenons on rail ends using dado blades in table saw. Clamp-on miter gauge acts as stop to ensure identical cuts on all parts.



3 Use dado blades to cut panel groove in stiles and bottom and middle rails. Use featherboard and push sticks for safe cut.



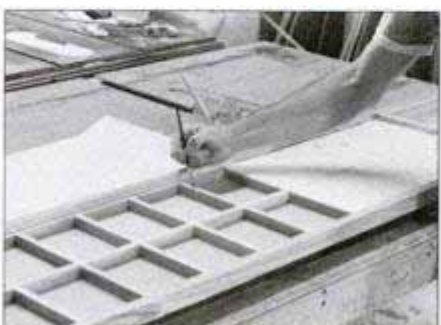
5 Tape vertical and horizontal grid parts together in separate groups. Then, lay out and cut cross lap joints using dado blades.



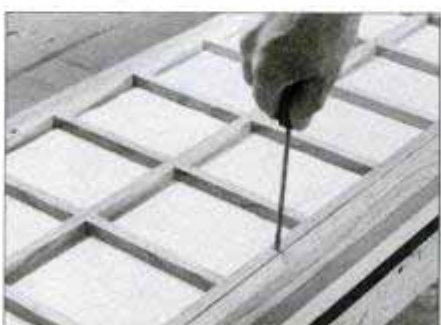
6 Apply glue to mating notches on grid parts, then bring each joint tight with a small clamp. Make sure assembly is square.



7 When grid assembly is dry, apply glue to grid tenons and frame mortises. Gently drive assembly in place with wood mallet.



8 Apply glue to back side of fixed grid, then press rice paper into place. Make sure seams in paper fall over grid member.



9 Assemble removable grid for each panel, then attach with #8 brass screws. Bore pilot holes and countersink flush to surface.

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Cherry Chest

A solid cherry chest for linens and blankets will challenge anyone's hand joinery techniques.

BY NEAL BARRETT



This simple, solid cherry chest features a large open compartment that can store a variety of items including linens, blankets, comforters and even seasonal clothing.

Blanket chests are just about as traditional as 4-poster beds, and in days gone by, nearly as popular. They provided needed storage space for linens, blankets and comforters before the days of central heat. And even though modern conveniences, such as the electric blanket, may have diluted some of their original purpose, these chests are still extremely useful. So much so, in fact, that some have moved out of the bedroom altogether and are being used for coffee tables, clothes hampers and seating benches.

The design shown here was chosen for its simple lines so the chest would complement a wide range of interior decors. But this piece also defers to tradition, in its hand-cut dovetail joinery and its solid cherry construction.

Preparing the stock

Begin by cutting 4/4 cherry stock to rough length for all parts, then surface each to 3/4-in. thickness and edge-join to form the panels. Match color and grain within panels as much as possible, and use 1/4-in.-dia. dowels every 6 or 8 in. along the joints to ease alignment of the boards. Glue and clamp each panel, alternating clamps above and below the work, to equalize pressure and eliminate buckling.

Black and white photos: Neal Barrett
Technical art: Eugene Thompson
Color photo: Harry Hartman
Photo stylist: Gabe Hemick

When the glue has started to cure, use a scraper or chisel to remove excess glue before it completely hardens. Smooth the surfaces using a belt sander with a 120-grit belt.

Cut the panels to finished size, then using the drawing as a guide, lay out the dovetail pins on the front and back panel ends. Note that both the pins and tails should be cut to leave 1/32 in. of wood projecting beyond the joint. It will be trimmed off after assembly.

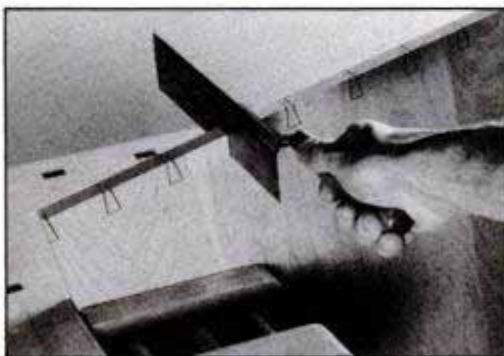
Clamp the rear panel in a workbench vise with one end up and the outside panel face toward you. Use a dovetail or backsaw to cut along each line to the specified depth. Be sure to cut just to the waste side of the line. If there's one thing that cannot be stressed too strongly, it is that careful cutting is the key to success in dovetail joinery.

After all the pins have been cut, place the panel on the bench with the outside face down, and using a razor-sharp chisel, cut the line between each pin. Make sure the bevel on the chisel blade faces the edge of the board. Then, turn the panel over and cut the line between the pins on this side.

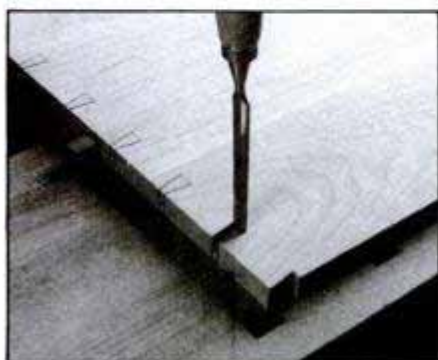
After all the pins are shaped, mark the position of the dovetails (pin sockets) on the chest ends. Do this by tracing the pins onto their corresponding joint member. If there is any minor variation in the pins, it will be directly reflected in the position of the matching tails and the joint will still fit properly. Mark the tails using a knife or very sharp, hard pencil. Remember that the tails should



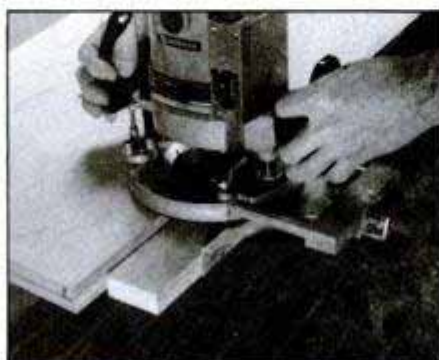
1 Lay out dovetail pins on the ends of the front and back panels. Then carefully cut the pin sides to depth using dovetail or backsaw.



2 After the pins are cut, trace their shape onto the ends of the side panels. Tilt side panels in a vise at 8° angle and cut the tails to depth.



3 Carefully remove waste between side panel tails using sharp chisel. Keep bevelled edge of blade pointing toward board edge.



4 Edge-join stock to form bottom and cut to specified size. Then cut decorative shape of all edges using router and core box bit.



5 Once chest sides are assembled, center bottom over them and attach with screws. Be sure to bore and countersink pilot holes.

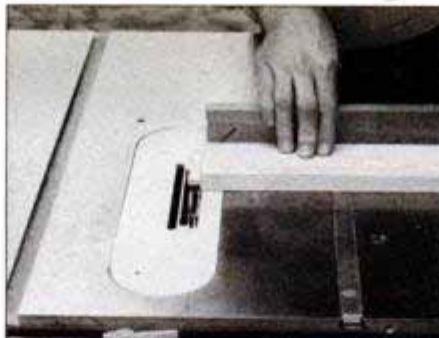
Woodworking Guide

be cut $\frac{1}{32}$ in. deeper than the front or back panel thickness.

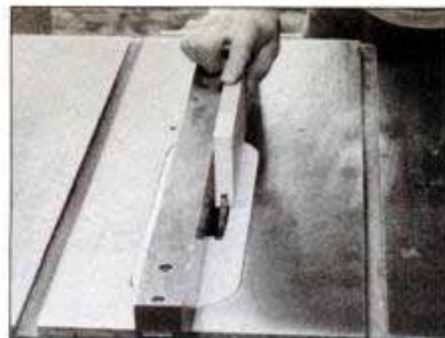
When cutting the tails, it's a good idea to clamp the panel in the vise tipped about 8° to one side so that your sawing motion will be nearly vertical. Use a razor-sharp chisel to remove the waste between tails employing the same technique used on the pins.

Test-fit the joints. They should require only gentle mallet blows to bring them tight. Use a sharp chisel to trim a tail or pin as necessary for a proper fit.

When all joints are adjusted, separate the assembly and sand the inside surfaces of each panel using 120- followed by 220-grit sandpaper. Then apply glue sparingly to all mating surfaces and



6 Cut both end rails for the chest lid to size, then cut a tenon on each end using dado blades in a table or radial-arm saw.



7 Using dado blades again, cut center groove down inside edge of both stiles to accept the floating chest lid panel.



8 Using router with guide, form a tongue on all four sides of lid panel by cutting $\frac{1}{4}$ -in.-deep rabbet on top and bottom edges.

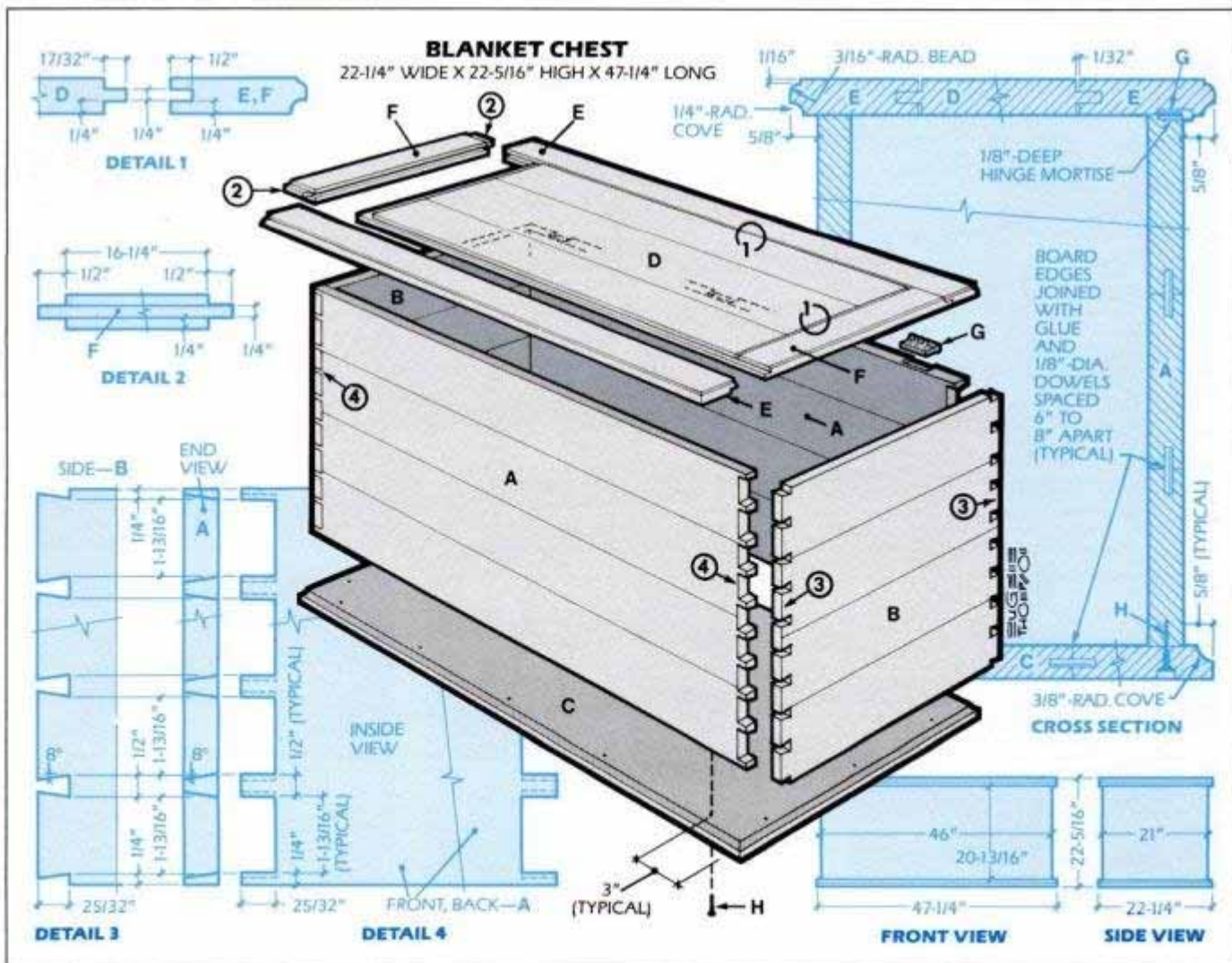


9 Lay out hinge position, then mortise leaves into back and lid. Carefully bore pilot holes and attach hinges with screws.

MATERIALS LIST—BLANKET CHEST

Key	No.	Size and description (use)
A	2	$\frac{3}{4} \times 20\frac{13}{16} \times 46\frac{1}{16}$ cherry (front, back)
B	2	$\frac{3}{4} \times 20\frac{13}{16} \times 21\frac{1}{16}$ cherry (side)
C	1	$\frac{3}{4} \times 22\frac{3}{4} \times 47\frac{1}{4}$ cherry (bottom)
D	1	$\frac{3}{4} \times 17\frac{1}{4} \times 41\frac{1}{4}$ cherry (lid panel)
E	2	$\frac{3}{4} \times 3 \times 47\frac{1}{4}$ cherry (lid stile)
F	2	$\frac{3}{4} \times 3\frac{1}{2} \times 17\frac{1}{4}$ cherry (lid rail)
G	3	Brainerd No. 6250 butt hinge
H	16	$1\frac{1}{4}$ " No. 8 fh screw

Misc.: Glue, 120-, 220-, 400-grit abrasive paper, $\frac{1}{8}$ -in.-dia. \times 1" dowels (as reqd.), $\frac{1}{4}$ -in.-wide \times 14-in.-long section of flat brass chain with two $\frac{1}{2}$ " No. 6 rh brass screws.



bring the joints tight. Work quickly so the glue does not set before the joints are assembled and use bar clamps to hold the joints in place as needed. Be sure to check the box for square by comparing diagonal measurements, then let the assembly dry overnight.

Next, using a sharp block plane, trim the excess wood protruding at each joint. Be sure to plane toward the center of each panel to avoid splitting the wood. Then sand all outside surfaces with 120- followed by 220-grit paper.

Use a 3/4-in. core box bit (Bosch No. 85448M) and router with an edge guide to cut the cove along the top edge of the chest bottom. Finish-sand the bottom as before, then bore and countersink pilot holes, as shown, for the screws that attach the bottom to the box.

Next, cut the lid rails and stiles to size. Then cut the tenons on rail ends and the grooves in the stile edges using dado blades.

Cut the lid panel to size, then install a 3/4-in. straight bit in the router and use the edge guide to rout a 1/4-in.-deep \times 17/32-in.-wide rabbet around top and bottom edges of the chest lid panel. By making the rabbet 1/32 in. wider than the groove in which it rests, a shadow line is formed around the panel's perimeter.

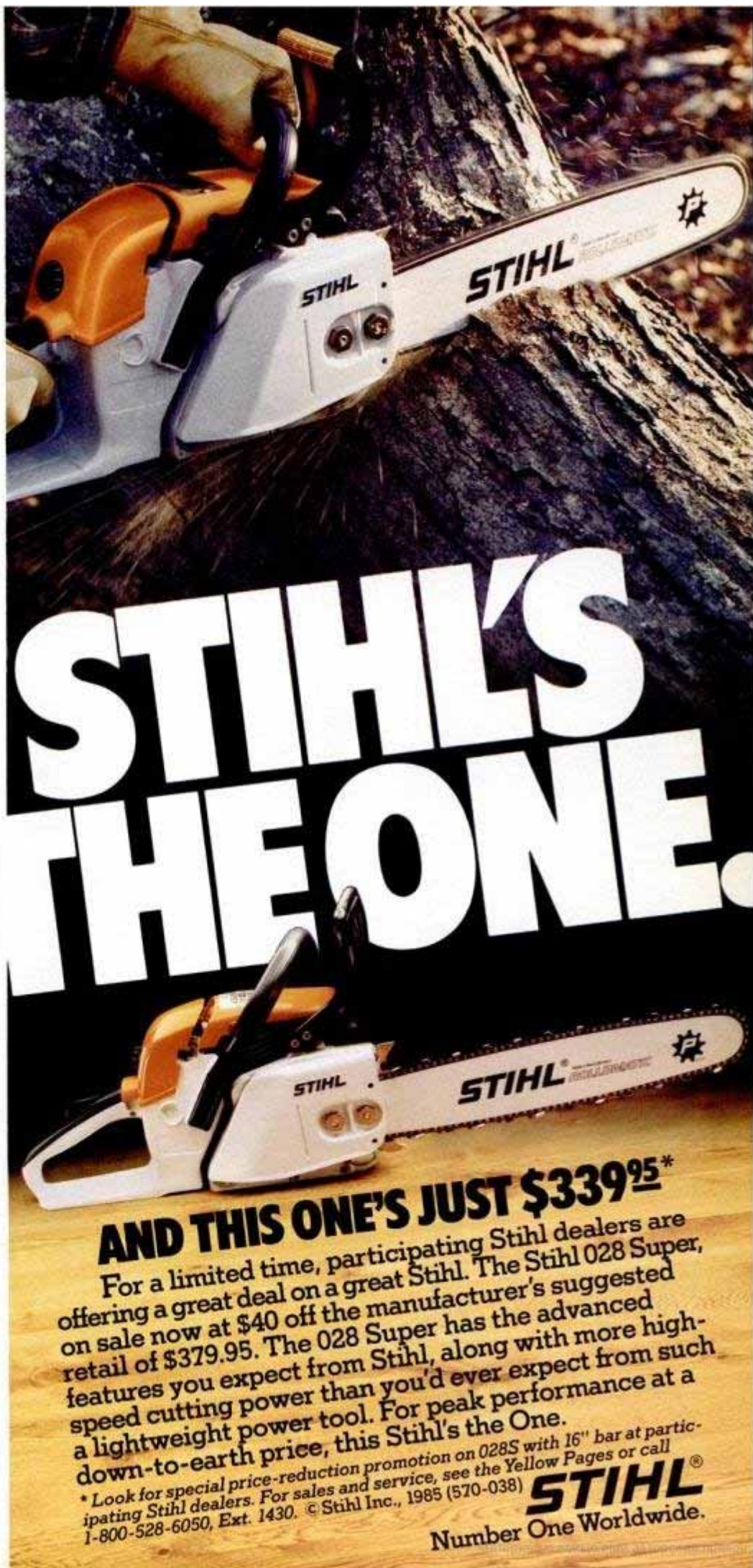
Assembling the lid

To assemble the chest lid, apply glue to rail tenons and to the sections of the stile grooves that will mate with the tenons. The panel is not glued in place. It must float to allow for seasonal wood movement. Clamp the parts together, check for square and let dry overnight.

Clamp the lid upside down on the bench and use a router with a 1/4-in. radius cove bit (Bosch No. 85205M) to rout the cove around the bottom edge. Then turn the lid over and use a 3/16-in. radius beading bit (Bosch No. 85493M) to rout the bead around the top edge of the lid.

Lay out and cut the hinge mortises on the top edge of the chest back and on the underside of the chest lid. Install hinges to the back first, then lay the chest on its back, and attach the hinge to the lid as shown. To remain faithful to the simplicity of the chest design, we used a brass chain as a lid restraint. It is simply screwed to the inside of the chest and the underside of the lid. If you prefer, a spring-loaded or friction lid support can be substituted.

Spot-sand as necessary with 220-grit paper to remove any marks, then wipe with a tack cloth. To finish, we applied three coats of Watco Natural Danish Oil Finish. For the first coat, liberally brush on the oil, sand with 400-grit wet or dry paper and wipe dry. Allow to set overnight. For the second and third coats, brush on the oil, let it soak in for about 30 minutes, then simply wipe dry. **PM**



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STIHL
Number One Worldwide.



An Armoire For All Reasons

This versatile furniture piece makes the most of your stock options. It can be used as a wardrobe, a display case or even as an extra kitchen cabinet.

BY ROSARIO CAPOTOSTO

In days gone by, houses may have been long on atmosphere, but they were certainly short on closet space. Because of this, an armoire—or wardrobe—was essential for storing clothing and other personal accessories. Even today, when walk-in closets can sometimes seem cavernous, the armoire's appeal remains because it is so versatile. Its large storage capacity is movable, so it can benefit every room in the house, even if you have all the closet space you need. Holding books, crystal, china, pottery and stereo equipment are just a few of the possibilities for this useful piece of furniture.

The piece shown here is based on large traditional dimensions. But we have taken the idea of versatility one step further by offering two different door options—glass and cane panels. And as a bonus we also provide a drawing for a flexible layout if you do, in fact, want to use the cabinet for storing clothes.

Construction details

This case is made of birch veneer plywood and solid maple stock, which are look-alikes and usually match up well. The reason for the mix is the issue of availability: most lumberyards stock birch plywood, while maple plywood is generally a special order item and may require a minimum quantity order.

Begin construction by cutting the sides to size. Then use a dado blade in the table saw to cut the lengthwise rabbets and grooves in these panels. Cut the cross dados and end rabbets with a router because the panels are too large for easy cross feeding on the table saw. Use a 3/4-in.-dia. straight bit and the jig shown in photo No. 1. The spacing between the boards on the jig should equal the diameter of the router base.

Next, cut the shelf standards to length and bore pilot holes for the attaching nails (or screws) but do not install the standards yet. Then, cut the back panel to size, as well as the top and bottom of the case. Sand all parts with 220-grit abrasive.

Case assembly

Begin assembly by laying one side panel on the floor resting on two strips of wood—one under the dado and one under the rabbet. With two helpers, set the top and bottom in the rabbet and dado, respectively. Then glue the other side panel to the ends of the bottom and top, and drive 6d finishing nails into each joint through the surface of the side. Set the nailheads. Then, flip the whole assembly over and glue and nail the other side in place. Before the glue sets, glue and nail the back panel in place to ensure square assembly.

Next, cut the face rails and stiles to size, then using a doweling jig, bore the holes for the dowel pins. Do not, however, join these parts until the legs are complete.

Legs

The face stiles extend to the floor and are doubled up at the bottom to form the front legs. Join these two assemblies with glue and clamps. When dry, cut the legs to shape using a tapering jig shown in photos 3 and 4.

Next, glue and clamp the face rails to the stiles using the dowel pins shown. Be sure to check the assembly for square. When dry, glue and clamp the face frame to the case, using a few finishing nails to keep the frame from sliding out of alignment. Be sure to set the nailheads and fill the holes.

The rear legs are also made of two separate pieces of stock. Notch the top ends of both as shown on the drawing, then glue and clamp together each assembly. When dry, cut to shape with the tapering jig on the table saw. Then join the three cross supports, glue and screw the rear legs to this assembly and, when dry, attach the legs and supports to the case bottom as a single unit.

Doors

Cut stock for the door rails and stiles. When



Black and white photos: Rosario Capotosto
Technical art: Eugene Thompson
Color photo: Harry Hartman
Photo stylist: Gabe Herrick

Woodworking Guide

making the cane doors, keep in mind that the caning fits into a simple rabbet in the back of the door frame, and is secured with wood cleats and brads. The glass panels, however, require a groove for the plastic spline as well as a rabbet. Make these cuts—as shown in photos 6 and 7—to the specifications given in the drawing.

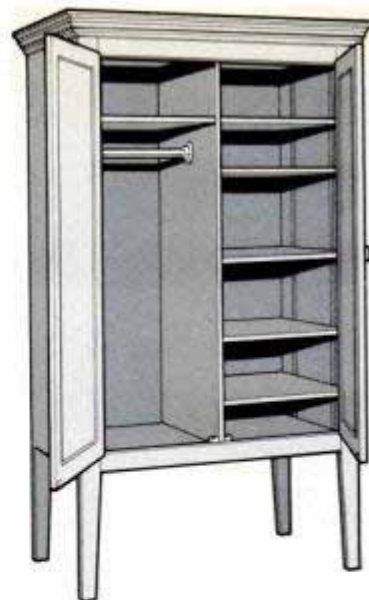
Next, cut the decorative edge on the inside of the rails and stiles using a roman ogee bit and router table. Then miter the corners on the door frame parts using the jig shown in photo 10. Finally, cut the spline grooves for the miters and cut the matching splines to the proper size.

Assemble the door frames with glue and clamps. Make sure each frame is

perfectly square and readjust the clamps if necessary. When dry, temporarily hang the doors on the case with nonmortised hinges. When you are satisfied with the doors' alignment, remove them from the case.

Next, lay the door frames on a flat surface and lower the glass into place. Cut the plastic spline to length, with ends mitered, and press into its groove with a kitchen spatula. When using the cane instead of glass, just cut the machine-woven cane to size with tin snips. Then press into the rabbet and secure with wood cleats and brads.

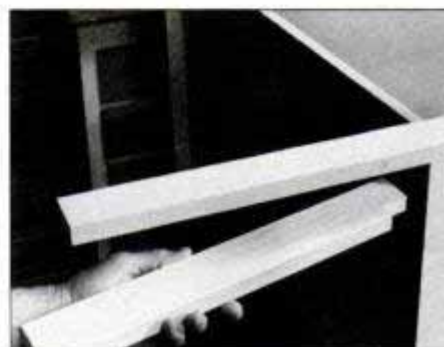
To outfit the case interior for use as a wardrobe, install a 3/4-in.-thick vertical partition in the middle of the case. On one side, hang a closet rod. On the other, install adjustable shelf standards and shelves to suit your needs. Then add either cane or solid panel doors, instead of glass ones.



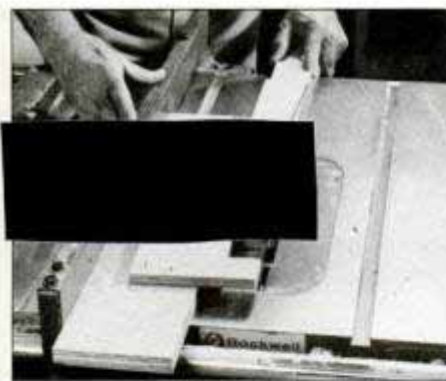
1 Cut lengthwise rabbets and grooves in case sides using dado blades in table saw. But cut cross rabbets and dados using router.



2 Cut standards to length, then bore pilot holes for their screws or nails. Do not attach standards until after finish is applied.



3 Clamp frame stile to case, then cut notch in rear member of front leg. Check for fit, then glue rear member to stile.



4 Cut taper on front leg assembly using simple jig. To set up, butt leg to blade, slide fence and jig against leg, lock fence.



5 To cut taper, place end of leg in jig notch then feed both over blade. Width of notch matches finished width of leg bottom.

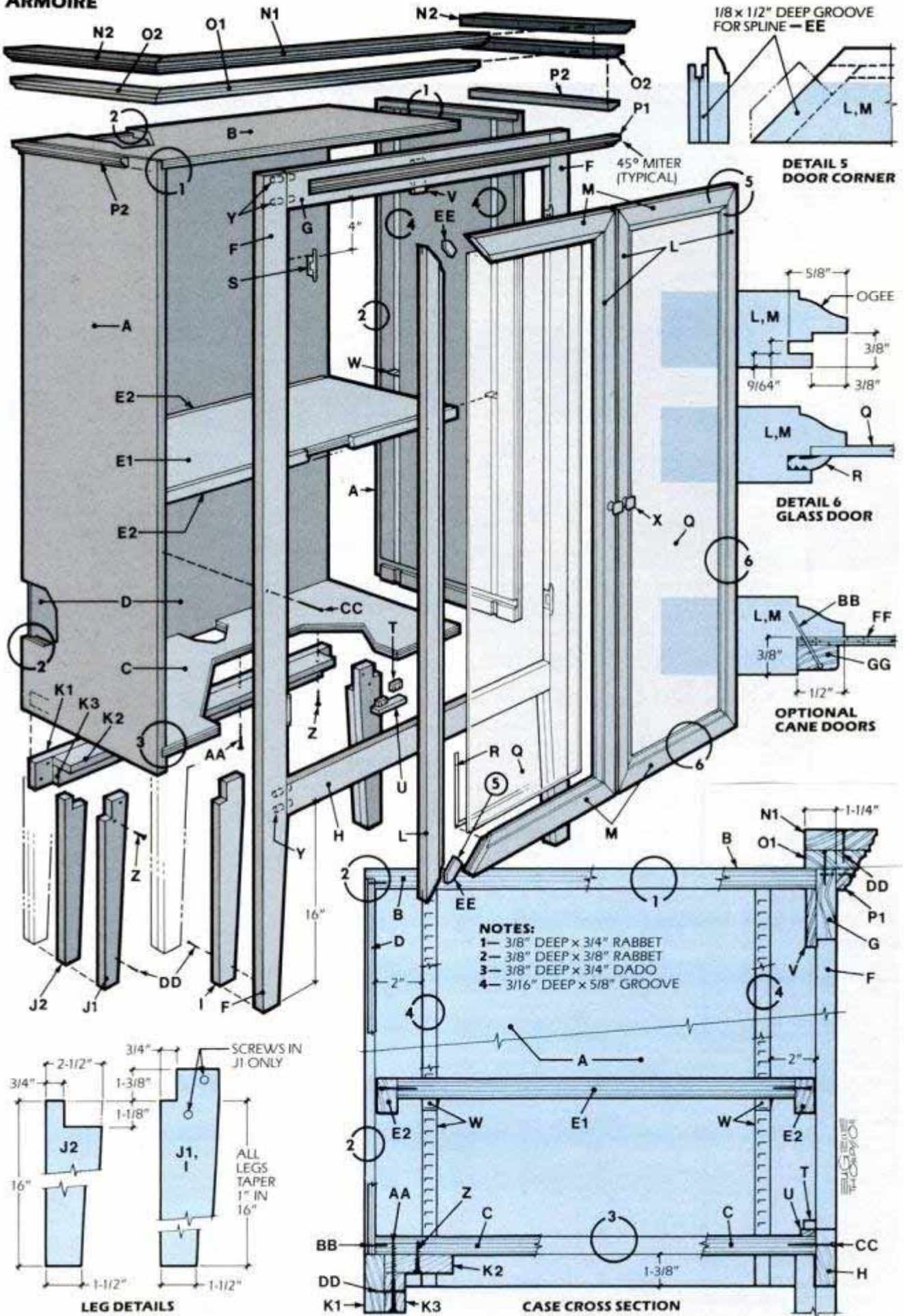


6 Glue frame to case using bar clamps spaced 2 ft. apart. Be sure to use glue blocks between clamp and face to avoid damage.

