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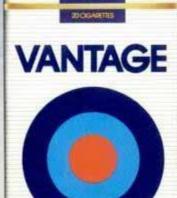
> POWER DRILLS Unlock The Potential Of Your Most Versatile Tool





 1987 Model Preview
 Complete Care And Maintenance Guide
 How To Customize
 Newest Accessories
 Plus New PM Contest Win a Nissan Hardbody

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One thing is for sure. If you work for someone else you'll never get rich. The boss might, but you won't. It's his business, he gets all the money, satisfaction, and recognition. What if you were free to call the shots?

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 lvory 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. With their permission, I recorded our conversations. We then had a record made which you can play on your record player when you receive our information. 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 somewhere between 55 and 60 thousand this year."

Fran Watts, Virginia

"If we need \$200 at the end of the week, it's simply a matter of making a couple of phone calls. The repeats are just fantastic!"

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 fulltime. Two or three an evening plus ten to sixteen on the weekends in the case of parttimers who keep their present jobs. Since the average charge is \$55 for the first and \$45 for each additional in the same house, it's easy to see how Ed and his wife Mo are making two grand a week.

But Why?

Why would anyone pay \$55 to have his or her chimney cleaned? That can be answered in one word—SAFETY! When solid fuels such as coal and wood are burned in a fireplace or woodstove, they give off a flammable by-product called soot. What is soot? Soot is a combination of fly ash and creosote. Creosote is the flammable unburned residue left over when wood doesn't burn completely. The creosote combines with the fly ash and the smoke carries it into the chimney flue. This soot then sticks to the flue. When a quarter inch or more or this stuff builds up on the chimney walls, it can cause a dangerous chimney fire.

A Chimney Fire

Imagine this tall stack coated inside with a quarter or half inch of flammable soot. When the right amount of heat and oxygen get this stuff burning, you have yourself a real fireworks show. As the creosote burns, the heat causes the natural draft of the chimney to increase ten fold. What you now have is a blast furnace that looks and sounds like a rocket taking off. The temperature of the chimney fire, 2000-3000 degrees, is enough to disintegrate the mortar holding the chimney together. The flaming balls of soot shooting out the chimney's top can land on the roof and the dry leaves surrounding the house. Needless to say—this situation is undesirable and the people who've lived through it get their chimneys cleaned regularly.

According to the National Fire Commission there were 60,000 chimney fires in the U.S. in one year causing \$300,000,000 of damage. 75% of all fatal residential fires in Vermont, for instance were caused by faulty installation and maintenance of woodstoves. Tens of millions of people are using wood to supplement the high cost of home heating. There are over 40 million woodburing chimneys in the U.S. These people need you to clean their chimneys.

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. When I first started cleaning chimneys I used a large vacuum truck. It worked well, but they cost over \$20,000 now. I also had a problem with the 100 feet of hose. It didn't always reach the fireplace from the outside. The powerful but portable SootSweeper has the same kind of air moving muscle as a vacuum truck, but