MATERIALS LIST—ARMOIRE

Key	No.	Size and description (use)		
A	2	3/4 x 19 1/2 x 56" birch plywood (side)	O2	2 1 3/16 x 2 1/2 x 21 3/16" maple (molding)
B	1	3/4 x 19 1/2 x 39 1/4" birch plywood (top)	P1	1 1 3/16 x 3/4 x 41 1/2" maple (molding)
C	1	3/4 x 19 1/2 x 39 1/4" birch plywood (bottom)	P2	2 1 3/16 x 3/4 x 21 1/16" maple (molding)
D	1	3/4 x 39 1/4 x 54 1/4" birch plywood (back)	Q	2 1/10 x 14 x 47" glass panel
E1	4	3/4 x 17 1/4 x 38 3/4" birch plywood (shelf)	R	22 ft. Plastic spline
E2	8	1 3/16 x 1 1/4 x 38 3/4" maple (edging)	S	4 Nonmortise butt hinge
F	2	1 3/16 x 2 1/2 x 72" maple (stile)	T	2 Magnetic catch
G	1	1 3/16 x 3 x 35" maple (upper rail)	U	1 3/8 x 1/2 x 4" maple (magnetic catch block)
H	1	1 3/16 x 2 1/2 x 35" maple (lower rail)	V	1 3/8 x 1 1/4 x 2 5/8" maple (door stop)
I	2	1 3/16 x 2 1/2 x 17 3/4" maple (front leg)	W	4 5/8 x 53" shelf standard with 16 support clips
J1	2	1 3/16 x 2 1/2 x 17 3/4" maple (rear leg)	X	2 1 x 1" square maple knob
J2	2	1 3/16 x 2 1/2 x 16" maple (rear leg)	Y	8 3/8"-dia. x 2" hardwood dowel
K1	1	1 3/16 x 2 1/2 x 38 1/2" maple (support)	Z	8 1 1/4" No. 12 fh screw
K2	1	1 3/16 x 3 x 35" maple (support)	AA	3 3" No. 12 fh screw
K3	1	1 3/16 x 1 1/16 x 35" maple (support)	BB	* 3/4" 18 gauge brads
L	4	1 3/16 x 2 x 50 1/2" maple (door stile)	CC	* 6d finishing nails
M	4	1 3/16 x 2 x 17 3/4" maple (door rail)	DD	* 3d finishing nails
N1	1	1 3/16 x 3 x 43 1/2" maple (molding)	EE	8 1/2 x 1 x 2" plywood (spline)
N2	2	1 3/16 x 3 x 22 1/16" maple (molding)	FF	2 14 1/4 x 47 1/4" woven cane (door panel)
O1	1	1 3/16 x 2 1/2 x 42 1/2" maple (molding)	GG	22 ft. 1/4 x 7/16" maple (cleats)
				*As reqd.

ARMOIRE



- NOTES:**
- 1— 3/8" DEEP x 3/4" RABBET
 - 2— 3/8" DEEP x 3/8" RABBET
 - 3— 3/8" DEEP x 3/4" DADO
 - 4— 3/16" DEEP x 5/8" GROOVE

Woodworking Guide

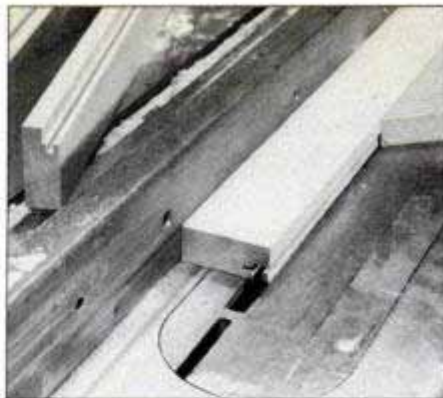
Crown molding

The crown molding is made of three pieces that are shaped, mitered and installed individually. Glue and nail the front piece of each set in place first, followed by the sides. Then apply the others in a similar fashion.

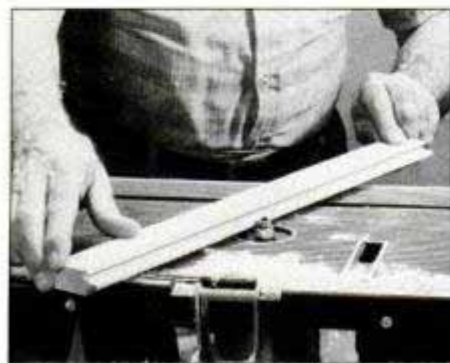
Once the glue on the molding has dried, finish-sand the entire piece with 220-grit abrasive. Wipe with a tack cloth, then apply two coats of polyurethane. We used McCloskey Satin Polyurethane—the first coat thinned six parts varnish to one part mineral spirits; the second coat was full strength. Final-



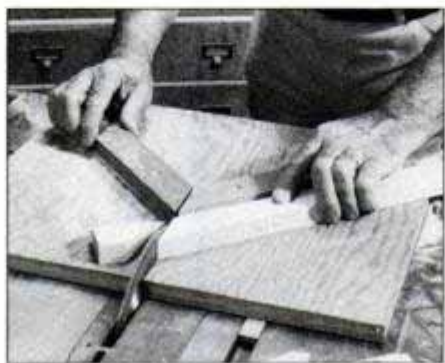
7 Rip grooves in door rails and stiles to accept glass panels. First cut is for spline. Second cut (shown) forms ledge for glass.



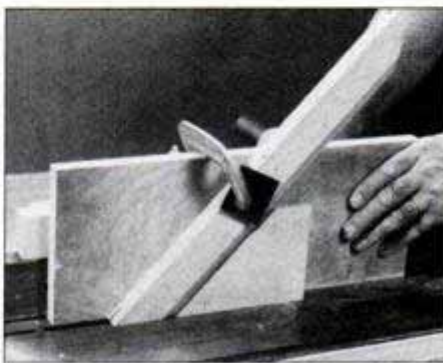
8 Third and final cut forms rabbet that provides clearance for inserting glass panel. Rabbet should align with glass ledge.



9 Cut ogee shape on inside edge of rails and stiles using router table. Feed against bit's rotation and cut in several passes.



10 Cut miters on door parts using platform jig. Jig has base that rides in table slots and two surface blocks that form 90° angle.



11 Cut spline groove in door parts using jig shown. Clamp work against jig side and on top of 45° block. Then push over blade.

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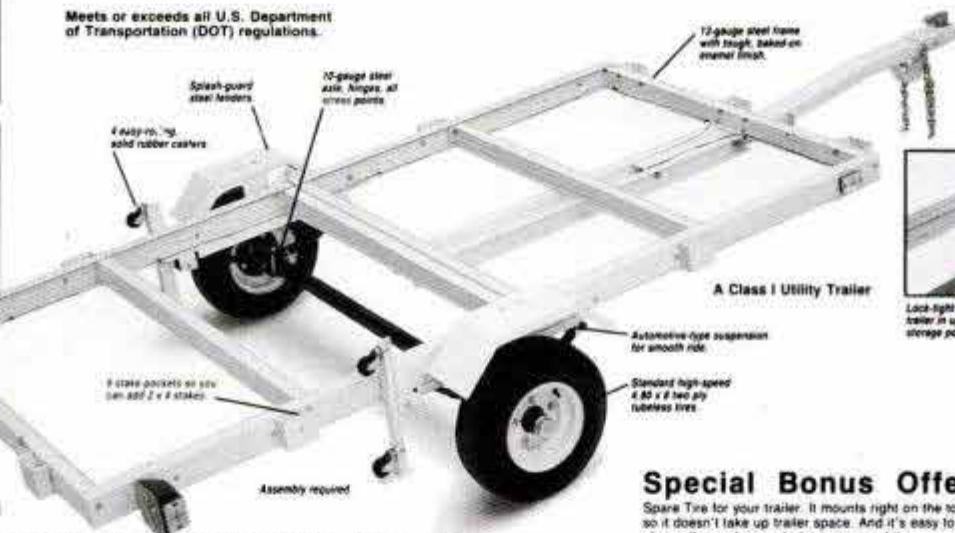
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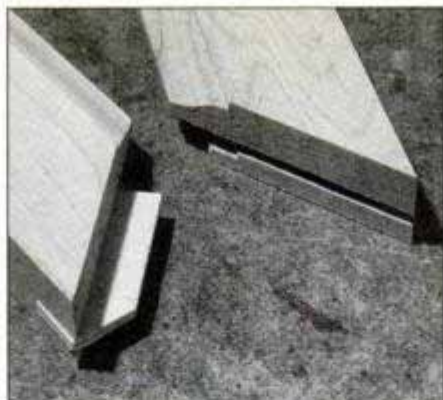
ly, cut the shelves to size, apply the edging and sand with 220-grit abrasive. When the finish is dry, install the shelf standards and other hardware. **PM**

SOURCE LIST

The caning is available from Constantine's, 2050 Eastchester Rd., Bronx, NY 10461. Write for a free catalog.

The four nonmortise butt hinges, two magnetic catches and 22 feet of plastic spline are available as a kit from Armor Products, Box 445, East Northport, NY 11731, for \$11.50, postpaid. The hardware kit less the spline is priced at \$8.50, postpaid.

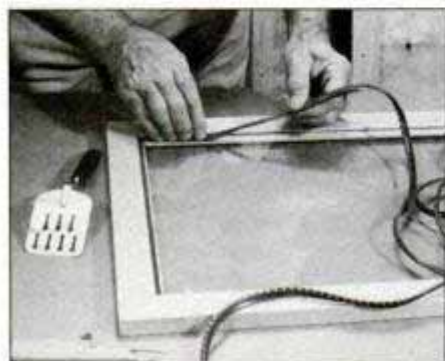
The cabinet router bits used to cut the crown molding are available with 1/4- or 1/2-in. shanks from Furnima Industrial Carbide, Biernackie Rd., P.O. 308, Barry's Bay, Ontario, Canada K0J 1B0. Write for prices.



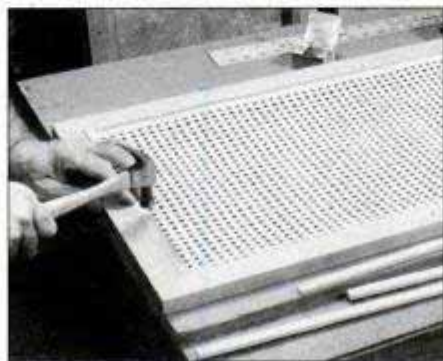
12 Splined miter joint is ready for assembly. Plywood works best for spline, but solid wood or hardboard can be substituted.



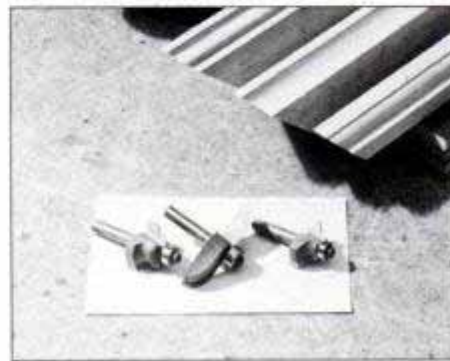
13 Attach doors with nonmortise hinges. For best alignment, hang outer leaf on case, then mark position of inner leaf on door.



14 Lay door frame on bench and slide glass into place. Secure with plastic spline forced into notch with end of kitchen spatula.



15 If caning is used, attach it with cleats and brads. Angle brads slightly to avoid breaking through front surface of door.



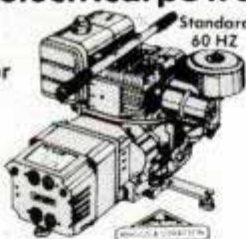
16 Crown molding is made from three boards using 1/4-rad. ogee (left), 1/2-rad. panel raising (middle) and 1/4-rad. beading bits.

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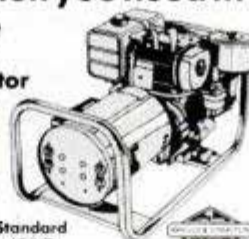
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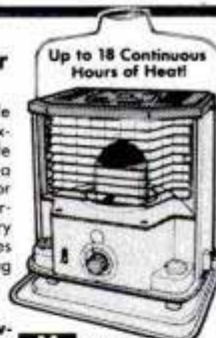
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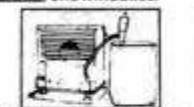
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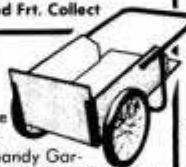
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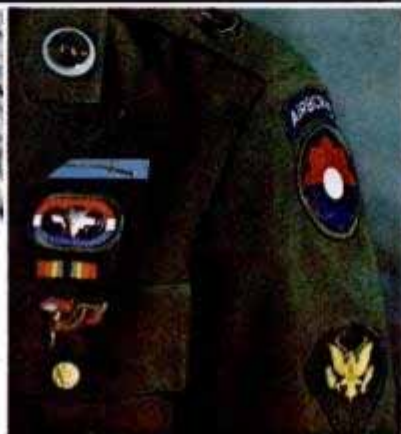
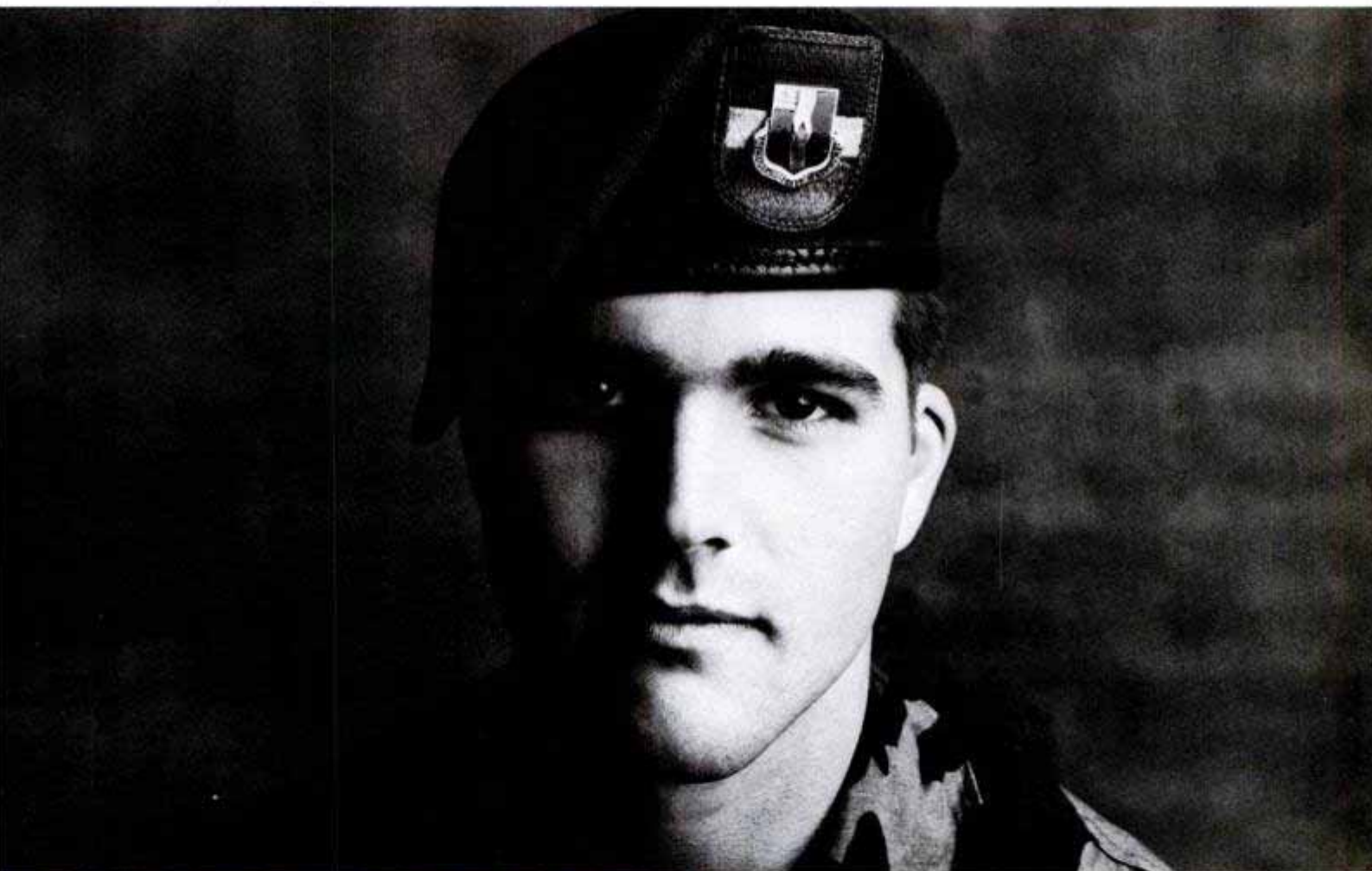
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Black Lacquer

Black is back and high gloss is hot. Bring today's most fashionable look into your home with this beautiful coffee table that gives you five finishing options.

BY ROSARIO CAPOTOSTO

A lacquer finish is the choice of many professional furniture manufacturers because it's very fast drying, durable and ideally suited for spray application. Presented here are four do-it-yourself methods of applying a high-gloss black lacquer finish to your woodworking projects. The methods include spraying with an air gun and compressor, using an airless sprayer, using spray cans and brushing lacquer. A fifth bonus

option shows how to achieve a lacquer look by brushing on an oil enamel.

The first thing to consider when building a lacquered piece is the choice of wood. Avoid using open-grained hardwoods such as oak, ash, walnut or mahogany, since these species require filling to produce a smooth surface. Instead, choose a close-grained wood such as

Color photo: Harry Hartman
Black and white photos: Rosario Capotosto
Technical art: Eugene Thompson
Stylist: Gabe Herrick



Build the table of close-grained hardwood such as poplar (above). Then, build up the finish (below) with sanding sealer and lacquers.



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poplar, birch, maple or cherry. Poplar was used for the table shown because it's easy to work with, accepts lacquer well and is relatively inexpensive.

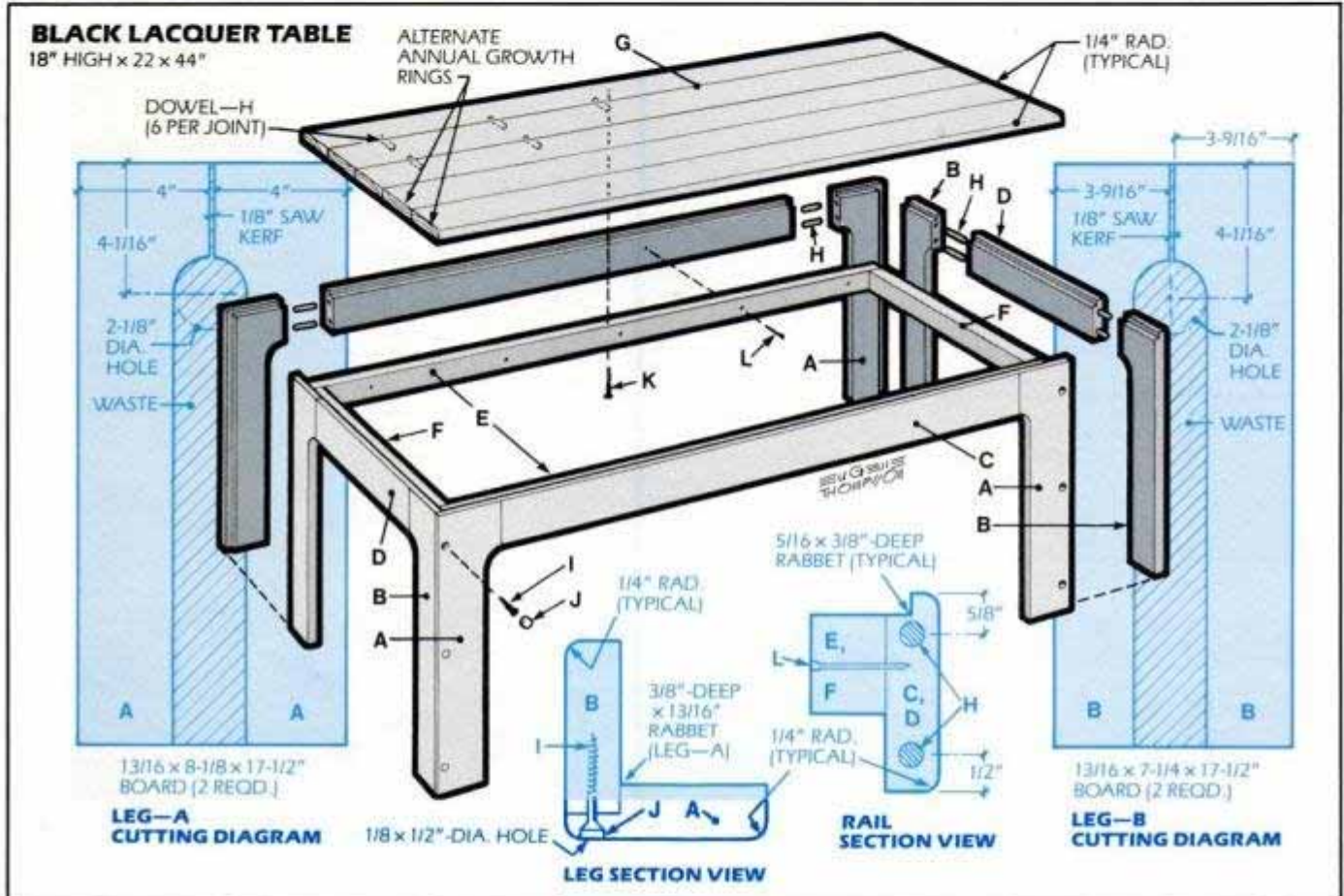
Start by cutting the eight pieces that form the four L-shaped legs. Note that each pair of leg members is cut from a single board. Rip two boards $7\frac{1}{4}$ in. wide x $17\frac{1}{2}$ in. and another two $8\frac{1}{8}$ in. wide x $17\frac{1}{2}$ in. Next, use a $2\frac{1}{8}$ -in.-dia. hole saw to cut a hole in each board as shown in the drawing. Then, make two

rip cuts in each board, tangent to the hole, to drop out the waste (see photo No. 2). Execute the first cut on the side of the hole farthest from the saw fence. This will prevent the work from springing between the blade and fence. After making all the tangent cuts, rip each board down the center to form the eight leg members (No. 3).

Cut a $\frac{3}{8}$ -in.-deep x $1\frac{3}{16}$ -in. rabbet in the edge of the four leg members that were cut from the $8\frac{1}{8}$ -in.-wide boards. Use these four pieces on the sides of the table. The remaining four leg members

don't get rabbeted and are used on the table's ends. Next, cut the four 3-in.-wide rails that join the legs. Match each pair of leg members with a rail and mark dowel pin locations. Mark each joint for two $\frac{3}{8}$ -in.-dia. x 2-in. dowel pins. Then, use a doweling jig to bore $\frac{3}{8}$ -in.-dia. x $1\frac{1}{8}$ -in. dowel pin holes in all the leg members and rails (No. 5).

Assemble the legs to the rails with glue and hardwood dowel pins. Use a single bar or pipe clamp to hold the joints closed. Then, place a C-clamp and blocks over each joint line to prevent



MATERIALS LIST—BLACK LACQUER TABLE

Key	No.	Size and description (use)
A	4	$1\frac{3}{16}$ x 4 x $17\frac{1}{2}$ " poplar (leg)
B	4	$1\frac{3}{16}$ x $3\frac{9}{16}$ x $17\frac{1}{2}$ " poplar (leg)
C	2	$1\frac{3}{16}$ x 3 x 36" poplar (rail)
D	2	$1\frac{3}{16}$ x 3 x 14" poplar (rail)
E	2	$1\frac{1}{8}$ x $1\frac{1}{2}$ x $42\frac{3}{4}$ " poplar (cleat)

F	2	$1\frac{1}{8}$ x $1\frac{1}{2}$ x $18\frac{1}{8}$ " poplar (cleat)
G	1	$1\frac{3}{16}$ x $21\frac{1}{8}$ x $43\frac{1}{8}$ " poplar (top)
H	40	$\frac{3}{8}$ -dia. x 2" hardwood dowel pin
I	12	$1\frac{1}{2}$ " No. 10 flathead screw
J	12	$\frac{1}{8}$ x $\frac{1}{2}$ -dia. hardwood plug
K	18	2" No. 12 flathead screw

L	$1\frac{1}{2}$ " finishing nail
Misc.	Carpenter's and hide glue, sanding sealer, gloss black lacquer enamel, clear lacquer, 280- and 600-grit abrasive paper, rubbing/polishing compound, felt pad.
	*Edge-join five $4\frac{3}{8}$ "-wide x 44" boards.



1 Form the inside leg corners using a drill and a $2\frac{1}{8}$ -in.-dia. hole saw. Drill guide attachment ensures accurate, true holes.



2 Drop out the waste area by making a tangent cut on both sides of the hole. High saw blade reduces length of undercut kerf.



3 Cut each board in half to produce two leg members. As a safety measure, place two fingers over the saw fence, as shown.

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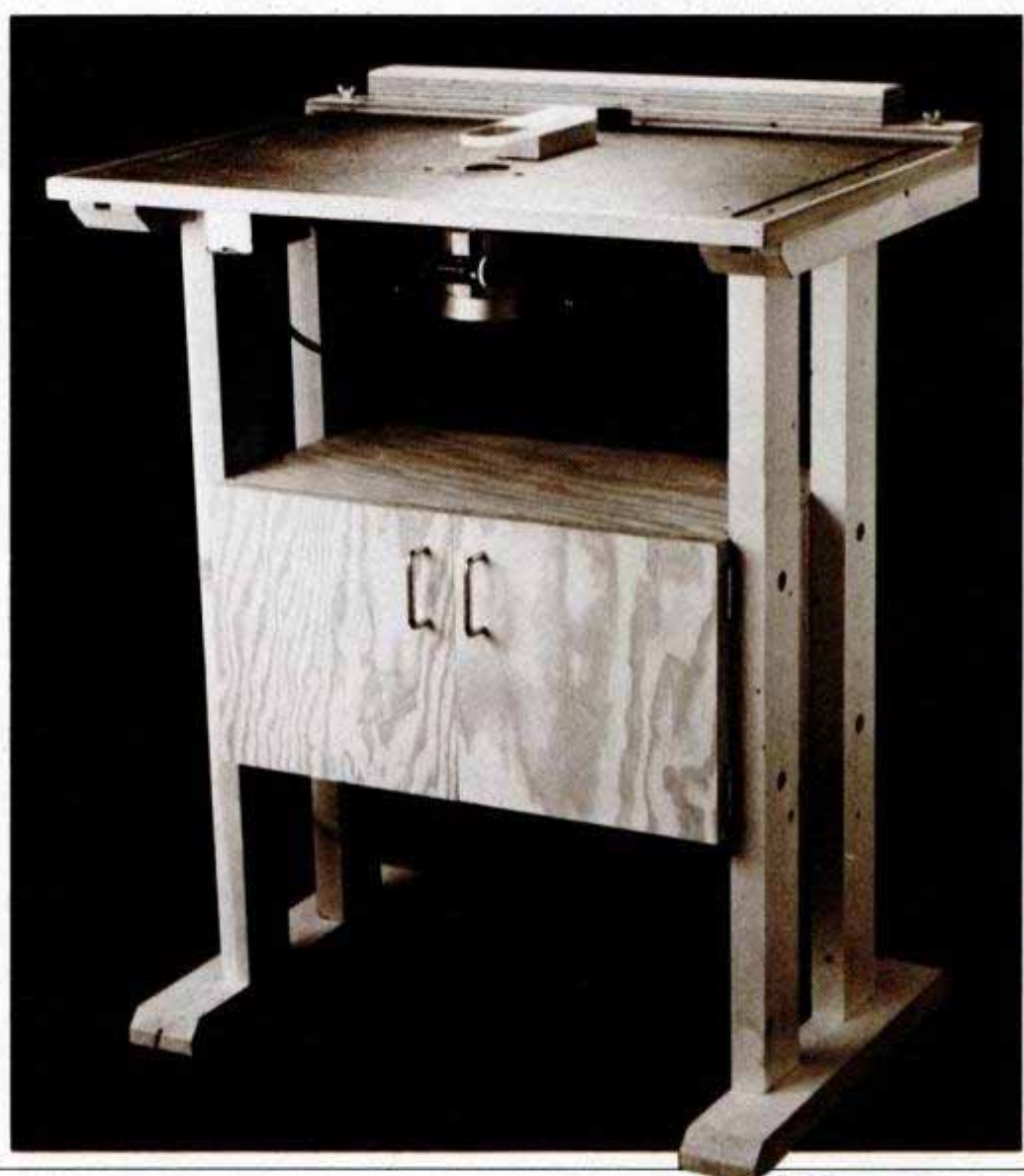
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bowing. After the glued assemblies have dried, scrape off any glue squeeze-out and sand the joints smooth.

Next, rabbet the top, inside edge of each assembly to accept the tabletop (No. 7). Then, prepare to join the four assemblies with glue and screws. First, counterbore a 1/8-in.-deep x 1/2-in.-dia. recess at each screw location to accept wood plugs. Bore a 1/8-in.-dia. screw-pilot hole through each counterbore, dry-assemble the parts with clamps and continue boring the pilot holes into the mating parts. Unclamp the assemblies and bore screw-shank clearance holes through the recesses.

Finally, assemble the parts with glue and 1 1/2-in. No. 10 flathead screws. Glue 1/2-in.-dia. wood plugs in place to conceal the screwheads. Glue and nail four cleats to the inside of the rails to support the tabletop. Next, belt-sand the plugs flush to the wood's surface and rout the edges of the rails and legs, as indicated on the drawing, using a 1/4-in. rounding-over bit.

Make the tabletop by edge-joining five 1 3/16 x 4 3/8-in.-wide x 44-in. poplar boards into a slab. Join the boards with glue and 3/8-in.-dia. x 2-in. dowel pins. Alternate the direction of the board's annual growth rings to deter bowing (see drawing detail). Slow-setting hide glue is used to assemble the tabletop so you can work at a less frantic pace. After the glued-up slab is dry, trim the top to the finished size, plane and sand the surface smooth and round-over the upper edges. Then, glue and screw the tabletop to the cleats.

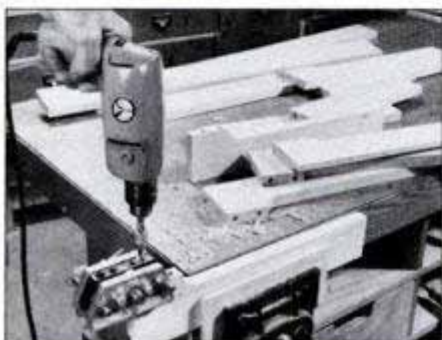
Applying the black lacquer finish

Lacquer, a clear, fast-drying, hard finish, is resistant to water, alcohol, oil, heat and mild acids. The addition of an opaque pigment—in this case, black—produces a lacquer enamel. Since lacquer is the thinnest of all on-surface coatings, a smooth finish is obtained only by building up the surface with several coats. The table shown was lacquered with a spray gun and an air compressor. It received two coats of sanding sealer, three coats of high-gloss black lacquer enamel and three top coats of clear lacquer. *Caution:* Extreme care must be exercised to avoid inhaling lacquer fumes. Be certain to wear a respirator and use an exhaust fan with an explosion-proof motor to ventilate the work area.

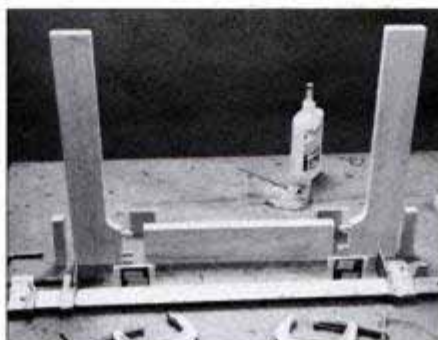
First, wipe the table with a tack cloth to remove all the sanding dust. Next, apply two coats of sanding sealer. Sand lightly between coats with 220-grit abrasive paper. Sanding sealer, which can be sprayed or brushed on, fills the minute pores in the wood and provides a smooth base for the lacquer enamel. Thin the lacquer with an appropriate thinner as recommended by the lacquer



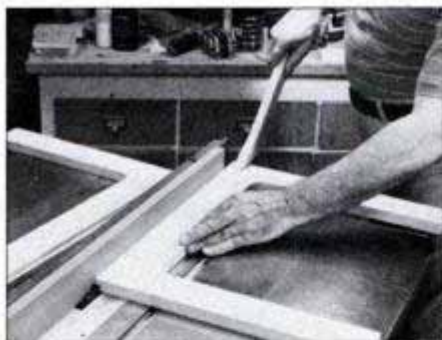
4 Rabbet four leg members, as indicated on the drawing, using a dado blade. Advance the work using a pushstick. An auxiliary wood fence covers part of the dado blade.



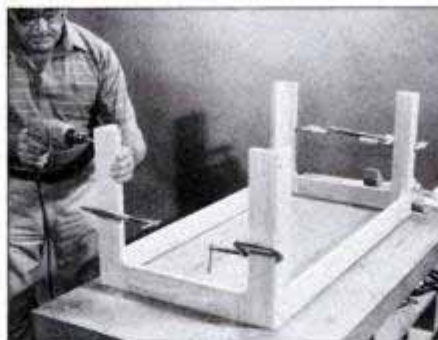
5 Bore dowel pin holes in the legs and in the rails using a self-centering doweling jig. Collar on drill bit controls the hole depth.



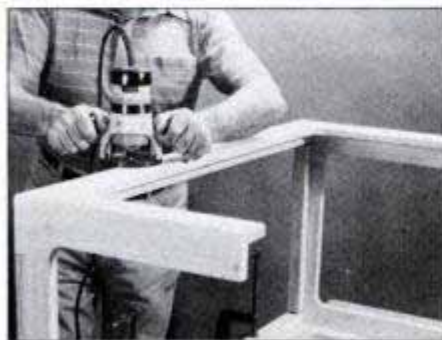
6 Use this setup for assembling the leg members to the rails. Tighten a C-clamp over each doweled joint to prevent bowing.



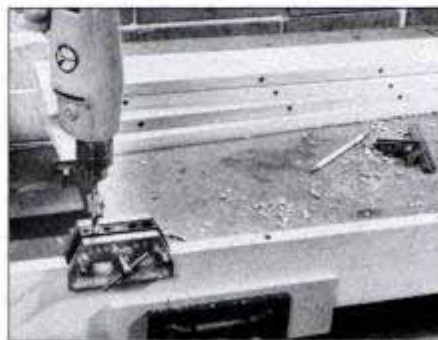
7 Rabbet the upper edge of each leg-and-rail assembly to accept the tabletop. Use a pushstick to advance the work safely.



8 Counterbore the 1/2-in.-dia. plug holes, then dry-assemble the leg-and-rail parts to permit boring the screw-pilot holes.



9 After assembling the table's frame with glue and 1 1/2-in. No. 10 screws, rout the edges using a 1/4-in. rounding-over bit.



10 Form the tabletop by edge-joining five boards into a slab. Bore dowel pin holes in the boards' edges using a doweling jig.

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manufacturer (usually 50:50). Add retarder to the lacquer whenever you're spraying on days when the relative humidity is greater than 50 percent. This will prevent blushing—a white, shadowy cast that appears in the finish due to moisture in the air.

When spraying finishes, it's important to hold the gun about 8 in. from the work and to move it *parallel* to the surface; avoid swinging your arm. Advance the gun at a steady rate to prevent irregular deposits. Begin by spraying the table's underside and the back of the legs. Then, paint the leg's edges and outside corners and the corners where the top meets the rails. Finally, spray the remaining areas of the legs, rails and tabletop.

Although lacquer dries to the touch in a few minutes, allow at least two hours between coats to permit the solvents below the surface to evaporate fully. Then, sand the surface using a felt-padded wood sanding block and 280-grit aluminum oxide, nonfilling (stearated) abrasive paper. The purpose of sanding the lacquer is to smooth out any unevenness and to obtain a uniform, level surface. Spray on at least two more lacquer enamel coats followed by three coats of *clear*, gloss lacquer. Be sure to sand between coats with 280-grit abrasive paper. Sand final coat with 600-grit. Next, apply rubbing/polishing compound to the table with a damp cloth. Rub the compound back and forth in straight lines using a felt pad. Check your progress frequently until the lacquer is reflective. Then, clean off all the compound with a soft cloth and buff the surface to a mirror-like sheen using an electric buffer fitted with a dry lambswool bonnet.

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We used a Wagner Series 100 sprayer, which comes with two spray tips. For applying thin-bodied materials such as lacquer and stain, use the .6-mm tip. For the sprayer to work efficiently, however, the lacquer must be thinned to the proper viscosity. The sprayer comes with a test cup that enables you to thin the material precisely. Simply fill the cup with lacquer and then time how long it takes for all the lacquer to run through the hole in the cup's bottom. Thin the lacquer according to the manufacturer's recommendations.

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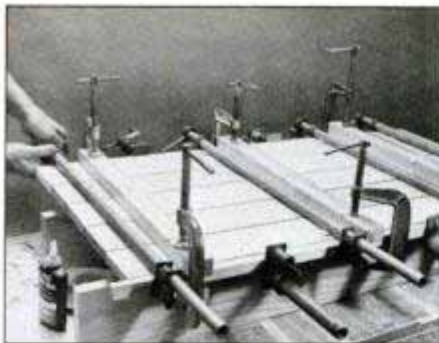
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11 Assemble top with slow-setting hide glue. C-clamps and hardwood cross supports prevent bowing due to pipe clamp pressure.



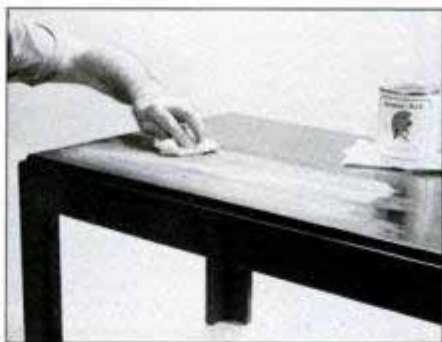
12 Trim the slab to the finished size. Then, plane and belt-sand the surfaces smooth. Finish-sand tabletop with orbital sander.



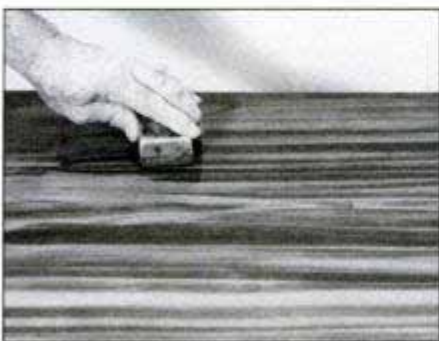
13 After applying two coats of sanding sealer, spray on three coats of gloss lacquer enamel. Move the spray gun parallel to the surface. Be sure that you wear a respirator.



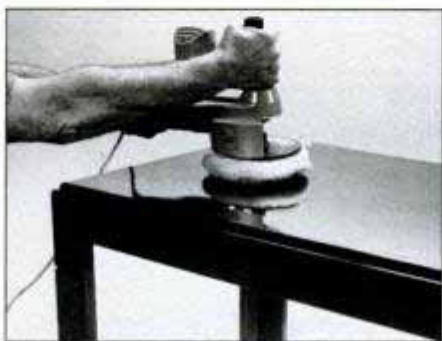
14 To acquire a smooth, level finish, sand each lacquer coat using a felt-padded wood block and 280-grit aluminum oxide paper.



15 After spraying on the final clear lacquer coat, apply rubbing/polishing compound liberally using a damp, soft, clean cloth.



16 Polish the table with a felt pad using long, straight strokes. Wipe away the compound occasionally to check your progress.



17 Finally, buff the black lacquered surface to a mirror-like sheen using an electric buffer fitted with a lambswool bonnet.



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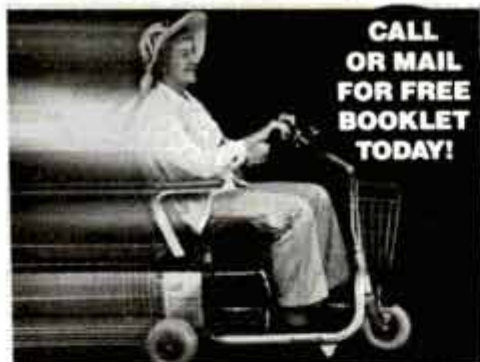
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Woodworking Guide

the spray pattern. Practice on a scrap board first, until the spray pattern is wide and the material is finely atomized and evenly applied. (For information on Wagner airless sprayers, contact Wagner, Literature Dept., 1770 Fernbrook La., Minneapolis, MN 55441.)

Power-painting alternatives

For those who don't have power spraying equipment, there are two alternatives for applying a lacquer finish—spray cans and brushing lacquers.

Spray-can lacquers are easy to use and readily available at most paint and hardware stores. But, they can be expensive if you're spraying a large piece. Start by spraying one coat of primer followed by three or four coats of gloss-black lacquer. Be sure to sand between each coat with 280-grit abrasive paper. Finish-sand with 600-grit. Then, apply three to four coats of clear lacquer to build up the finish.

Brushing lacquers contain retarders that slow the drying process to allow application by brush. But, even brushing lacquer must be applied quickly and evenly to avoid ridges. Apply brushing lacquer with a natural bristle brush. First, seal the wood with a coat of sanding sealer thinned 50:50 with brushing-lacquer thinner. Next, apply a full coat of lacquer using long, straight brush strokes. Overlap the strokes slightly, but don't brush back and forth over the same area. This will lift and roughen the preceding coats. Brush on at least two more coats and be sure to sand between applications as described for spraying lacquer.

Another brush-on technique that produces a lacquer-like finish involves using a gloss oil enamel. This is essentially a varnish that contains a pigment. The advantage to brushing on enamel, rather than lacquer, is that it doesn't dry as quickly and is, therefore, easier to apply. Brush on the enamel in thick stripes spaced about 3 in. apart. Then, crossbrush the stripes to spread the enamel evenly over the entire surface. Now, while holding the brush nearly vertical, brush very lightly over the surface allowing only the bristles' tips to touch. This stroke, known as tipping off, produces a level, bubble-free finish. Apply three more coats in this fashion. Sand between coats with 240-grit abrasive paper lubricated with water. Finally, rub the surface with pumice and polish it with rottenstone.

If you can't locate the lacquers and other finishing supplies discussed in this article, then contact any of the woodworking mail-order firms located around the country. Two such sources are: Garrett Wade, 161 Avenue of the Americas, New York, NY 10013, and Constantine's, 2050 Eastchester Rd., Bronx, NY 10461. **PM**

Airless sprayer



Viscosity test cup determines if the lacquer is the right consistency for spraying. Time how long it takes for the cup to empty.



Airless sprayer operates using an electromagnetic coil. Regulate spray pattern by adjusting pressure-control knob (arrow).

Spray-can lacquer



Spray-can lacquer enamels are convenient for small projects. Apply a primer coat first, then spray on gloss black lacquer finish.



Apply three or four topcoats of clear lacquer to give the finish greater depth. Then, rub the surface with polishing compound.

Brush-on oil enamel



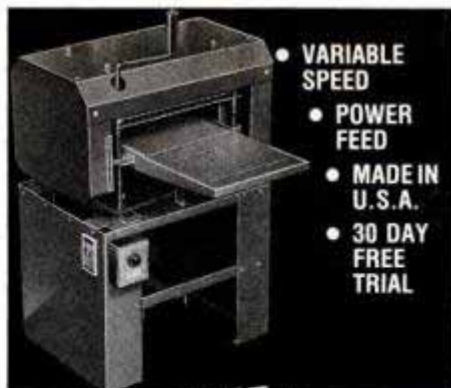
Gloss oil enamel produces a lacquer-like finish. Apply the enamel in full stripes spaced about a brush-width apart.



Then, cross-brush the stripes to spread the enamel evenly over the entire surface. Oil enamel doesn't dry as quickly as lacquer.



Tipping-off the surface produces a level, bubble-free finish. Hold the brush almost vertical and then make very light, long strokes. Allow only the bristles' tips to touch.



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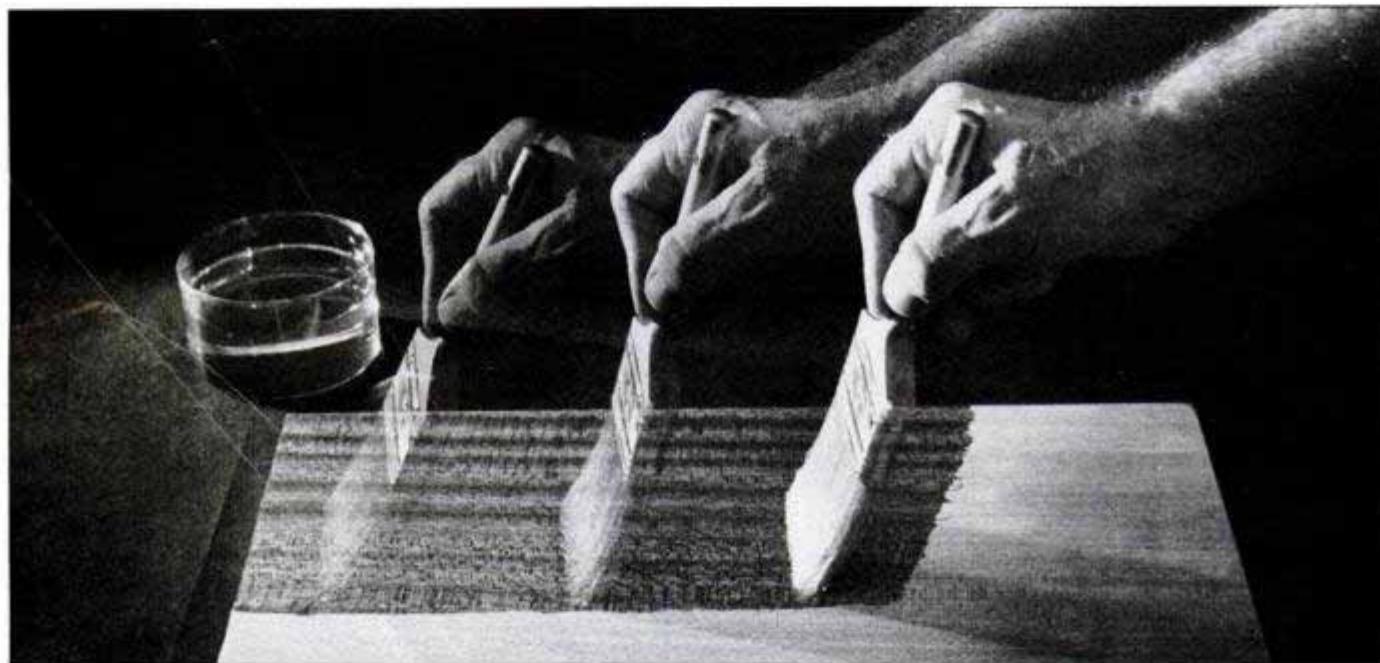
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Fantastic Finishes

Here's how to apply four of the most popular clear hardwood finishes.

TEXT AND PHOTOS BY ROSARIO CAPOTOSTO



The rich grain of ribbon-striped mahogany comes alive as varnish is applied. Clear finishes add more than beauty, they also provide valuable protection.

To enhance and protect the *natural* beauty of wood, nothing can compare to a clear finish. Clear finishes accentuate the wood's texture and natural grain patterns while sealing the wood's porous fibers from stains, moisture and dirt.

Finishes most commonly used on wood include penetrating oil, shellac, varnish and lacquer. The finish that you choose depends on several factors, including ease of application, durability and desired appearance. Note that penetrating oil is an in-surface finish that leaves the wood's texture exposed. Shellac, varnish and lacquer are on-surface finishes.

Surface preparation

The first step to successful wood finishing lies in proper surface preparation. This is especially true when using clear finishes since they won't hide minute scratches and nicks. In fact, a clear finish will often highlight surface

defects as it accentuates the wood's grain.

Fill small holes and gouges with wood putty (patching compound). Choose a putty color that matches the wood, but remember that the putty will darken slightly when the finish is applied. Remove dried glue, scratches, tool marks and other minor surface imperfections with a hand or cabinet scraper and/or abrasive paper. Keep in mind that the finish will only be as smooth and level as the bare wood.

Coated abrasives, or sandpaper, come in various grit sizes (coarseness) and types. The abrasive papers used in woodworking are coated with garnet, aluminum oxide and silicone carbide.

Abrasives range from coarse to extra fine. The grit numbers, which range from 40 to 600, refer to the number of abrasive particles per linear inch. The grit number system is the most helpful and widely used today. A third, less used abrasive grading order is the 0-grade system. For example, fine-grade paper (150-grit) is listed as 4/0.

Surface preparation

Grain-filling

The porous surface of open-grained woods such as oak, ash, mahogany and walnut must be filled in order to obtain a smooth, glass-like finish. If, however, you prefer to have the wood's texture show through the finish, then skip the grain-filling step. Paste wood filler (not to be confused with patching compound) is used to fill the wood's pores. Fillers come in various wood-tone colors and in a natural shade that can be tinted. For best results, tint natural shade fillers with Japan colors—a varnish-like vehicle containing pure pigments.

Before application, thin the paste filler with benzine or naphtha to the consistency of a very thick paint. Dust the surface clean and apply the filler with a stiff bristle brush. First, brush with the wood's grain, working the filler into the open pores, then brush lightly across the grain. Allow the filler to set until it has lost its wet look and has turned dull. This usually takes about 10 to 20 minutes. Now, wipe across the grain using a coarse rag such as burlap or terrycloth. If a second filler coat is needed, apply it immediately. Allow the filler to dry overnight, then

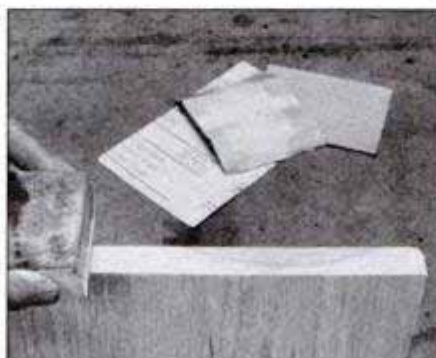
Finishing supplies provided by Garrett Wade Co., 161 Ave. of the Americas, New York, NY 10013.



Surface preparation tools (clockwise from upper left): finishing and palm sanders, rubber and felt-backed sanding blocks, scraper.



Fill small holes and gouges in the surface with wood putty (patching compound). Select a putty color that matches the wood.



Pay particular attention to end grain when sanding. Be certain to remove all scratches and saw blade marks before finishing.



After sanding, wipe surface with a tack cloth. Note how much dust is picked up on hand after just brushing and vacuuming.

Grain-filling



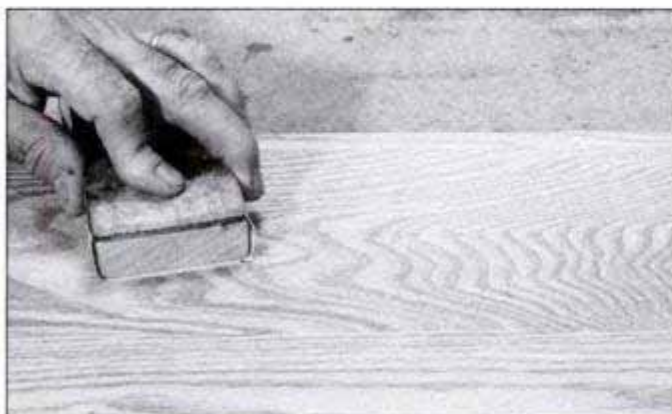
Thin the wood paste filler to the consistency of very thick paint with naphtha. Tint natural shade wood filler with Japan colors.



Brush with the wood's grain using a stiff bristle brush. Force the filler into the open pores. Then, brush across the wood's grain.



Once the filler has lost its wet look and has turned dull, wipe across the wood's grain using a coarse rag to remove excess filler.



After the paste filler has dried thoroughly, sand the entire surface using a sanding block and 220-grit abrasive paper. Be certain to sand with the wood's grain to avoid any cross-grain scratches.



Here's a close-up view of an unfinished piece of red oak. The unfilled left side has a porous, rough texture. The right side has been filled to produce a smooth foundation for the clear topcoat finish.

Woodworking Guide

sand with 220-grit abrasive paper.

Penetrating oil finish

Penetrating oils such as tung oil, linseed oil, Danish rubbing oil and wood bowl sealers provide an easy way to protect wood without concealing its natural texture. For maximum protection, use an oil finish that contains a resin such as urethane. As the oil soaks into the wood, the resin will harden to provide a tough, resilient surface. And, an oil finish won't chip, crack or flake off like an on-surface finish might.

Work the oil into the bare wood with a soft rag or brush. Wait about 30 minutes for the wood to absorb the oil. Then, wipe the surface dry with a clean, lint-free rag, wait 30 minutes and apply a second coat. Build up a sheen by rubbing the surface with very fine (4/0) steel wool. Then, buff the wood vigorously with a soft, clean cloth. **Caution:** To avoid spontaneous combustion caused by oxidation, store oil-soaked rags in an air-tight metal container.

Shellac

Shellac, one of the oldest wood finishes still in use today, is derived from the

secretions of the lac bug—a small insect indigenous to southern Asia. The resinous secretions are processed and refined into dry flakes which are then dissolved in alcohol to form shellac.

Because shellac has such a short shelf life, it's best to buy dry shellac flakes and alcohol and mix fresh shellac as you need it. Shellac is designated according to the proportion of shellac resin to alcohol. This is referred to as the cut. For example, 1 pound of shellac dissolved in 1 gallon of alcohol produces 1-pound cut shellac. Liquid shellac comes premixed in 3-, 4- or 5-pound cut.

Shellac can be sprayed on or applied

Hand-rubbed oil



Easy-to-use penetrating oil contains tung oil and urethane to seal and protect the wood's surface. Apply the oil liberally.



Work the oil into the wood using a soft rag. Wait about 30 minutes, wipe the surface clean and then apply a second coat.



After applying the final coat, build up a lustrous sheen by rubbing the surface with the grain using very fine (4/0) steel wool.

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with a pad (French polishing), but the easiest way to apply shellac is with a brush. Begin by diluting the shellac to 1- or 2-pound cut. Brush it on with long, straight strokes in the direction of the wood grain. Don't backbrush over the same area. Shellac dries quickly and once it starts to gel, further brushing will only striate the surface. Wait at least 1 hour before sanding lightly with 220-grit abrasive paper. For best results, apply six to eight coats. Rub out the final coat with 3/0 steel wool to obtain a satin finish.

SHELLAC DILUTION TABLE

To thin 1 quart of basic cut shellac to the desired cut, add the amount of denatured alcohol shown.

1-quart basic cut	Desired cut	Add this much denatured alcohol (per quart)
5-pound	3-pound	16-oz.
5-pound	2-pound	32-oz.
5-pound	1-pound	85-oz.
4-pound	3-pound	8-oz.
4-pound	2-pound	24-oz.
4-pound	1-pound	64-oz.
3-pound	2-pound	8-oz.
3-pound	1-pound	48-oz.

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Shellac



Use a postal scale to measure the correct amount of shellac flakes. Dissolve the flakes in denatured alcohol or compatible solvent.



Thin the shellac to 1- or 2-pound cut and apply it in long, straight brush strokes. Overlap each successive stroke slightly.



After the shellac has dried, sand the surface lightly with 220-grit abrasive paper to provide good adhesion for the next shellac coat. Rub out final coat with steel wool.



Clogged sandpaper indicates that shellac wasn't thoroughly dry. Do not use clogged paper because particles will scratch finish. Apply at least six to eight coats.

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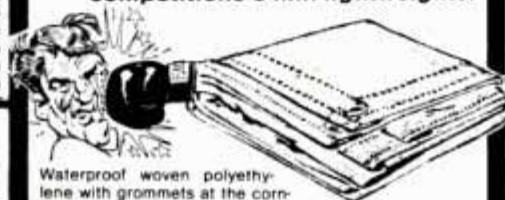
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or on your order.) (We carry sizes to fit ALL makes & models
& chain made to order at comparable sale prices!)

ALASKAN MK 111 Portable CHAIN SAW LUMBER MILL



NOW a saw mill that's portable and easy to afford!
Designed for heavy duty use. Cuts lumber from 1/2" thick
to 12" thick. Will accommodate different bar lengths and
clamps right onto the bar (no drilling). Comes in both 24"
and 30" sizes. *Don't Pass Up This Deal!*

#11871.....24" Size.....Wt. 16 lbs..... **\$109.50**
#11872.....30" Size.....Wt. 18 lbs..... **\$129.50**

SAWTUNE 12 VOLT SHARPENER



14,000 RPM, 12 volt grinder designed for heavy duty
use. "EZ" gauge makes sharpening a breeze! Sh. wt. 3
lbs. Works off your car or truck battery!

Item # List Sale
15081 \$29.95 **\$19.50**

PROPANE HEATERS

Tanks Not
Included

Mr. Heater

11,000 BTU! Has 100%
safety shut-off valve, lights in
seconds, adjustable control,
maintains constant heat
down to -30° F. Infra-Red Heat.

Item # Sh. Wt. List Sale
1726 6 lbs. \$87.95 **\$39.95**



Mr. DOUBLE HEATER

Unique design allows you to
use both side (24,000 BTU), or
one side (12,000 BTU). Adjust.
control for 6000 BTU to 24,000
BTU. Each burner has 100%
safety shut-off valve. Infra-Red.

Item # Sh. Wt. List Sale
1727 14 lbs. \$167.00 **\$89.95**



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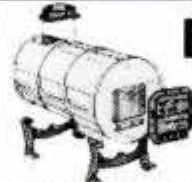


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24" Stroke!
32,000 Pounds of
Splitting Force!

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- 12 Ton (High Speed Wheels), #1125.... **\$689.00**
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(Some assembly may be required)



BARREL STOVE KITS

STANDARD KIT, Is 100% cast iron and will convert any 55 or 30 gallon barrel drum into an efficient and economical wood burning heater. A **SUPER VALUE!**

#15056, Wt. 32 lbs., List \$49.95..... **\$27.95**

DOUBLE BARREL KIT, when used with above kit will convert it into a double barrel stove. The secondary gases are trapped and create greater efficiency as they travel through the top barrel.

#15057, Wt. 19 lbs. List \$39.95..... **\$18.95**



GAS ENGINES

(HORIZONTAL)



- 5 HP Tecumseh, 1/2" Shaft, #6051..... **\$139.95**
- 5 HP Briggs, 1/2" Shaft, #6052..... **\$141.95**
- 5 HP Briggs 1/2", 1/2" Shaft, #6054..... **\$183.95**
- 5 HP Tecumseh, 3/4" shaft, #6061..... **\$159.95**
- 8 HP Briggs, 1" Shaft, #6080..... **\$215.95**
- 10 HP Tecumseh, 1" Shaft, #6010..... **\$232.95**
- 10 HP Tec., (Elec.Start), 1" Shaft, #60101..... **\$289.95**
- 16 HP Tecumseh, 1 1/2" shaft, #6016..... **\$462.95**

3-20 HP Horizontal & Vertical gas engines available at Super Low Discount Prices!!!



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Item	Type	Fits This Size & All Sizes In Between	List
1540	Round	6", 7", 8", 9", 10", 11"	\$32.50
1541	Square	6", 7", 8", 9", 10", 11"	\$19.95
1542	Rectangular	6 x 10, 7 x 11, 8 x 12	\$19.95
		9 x 13, 10 x 14	

AMMO BOXES

Government surplus, heavy gauge steel with rubber gaskets for waterproof storage of ammo, tools, camera, fishing tackle, etc. **GOOD BARGAIN!**

- 30 Cal., 3 1/2"W x 6 1/2"D x 10"L Item #0311..... Sh.Wt. 6 Lbs. **\$3.95**
- 50 Cal., 5 1/2"W x 7"D x 11"L Item #0312..... Sh.Wt. 5 lbs. **\$4.50**
- 20 MM, 14 1/2"W x 8"D x 17"L Item #0313..... Sh.Wt. 22 lbs. **\$9.95**



GENERATORS

- 4000 Watt, 8 HP Briggs, 33 amps @ 120 volt, 16.6 amps @ 240 volts, List \$1009/ **\$16402**..... 108 lbs. **\$425.00**
- 4000 Watt (Electric Start), List \$1143/ **\$16403**..... 113 lbs. **\$487.00**

- 5000 Watt, 11 HP Briggs, 42 amps @ 120 volts, 21 amps @ 240 v. List \$1174/ **\$16404**..... 140 lbs. **\$639.00**
- 5000 Watt (Electric Start), List \$1299/ **\$16405**..... 146 lbs. **\$739.00**

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LOG SPLITTER PARTS



- 11 GPM 2 Stage Pump, #1012..... **\$99.95**
- 13 GPM 2 Stage Pump, #1013..... **\$129.00**
- 16 GPM 2 Stage Pump, #1015..... **\$157.00**

- Standard 4-Way Control Valve, #2010 **\$46.50**
 - Auto-Detent Valve, #2020..... **\$49.95**
 - 4x24x2" Cylinder (Welded Type), Item #902424 (Can ship UPS)..... **ONLY \$119.95**
 - 5x24x2" Cylinder (Tie Rod Type), Item #909524 **ON SALE NOW..... \$222.00**
- Many Other In Stock at Low Discount Prices!

COMPRESSORS

SANBORN®

5 HP, 60 GALLON

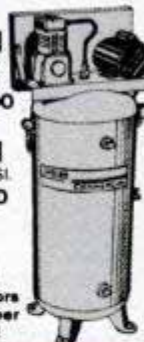
A great vertical 60 gallon two cylinder single stage. Lists for \$1160/ Item #159545..... **ONLY \$497.00**

5 HP, 60 GALLON

IMC, 2-stage, 17.3 CFM at 100 PSI. #15975, \$1202 List.... **\$879.00**

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Woodworking Guide

water, alcohol and abrasion. Varnish brushes on smooth and easy, but its slow drying time allows dust particles to settle in the finish.

There are two kinds of varnish: natural and synthetic. Natural resin varnishes, which have a painfully slow drying time of 24 to 48 hours, are classified by their oil to resin content. Varnishes with a high oil content are called long oil varnishes. These tough finishes are used for exterior and marine applications. Short oil varnishes contain less oil and are used on fine furniture.

Synthetic varnish contains a man-made resin such as alkyd, vinyl, phenolic or polyurethane. These finishes are

easier to apply, more durable and faster drying than natural resin varnishes.

Apply varnish with a top-quality natural bristle brush. Thin the first coat four parts varnish to one part thinner (mineral spirits). Sand the sealer coat lightly with 240-grit abrasive paper. Next, apply full-strength varnish in full stripes spaced about a brush width apart. Then, without dipping the brush back into the varnish, brush across the grain to spread the varnish over the entire surface. Wipe the brush clean of excess material and "tip off" the varnish to produce a smooth, bubble-free surface. Hold the brush nearly vertical and make long, continuous strokes with only the bristles' tips touching the surface. Apply two to three coats in this

fashion. Sand between coats with 240-grit wet/dry paper lubricated with water to remove dust specks and to provide good adhesion for the next coat.

Lacquer

Clear lacquer is the top-coat finish used by nearly all furniture manufacturers. Lacquer is very hard, very fast drying and resistant to water, alcohol, heat and mild acids. And, unlike most finishes, lacquer dries crystal-clear.

The major drawback is that lacquer dries so quickly that it can be difficult to apply. The ideal way to apply lacquer is with a spray gun (see *Black Lacquer*, page 128). But, there are brushing lacquers available that contain retarders to slow the drying process slightly.

Varnish



Brush on varnish in full, wet stripes spaced about a brush-width apart. Varnish can be applied heavier than shellac or lacquer.



Next, without adding any more varnish to the brush, crossbrush the stripes to spread the varnish evenly over the entire surface.



Tip-off the finish allowing only the bristles' tips to touch the surface. Strike wire on can is used to clean bristles of excess varnish.

Lacquer



After applying a base coat of sanding sealer, brush on lacquer with long, quick strokes. Lacquer dries fast, hard and crystal clear.



Once the lacquer has dried, sand the surface level using 280-grit wet/dry abrasive paper lubricated with paraffin oil.



Using a felt pad, rub the final coat with pumice stone lubricated with paraffin oil or water. Stroke with the wood's grain.



Polish the finish to a high luster using rottenstone lubricated with water or oil. Never use water as a lubricant on shellac.

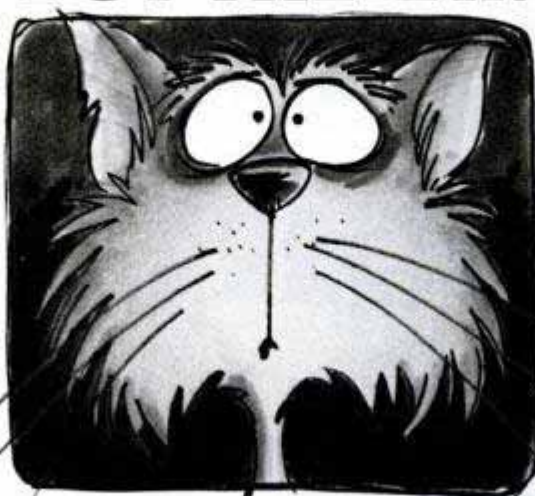
First, seal the wood with sanding sealer thinned 50:50 with an appropriate thinner. Sand the surface lightly with 220-grit abrasive paper to knock down dust specks and to level the surface. Next, apply full-strength lacquer in long, straight strokes. Overlap each successive stroke slightly. Don't backbrush over the same area, as this will roughen the preceding coat. Apply two to four more coats. Sand between each coat with 280-grit wet/dry paper and oil, if leveling is necessary.

Pumice and rottenstone rub

To produce a lustrous finish on lacquer, shellac or varnish, rub the final coat with pumice stone and rottenstone.

Pumice stone cuts and polishes and is lubricated with water or paraffin oil (never use water as a lubricant when working on shellac). Superfine rottenstone only polishes. Wet the surface and sprinkle on 4f pumice. Use a felt pad to rub the entire surface in long, straight strokes. Keep the abrasive wet and don't add more pumice as this will scratch the area already rubbed out. Check the finish frequently and stop when it has a soft, smooth sheen. Next, clean the surface and polish it to a high luster using rottenstone lubricated with oil or water. **PM**

THE DREMEL MOTO-TOOL.[®] IT'LL FIX EVERYTHING IN THE HOUSE BUT THE CAT.



Now that you know what the Moto-Tool can't do, it's time to learn a few things it can. With a variable speed motor that ranges from 5,000 to 28,000 RPM, the compact, 3801 Moto-Tool cuts, grinds, sands, carves, polishes and drills its way through just about anything.

The key to its versatility lies in the 40 bits and accessories that come included. Just drop in a new bit and you've got an entirely new tool. With the emery cut-off wheel, you've turned it into a saw.

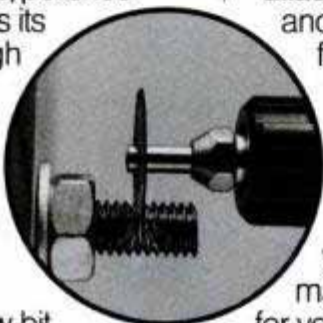


Then, drop in the sanding drum and let the sawdust fly. Shape out keyholes and take paint off those hard-to-reach spots

your three-year-old never found hard-to-reach. Slip the Moto-Tool into our routing

attachment, pop in a router bit and you can finish a frame for that portrait of your wife's Uncle Todd.

With our high-speed cutters, it's a wood carver, too. A tool you can really make a name for yourself with. The kind that



And when it comes to polishing brass, silver and semi-precious stones, the Moto-Tool and a polishing wheel save time, rags and elbows.

**FREE
GLUE
GUN**



It's so versatile, the Moto-Tool will even help with the Christmas shopping this year. Buy the Variable Speed 3801SP Moto-Tool Kit now and get a free Pro-Bonder[™] Hot Melt



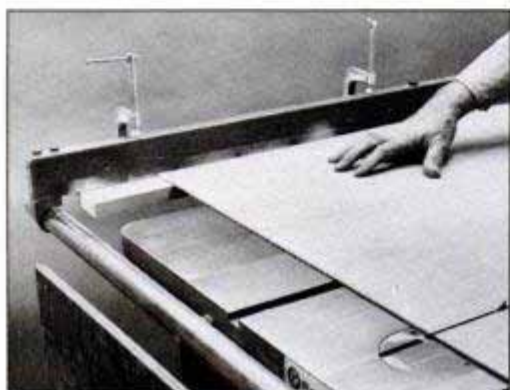
Glue Gun. With four 2" Glue Sticks, the Glue Gun is perfect for passing along as a gift. In all, that's \$17.95 worth of extras—Free.

The Dremel Moto-Tool. With all the jobs it can do, you'll think it has more lives than a cat.

DREMEL[®]
Gets the job done bit by bit.

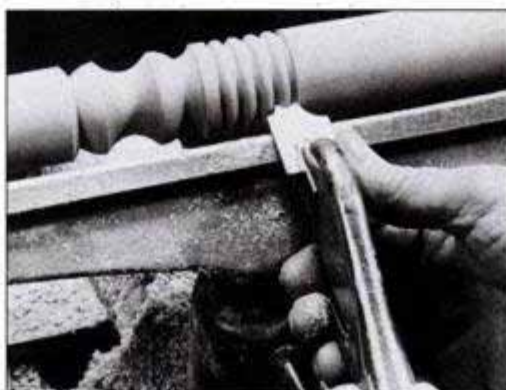
Woodshop Wisdom

These tricks of the trade will make you a better woodworker.



Rip fence aid

Prevent pieces of thin stock from slipping under the fence, when it's extended beyond the table, by clamping a wood support under it. Use C-clamps to fasten the board so it extends toward the table.



Turning beads the easy way

Precisely shaped beads can be turned by using a cutting knife borrowed from a table saw molding cutter set. Grip the knife with a pair of locking pliers and feed it slowly into the work. Set the lathe at medium speed.



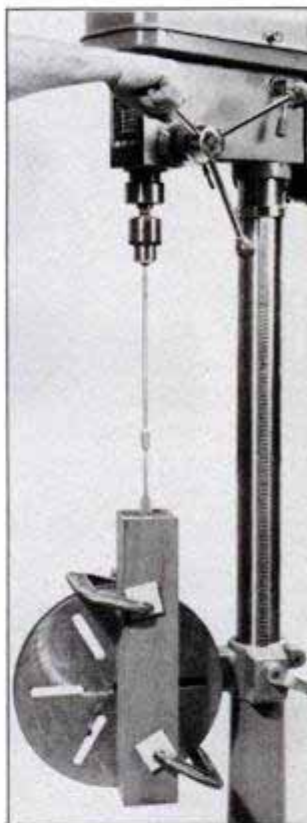
Taper turning guide

You can turn accurate tapers easily with this simple jig if your toolrest has a flat back ledge. Clamp the spear-point chisel to a block of wood with its cutting edge parallel to the edge of the block. Angle the toolrest to equal the degree of taper desired. Slide the jig assembly against the ledge, shaving small amounts of wood. Then move the toolrest closer for each succeeding pass.



Edge-gluing tip

When you are edge-gluing boards together, some will invariably be bowed or otherwise out of alignment. Getting dowels into the holes will be easier if you countersink the mating holes slightly. Because the dowel pins are chamfered, they will ease into the countersunk holes. You should use a $\frac{5}{8}$ -in.-dia. countersink bit for a typical $\frac{3}{8}$ -in.-dia. hole in 1-in.-thick stock.



Long-bore holes

You can bore extra long holes on a drill press by using a spade bit installed in a standard drill extension rod. The bit's blade diameter must be larger than the collar diameter of the extension rod. After each full stroke of the quill, raise the table, then bore again—until the hole is complete. Make sure that each time the table is raised, it is realigned vertically with the bit.

We'll pay you \$200 for your finished model of this magnificent clipper ship!

(If you want to part with it!)



Here's a hobby that pays off twice—in fun and in cash! Investment in this fine historic wooden ship model kit—at absolutely no risk! Imagine! You can build the sleek-hulled Harvey, typical of the Baltimore Clippers used by American Colonists against the British in the early 1800's. And you have our guarantee that we'll buy it back from you for more than double what you paid for it.

The Harvey measures an impressive 37" long from transom to bowsprit, and her masts tower 27" high. She's delicately rigged and fully armed with eight beautifully turned brass cannon. Even if you've never built a quality, plank-on-frame wood ship model before, you can build the Harvey, specially designed for the ambitious beginner.

The secret's in our kit!

We've done the hard work for you—nearly all wooden parts are pre-cut, to make assembly easy. Premium woods, such as beech and African walnut, are used throughout. All fittings—of brass, copper, and hardwoods—are included. And giant plans and clear, step-by-step instructions virtually take you by the hand and guide you every step of the way. The result? A museum quality, historic wooden ship model you can display with pride to friends and family. Or, you can cash in on our special "buy-back" offer that gives you an instant, guaranteed profit.

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Order the Harvey kit, today. We'll guarantee to buy back your finished model for \$200 anytime within 6 months of purchase.

We can make this no-risk offer because we can resell your finished model—quickly, and at a substantial profit. (You must know that ship models are in great demand by collectors and auctioneers—for executive offices, banks, and restaurants everywhere. And by decorators with clients who delight in a nautical motif for their home.)

But you'll profit, too! By experiencing the relaxing pleasure and pride of accomplishment of this fascinating hobby. Or by selling other models you can build, yourself. Either way, we're sure you'll be back for more! And we've dozens of other models you can build. We'll send you our 116-page, full color catalog, FREE. Just mail the coupon below. Or for faster service on credit card orders, call TOLL-FREE **800-228-2028 ext. 68.** (In Nebraska, call 800-642-8300.) We'll rush your model kit, tools, and materials to you so you can get started right away!

You get everything you need to build:

1. Complete Harvey kit—including wood, fittings, and plans.
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5. OUR GUARANTEE to buy your finished model for \$200 anytime within 6 months of purchase. (Just send a photo of your finished model and we'll give complete instructions for packing and shipping to us.)

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Special introductory price, only **\$89.95** for everything!
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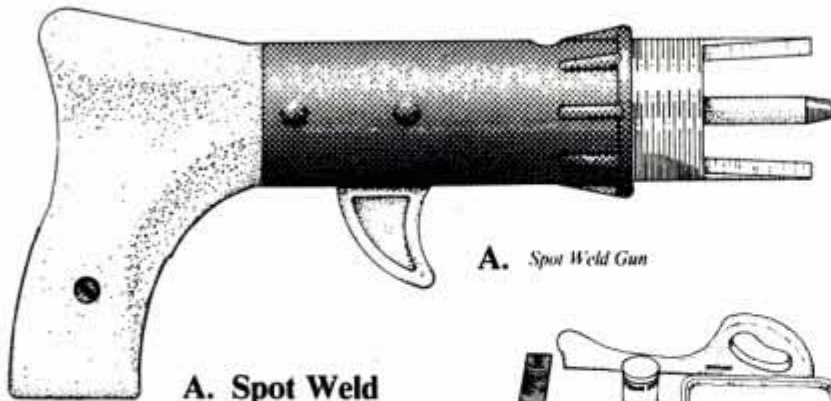
- YES!** I want to make money on my hobby. Send me your Harvey kit and "Buy-Back" package, as described.
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A. Spot Weld Gun

A. Spot Weld Perfectly In 6 Seconds

Make Fast, Distortion-Free Welds

Spot welding has some distinct advantages. It's very fast — a few seconds for a sound weld. Because the heat is confined to a small area (the 1/4" diameter electrode) it avoids warpage or distortion. Allows for accurate control that lets you make consistently uniform welds.

Easy to Use — Even for Beginners

Hook it to the electrode holder of your A.C. arc welder (set at 50 amps) and ground to car body. Just pull back trigger to retract electrode, line up weld point and press head against the metal. Metal must be free of rust, paint or grease. Release the trigger and allow the electrode to contact the metal and glow for 1-2 seconds. Then raise the electrode with the trigger and allow an arc to form a molten puddle of metal (always use welding goggles or shield). Each weld takes about 5-6 seconds. Auto manufacturers used spot welds to build your car; you can restore it with the same authentic technique.

Converts an Arc Welder to a Spot Welder

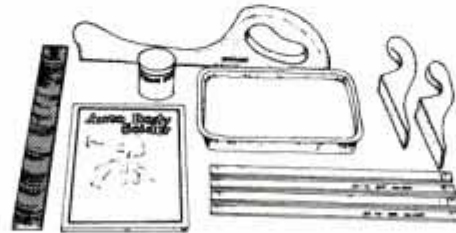
It welds any steel between 18-26 gauge. (Auto body sheet metal is between 18 and 22 gauge). Ideal for welding replacement panels, floors, brackets, clips, braces, etc. Welds from one side so it can even do blind panels that ordinarily can't be spot welded. Comes with two pressure heads — four prong for control on flat areas and two prong for reaching into edge and recess work. Proper replacement electrodes available through Eastwood. Gun comes complete with connection wire, spare electrode, 2 pressure heads and complete instructions.

4355 Spot Weld Gun — \$35.95

4321 Package 10 electrodes — \$9.75

B. Body Solder: The Permanent Panel Repair

Body solder makes a permanent, professional-quality repair that won't crack, lift or shrink. Easy to apply with a household propane torch and can be shaped to any contour. Great on patch panels, seams, and edge work. Accepts paint just like sheetmetal. Far more durable than synthetic fillers. The craftsman's



B. Body Solder Kit

method still used today by best body shops, restorers — even by auto manufacturers. The kit includes four 1/2 lb. sticks body solder, two paddles, 1 lb. tallow, 1/2 lb. tinning butter, 14" body foil with holder, and FREE instruction book "Auto Body Solder" (contains 50 pages with over 50 illustrations — the most complete source of body solder techniques available!).

6730 Home Craftsman Body Solder Kit \$58.00

6400 Extra Sticks 30-70 Body Solder — \$3.50 ea.

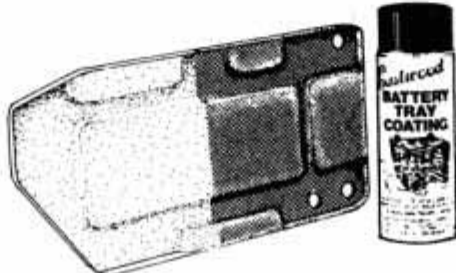
6645 Body Solder Book — \$6.95

C. Battery Tray Coating Passes The Acid Test

This special coating looks just like paint but battery acid won't harm it. Sprays on and leaves a smooth satin finish. Washable. Saves replacing battery trays. Black.

5580 Battery Tray Coating — \$7.50

Two or more — \$6.50

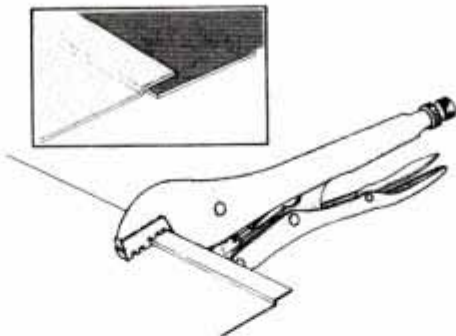


C. Battery Tray Coating

D. Flangers For Flush Fit Panels

Adjust tool to metal thickness, flange repair area and lay in patch panel. Lets you weld flush with body metal, which minimizes grinding and filling. Works in tight areas and on sharp curves. Perfect results with very little effort.

6286 Panel Flanger — \$29.95

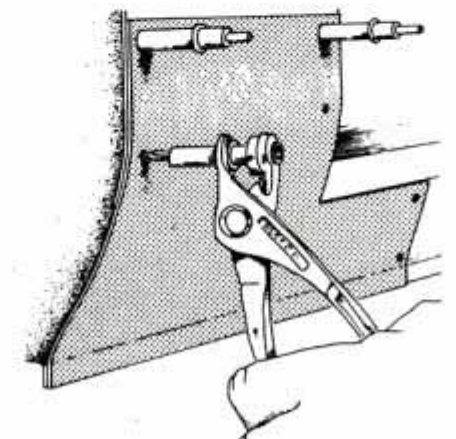


D. Panel Flanger

E. Panel Holding System Leaves Hands Free

Keeps patch panels in place while welding. Just drill 1/8" hole and insert. Holds with 19 lbs. pressure and removes in seconds. Replaces awkward clamps. Reusable. Comes with compression tool and ten blind style holders.

1288 Panel Holders — \$24.95



E. Panel Holding System

F. Convert Your Arc Welder For Mig-Like Results

Most arc welders have been designed for joining 1/4" metal; our stitch welder attachment controls welding heat to produce smooth, even welds on body panels — limits distortion and burn-through.

The current's directed through an electrical solenoid and diode circuit. The solenoid, which pulses thousands of times per minute, gives you normal welding amperage while allowing you to weld thin pieces. Although the arc never appears to break, the reciprocating electrode action pulls the electrode in and out of the weld puddle to limit welding heat.

Welding's easy: once you strike the self-starting arc, lay the rod on the metal and let the machine do the work. Resulting bead is smooth and even, with slag coming off in large pieces. Easy to master with practice.

The stitch welder's five foot power cord attaches to any A.C. arc welder's electrode holder (must run at 80 amps or less). Uses arc welding rods up to 3/32" steel and stainless. Tool body cast aluminum with vinyl insulated grip for positive control. Electrodes held with set screw and can be easily replaced. Designed for years of trouble-free service.

4369 Stitch Welder — \$49.95

4372 Arc Welding Rods (2mm dia, 3 lb. pkg. approx 120 rods) designed with special flux for welding sheetmetal — **\$9.95**

Welding gloves — your hand deserve the right protection.

9612 Gloves — \$8.95

G. Nibbler Cuts Metal Fast

Our nibbler cuts curves, straight lines — any shape you need. Leaves flat, no-distortion, burr-free finish. Uses less effort than ordinary snips. Chromed steel construction with cushioned vinyl grips. Heat-treated tool steel jaws. Cuts up to 18 gauge steel, 16 gauge aluminum. Jaws replace easily.

6281 Nibbler — \$28.95

6284 Replacement Blades (pkg. 2) — **\$9.95**

H. Fabricate Panels With A Sheet Metal Bender

Will form 90° angles in 20 gauge up to 18" wide. Bends heavier gauge metal in smaller widths. Great for reproducing body panels, covers, etc. All-aluminum. Bolts or screws to workbench.

6260 Bender — \$29.95

6261 Clamps — \$4.50

I. High Temperature Paint For Exhaust Systems

Imagine your rusty manifold looking new again. Our high temperature paint (up to 1200° F) gives a natural metallic finish similar to a sandblasted part. Just clean the part with a wire brush and paint or spray. No primer necessary. Fast drying. Looks great.

1256 High Temp Paint (1 pt.) — **\$11.95**

J. Cut Spotwelds In Seconds

Remove spotwelds without cutting through the lower panel. ¼" arbor has adjustable pilot to insure perfect cuts without damaging metal. Pilot pops out slug after cutting. Works on air and electric drills (900 rpm max) with ¼" chuck. Use with sheetmetal up to 3/16".

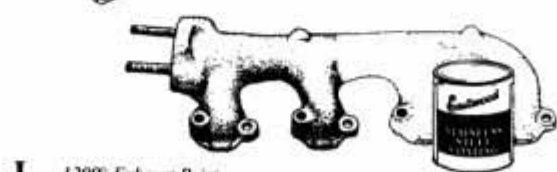
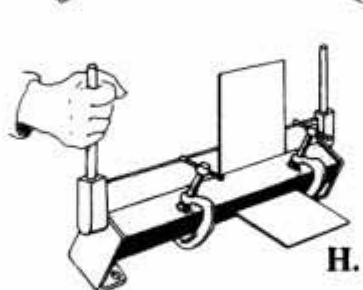
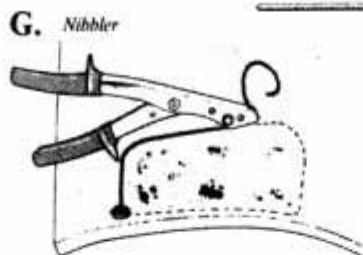
3219 Spotweld Cutter — \$12.95

3220 Replacement Cutter — \$4.50

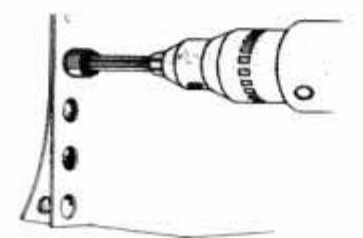
K. Sandblast Away Rust

Our sandblaster is field proven (thousands in use) and priced right. This sandblaster gives you the ability to remove rust, scale, paint and corrosion in minutes. Also doubles as air gun/degreaser for cleaning parts.

The Eastwood sandblaster package includes all-metal power (same as used on our larger units), ten foot hose, 14" pickup tube, spare nozzle and complete instructions. Just attach to 1 HP compressor, insert pickup



I. 1200° Exhaust Paint



tube into sand or other abrasive and you're ready.

8532 Sandblast Gun — \$30.95

9536 Blast Hood w/Replacable Lens \$19.95

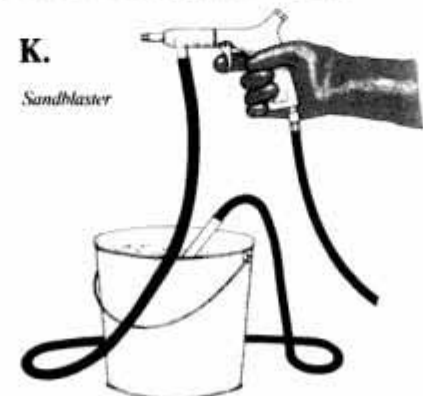
L. Remove Rust Without Harming Good Metal

Oxi-Solv removes rust and corrosion fast on any metal. Just spray, dip, or brush on and see it work!! Oxi-Solv is non-flammable, non-toxic, non-caustic and odorless.

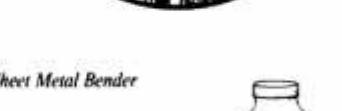
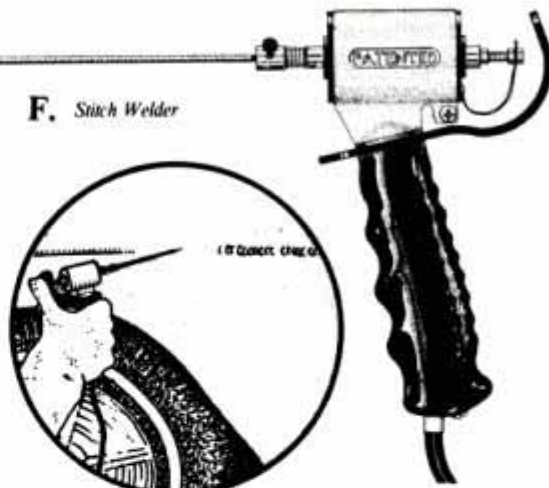
Extra bonus: After removing rust, Oxi-Solv gives a zinc phosphate coating to metal for better paint adhesion. Reusable.

3430 Oxi-Solv, 16 oz. — \$8.95

3432 Oxi-Solv, 1 gallon — \$24.95



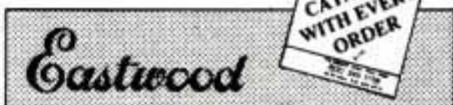
K. Sandblaster



F. Stitch Welder



L. Rust Remover



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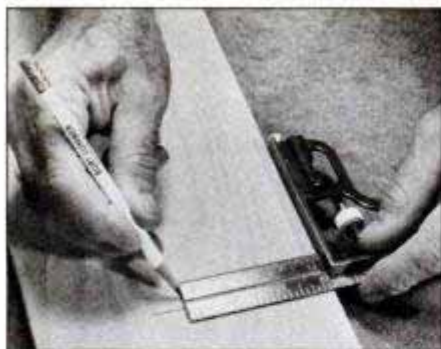
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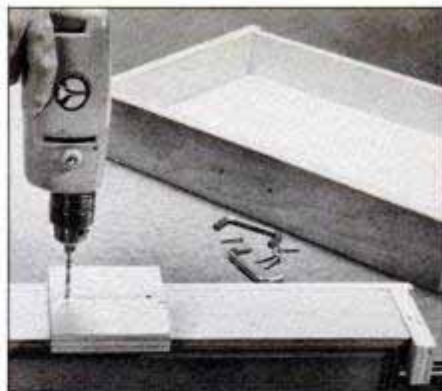
Quick centerline

Use an adjustable square to find the center of a board and therefore avoid possible mistakes in division. Estimate the board's center, set the blade at that point and make a mark. Then make another mark with the square against the opposite edge of the board. If the lines are close, the center is exactly between them. If they are far apart, reset the square and mark again.



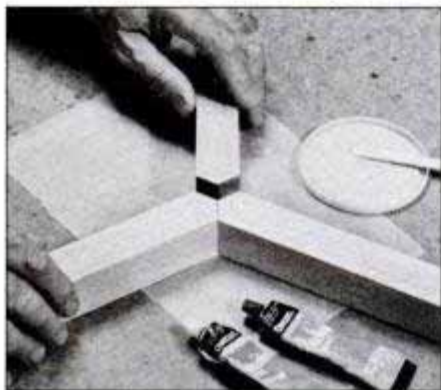
Sander cord hangup

Eliminate the nuisance of dragging a cord behind your belt sander by suspending the cord from the ceiling with a length of string. This will prevent the cord from snagging on the corners of the work or getting run over and cut by the sander. Adjust the length of the string so that it will give the cord enough slack to allow the sander free movement over the work.



Drawer-pull jig

Use a jig to bore holes for drawer pulls if you have a batch of drawers to make—providing the pulls are uniformly located. Bore two holes in a scrap block spaced the same distance as the drawer screws. Nail this block to a backing strip that has an end stop nailed to it. Position the scrap so its holes fall the correct distance from the end stop and the correct distance from the backing strip.



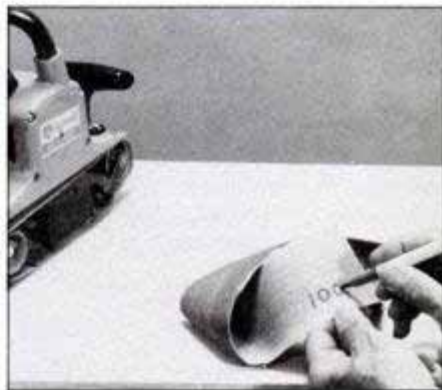
Gluing irregular pieces

Use quick-setting epoxy adhesive to join odd-shaped assemblies that can't be clamped easily. Mix the epoxy and hardener and apply it to the joint with a small stick. Butt the parts together on a flat surface. Be sure to place a piece of wax paper under the workpiece to prevent it from sticking to the table.



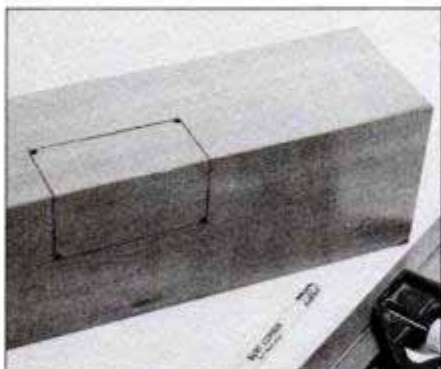
Finish record

Record the type of finish used on a project after it has been completed by writing its name and serial number in an easily accessible place, like the bottom of a drawer or on the back. By doing so, you'll be able to match the finish if you build a companion piece or have to refinish the piece in the future.



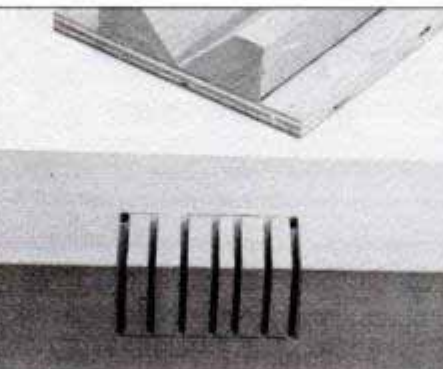
Save the belt

Don't throw out a sanding belt prematurely. While the belt may no longer cut like new, it will still cut, and you can use the somewhat worn belt for smoother sanding. For instance, an 80-grit belt may cut like a 100- or 120-grit belt. Make an educated guess as to the belt's grit equivalent and label it.



Notching shortcut

Here's a shortcut for cutting clean and square inside corners on deep mortises at the edge of a workpiece. Mark the outline for the mortise, then bore four small holes at the inside corners of the outline (above left). Use a drill press or



portable guide to make sure the holes are perpendicular. Then, make a series of corner kerf cuts with the radial-arm saw using a V-block like the one shown (center). Using a sharp chisel, cut away the kerf cuts first, then remove the remaining stock using the holes as guides (right).



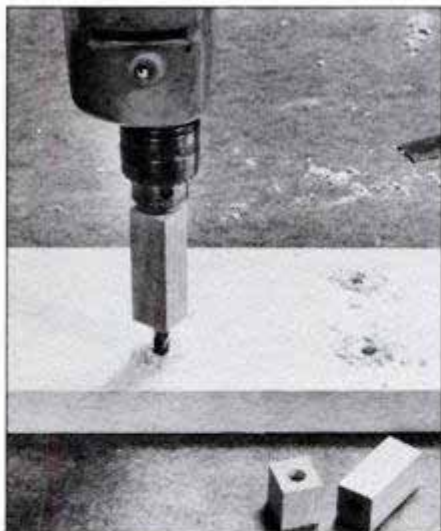
Check before sawing

Construction-grade stock that knocks around a lumberyard may have bits of sand or gravel embedded in its surface. A saw blade striking this will quickly dull. Check your stock and remove debris with an awl or old screwdriver.



Clamp pads

Prevent miter gauge clamps, quick-action C-clamps or standard C-clamps from marring work by attaching protective pads. Cut disks from fiber gasket material, clean the clamp jaws with turpentine, and use contact cement.



Drill depth gauge

This gauge made from scrap will allow you to accurately bore a series of holes to the same depth using a portable drill. Bore a centered hole through a section of $\frac{3}{4}$ x $\frac{3}{4}$ -in. hardwood stock. Use a bit that matches the hole diameter you need. Crosscut the stock so you have a piece equal to the length of the bit, minus the depth of the hole desired. Slip this sleeve over the bit.

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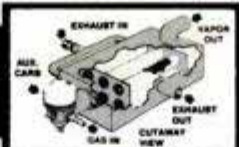
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Woodworking Guide



Inside band saw cuts

You can use a band saw for making interior cutouts if you make a lead-in cut first. It's best to make the lead-in cut on the table saw with a smooth cutting blade, going with the grain. This comparatively wide kerf allows space for a thin filler block to be glued in place later. Cut the filler block from waste of the same stock and use masking tape to hold the joint together until the glue dries. After the piece is sanded and finished, the filler is unnoticeable.



Depth collar check

To make sure a depth collar on a drill bit is maintaining its position, wrap a piece of masking tape around the bit directly above the collar. If the setscrew becomes loose during use and the collar begins to slip, the tape will crinkle. If this occurs, readjust the collar and retighten the collar's setscrew. If the setscrew becomes loose frequently, it's time to buy a new depth collar.

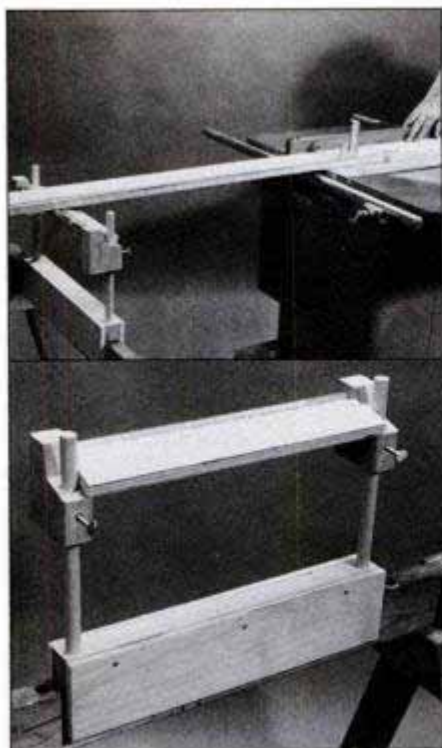


Table saw work support

You can make this stand for supporting long work as it comes off the table saw in one or two hours. It fits on a sawhorse and its height is adjustable with two thumbscrews. Its slanted platform, a 3/4-in. x 17-in. piece of plywood, directs work off the saw to the five rollers. Cut the rollers from 1-in. o.d. aluminum tubing fitted over a 3/4-in. dowel rod, 18 in. long. The rollers and the support platform are attached to movable support blocks held to the uprights by 1/4-in.-dia. thumbscrews. The screws feed through 1/4-in.-dia. threaded inserts. The uprights are 3/4-in. dowels, 12 in. long. Bore two holes in the 2x4 base to accept the uprights, then sandwich the 2x4 between two sheets of 1/2-in. plywood, in a U-shape.



Prevent steadyrest burn

The lathe steadyrest, essential in preventing long turnings from vibrating, can leave friction burns. To prevent this, wrap several thicknesses of masking tape around the turning where it contacts the steadyrest.

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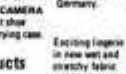
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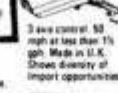
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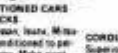
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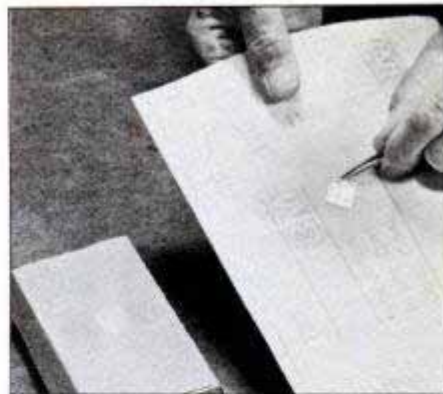
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Woodworking Guide



Pesky price stickers

Remove price stickers from the back of sandpaper sheets before using them. Otherwise, sheets will wear unevenly due to the high spot formed over the sticker, as the paper sample at left shows. In the process, sanding will be inefficient and paper life shortened.



Skim light

A light held at an oblique angle, so it skims the surface of the work, will make carving or sanding irregularities apparent. Use it to check your progress when shaping contours, where imperfections are hard to spot. A clear bulb will form sharper shadows than a frosted one.



Tool caster stop

Prevent a power tool on casters from rolling about by laying scrap of rubber-encased electrical cable on the floor behind two of the casters. This will hold the tool in place while you work, yet can be removed easily.



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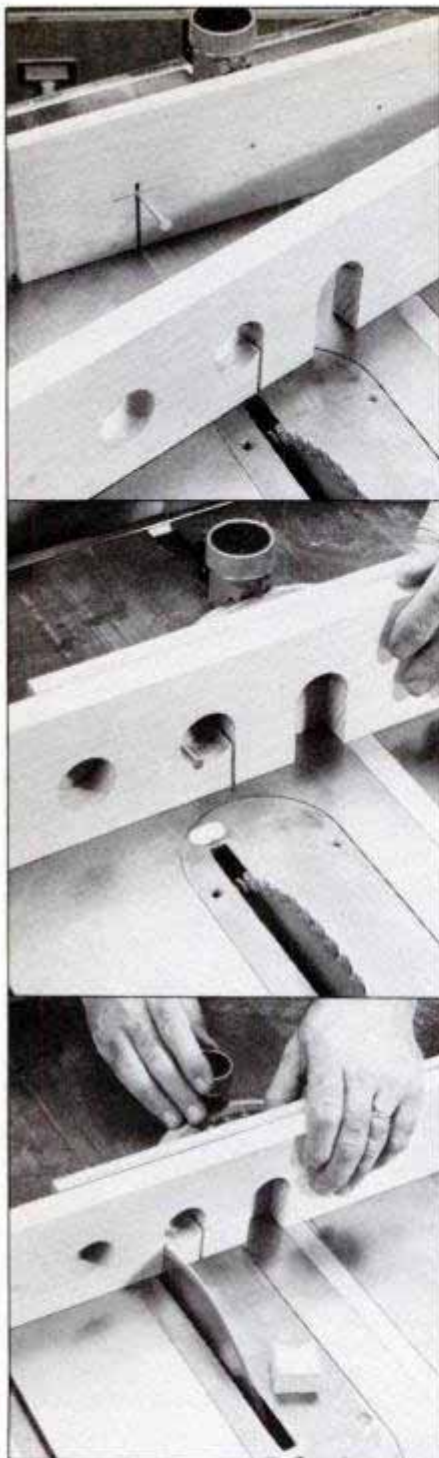
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Sawing tangents

Here's a way to cut precise tangents to circular holes using a table saw. Begin by attaching a wood fence to the miter gauge. Then cut a kerf through this fence slightly higher than the center of your prebored hole. Mark the exact center of the hole with a horizontal mark on the fence and readjust the blade to that height. Insert a nail so it fits snugly in the kerf at the center point. Then, butt the edge of the hole up to it. Grip the work firmly or clamp it to the fence, pull out the nail, and make the cut. Reinsert the nail to align the other side of the hole, then remove the nail and make the second cut.

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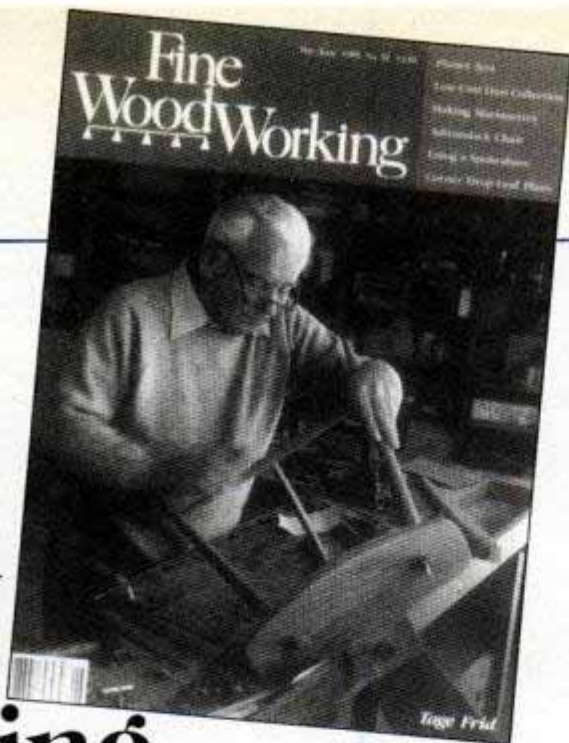
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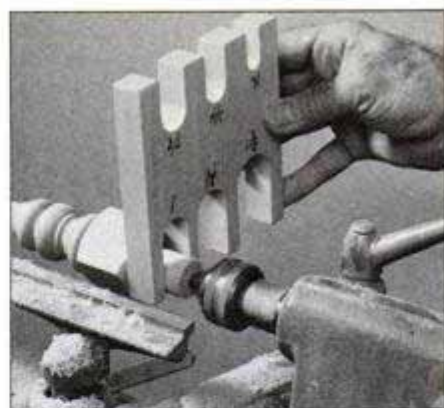
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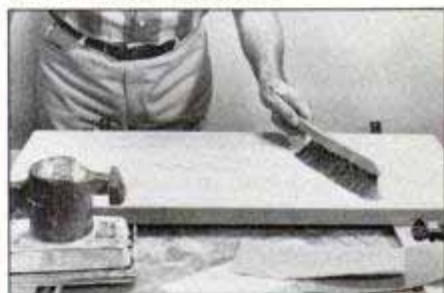
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Woodworking Guide



Tenon gauge

A caliper is fine for checking the diameter of most turnings, but for tenons, where a perfect fit across a wide surface is a must, you can improve your accuracy with this gauge made from 3/4-in.-thick hardwood. Bore holes of a varying diameter in the scrap block, centered from 1 to 2 in. from the edges. Then, drop out the waste on a table saw, using the technique described in the previous tip. Mark each hole with a pen to identify its diameter. Turn off the lathe when using the gauge.



Sweep away those grits

Make sure to dust off the work surface when you switch to a finer grit paper. If you don't, abrasive that breaks away from the coarser paper can remain on the surface, get under the new paper and mar the work. This is true of all sanding operations, hand or machine.



New tool coating

If your new hand plane or chisel seems to drag, this may be caused by the clear film of plastic or lacquer applied to the working surface to prevent rust. Remove the film by scraping with a razor blade or by wiping it off with a rag soaked in lacquer thinner.

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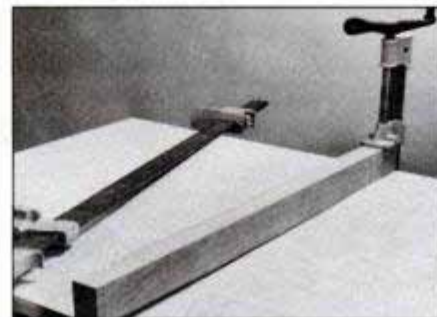
Write McPherson, Inc., Dept. 16
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Woodworking Guide



Patching board defects

Here's a way to use stock with a wane—an absence of wood along one edge—without ripping off the entire edge. You can use the full width of the board by sawing out the defective area and gluing in a replacement strip. Match the face and edge grain of the replacement and the repair will be unnoticeable.



Curved clamp block

Use a clamping block or caul with a slight curve when gluing and clamping a large case that is not going to be fastened with screws. The caul, placed with its curved surface against the work, will distribute the clamp pressure from the edges to the center. Use a hand plane or belt sander to shape the curve. For a caul 1 in. thick by 1 1/2 in. wide, use a curve of about 1/8 in. per foot. Apply even pressure to both ends of the caul when clamping.



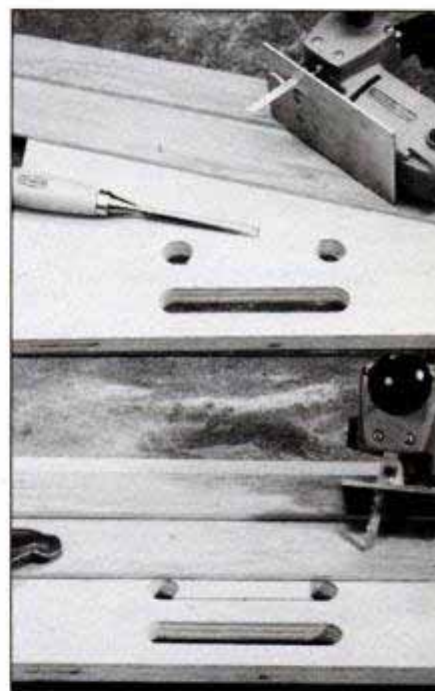
Cleaning a machine

Rust spots or film on a machine table can be removed by rubbing with wet-dry 320-grit silicone carbide paper lubricated with turpentine. When rust is gone, wipe off the slurry with a clean cloth dampened with turpentine. After the table has dried, apply rust inhibitor, like WD 40 or paste wax.



Spade bit technique

Don't run out in the middle of a project just because you've found the spade bit you want to use is slightly out of true. As the point of the bit enters the wood, it self-stabilizes and the hole progresses nicely until the bit is withdrawn. When the bit's point is no longer captive in the wood, the bit will wobble and tear up the hole. To prevent this, bore the hole with the stock securely clamped to the drill press table and stop the drill before withdrawing the bit.



Hole-to-hole tangents

Use a sabre saw with a shop-made fence to make clean tangent cuts from one hole to another, such as for making a hand slot. To make the fence, attach a 1/4 x 2-in.-wide strip of plywood to another strip about 6 in. wide. Cut the excess off the 6-in. piece by guiding the saw base along the edge of the narrow strip. Use a chisel to pare a notch on each hole where the saw blade will begin the cut, so that the blade will lie flat. Then clamp the fence so its newly sawed edge aligns with the hole edges. Cut the tangents by again guiding the saw base along the edge of the narrow plywood strip. You should use a saw blade with standard set teeth; blades with hollow ground teeth will tend to drift off course.

PM

TELEVISION TOUCHDOWNS

(Continued from page 74)

audio man sits alone, glassed in like an ancient quiz-show contestant in an isolation booth. He coordinates all the sounds that go out over the air: the words of the commentators, the sounds of action picked up by the nightly directional parabolic mike aimed at the field, the grunts and gasps of colliding athletes captured closeup by the wireless microphone worn by the ref.

In the back section of the van, the video man monitors the picture and attempts to keep the color and the contrast consistent. Next to him, two videotape editors attend the machines that provide slow-motion replays when the director calls for them.

The van has been parked inside the stadium since 7 a.m., its crew working to set up and test the equipment. The first serious hitch comes less than an hour before kickoff, a human problem, not a mechanical one. Herschel Walker, loosening up on the field, jogs over to Mike Haffner, the former NFL wide receiver and now a broadcaster. "Old man won't let me do it," Walker says, nodding toward his coach, Walt Michaels, who has ordered him not to do a planned pregame interview. Haffner winces, reports to Wildhack.

Part of the Walker interview was going to be fed into a pregame sports-news show to tease the game. Instead, ESPN will have to go with an interview Haffner conducted earlier with Doug Flutie, New Jersey's injured quarterback. Wildhack is not happy. He knows that Walker is the primary story of the game, Flutie the secondary.

Technical difficulties

Soon Mole, the director, is more unhappy. "I've lost intercom to the cameramen," he calls out 20 minutes before the kickoff. "Tell them we're having technical difficulties," Wildhack says to the associate director, who is on the phone to headquarters. The engineer quickly restores communications.

In the broadcast booth overlooking midfield, Haffner and Tim Brando, the play-by-play men, straighten their ties, slip into their jackets, pat down their hair. They rehearse their opening remarks. Brando emphasizes Walker and the rushing record, Haffner the two missing injured quarterbacks, Brian Sipe of Jacksonville and Flutie.

"We're one minute from air," Wildhack says.

"Keep your mikes closed unless you're talking to me," Mole tells the cameramen.

"The first font is okay," the associate producer says, indicating the first chyron caption for the home viewers.

(Please turn to page 162)

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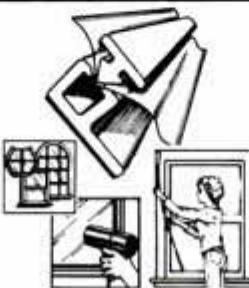
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Distributor Hold Down (S.B. Ford)	19660	\$2.50
Fuel Line (3/16" 2 Holes)	19519	\$4.50
Fuel Line (Double Pumps)	19520	\$5.50

CHROME BOLTS

Inake Bolts S.B. Chevy	19125	\$14.25
Oil Pan Bolts S.B. Chevy	19175	\$11.75
Timing Cover Bolts	S.B. Chevy	\$7.25
Water Pump Bolts	S.B. Chevy	\$4.25
Header Bolt S.B. Chevy	19126	\$6.50
Rear Axle Cover Bolts G.M.	19126	\$11.00

VALVE COVERS

AMC 290-401 V8	19549	\$26.95 PR
Buick 231 V6	19449	\$24.95 PR
Chevy V8	19251	\$24.95 PR
Chevy 58 Short	19196	\$18.95 PR
Chevy S.B. Tall	19195	\$19.95 PR
Chevy B.B. Short	19333	\$26.95 PR
Chevy B.B. Tall	19238	\$29.95 PR
Mopar S.B.	19332	\$24.95 PR
Mopar B.B.	19547	\$29.95 PR
Ford S.B.	19331	\$24.95 PR
Ford 351C-351M-400	19332	\$26.95 PR
Ford 360-390-428	19543	\$26.95 PR
Ford 429-460	19542	\$29.95 PR
Oldsmobile V8	19544	\$28.95 PR
Pontiac V8	19525	\$26.95 PR

WATER NECKS

Chevy Angled	19286	\$5.00
Chevy Straight	19287	\$5.00
Mopar 84 Unit	19286	\$5.95
Ford S.B.	19289	\$5.95

CHROME DIFFERENTIAL COVERS

Chevy 12 Bolt	19126	\$9.95
Chevy 10 Bolt	19125	\$9.95
Chevy 510/Camaro 90 Unit	19548	\$10.95
GM Truck 14 Bolt 73-81	19123	\$
Dana 44	19124	\$9.95

TIMING CHAIN COVERS

S.B. Chevy	19122	\$3.95
B.S. Chevy	19221	\$5.95
Mopar S.B.	19157	\$1.50
S.B. Timing Tab	19255	\$1.50
B.S. Timing Tab	19256	\$1.50

AIR CLEANERS

14" Low Profile	19112	\$10.95
10" Low Profile	19279	\$10.95
6" 4 Barrel	19512	\$7.95
6" 2 Barrel	19513	\$7.95

VALVE COVER ACCESSORIES

Breather & Grommet	19196	\$2.50
V.C.T. Bolts Long	19261	\$1.75
V.C.T. Bolts Short	19262	\$1.65
Hold Down Tabs Long	19409	\$1.30
Hold Down Tabs Mini	19529	1.60

MISC.

S.B. Chevy Dipstick	19171	\$3.95
B.S. Chevy Dipstick	19170	\$4.95
S.B. Chevy Early Breather Tube	19284	\$2.95
Push In cap for above	19270	\$2.99
Fuel Pump Block Off Plate (SBC)	19504	\$1.50
Fuel Pump Block Off Plate (MCP)	19505	\$1.60
Cap Cover Bracket	19660	\$2.20
Distributor Hold Down (Chevy)	19660	\$2.50
Distributor Hold Down (S.B. Ford)	19660	\$2.50
Fuel Line (3/16" 2 Holes)	19519	\$4.50
Fuel Line (Double Pumps)	19520	\$5.50

CHROME BOLTS

Inake Bolts S.B. Chevy	19125	\$14.25
Oil Pan Bolts S.B. Chevy	19175	\$11.75
Timing Cover Bolts	S.B. Chevy	\$7.25
Water Pump Bolts	S.B. Chevy	\$4.25
Header Bolt S.B. Chevy	19126	\$6.50
Rear Axle Cover Bolts G.M.	19126	\$11.00

CARTER PERFORMANCE FUEL PUMPS

MECHANICAL	STREET & OFF ROAD	\$24.95
RACE	Produces 6 psi 80 GPH	\$29.95
Produces 8 psi 70 GPH		
ELECTRIC	STREET & OFF ROAD	\$36.95
RACE	Produces 7 psi 72 GPH	\$39.95

CARTER AFB CARBS

9635 625 CFM Chevy	\$109.95
9636 625 CFM Mopar	\$108.95
9637 625 CFM Ford	\$109.95

CARTER THERMO-QUAD CARBURETORS

9610 800 CFM Chevy	\$209.95
9611 800 CFM Mopar	\$209.95

ON SALE SAVE OVER 50%

HOLLEY WATER INJECTION KITS

- SUPPRESSES DAMAGING ENGINE KNOCK
- OPERATES ONLY WHEN ENGINE IS WARMED UP
- USES WATER ONLY AS NEEDED
- MAXIMUM RELIABILITY AT LOWER COST

THE HOLLEY SYSTEM COMES COMPLETE WITH STEP-BY-STEP INSTRUCTIONS AND ALL MOUNTING HARDWARE.

LOW COMPRESSION #19-1	REGULAR PRICE \$58.95
HIGH COMPRESSION #19-2	SAVE OVER 50%
RV'S/MOTORHOMES #19-3	

YOUR SPECIAL LOW PRICE \$19.95

HURST SHIFTERS

AUTOMATIC

Indy Matic	\$29.95
Chevy 10 Bolt	\$129.95
Auto Stick 3	\$109.95
Auto Stick Van	\$109.95
Automatic Pick up	\$69.95
Lightning Rods	\$154.95
Quarterstick	\$129.95

MANUAL

Super Shifter (4 Spd.)	\$129.95
Indy 3 Spd.	\$42.95
Indy Pick up (4 Spd.)	\$42.95
Indy (4 Spd.) Performance	\$79.95
Super II (4 Spd.)	\$129.95
with reverse gear lever	\$129.95
Competition Plus (4 Spd.)	\$119.95

ACCEL or MALLORY DUAL-POINT DISTRIBUTORS (YOUR CHOICE)

MECHANICAL ADVANCE

Chevy V8	\$48.95
Ford 289-302	\$54.95
Ford 351 W	\$54.95
Ford 351C-400	\$54.95
Ford 429-460	\$54.95
MOPAR	
318-340-360	\$54.95
MOPAR 383-440	\$54.95

VACUUM ADVANCE

Chevy V8	\$69.95
Ford 289-302	\$99.95
Ford 351 W	\$99.95
Ford 351C-400	\$79.95
Ford 429-460	\$79.95
MOPAR	
318-340-360	\$79.95
MOPAR 383-440	\$79.95

MALLORY ONLY

MALLORY UNILITE

MECHANICAL ADVANCE

Chevy V8	\$9.95
Ford 289-302	\$9.95
Ford 351 W	\$9.95
Ford 351C-400	\$9.95
Ford 429-460	\$9.95
Mopar 318-340-360	\$9.95
Mopar 383-440	\$9.95

CHROME COIL & BRACKET

19665 Coil & bracket \$14.95

HOLLEY PERFORMANCE CARBURETORS

Brand New No Seconds No Rebuilds

4 BARREL UNIVERSAL VACUUM SECONDARY

800 CFM	1850	\$96.95
750 CFM	3310	\$107.95

Electric Choke

350 CFM	8067	\$149.95
600 CFM	9534	\$132.95

2 BARREL UNIVERSAL VACUUM SECONDARY

350 CFM	7445	\$109.95
500 CFM	4412	\$96.95

DOUBLE PUMPS

800 CFM	4778	\$157.95
850 CFM	4777	\$159.95
700 CFM	4779	\$159.95
750 CFM	4779	\$159.95
800 CFM	4780	\$219.95
850 CFM	4781	\$239.95

CHEVY SPREAD BORE QUADRAJET REPLACEMENTS

850 CFM	8210 Max Sec	\$163.95
850 CFM	8679 Vac Sec	\$162.95

NEW TRW FUEL PUMPS

Available for all Makes & Models Phone for Your Low Price

\$12.95 S.B. CHEVY

EDSELBROCK PERFORMER PLUS CAMSHAFT KITS

Kit includes Camshafts-Lifters-Springs

\$139.95

AMC 304-401	2132	\$144.95
Buick V8 70 up 751	5487	\$124.95
S.B. Chevy up to 350 2102	5136	\$95.95
S.B. Chevy 400	2103	\$136.95
B.S. Chevy	2162	\$139.95
S.B. Mopar 318-360	2177	\$149.95
S.B. Mopar 413-480 2192	1962	\$95.95
S.B. Ford 289-302	2122	\$145.95
39194 Ford	2182	\$152.95
351M-400 Ford	2172	\$147.95
390-428 Ford	2106	\$145.95
429-460 Ford	2167	\$146.95
Mustang 400-455	2157	\$149.95

GENUINE HAYDEN RAPID COOL ELECTRIC FANS

WITHOUT THERMOSTAT

10 #2630	\$39.95
12 #2640	\$42.95
14 #2650	\$45.95

YOUR LOW PRICE \$49.95

WITH THERMOSTAT

10 #2625	\$39.95
12 #2635	\$42.95
14 #2645	\$45.95

YOUR LOW PRICE \$59.95

S.B. CHEVY WEIAND MANIFOLD SPECIAL

OPEN PLENUM

RPM RANGE	2000 - 6000
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YOUR LOW PRICE \$69.95

7546 Your Low Price S.B. Chevy

ON SALE ACCEL BREAKERLESS ELECTRONIC IGNITION DISTRIBUTORS

MECHANICAL ADVANCE

Chevy V8	\$9.95
Ford 289-302	\$9.95
Ford 351C-400	\$9.95
Ford 429-460	\$9.95
Mopar 318-360-360	\$9.95

VACUUM ADVANCE

Chevy V8	\$9.95
Ford 289-302	\$10.95
Ford 351C-400	\$10.95
Ford 429-460	\$10.95
Mopar 318-360-360	\$10.95

TRANSPARENT DISTRIBUTOR CAPS

AVAILABLE FOR Ford/GM/Mopar V8

YOUR CHOICE OF CLEAR/RED/BLUE/YELLOW

PERFORMANCE V BELT & RADIATOR HOSE SPECIAL

Kit includes 2 "V" BELTS & UPPER & LOWER RADIATOR HOSE.

YOUR LOW PRICE \$8.95

PERFORMANCE V BELT & RADIATOR HOSE SPECIAL

Kit includes 2 "V" BELTS & UPPER & LOWER RADIATOR HOSE.

YOUR LOW PRICE \$14.95

Most Domestic Cars 1960-1990

Get both of the above Kits for one Low Price of \$19.95

SUPER COILS

Accel Supercoil	\$28.95
Accel Supercoil HEI	\$28.95
Accel Yellow Supercoil	\$14.95
Mallory Voltmaster	\$29.95
Chrome Coil & Bracket	\$14.95
Mallory Pro-Master	\$6.95
O.E.M. Universal Replacement 12V	\$ 6.95

ISKENDARIAN SUPER CAMS

Economy Hi-Torque/RV Kit includes Camshafts-Lifters-Springs

\$139.95

BOOKS

H.P. BOOKS

HOW TO REBUILD BOOKS

Ford 351C-351M-400-429-460	\$9.95
S.B. Ford 289-302 351W	\$9.95
S.B. Ford F.E. 390-428	\$9.95
Ford 3.7 L & 2.0 OHV	\$9.95
S.B. Chevy	\$9.95
B.S. Chevy	\$9.95
S.B. Mopar	\$9.95

STAINLESS STEEL FLEX-A-LITE FANS

UNIVERSAL FIT

8000 RPM RATING

#1070 17" DIAMETER #1080 18" DIAMETER

YOUR LOW PRICE \$10.95

WIRES

7mm Yellow Silicone 8.95

8mm Yellow Silicone 15.95

Straight or angle boots, copper or suppressed wire.

MALLORY PRO WIRE

The Wire the Pro's Use

V8 Set \$24.95

Straight or Angle Boots Copper or Suppressed Wire

AUTOMETER AUTOGAUGE PERFORMANCE STREET TACH'S

YOUR LOW PRICE \$27.95

#2300 Satin Black \$29.95

#2301 Chrome

Full 3/4" Diameter 0-8,000 RPM Red Line Pointer Universal Mounting

AUTO-GAGE'S

Oil Pressure #2321	\$11.95
Water Temp. #2331	\$14.95
Vacuum #2371	\$11.95
Amps #2386	\$4.95

FRAM OIL & AIR FILTER SPECIAL

YOUR LOW PRICE \$8.95

PERFORMANCE V BELT & RADIATOR HOSE SPECIAL

Kit includes 2 "V" BELTS & UPPER & LOWER RADIATOR HOSE.

YOUR LOW PRICE \$14.95

Most Domestic Cars 1960-1990

Get both of the above Kits for one Low Price of \$19.95

TUNE-UP SPECIAL

2 "V" Fan Belts

Upper/Lower Radiator Hoses

Fram Oil Filter & Air Filter

8 Automatic Spark Plugs

YOUR LOW PRICE \$29.95

Most Domestic Cars 1960-1990

KONI ADJUSTABLE PERFORMANCE SHOCKS

Available for Most Domestic 6 CYL & V8 Engines

Kit includes POINTS-ROTOR-CONDENSER & DISTRIBUTOR CAP.

AMC	6 CYL	68-74	\$74.95
G.M.	6 CYL	63-73	\$74.95
MOPAR	6 CYL	62-72	\$67.95
FORD	6 CYL	56-65	\$60.75

YOUR LOW PRICE \$59.95

GENUINE HAYDEN RAPID COOL TRANSMISSION OIL COOLERS

1518 CARS (MEDIUM DUTY)	YOUR LOW PRICE \$19.95
1522 CARS, TRUCKS & TOWING (MEDIUM DUTY)	YOUR LOW PRICE \$29.95
1526 MOTORHOMES, TRUCKS & ALL HEAVY TOWING	YOUR LOW PRICE \$34.95

RAPID COOL FAN CLUTCHES

BY HAYDEN

NON THERMAL (CARS)

\$22.00

THERMAL (CARS)

\$32.00

HEAVY DUTY TRUCK (FORD-GM)

\$59.95

RAPID COOL ENGINE OIL COOLERS

BY HAYDEN

8000 FORD-MOPAR	YOUR LOW PRICE \$39.95
8001 A.M.C.-GM	

O.E.M. REPLACEMENT IGNITION PARTS

ELECTRONIC IGNITION KITS

Available For Most Domestic 6 CYL & V8 Engines. KIT INCLUDES ROTOR & CAP.

G.M.	V8	76-84	\$8.95
FORD	MOPAR & CYL	76-84	\$3.95
FORD	V8	72-84	\$3.95
FORD	V8	62-84	\$3.95

TOP QUALITY TUNE-UP KITS

FOR POINT TYPE IGNITION

Available For Most Domestic 6 CYL & V8 Engines

Kit includes POINTS-ROTOR-CONDENSER & DISTRIBUTOR CAP.

AMC	6 CYL	68-74	\$74.95
G.M.	6 CYL	63-73	\$74.95
MOPAR	6 CYL	62-72	\$67.95
FORD	6 CYL	56-65	\$60.75

YOUR LOW PRICE \$59.95

California residents: Items in this ad are Not legal for sale or use on pollution controlled motor vehicles in California. Legal in California only for racing vehicles which may not be used on highways

WE CARRY A COMPLETE LINE OF MECHANICAL ENGINE PARTS FOR ALL APPLICATIONS. STOCK REPLACEMENT, HI-PERFORMANCE & RACING.

MONROE SHOCK SPECIALS

MONROE VIP
1-3/16 BORE HEAVY DUTY CONSTRUCTION EXCEEDS MANUFACTURER'S SPECIFICATIONS AVAILABLE FOR ALL U.S. MODEL CARS

MONROE-MATIC
MONROE'S BEST SELLING REPLACE MENT SHOCK 55% INCREASE IN RIDE CONTROL OVER REGULAR OEM SHOCKS. AVAILABLE FOR ALL U.S. CARS & LIGHT TRUCKS.

MONROE GAS-MATIC
THE ULTIMATE IN RIDING COMFORT & CONTROL LOW PRESSURE GAS CHARGED AVAILABLE FOR ALL U.S. CARS & LIGHT TRUCKS

MAGNUM 60
HEAVY DUTY ALL TERRAIN SHOCKS FOR HI-PERFORMANCE & HEAVY DUTY APPLICATION FOR LIGHT TRUCKS & 4x4's

LOAD LEVELERS
INCREASES LOAD CAPACITY FOR U.S. CARS OR TRUCKS. HEAVY DUTY SHOCK & SPRING COMBINATION FOR FRONT & REAR APPLICATIONS.

AIR SHOCKS
INFLATES TO 150 LBS WITH VEHICULAR LOADED FOR HAULING THOSE HEAVY LOADS FOR ALL U.S. CARS & TRUCKS

ELECTRIC RIDE CONTROL (DASHBOARD MOUNT) ADD \$84.95

WE HAVE A COMPLETE SELECTION OF MONROE SHOCK, ABSORBERS & REPLACE MENT STRUT ASSEMBLIES, CARTRIDGES. PHONE FOR YOUR LOW PRICE.



HI PERFORMANCE LONG SLOT ROCKER ARMS
SB Chevy 39.95 set 16
BB Chevy 59.95 set 16
Kit includes Arms, Balls, Nuts

ROCKER ARMS
FORD
S.B. Ford 289-302-351W \$69.95 Set Of 16
State Year, Rat or Non Rat
351C Boss-429 \$96.00 Set Of 16
Adjustable Kit w/ Arm, Ball, Nut 390-427-428 \$82.00 Set Of 16
Adjustable Rockers

PONTIAC
V8 1.6 Ratio \$59.95 Set Of 16
V8 1.6 Ratio \$59.95 Set Of 16
Kit includes Arms, Balls, Nuts

MOPAR
S.B. Mopar Adjustable \$122.00 Set Of 16
B.B. Mopar Adjustable \$112.00 Set Of 16
We have Rocker Arms for all engines. Phone for your low price.

NEW STOCK REPLACEMENT CAMSHAFT-LIFTERS SPRINGS KIT
Available for most V8 & 6 cyl. Domestic engines
Ford - Chevrolet - Mopar
Your Low Price **\$119.95**

SUPER STOCK ENGINE KIT



COMPLETE UNASSEMBLED HOME BUILT SPECIAL

STREET/COMPETITION SHORT BLOCK

• BLOCK: Sealed block (cast or custom head) (steel, iron lined) fitted with head gaskets, cam bearings, painted factory covers. Cam Bearings in steel.

• PISTONS: Available in all popular stock compression ratios. Your choice of size & ring.

• PISTON RINGS: Non-compression with premium chrome or tin.

• CONNECTING RODS: Complete kit manufactured by maximum strength.

• CRANKSHAFT: Custom ground on Rod and Main journals (steel, polished with chrome shaft).

• BEARINGS: Top and Bottom main bearings, bearings for perfect fit.

• TIMING CHAIN SET: Steel gears with shock & oil seal.

• CAMSHAFT: Your choice stock, 1/2" lift, 1/2" lift or 1/2" lift.

YOUR LOW PRICE CAST FORGED PISTONS

CHEVROLET	PISTONS	CAST FORGED
350 (12 Bolt Main)	790.00	800.00
360 (12 Bolt Main)	800.00	850.00
360-400-427	800.00	850.00
427 (12 Bolt Main)	1080.00	1180.00
454 (12 Bolt Main)	1080.00	1180.00
FORD		
289-302-351W	790.00	840.00
351 (12 Bolt Main)	800.00	850.00
351M-351C	800.00	850.00
400-300	890.00	940.00
460	940.00	990.00
460	940.00	990.00
MOPAR		
360	820.00	870.00
440	900.00	1000.00

TRW FORGED FLAT TOP PISTON & RING SPECIAL
Available Std. 030-040-060 CALL

Chevrolet	440	209.00	
283-327-350	454	219.00	
119.00	Ford	351C-400	119.00
Mopar	289-302-351W	119.00	
318-340-363.00	351C	154.00	
383	189.00	390	144.00

HI-PERFORMANCE DOUBLE ROLLER CHAIN SETS
SB Chevy **\$19.95**

Others Your Low Price

BB Chevy	29.95
SB Mopar	29.95
BB Mopar	29.95
SB Ford	39.95
351C-400 Ford	39.95
429-460	49.95
390-428	29.95
Odsmobile	49.95
Pontiac	39.95

PERFORMANCE CRANKSHAFT KITS
Custom ground on Rod & Main Journals, Con Rod & Main Bearings supplied for perfect fit. Available for most 6cyl & V8 **\$158.00**

ON SALE
TRUCKED UP! ADD-A-LEAF
FOR FRONT OR REAR SPRINGS FITS MOST DOMESTIC TRUCKS ETC.
YOUR LOW \$44.95 PAIR PRICE

FLAT TOP PISTON SPECIALS WITH RINGS
Available Std. 030-040-060

Chevrolet	99.00
350-350	119.00
460	
Ford	
302-351W	99.00
351C-351M-400	114.00
Mopar	
318-340-360	99.00

For Mopar Rings ADD \$15.00

HIGH VOLUME OIL PUMPS
20% More volume than stock pump

S.B. CHEVY **\$19.95**
ALL OTHERS **\$24.95**
Chevrolet Mopar Ford Pontiac

SUPER STOCK MASTER KIT



• PISTONS & PINS
• PISTON RINGS
• CONNECTING RODS
• ROD & MAIN BEARINGS
• CRANKSHAFT
• CAMSHAFT-LIFTERS-SPRINGS
• TIMING CHAIN SET
• OIL PUMP
• GASKET SET

Your Low Price CAST FORGED PISTONS

AMC	199-210-238	497.00	344.00
211-156	287-290-304-327	509.00	546.00
360	343-360-401	509.00	546.00
380		509.00	
BUICK			
221-156	483.00	504.00	
300-340-360	509.00	514.00	
400-401-425-430-455	583.00	684.00	
CADILLAC			
360-429-472-500	583.00	684.00	
CHEVROLET			
194-230-250-282	456.00	504.00	
285-280-327	456.00	504.00	
305-307-350	479.00	504.00	
360-400-427	484.00	529.00	
424	524.00	589.00	
FORD			
144-170-200-230	456.00	499.00	
260-289-302-351W	456.00	499.00	
351 (12 Bolt Main)	479.00	519.00	
429	494.00	529.00	
429-460	509.00	549.00	
MOPAR			
175-198-225	456.00	504.00	
275-318-340-360	456.00	529.00	
361-363-413	456.00	529.00	
440	456.00	529.00	
DODGE			
330-350	306.00	338.00	
364-400-425-455	349.00	381.00	
PONTIAC			
230-250	456.00	504.00	
326-350-360-400-455	509.00	579.00	

PAW T-SHIRTS & HATS
The Fabulous PAW Blown Motor Logo in 3 Colors on both Front & Back of a Quality Hanes Beefy T-Shirt. Available SM, M, L & XL. State Your Size **ONLY \$6.50**
PAW Hat with Logo - fits all sizes **ONLY \$4.50**

P.A.W. MONEY BACK GUARANTEE
BUY WITH CONFIDENCE FROM P.A.W. - IF FOR ANY REASON YOU ARE NOT SATISFIED WITH OUR PRODUCTS, JUST RETURN THEM WITHIN 90 DAYS FROM DATE OF RECEIPT AND WE WILL REFUND YOUR MONEY.

NOTE: NO REFUND ON SHIPPING CHARGES. PRODUCTS MUST BE IN NEW AND UNUSED CONDITION IN ORIGINAL PACKAGE. INSTALLED ITEMS CANNOT BE REFUNDED. CALL 818-998-3641 FOR RETURN AUTHORIZATION.

WE SHIP COD, NO DEPOSIT REQUIRED ON MOST ITEMS IN STOCK
WE ACCEPT MASTERCARD & VISA
TECH LINE & PHONE ORDERS
CALL 818-998-6000
8:30 AM to 5:30 PM Pacific Time
Monday thru Friday

CUSTOMER SERVICE: For Return Information and Inquiries Regarding Previous Orders Call 818-998-3641.

MAIL ORDER
PERFORMANCE AUTOMOTIVE WHOLESALE, INC.
21122 Lassen Street, Chatsworth, CA 91311

HOW TO ORDER
State Make, Model, Year & Engine Size. Send at least 50% deposit by Cashiers Check or Money Order, no personal checks accepted or use your Mastercard or VISA. All Overseas & Canadian orders must be paid in full. No C.O.D. on truck freight shipments. C.O.D. on UPS only. All Engines & Master Kits must be paid in full. Customer responsible for all shipping charges.

Print Name _____ Phone # () _____
Address _____
City _____ State _____ Zip _____
Make _____ Model _____ Year _____ Engine Size _____

NOTE: P.A.W. is not responsible for typographical errors in pricing or applications, including all contents of this advertising.

SUPER STOCK CRANKSHAFT KIT



• PISTONS & PINS
• PISTON RINGS
• CONNECTING RODS
• ROD & MAIN BEARINGS
• CRANKSHAFT

Your Low Price CAST FORGED PISTONS

AMC	199-210-238	497.00	344.00
211-156	287-290-304-327	509.00	546.00
360	343-360-401	509.00	546.00
380		509.00	
BUICK			
221-156	483.00	504.00	
300-340-360	509.00	514.00	
400-401-425-430-455	583.00	684.00	
CADILLAC			
360-429-472-500	583.00	684.00	
CHEVROLET			
194-230-250-282	456.00	504.00	
285-280-327	456.00	504.00	
305-307-350	479.00	504.00	
360-400-427	484.00	529.00	
424	524.00	589.00	
FORD			
144-170-200-230	456.00	499.00	
260-289-302-351W	456.00	499.00	
351 (12 Bolt Main)	479.00	519.00	
429	494.00	529.00	
429-460	509.00	549.00	
MOPAR			
175-198-225	456.00	504.00	
275-318-340-360	456.00	529.00	
361-363-413	456.00	529.00	
440	456.00	529.00	
DODGE			
330-350	306.00	338.00	
364-400-425-455	349.00	381.00	
PONTIAC			
230-250	456.00	504.00	
326-350-360-400-455	509.00	579.00	

GET OUR GIANT NEW 1985 CATALOG
FREE with an order from this advertisement or send \$4.00

PERFORMANCE CRANKSHAFT KITS
Custom ground on Rod & Main Journals, Con Rod & Main Bearings supplied for perfect fit. Available for most 6cyl & V8 **\$158.00**

ON SALE
TRUCKED UP! ADD-A-LEAF
FOR FRONT OR REAR SPRINGS FITS MOST DOMESTIC TRUCKS ETC.
YOUR LOW \$44.95 PAIR PRICE

FLAT TOP PISTON SPECIALS WITH RINGS
Available Std. 030-040-060

Chevrolet	99.00
350-350	119.00
460	
Ford	
302-351W	99.00
351C-351M-400	114.00
Mopar	
318-340-360	99.00

For Mopar Rings ADD \$15.00

HIGH VOLUME OIL PUMPS
20% More volume than stock pump

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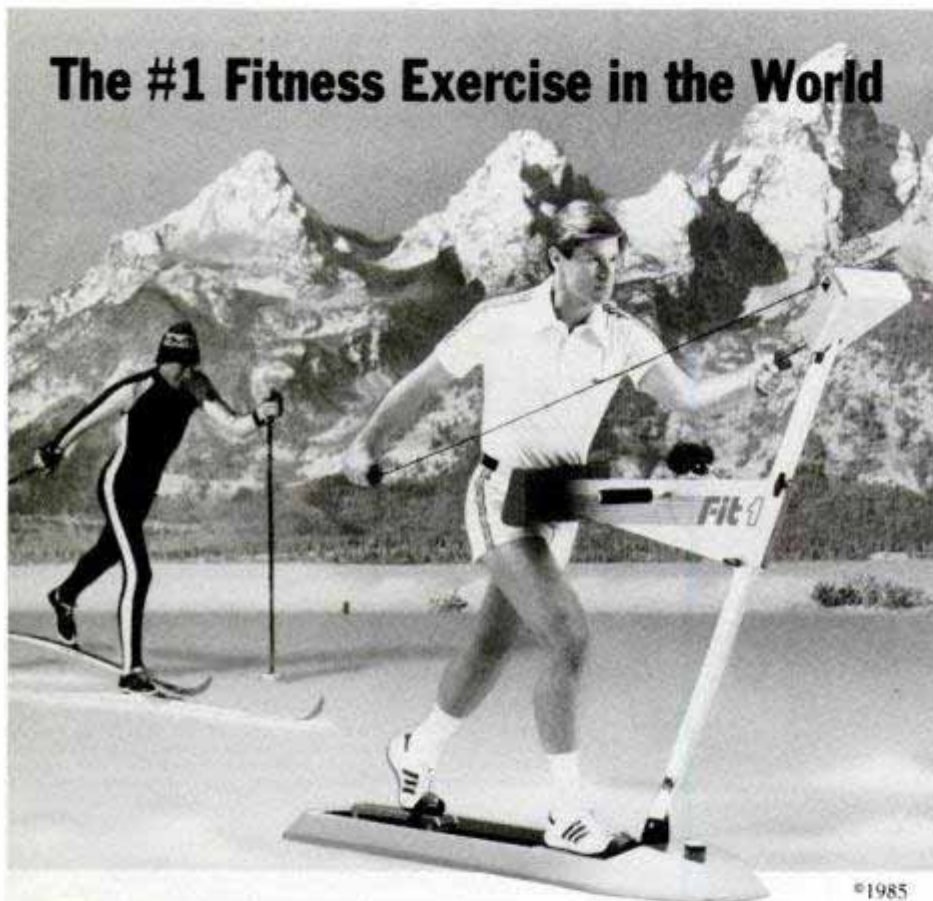
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TELEVISION TOUCHDOWNS

(Continued from page 159)

"Have a good one, everybody," Wildhack says, and begins the 10-second countdown to air.

The game goes on. A field of X's and O's flips and dissolves into the logo of the USFL/ESPN. Haffner and Brando breeze through the opening much more smoothly than in the rehearsal. Jacksonville loses the toss and prepares to kick off. "I want Herschel looking into the game on three," Mole tells the operator of camera three.

Early in the game, confusion on the field creates confusion in the van. An apparent New Jersey touchdown pass is disallowed because the receiver is ruled to be out of bounds. What seems to be the point after touchdown is actually a short field goal. A 7-0 score flashes on the screen; it is really 3-0.

Controlled chaos

The 28-man ESPN team doesn't make another noticeable mistake. At least two men are talking at all times. Voices are crackling in the ear, yet in the middle of controlled chaos, the telecast moves along briskly.

"Ready one!" The picture from camera one pops up on the preview screen.

"Take one!" The picture from camera one goes on the air.

"Font's good!"

"Ready five!"

A Jacksonville player goes down with an injury, and Wildhack turns to the associate producer and says, "Get an update quick. That looks serious."

In the first quarter, Herschel Walker goes over 2000 yards for the season, and the chart on the screen is an updated chart, placing him between Eric Dickerson, the record-holder, and O.J. Simpson, the first man to exceed 2000 yards in a season. Another chart lists the elite group of men who have rushed for more than 200 yards in a game. Walker, Dickerson and Simpson are on that list, too.

Haffner and Brando roam around the broadcast booth, their jackets stripped off now. Headsets in place, they talk as they move, sometimes to each other, sometimes to the field, sometimes to the wall, occasionally glancing down at notes and flip cards. They know their material and they react quickly to events on the field and in the van. "One of the toughest things for ex-football players," Haffner says, "is to learn to think while they're talking to you."

"Any flags?" Wildhack calls out after a punt. "No flags? Okay. Go to the commercial."

The Red Hat, cued in, folds his arms.

As the first half ends, Wildhack turns to the row behind him and says, "Hey,

(Please turn to page 164)



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TOUCHDOWNS

(Continued from page 162)

Mike and Joe, nice job back there. Nice job, everybody."

Early in the second half, the associate director relays the word from Bristol that the broadcast is to go off the air at 9:56:40. Wildhack nods.

"I've lost intercom again," Mole says, "I don't believe this truck.

The problem is cleared up.

Walker is up to 2056 yards rushing, within 49 of the record. Suddenly, he breaks loose, bursts through the Jacksonville secondary, twists and sprints 55 yards to a touchdown.

"That's it!"

"He's up to 2111. He's six past Eric."

"Font's good!"

The screen announces: NEW PRO FOOTBALL RUSHING RECORD.

Mole calls for replays from both videotape editors, isolated shots of Walker from two different angles, highlighting his power, his speed, his elusiveness. ESPN shows the record-breaking touchdown run from both angles.

"Ralph, you were marvelous," Haffner tells Mole, imitating Billy Crystal imitating Fernando Lamas.

After the commercial, Mole reruns Herschel's run from both angles. Wildhack turns to the associate director who

is linked to Bristol and says, "Tell 'em I don't care if we run long, I still want to do an interview with Herschel."

Bristol agrees. Wildhack can go past 9:56:40.

When a New Jersey player gets hurt, and Mole does not immediately spot him on any of his screens, the director shouts, "Where's the dead man?" He pauses. "Dead man's on five," he says. Up comes camera five, showing the injured man lying on the field.

The game comes down to the closing minutes, and Jacksonville cuts the Generals' lead 31-24, then recovers a fumbled kickoff and is poised inside the 10-yard line, first down and goal to go for a touchdown that could tie up the game and send it into overtime. "Everybody calm down," Wildhack says. "Good basic coverage now. Let's not force anything." He sounds like a coach.

On third down, the Jacksonville quarterback, Ed Luther, suffers an injury, and Mole calls for a replay that shows, vividly, the Jacksonville center turning and stepping on his quarterback's foot, twisting and damaging Luther's knee. "Great roll," Wildhack cheers.

On fourth down and goal to go, New Jersey turns back the final Jacksonville thrust, and Mole rattles off, "Ready one. Take one. Ready three. Take three. Reset one. Red shirts. Red shirts. Get

me red shirts." The director wants to see the Generals on the sidelines cheering their goal-line stand, and as that picture comes up on the screen, some of the men in the van start cheering, too. The last thing they want to see is an overtime game. Some of them have been working since morning.

The game ends. "Get Herschel on the headset," Wildhack says.

Herschel Walker is guided to the sidelines, to an ESPN headset. "Herschel, can you hear me?" Haffner says.

"Yes, I can," Walker says.

"Congratulations," Haffner says.

"Can I have two minutes for roll-outs?" Wildhack asks the associate director who asks Bristol. Wildhack wants to show the historic Walker run in slow motion at the end of the interview.

"You've got it, John," the AD replies.

Haffner wraps up his interview with Walker, the rerun of the record-breaking touchdown run extends beyond the closing credits, and as the show goes off the air at 10:05:40, precisely three hours after the opening kickoff, Wildhack smiles and says, "Nice job, everybody, nice job."

The van is packed up and out of Giants Stadium by midnight. The next night, it is in Atlantic City, and there is a new bunch of boys in the van. They're televising a boxing match. **PM**

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MUSCLECARS: THEN AND NOW (Continued from page 79)

SPECIFICATIONS AND DIMENSIONS: OLD-FASHIONED POWER

CAR*	BASE PRICE	PRICE AS TESTED	ENGINE	TRANSMISSION	WHEEL-BASE (in.)	LENGTH (in.)	WEIGHT (lb.)
1970 Buick GSX	\$3283	\$7000-\$9000	360-hp OHV, 7.5-liter V8	3-speed automatic	112	203	3750
1970 Chevelle SS 454	\$2809	\$12,000-\$14,000	450-hp OHV, 7.5-liter V8	4-speed manual	112	203	3850
1970 Dodge Charger R/T	\$3711	\$10,000-\$12,000	425-hp OHV, 7.0-liter V8	4-speed manual	117	208	3900
1969 Ford Cobra Talladega	\$3249	\$7000-\$9000	335-hp OHV, 7.0-liter V8	3-speed automatic	116	206	4100
1970 Oldsmobile 442 W-30	\$3376	\$6000-\$8000	370-hp OHV, 7.5-liter V8	3-speed automatic	112	203	3775
1965 Pontiac GTO	\$3026	\$7000-\$9000	360-hp OHV, 6.3-liter V8	4-speed manual	115	206	3600

*All are 5-passenger, 2-door.

slalom testing, so these performance figures simply didn't exist before. Our quarter-mile test results are among the most representative figures ever seen for these cars. Most of the acceleration numbers widely publicized back in the heyday of the musclecar were posted by cars that were, ah—not quite *stock*. Our figures are not only accurate, but a little conservative, if anything. Well aware that these owners don't even take their cars out in the rain, and they were letting us drive them on a race track, we carefully throttled back a notch from the ragged edge.

In addition, we were testing on one of those humid, horsepower-sapping days when everything is a little slower than usual. On a cooler, drier day, without the owner and his family standing next to the track covering their eyes, you might shave a bit from our times right across the board.

The old musclecars were significantly quicker in the quarter-mile than the

new musclecars. We only saw one car do a quarter-mile in the 13s, though on a faster day virtually all six of these golden oldies could be fine-tuned into quarter-miles of under 14 seconds, at over 100 mph. That's a full second and nearly 10 mph faster than any new production car you can buy.

The only new car in the same acceleration range was Ford's hot Mustang GT, which just barely broke into the 14-second range, astounding indeed for a 1985 model, but abysmally slow by 1970 standards. That's what we expected all along: When it comes to straightline acceleration, there's not a new car you can buy that is a true musclecar, in the 1970 meaning.

One of the new cars, the Olds 442, was way off pace in the acceleration test. Despite our best efforts to cure the Oldsmobile's fuel-starvation problem, we couldn't do any better than the 18-second elapsed times noted in the performance chart.

The big surprise was how well the old cars handled. The new cars were faster around a corner, but not by much. And the fastest-slaloming old musclecar—the Dodge Charger R/T—actually beat the slowest new car, the Firebird Trans Am. All other things being equal, a short, quick-handling car will perform best weaving through the slalom, so the performance of the long-wheelbase, heavy old musclecars—most of which take four or five turns of the steering wheel lock-to-lock—was a truly remarkable showing.

On the skidpad, the old cars all posted better than .70, and the best ones were over .75. The 1970 Chevelle and Olds 442 W-30 were just as quick as the 1985 Olds 442 at .76, and that's a very respectable steady-state cornering figure, even in 1985. The other new musclecars all bettered .80, which makes this the best handling group of cars we've ever tested.

(Please turn to page 166)

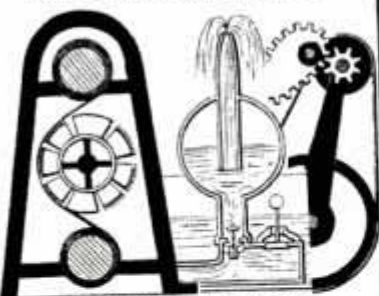
VS. NEW-FANGLED SOPHISTICATION

CAR*	BASE PRICE	PRICE AS TESTED	ENGINE	TRANSMISSION	WHEEL-BASE (in.)	LENGTH (in.)	WEIGHT (lb.)
1985 Buick Regal GN	\$12,890	\$15,837	200-hp OHV, 3.8-liter V6 turbocharged	4-speed automatic	108	200	3500
1985 Chevrolet Monte Carlo SS	\$11,380	\$14,139	190-hp OHV, 5.0-liter V8	4-speed automatic	108	202	3500
1985 Dodge Shelby Charger	\$8995	\$11,087	146-hp SOHC, 2.2-liter inline-4 turbo	5-speed manual	97	175	2500
1985 Ford Mustang GT	\$10,598	\$12,904	210-hp OHV, 5.0-liter V8	5-speed manual	100	181	3250
1985 Oldsmobile 442	\$11,399	\$14,343	190-hp OHV, 5.0-liter V8	4-speed automatic	108	200	3600
1985 Pontiac Firebird Trans-Am	\$11,335	\$13,987	205-hp OHV, 5.0-liter V8	4-speed automatic	101	191	3400

*All are 4-passenger, 2-door.

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MUSCLECARS

(Continued from page 165)

Once again, there's a caveat. Simply bolting Eagle GT radials onto a car designed for bias-ply tires will improve the handling, but you'd get still more improvement by setting up the suspension to take advantage of the unique handling characteristics of radial tires. Remember when Pontiac advertised its Radial Tuned Suspension? None of our old musclecars was exploiting its new tires to the fullest, while the new cars have all been designed with these tires in mind.

Pretty much the same thing was true in our braking test. The best old car beat the worst new car, but as a group, the new cars were superior. This group of new cars, though, did far better than average in braking, and we've tested many well-thought-of 1985 models that can't stop as quickly as some of these 15- and 20-year-old musclecars.

We didn't measure fuel economy, since our full-throttle test figures would be meaningless. Using contemporary road tests, plus talking to the owners, we were able to come up with some representative figures. Surprisingly, the figures for the older cars aren't much worse than the EPA City figures of the 1985 musclecars.

The difference is that the early cars have only rudimentary emissions controls and require the highest octane gas you can find because of their sky-high compression ratios. Indeed, most of the old car owners brought along their own octane-boosted gas. The modern musclecars run on 92 octane.

Muscle developments

Driving the cars side-by-side, it was easy to see the tremendous development that took place between the first GTO and, say the 450-hp Chevelle LS-6 just six years later. The GTO performed well, but it felt like an old car—uncomfortable and awkward to drive, and a nose-heavy handful in the braking and handling tests. It felt exactly like what it was, an early compact with a heavy V8 under the hood.

The Ford Talladega had much the same feeling. It was large, awkward and not all that comfortable. But it sure was fast. And like all six of the old musclecars, it felt sturdy, as though every part was built to last a millenium.

The 1970 Charger and Chevelle SS 454 were surprisingly similar to drive. Neither felt particularly bulky despite their large size and weight, and neither exhibited any handling histrionics. Both went where you pointed them, and were a cinch to drive fast. Especially when you consider the weight of the engine and drivetrain components, both these giants were surprisingly tame.

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The 1970 Buick GSX and Oldsmobile 442 were similar to each other, and to the Chevelle. Neither was as capable as the Chevy, neither felt as much all-of-a-piece. The Buick, Chevrolet and Oldsmobile musclecars you can buy off a dealer's lot today feel closest to the golden oldies, but are very old fashioned by modern standards. The best is probably the Buick Grand National, though we'd rather have a V8 than the turbo V6.

Dodge's Shelby Charger is a cute little car and zippy enough, but the Omni GLH Turbo is a better performance buy—quicker and faster, because it's lighter but uses the same engine. And also \$2000 less. Despite their excellent performance, neither strikes us as a musclecar. Perhaps they're too small and soft-edged.

We've always loved the Pontiac Trans Am and similar Z28, even this particular car, which seemed down on both handling and power compared to other examples we've driven. The car is inexpensive, durable, performs flawlessly and looks like a million dollars. But really, it's a 2+2 Grand Tourer, not a musclecar.

Picks of the litters

Our favorite of the six new machines was the Mustang GT, which has to be one of the best all-around packages on the market. For less than \$11,000, it outperforms just about every new car on the road except a couple of Porsches and the Corvette. It looks good, is virtually indestructible, marvelously livable and you can even order it as a convertible. Best of all, it's bags of fun to drive.

Of course, if you want *real* musclecar performance, you can spend even less and buy any number of restored original musclecars. Our favorite is the awesomely competent Chevelle SS 454 LS-6, but you could have a wonderful time with almost any of them. Even cars that were considered sleds in 1970 seem like projectiles today.

The only drawback to using an old musclecar on a regular basis is finding high-octane fuel. You can lower the compression ratio, you can use octane boosters or aviation fuel and you can put up with some detonation under acceleration, but realistically, an old musclecar will be a lot more trouble to own than a new one.

On the other hand, it'll be more fun. If we learned anything from our days at Englishtown, it's that today's performance cars are better all-around packages than they were 20 years ago. But not *that* much better. Except at the limit of adhesion, you'd never discover that a Mustang GT will outcorner an SS 454 Chevelle. And when it comes to acceleration, there's no contest. **PM**

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SPACE VACATION 1995

(Continued from page 62)

proposal was made to send an expedition to Mars with chemicals designed to alter the Martian atmosphere. Space writer James Oberg has suggested that the current Martian environment is so close to being hospitable to humans that only slight alterations would be necessary to make it livable.

"We have studied in detail photos and maps sent to earth in the 1970s by the Viking Lander," Ebersol says. "There are canyons and valleys that appear to be habitable. We'd like to explore them and map them carefully for a future generation of miners and developers."

Shuttle shopping

Several West German groups have proposed purchasing a Space Shuttle collectively for \$1 billion. NASA would operate it, but they would use it to privately place satellites in orbit and carry tourists into space. NASA's initial reaction was negative—but not final. The word from NASA is that \$1 billion would not cover the cost of building and testing a Space Shuttle. The West Germans, who have incorporated under the name Saturna, say the cost of producing a Shuttle should be drastically reduced once NASA starts adding to its 4-vessel fleet.

"We would like to modify the cargo bay rather than simply insert a passenger module," says Dieter Lauter of Saturna. "That would give us more places for passengers and allow us to launch commercial satellites on the same flights."

Modifying the Shuttle would cost another \$250 million, but the West Germans say they can raise most of the money on European stock exchanges and have reason to believe that other cash would be available from European governments.

Now that NASA has sent a senator into space and is training a school teacher for a launch, the prospect of civilian flights does seem brighter. But isn't it farfetched to assume that tourists will be able to meet the stringent physical and mental requirements of space travel?

"The Space Shuttle is designed so your grandmother could fly in it," NASA's O'Donnell told me in a recent interview. "People who have been dreaming about space travel all their lives are probably ready to go right now. And it won't be too long before we're ready to take them."

If you have \$1 million and think you might want to join Society Expeditions on its first flight to space, write to the company at 723 Broadway East, Seattle, WA 98102.

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DREAM BOATS

(Continued from page 83)

passengers secure while under way. The helmsman's and navigator's stations port and starboard are deep and comfortable to cushion the rude shocks these boats are heir to at sea, with drop-away seats so you can safely stand while driving.

Wellcraft's Scarab II is similarly equipped, but the boat is downscaled to pack as many appointments as possible into its 30-foot hull form. The pleasing thing about the Scarab II is its lightning speed. The one we drove had the same displacement engines as the 42 Excalibur. While she evinced much of the 42's luxury, she also produced eye-watering high-end performance and the kind of nimble maneuverability you'd expect from the dodge-'em concession at the county fair.

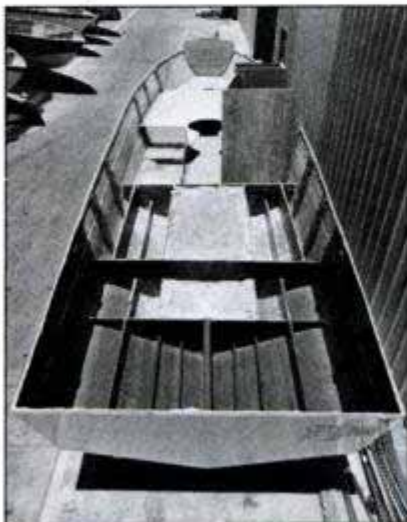
Wellcraft is considered one of the value manufacturers in the field, where volume production and economies of scale permit cost savings to the consumer. Many consider Cigarette to be the premium builder.

The people at Cigarette hand-machine much of their own metalwork from steering tie bars, to back-up plates for stanchions and pad-eyes, to out-drive stand-off boxes. Their interior joinery has that limited-production look. And, perhaps, the *pièce de résistance*, their upholstery is hand-sewn to custom color specifications that perfectly match a hull's color scheme.

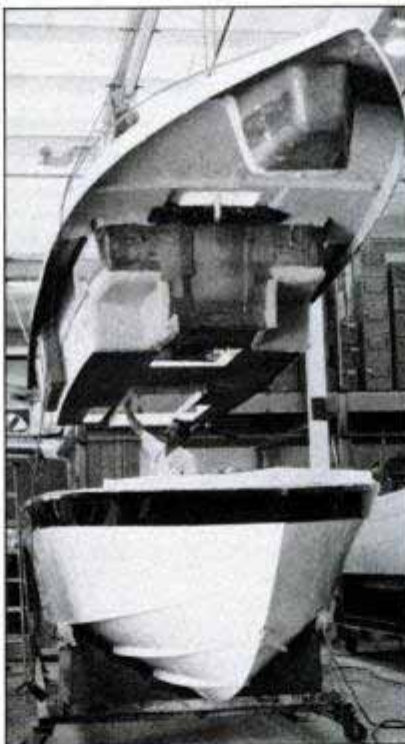
What do you pay for these extras? Well, toss in an extra 100K. As you realize as you sprint toward the horizon, it's only money. **PM**

A hull is born

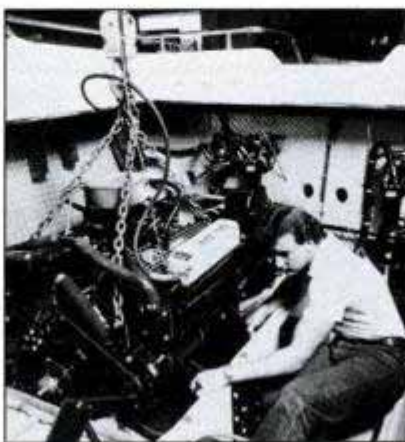
The process of building high-performance boats can be condensed to three principal elements. *Fiberglass layup* of hull and deck—to a precise schedule of mat, roving and resin—precedes the installation of furniture, recesses, tankage, compartments and stringer reinforcements. Plumbing and much of the wiring is installed inside the bare hull and through channels in the deck. Much of the interior's fabric liner is affixed just prior to the *mating of hull and deck*. The hull-deck joint is obviously critical to seaworthiness and is normally achieved with a combination chemical agent and mechanical through-hull fasteners. *Engines are installed* on mounts made of angle-iron fastened to the stringer grid in the engine compartment. Next comes the critical chore of lining up the powerplant and the outdrive and attaching controls, fuel lines and electrical hookups for lighting and instrumentation. The boats get a cosmetic touchup and a thorough cleaning at the end of the line. Modern tools and efficient manufacturing methods make it all look easy.—T.C.



Fore-and-aft stringers in a Wellcraft 42.



Deck and hull become one.



Engine installation, then testing.

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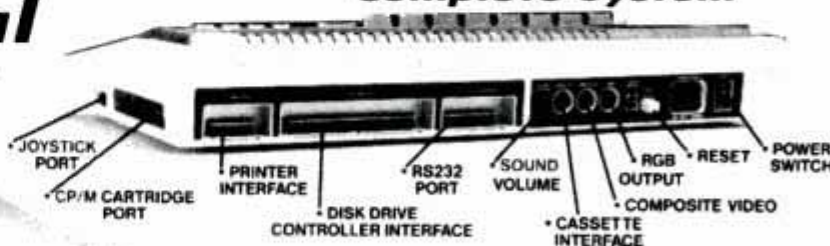
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SPECIFICATIONS

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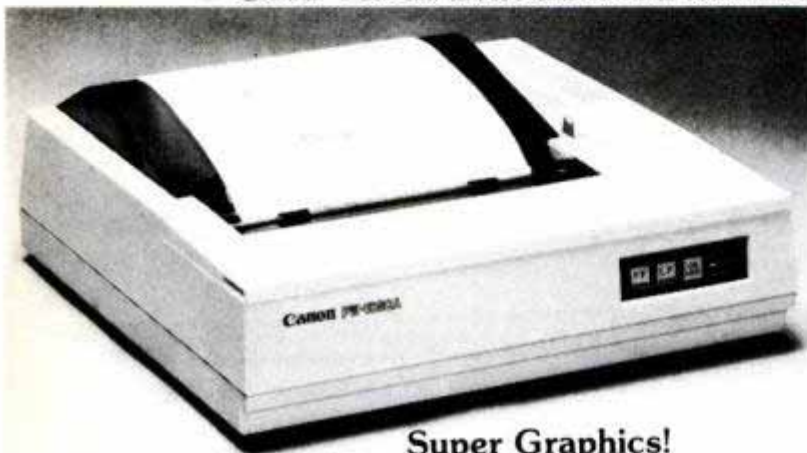
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Down Loading

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SNOW MOTION

(Continued from page 87)

conditions, it's best to adjust the white-balance (just follow the instructions for your vidcam)—and readjust it whenever your lighting conditions change.

With filter, sensitivity and white-balance fine-tuned for the slopes, you can use your camera's iris control to deal with backlighting and glare.

Decent exposure

Most vidcams today have an auto-iris feature that automatically opens and closes the lens aperture (iris) to admit

the amount of light needed for correct exposure. But the vast areas of bright, reflective white encountered in winter sports can trick the auto-iris, and render objects (such as skiers) as featureless silhouettes. Additionally, depending on your position on the slopes, you might find yourself facing the sun at certain times of day. This backlighting, too, will result in under-exposed skiers.

Under these conditions, you might find it worthwhile to revert to manual iris control—if it is available—or to lock the iris in a fixed position once the auto-iris function has found the best exposure for the scene.

The procedure is similar to spot-metering in conventional film photography. Use your telephoto to zoom in on the object you wish to record. In the manual mode, adjust the iris until your subject is properly illuminated, then zoom back to frame the scene as you desire. In the auto-iris mode, depress the iris-lock button and hold it down for as long as you wish that exposure to remain. This is particularly effective when you're zooming out from a tight focus, and the background or surroundings are very bright.

Pick your spot

Positioning yourself relative to the action is the key to an exciting, comprehensible videotape. At organized sports events, the positions from which you can shoot will be determined by terrain and the course. While you won't have access to the prime spots reserved for TV crews, you can often position yourself nearby.

When you pick your spot, give some thought to where the sun will be at the time you plan to shoot. If possible, have the sun at your back in order to avoid backlit situations.

Tips on planning

It's wise to develop a rough script for organized sporting events. This will help you determine the amount of tape and battery power you'll need.

Alpine skiing, for example, is comprised of downhill, slalom and giant slalom events for which there are qualifying, quarterfinal, semifinal and final runs—each involving a great many contestants. Consult a program guide for the events and contestants before you tape. If you tally the skiers' average times for the runs, and add a 2-minute interval between contestants, you'll get a close approximation of your total taping time.

You should also plan for the unexpected—and on the slopes, this might be snow. Carry clear plastic bags to protect your gear from the elements. Cut holes for the lens and viewfinder and secure the bags with elastic bands. Remember that moisture will cause your videogear to shut down automatically to protect itself. If you enter warm surroundings from the cold outdoors, moisture might condense inside your gear, causing this reaction. Try to avoid extremes of temperature.

Once you've made your tapes, you'll want to see them, so bring the right cables to connect your VCR or camcorder to a color TV in your ski lodge or hotel room. Prompt reviewing of your tapes will help you correct errors and retain the lessons you've learned—and not just for taping. Studying the styles of top-ranked athletes is as fine a way as any to improve your skills. **FM**

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B-1B: OUT OF THE SHADOWS

(Continued from page 90)

ics are built around the AIL/Eaton ALQ-161 electronic countermeasures system, more than 100 boxes and antenna weighing more than 2½ tons. Zoned to detect enemy signals from any point, they respond automatically with electronic deception, chaff and flares. Avionics, electrical equipment and wiring are shielded from the destructive effects of electromagnetic radiation from nuclear weapons detonations.

Transparent ceramic cockpit panels and portholes, made of a new material with the jaw-breaking name of polarized lead lanthanum zirconate titanite (PLZT), are capable of turning opaque within microseconds in response to intense light. They protect the crew from being blinded by the flash of nuclear weapons detonations.

Bomber forms and formulas

The B-1B's blended VG wing is a more advanced design than the unblended VG wing of the General Dynamics FB-111A, now our only low-level all-weather attacker. Bomber shapes depend on the state of aerodynamic art. The Boeing B-29 (1944) and the Consolidated-Vultee B-36 (1946) were based on formulas for the 1940s, their large-span wings optimized for long-range flight. The Boeing B-47 (1947) and B-52 (1954) had wings swept back for speed.

There were mavericks. Northrop's YB-49 (1947) was an all-wing jet-powered bomber eliminated by stability problems. The General Dynamics B-58 (1956), a supersonic delta-winged speedster, served in limited numbers until the realization that its high-speed, high-altitude attack would not save it from enemy surface-to-air missiles.

More radical was North American's XB-70 (1964), with its delta wing and forward canard. Planned for searing supersonic flight in the stratosphere, the XB-70 also would have been an exceptionally large missile target.

Both B-52 and FB-111 suffer from frequent failures of major systems, and have disappointing readiness records. If the whistle blew, they'd go; but performance could be below par.

The B-1B began with a 1962 Air Force study and concepts by Boeing, General Dynamics and (then) North American for a bomber for the mid-1970s. It was to fly faster than Mach 2 at altitudes of 70,000 feet, carry more bombs than the B-52 and have comparable unrefueled range.

The Air Force contracted with North American Rockwell on June 5, 1970, for five B-1 prototypes for flight test and two for ground tests of structures, and with General Electric for 40 F101 en-

gines. Projected B-1 flyaway cost: \$25 million each, with an expected production run of 240 bombers.

The designers adapted the blended wing-body shape developed for their F-15 proposal, chose a VG wing, included a soft ride system for low-level penetration, and froze the outlines in January 1971. Four months later came the first brickbat: a congressional recommendation to terminate the program, on the grounds of underestimated costs, vulnerability to advanced enemy air defenses, and whether there would be a manned bomber mission after 1980.

Late in June 1977, President Jimmy Carter cancelled production of the B-1, but continued funding for developmental flight testing. By then, estimated cost of each bomber was \$100 million.

Relaunching the bombed bomber

The Air Force and Rockwell persisted, flight-testing continued, and President Reagan resurrected the program in October 1981, as an interim long-range combat aircraft (LRCA), with a planned buy of 100. Program cost: \$20 billion. The B-1 was reborn as the B-1B.

More changes followed. The B-1B flies at Mach 1.2, about half the former target of Mach 2.2 to 2.3. Stronger landing gear compensates for a higher operating weight. About 70 percent of its airframe is in common with the B-1. Advanced technology makes its avionics 80 percent different, with all new offensive and defensive systems.

B-1B testing began March 23, 1983, with the flight of the second B-1 prototype, now incorporating some B-1B features. In August 1984, it was destroyed in a crash.

The first production B-1B was rolled out Sept. 4, 1984, from Rockwell's huge assembly plant at Palmdale, California. It was five months ahead of the latest schedule, and within budget. It first flew on Oct. 18, 1984, and is on flight-test status. Deliveries to the Strategic Air Command began last June. The first 15 of an eventual complement of 26 B-1B's go to SAC's 96th Bomb Wing at Dyess AFB, near Abilene, Texas.

Subsequent deliveries, building to a maximum rate of four a month, will be made to SAC bomb wings at Ellsworth AFB, South Dakota (32 aircraft); Grand Forks AFB, North Dakota; and McConnell AFB, Kansas (16 aircraft each). The final plane will be delivered in 1988.

As you read this, the 96th Bomb Wing will be about one year away from its Initial Operational Capability (IOC), a milestone once scheduled to be passed in 1974.

Possibly the arguments will continue to rage. After all, whether the B-1B is a super bomber or a bummer can only be answered in the lethal circumstances nobody wants: War. **FM**

SUPER SCOPES

(Continued from page 93)

dim-light or no-light conditions. Adjustment turrets, like those on a scope, let you zero the bullet impact accurately.

The simplest reflector is made by Daisy. In bright daylight, it works very well. The Army is even trying it out for military assault rifles. A much higher



The Daisy Point Sight bare-bones reflector costs less than \$15 for air rifles and has done well in tests by the U.S. Army.

hit ratio is claimed for it than the troops achieve with issue iron sights, yet the sight is almost as rugged and simple as iron sights. By making the aiming point glow in the dark, it could also become a good dim-light sight.

Tasco's reflectors come both ways. The Tascorama Battery Dot models light up in the dark while the Shurepoint designs use available light to



This triplet of rifle scopes comes in various sizes, shapes and powers for various hunting needs. Left, the compact rubber-armored Beeman SS-1, and right, the compact Leupold M8. Both have 2.5X power. The Bushnell Lite-site 3-9X, center, has a lighting reticle for low-light shooting.

illuminate the red dot aiming point that appears to cover the target. Daisy's Point Sight 800, designed for air rifles

but also fine for firearms, is smaller, cheaper and quite effective. In Army tests on MM16-A2 rifles, it has increased hitting ability compared with iron sights.

The Swedish Aimpoint is the grandfather of currently available reflector sights and lights up by battery power for dim-light shooting. Designed as a rifle sight, it has won fame and fortune in handgun competition shooting.

Sighting devices have come a long way, and more are on the horizon. Look for smaller, lighter models, possibly with computer chip ranging and bullet-drop compensation in a future sequel to this story. **FM**

SCOPE AND SIGHT SOURCES

Aimpoint, U.S.A., Inc., 201 Elden St., Suite 103, Herndon, VA 22070
 Beeman Precision Arms Inc., 47 Paul Dr., San Rafael, CA 94903
 Burris Co. Inc., 331 E. 8th St., Greeley, CO 80631
 Bushnell Optical Co. (includes Bausch & Lomb Inc.), 2828 Foothill Blvd., Pasadena, CA 91107
 Hansen Cartridge Co., 224 Old Post Road, Southport, CT 06490
 John Unertl Optical Co., 3551-5 East St., Pittsburgh, PA 15214
 Leupold & Stevens Inc., Box 668, Beaverton, OR 97075
 Redfield Gunsight Co., 5800 Jewell Ave., Denver, CO 80222
 Shepherd Scope Ltd., RR #1, Box 23, Waterloo, NB 68069
 Springfield Armory Inc., 420 West Main, Geneseo, IL 61254
 Tasco, 7600 N.W. 26th Street, Miami, FL 33122
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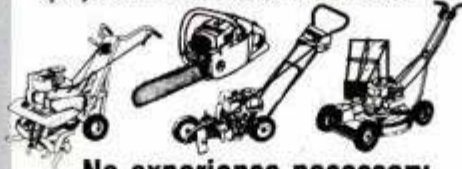
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We guide you every step of the way, including tested and proven instructions on how to get business, what to charge, how to get free advertising, where to get supplies wholesale... all the "tricks of the trade"... all the inside facts you need to assure success right from the start.

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Campbell, California

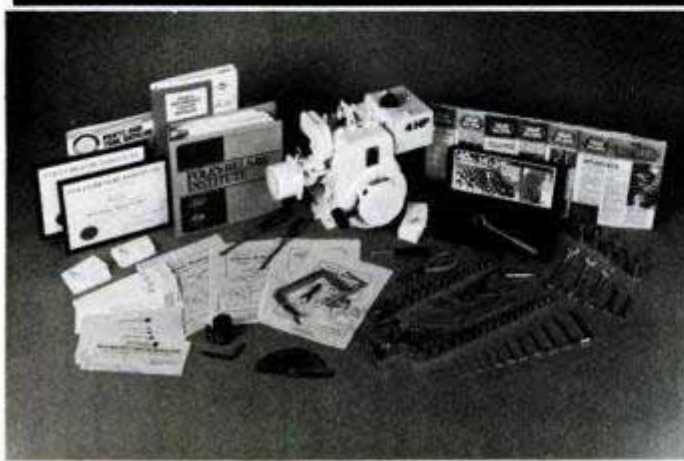
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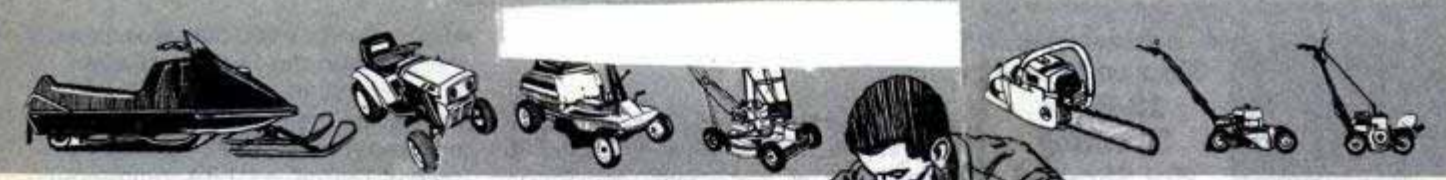
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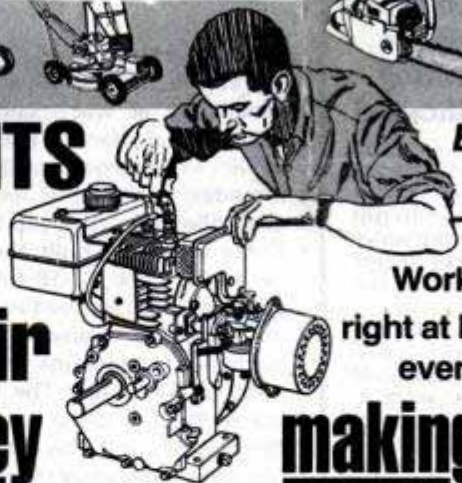
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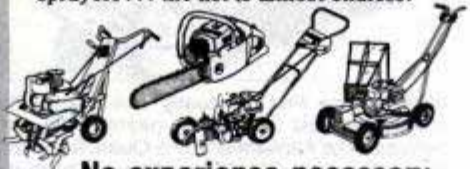
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A mechanic's snap-lock folding case included free of charge (see photo). It keeps each tool neatly in place and actually *folds the entire set of all 45 tools into just one-inch of space*, for handy storage in kitchen drawer, car glove compartment, office shelf or home workshop.



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9463	IBM PC computer, repair & maintain		\$12.95
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9804	Typewriter Repair, manual & electric		\$12.50
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9791	Oil Burners, install, service, repair		\$16.95
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9588	Citroen ID, 05 67-75	all DS19, 20, 21	\$13.95
8732	Citroen CX 78-83	front whl drive	\$13.95
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3739	Datsun 310 78-82	covers all models	\$13.95
0871	Datsun 510, 610, 710 68-77	all models	\$13.95
8271	Datsun 810/Mazda 77-84	all gas eng mds	\$13.95

5948	Datsun F-10 76-79	covers all models	\$13.95
9297	Datsun 70-81	pick-up all 2 whl dr mds	\$13.95
0925	Datsun 80-82	pick-up 720 2 & 4 whl dr	\$13.95
1257	Dodge 72-84	tune all rear whl dr mds	\$11.95
8064	Dodge Ares 81-83	for all models	\$13.95
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0863	Dodge 67-84	pick-up all 4 whl dr mds	\$12.95
1298	Dodge 71-84	tune all rear whl dr mds	\$11.95
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8203	Dodge 67-70	vans to 1 ton + Plymouth	\$12.95
6070	Dodge 71-83	vans to 1 ton + Plymouth	\$13.95
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9688	Duster 81-84	all mds inc EXP	\$13.95
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9776	Fiat 124 67-82	all Spyder, 2000, turbo	\$13.95
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8106	Fiat 131 75-80	all 1.8 & 2.0 engs	\$13.95
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1725	Freight, Trans-Am High-Perf Hotrod		\$8.95
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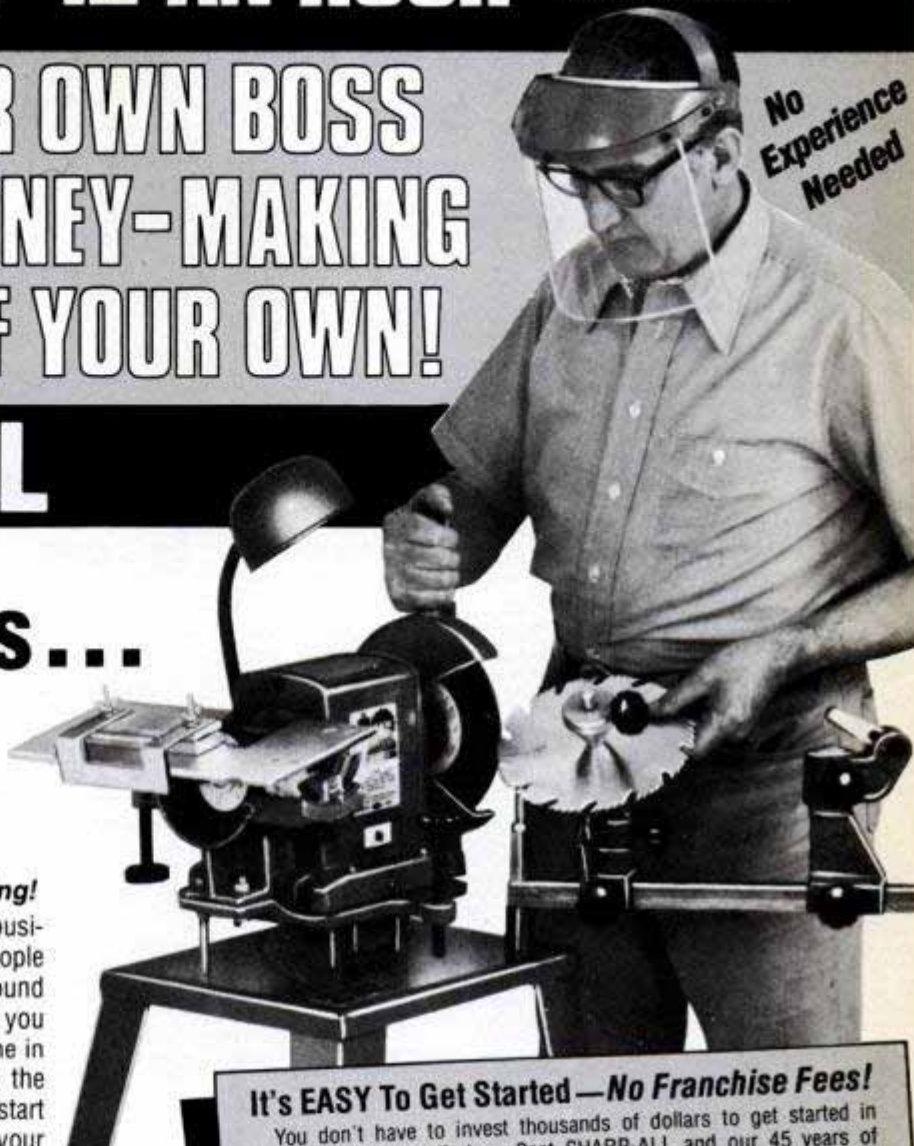
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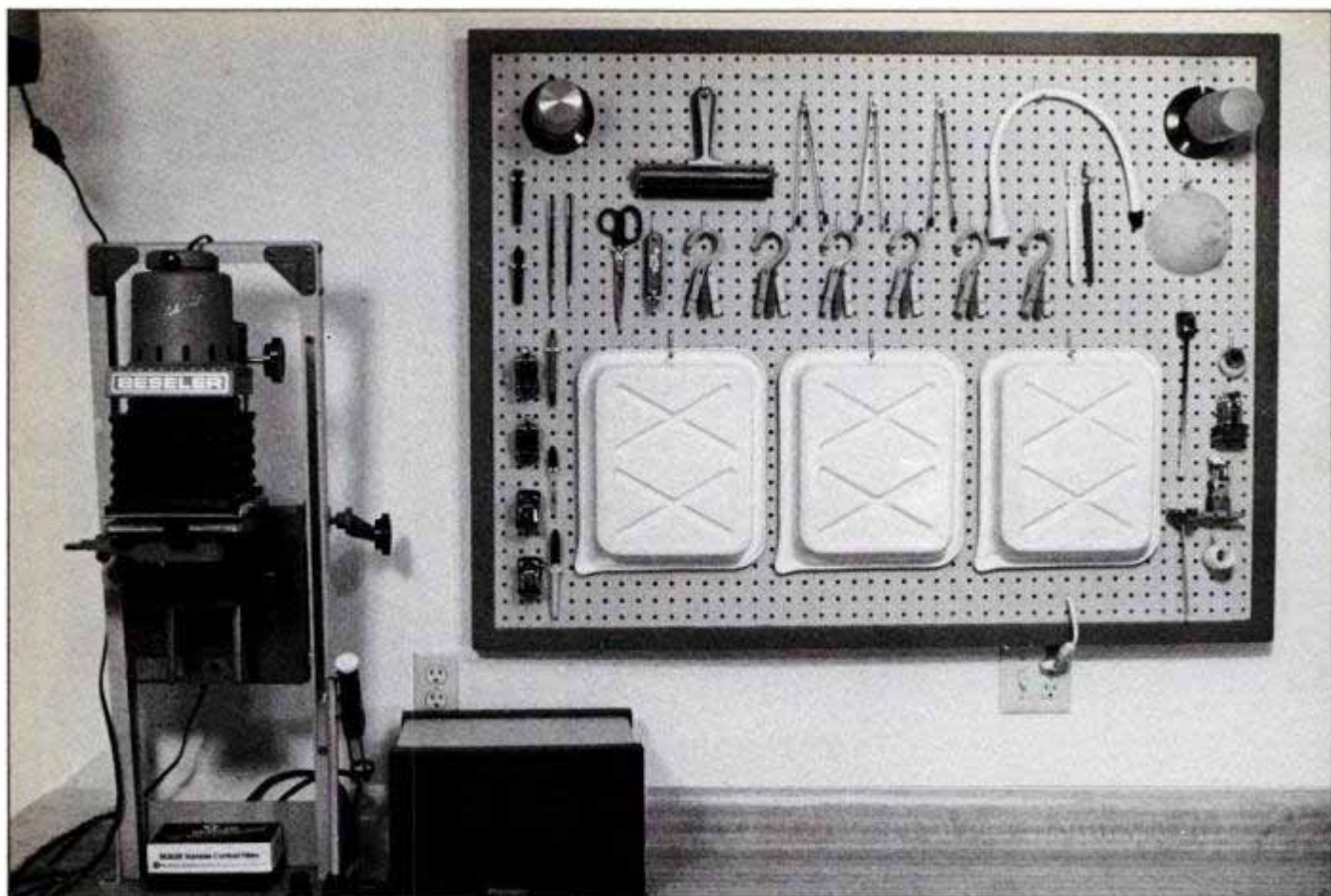
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This wall-hung organizer, made of perforated hardboard, holds lots of accessories. The safelights are built into the corners (below).

DARKROOM SPACESAVER

BY KENN OBERRECHT

One problem with darkroom photography is the clutter from all the necessary paraphernalia. Bulky accessories defy organized storage. Small ones are elusive in white light, and impossible to find in the dull-red glow of a safelight. You can remedy the situation—and save space, too—by building a perforated hardboard storage unit that hangs like a picture. Two 100-pound-capacity picture hangers, nailed to the wall about 18 in. apart, will support a lot of gear.

The size and shape of the unit depends on available wall space and the number of items you plan to hang, but to duplicate the organizer shown here, start with a 36 x 48-in. perf-board. Cut two 1x2s to 48 in. and two more to 36 in. With the board face down, glue and clamp the 1x2 strips along the edges to form the rear frame.

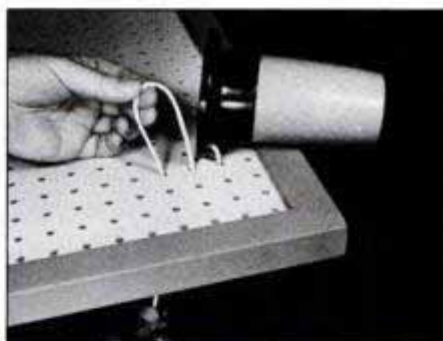
With a miterbox and backsaw, cut

outside corner molding at 45° angles to fit the edges of the unit. Attach the molding with glue and brads to form the front frame. Countersink the brads and plug the holes with wood filler.

On the inside edge of each rear-frame vertical, install a 1-in. screw eye about a fourth of the way down from the top. Install two more in the bottom horizontal piece, about a fourth of the way inside each corner.

Begin inserting picture-hanging wire through the bottom left screw eye, and secure it by wrapping several inches of the tag end around the main length. Run the wire up and through the top left and top right eyes, then down to the bottom right eye, and secure as before. Leave enough slack so the wire comes within an inch of the rear-frame top when pulled taut. Lightly sand the frame and apply two coats of paint.

To wire safelights, clip off the plug



cord ends. Then at each upper corner of the board, count two holes from the top and four holes from the side, and insert the cord. Bring the cord back through the hole immediately beneath, and run it through the one under that. Pull it tight enough for the light to hang securely, flush against the pegboard.

Attach snap-on plugs to the cord ends and connect these to an extension cord whose plug end has been clipped. Run the cord through a bottom hole nearest to your electrical outlet and trim the cord so it's just long enough to reach the outlet. Attach a snap-on plug to the cord, and for more convenience, install an in-line switch an inch or so above the plug by following the simple directions that come with the switch.

Finally, a length of self-adhesive foam weatherstripping attached along the bottom of the rear frame will cushion the unit and keep it level. **PM**

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As part of a nationwide advertising campaign, a New York firm will give away one million (1,000,000) of its most expensive hunting knives—the best-selling MALIN-15™ SURVIVAL KNIFE—for the astonishing publicity price of only \$5 each to the first one million persons who write to the company address (below) before Midnight, December 31, 1985.

This original publicity ad must accompany your request. Copies or photostats are not acceptable.

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If you had to describe the MALIN M-15 in just one word, that word would have to be...*big!* Each MALIN M-15 is a whopping 12 inches long—a *foot in length!*—yet so perfectly balanced it cuts and thrusts like an extension of your own hand. Heft this beauty just once; you'll never want to put it down!

Each MALIN M-15 blade is crafted *entirely of 420 molecular stainless!* Thick as a silver dollar at the spine, it's tough enough to split wood or shatter bone. Yet the edge is so wickedly sharp it slices thin as a whisper!

Survival Kit hidden in the hollow handle

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**Compass
Unscrews
To Reveal
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survival knife of its kind ever sold by this multi-million dollar New York firm.

These Famous Nationally Advertised MALIN M-15 SURVIVAL KNIVES will not be sold at this price by the company in any store. Limit of two (2) at this price, but if your request is made early enough (before Dec. 25) you may order up to five. Each knife is covered by the company's unconditional one-year money-back guarantee.

To get your MALIN M-15 SURVIVAL KNIFE, mail this *original* publicity ad (no copies or photostats) together with your name and address and \$5 for each knife. Add only \$2 shipping and handling per knife. (New York residents add sales tax.) Mail promptly and we guarantee earliest shipment for holiday season. *Make check payable to A&C Co.* Mail to: A&C MALIN M-15, Dept. 114-105, Box 1793, Hicksville, New York 11802. (A29140)

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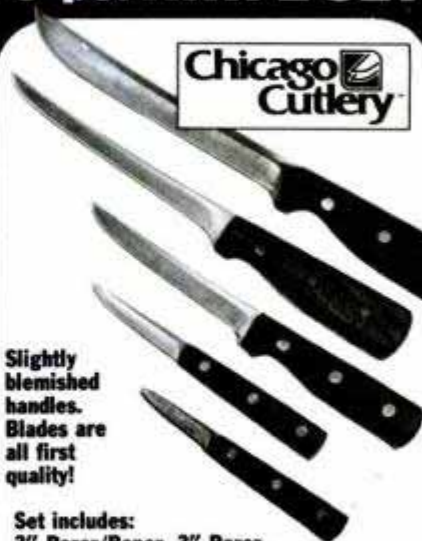
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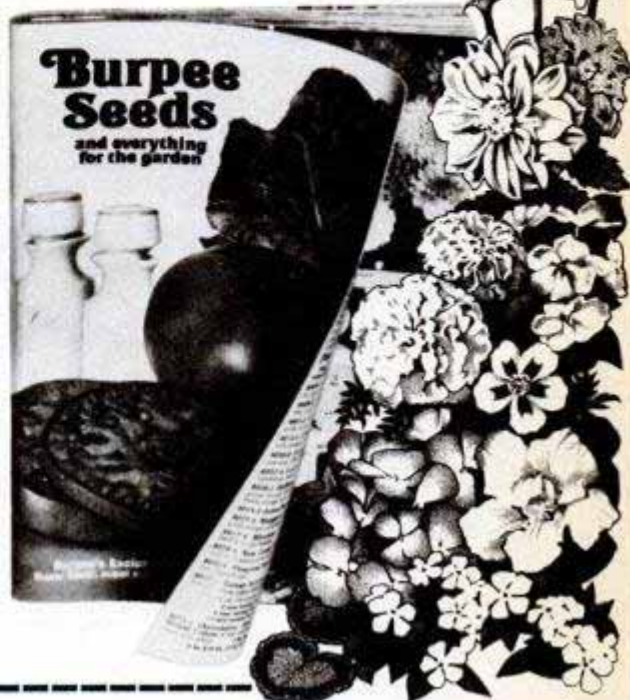
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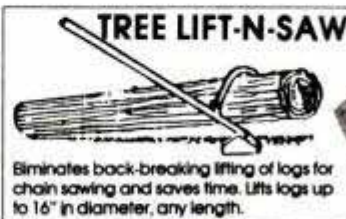
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Sotz Inc., 13643-N5 Station Rd., Columbia Station, OH 44028

QUIT YOUR JOB or START PART-TIME. Chimney Sweeps Are Urgently Needed Now!

My name is Tom Risch. I'm going to show you how to make \$200.00 a day saving people from dangerous chimney fires.

This is serious business. People are paying \$45.00 to have their chimneys cleaned, and the average sweep completes the job in less than an hour. You can make \$200 a day part-time—\$1,000 or more a week full-time. Now before you turn the page, let me explain.

Tens of millions of people are burning wood to supplement the high cost of oil, gas, and electric heat. There are now over 50 million woodburning chimneys in the U.S.—an increase of 10 million in only one year.

As a result, an estimated 44,000 chimney fires killed almost 1,000 people last year and destroyed over 180 million dollars in property.

Thousands of chimney sweeps are needed now.

Time Bomb In Your Chimney

A dirty chimney with about a quarter inch of soot contains a highly flammable substance called Creosote. If a spark from your fireplace or woodstove ignites the creosote in your chimney—watch out! The draft gets stronger and stronger, and before you know it, the entire inside of the chimney catches on fire.

As the fire grows in your chimney, the draft also increases to a tremendous velocity. The heat, generated from the draft and the burning creosote reaches a temperature of up to 3,000° F which is hot enough to melt the mortar holding the bricks together. Secondly, small flaming balls of creosote loosen from the side of the chimney and are projected out of the top with the force of a jet engine.

Like a roman candle, these flaming creosote balls shower the area. Some land on your roof, on your lawn and on your neighbor's home. The excessive heat of the chimney can catch the wood framing of your house on fire.

The only way to avoid a disaster like this is to clean the chimney before it catches fire. This is where you come in.

Chimney Sweeping

Here's a new business where you can earn more in one hour than most jobs pay for a whole day. More in one week than a lot of people make in an entire month. You're the boss. You set the hours and best of all, it's fun. You'll work your tail off, but the business will be your baby. I've had people tell me that the August West Chimney Cleaning System literally changed their lives. Not just because of the money they are making or the fact that they use more Ivory soap, but mainly because they are motivated. They're doing their own thing and loving it.

How Much Money?

Recently I telephoned some of the people we helped get started in the chimney cleaning business. I wanted to find out—first hand—just how well they were doing. Here's what a couple of them said...

Dave Richison, Ohio

"The 3rd quarter of this year I did \$23,000. The 4th quarter I did \$24,000. We should hit between 55 and 60 thousand this year."



"Home heating is now the number one cause of residential fires. Eighty-six percent of wood heat related fires originate in the chimney. The demand for qualified chimney sweeps is skyrocketing and now is the time to get started," says Tom Risch, Founder of August West Systems, Inc.

Chris Nestor, Massachusetts

"My first day on the job, I cleaned seven fireplaces. Now, after sweeping over 8,000 flues, I still look forward to going to 'work' every morning—six days a week, all year round."

John Moszulski, Canada

"Last month I worked 18 days, and I made 2,600 bucks!"

Ed & Mo Simonson, Texas

"We're very pleased with it. We're making a dream come true. We've always wanted some land, and thanks to chimney sweeping we now own 30 acres."

Just what do these people do to earn that kind of money? Sweep chimneys. Six to eight a day if they're full-time. Two to three an evening, plus ten or so on the weekends for those part-timers who keep their present jobs. Since the average charge is \$45 for the first and \$35 for each additional in the same house, it's easy to see how John Moszulski made \$2,600.00 in 18 days!

The Height of Technology

How do you clean a chimney? You do it as quickly and efficiently as possible. The more chimneys you can clean in a day the more lives and loss of property you'll save. And how do you do a good job in record time? You use the most advanced system available—The August West System.

One of the key elements in the August West System is the SootSweeper. This machine is a high-powered, high-volume dust collection unit that was designed specifically for cleaning chimneys. New filter technology is the key to its efficiency and dependability.

Other key elements of our system are an assortment of high carbon steel brushes, spe-

cially designed fiberglass cleaning rods (that let you do most jobs from below), an easy-to-follow handbook with everything from advertising to chimney design, a bi-monthly newsletter, telephone consultation and much, much more. I don't have room to go into all the details right now. Our information kit will explain everything to you.

10 Years of Dependable Service

I'd just like to say that many years and a tremendous amount of devotion have gone into the development of the August West System. We are a strong, national company with thousands of dedicated sweeps in our network! You can join us and count on us to help you build a business you can be proud of. We take pride in the quality of our equipment and service to you.

Sweep John Moszulski says, "Not only do I think your System is fantastic, but I am also totally impressed by the way you treat people who have bought your System. I have just finished my third \$1000 week—on a part-time basis."

To Sum Up, Then...

Sweeping chimneys may not exactly be a "Lazy man's way to riches"... you'll work hard—but the pay is exceptional, the demand is steadily growing, and new equipment and methods make the job far easier, faster and safer than ever before. Perhaps best of all, this is one of those "dream" businesses that so many of us are always looking for: a cash business with flexible hours, low overhead and a reasonable start up cost—figure about \$1900 to get started.

And don't forget, when you run a small business out of your home, you can take tax deductions for that portion of your home you use for your office and work area, as well as car payments, phone bills, utilities and anything else you use in business.

As a matter of fact a lot of sweeps pay for their system in tax savings alone.

FREE Information Kit

Find out more about what it's like to be a chimney sweep cleaning 25 chimneys or more a week. Just call TOLL-FREE 800-225-4016 and ask for extension 433. I'll rush you a detailed information kit with the complete August West Story and your 33 1/3 RPM record entitled, "Now Hear It From The Sweeps." We urge you to call us at no obligation, TODAY.

Call TOLL-FREE 1-800-225-4016

Ask for extension 433
(In Mass. 617-753-5544)

or write:
Tom Risch, Founder
August West Systems
38 Austin Street
Box 658, Dept. 4122
Worcester, MA 01601

Yes, please rush me your FREE information kit.

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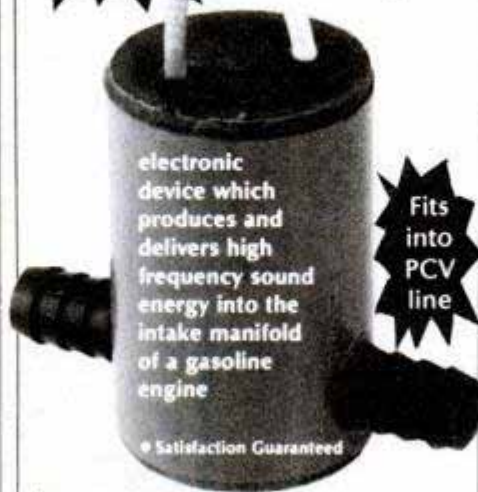


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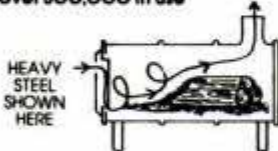
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* Sotz Top Kit includes heavy duty connector pipe - Other brands don't.

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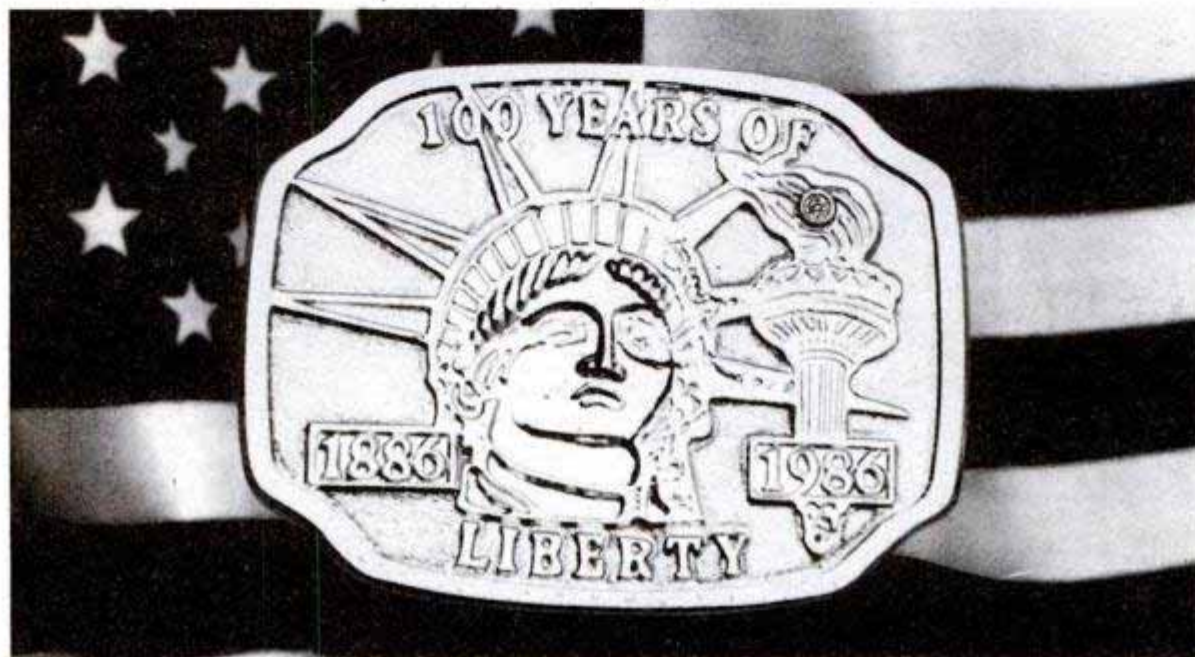
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Why are we giving away **STATUE OF LIBERTY DIAMOND BELT BUCKLES** for only \$5?



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Hard to believe, but true.

As part of a nationwide publicity campaign, the National Historic Mint will give away 1,000,000 (one million!) of its Statue of Liberty Diamond Belt Buckles for the astonishing price of only \$5 each to the first one million persons who return this original printed ad to the Mint's New York Headquarters (below) before Midnight, Dec. 29, 1985.

This original printed ad must accompany your request. Copies or photostats are not acceptable.

This is the same Statue of Liberty Diamond Belt Buckle nationally advertised in leading media and publicized by the Mint throughout America. A proud symbol of our nation's ideal of freedom, each buckle is layered in *both* genuine sterling silver *and* genuine 14 karat gold.

And in addition—directly at the center of Miss Liberty's famed Torch of Freedom—there sparkles the breathtaking beauty of a genuine 17-facet .25 pt solitaire diamond.

Issued only in this special Limited Edition, the dies for this buckle will be immediately destroyed after final distribution, *thus assuring permanent rarity for collectors.*

These Statue of Liberty Diamond Belt Buckles will not be sold by the Mint at this price in any store. To obtain one at

this special direct-from-the-Mint price, mail this original printed ad before Midnight, December 29, 1985.

50-Year Repurchase Guarantee For Your Protection

Should you ever wish to sell or redeem your historic Statue of Liberty Diamond Belt Buckle, the National Historic Mint pledges to repurchase it from you upon demand, any time within the next fifty (50) years, for the full cash price you paid.

There is a limit of two (2) Statue of Liberty Diamond Belt Buckles per address at this special price, but if your request is mailed early enough (before December 21) you may order up to seven.

To obtain your historic Statue of Liberty Diamond Belt Buckle, mail this original printed ad together with your name and address and \$5 for each buckle. Add only \$2 shipping and handling no matter how many buckles you are requesting. (New York residents add sales tax.) Mail promptly and we guarantee earliest shipment for holiday season. Mail to: **National Historic Mint, Statue of Liberty Belt Buckle Offer, Dept. 114-103, Box 1733, Hicksville, New York 11802.** (A25420)

"The National Historic Mint is a private corporation not affiliated as an agent or otherwise with the U.S. Government or the Statue of Liberty/Ellis Island Foundation."

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CHINESE Soup recipes by Mei Ling. \$2.00. Mei, P.O. Box 574, Newbury, OH 44065.

SUPERB GRAVY everytime. \$2.00. Prestige Referrals A, 4171 Wheaton A-8 #4, Bremerton, WA 98310

AUTHENTIC ITALIAN RECIPES! Unique, Mouthwatering Specialties. Cassette \$5.00 To: Tabellario, Box 1100, Deerfield Beach, FL 33441

DULMA Stuffed cabbage recipe. Send \$1.00 self-addressed stamped envelope. Cookery, Box 4787, Modesto, CA 95352-4787.

WINEMAKING, BEERMaking, ETC.

WINEMAKING-BEERMaking-GASOHOL. Free Supply Catalog. Yeast Equipment. Continental, Box 188PM, Casselberry, FL 32707

FREE BEERMaking CATALOG. —Best Value. Selection. 24-hr. Service. **HOMEBREW,** Box 158M, Haslett, Michigan 48840.

WINEMAKERS-BEERMakers— Free Catalog—Fast Service—Large Selection: Kraus, Box 7850-L, Independence, Missouri 64053.

WINEMAKERS-BeerMakers: Free illustrated catalog of supplies. Semplex, Box 12276R, Minneapolis, Minnesota 55412-0276

BEERMakers ONLY! Free Catalog/Newsletter. Williams, Box 461MV, Oakland, California 94604

MAKE QUALITY BEER, Wine. Free catalog. Village Store, Box C-51PM, Westport, MA 02790.

WINEMAKERS — BeerMakers Free Catalog, Low Prices. Free Recipes. Cellar-M, Box 33525, Seattle WA 98133.

WINE/BEER MAKING Catalog: B&J Enterprises, 1845 South 19th, Springfield, Illinois 62703

BEER LOVERS — Brew your own. Delicious! Inexpensive! Free Catalog. Beer Gear, Box 25093M, Lansing, Michigan 48909

GOURMET BEER SUPPLIES. New Dawn, Box 68AA, Rt. 1, West Fork, AR 72774.

FREE BEERMaking BOOK Plus Catalog. Finest Equipment, Ingredients. Fully Guaranteed. SPI, Box 784-M, Chapel Hill, NC 27514

WINEMAKERS - DON'T GET RIPPED-OFF. Gadgets/Kits Unnecessary. You Need Know-How. Illustrated Booklet—Easy Instructions—\$2.00. Winemaster, Box 245, Winfield, Missouri 63369

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TIME MACHINE

75 YEARS AGO: November 1910



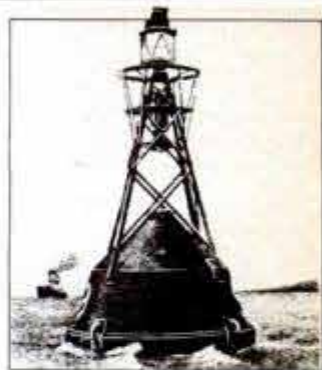
She had every safety device.

A sinking question

The Pere Marquette, a huge railroad car ferry plowing the Great Lakes, was regarded as unsinkable and was equipped with the most advanced safety equipment. On Sept. 8, the Pere foundered and sunk in Lake Michigan killing 27 crewmen and her captain, who refused to believe his invincible Pere would go down. Later, analysts said a deadlight (port-hole cover) had been left open during rough weather and the Pere had taken on a lethal, but undetected, dose of water.

Mme. Curie's find

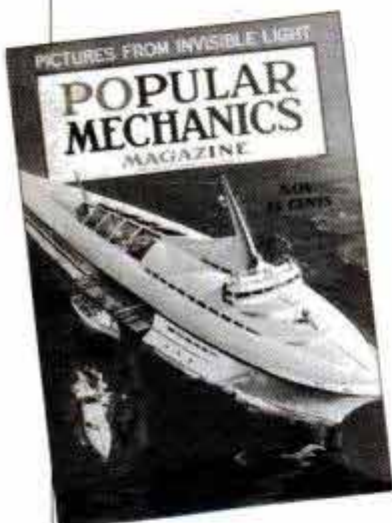
The Curies' discovery of radium opened a new era in medicine, but the radium the Curies found were salt compounds. Seven years after their initial discovery, Mme. Curie discovered and isolated an infinitesimal piece of pure radium. It was enclosed in a glass vacuum tube. It had a white appearance, oxidized rapidly, adhered to iron, burned paper and decomposed water. This was encouraging since radium salts had been successful against skin cancer and vascular tumors.



Last of the keepers

Government adoption of acetylene-powered buoys seemed to spell the end for the lighthouse keeper, but a truly maintenance-free beacon was years away.

50 YEARS AGO: November 1935



Smoothing a liner's lines.

Built for speed

It was the '30s and streamlining was the rage. Planes, automobiles, motorcycles and trains had all taken on that look of effortless speed. Designer Norman Bel Geddes felt the ocean liner was a prime source for streamlining. He constructed a model of a "liner of the future." Its decks were enclosed and every inch of the vessel's silhouette was curved to give the least water and wind resistance. Many of Bel Geddes's techniques are applied to today's ocean-going behemoths.

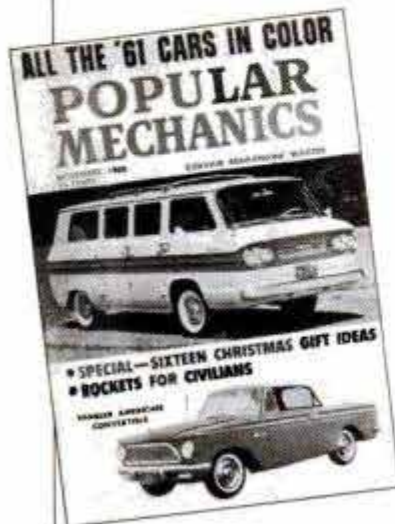


A 'Tommie' gun

It was developed by Czechoslovakia and the British adapted it to their use because of its light weight. It was nicknamed the "Bren" and could be fired from the shoulder, a tripod or a fold-up bipod. The Bren made way this

year for the SA-80 rifle. The SA-80 fires standard 5.56-mm NATO force rounds. A "Tommie" would be able to carry almost twice the ammunition—some 180 rounds.

25 YEARS AGO: November 1960



The car begins to shrink.

Recollecting autos

A gander at some of the new cars brought back some memories. For example, who could forget the ultimate sports car for the well-to-do, the Thunderbird, with now-extinct convertible top and gas-guzzling 430-cubic-inch V8. The fin age was waning but the Cadillac, Imperial and Desoto sported enough fin to initiate a count-down. PM forecasted the trend for the future: lighter, fuel-efficient models such as the compact Comet, Lark, Falcon, Valiant and rear-engine Corvair.

Splash to screech

Lt. Cmdr. Walter M. Schirra, one of Project Mercury's astronauts, was shown climbing out of a working model of the Mercury space capsule in the Gulf of Mexico during a splash-down exercise. Wearing a full-pressure space suit, Schirra was assisted from the capsule by astronauts Allen Sheppard and Virgil Grissom and a Navy frogman. The recovery practice seems primitive in light of the Shuttle's spectacular, sound-barrier-splitting glides to an exciting wheeled landing.



High hopes

The rocket belt was envisioned as standard GI equipment. A modified model is now used on Shuttle missions. **PM**



Rickie Smith's Motorcraft Pro Stock Thunderbird



Willy T. Ribbs
Chris Kneifel
SCCA Trans-Am
Mercury Capri



Wally Dallenbach Jr.
John Jones
IMSA Mustang GTD



Ricky Rudd's NASCAR
Motorcraft Thunderbird

All these winners go with winners: Motorcraft parts.

The Motorcraft Mustang didn't win by just a mile at the 1985 Daytona 24-Hour. It left competition 135 miles behind as Dallenbach, Jones and Bundy took the GTD class. The same car also finished miles ahead of competition in the 12 Hours of Sebring. Mercury Capris flying Motorcraft colors are out to capture the SCCA Trans-Am manufacturer's championship again this year. Motorcraft is on the 1985 NASCAR Winston Cup Circuit with Ricky Rudd in his Thunderbird. Bud Moore, Rickie Smith—first Pro Stock driver to break the 180 mph and 8 second barriers—is driving his Pro Stock Motorcraft Thunderbird in '85 NHRA and IHRA events. All of these are proof positive of Motorcraft parts' exceptional performance under all types of rugged racing conditions. Get Motorcraft's out-to-win performance going for you out on the street. Motorcraft. Quality parts for all makes of cars and trucks.



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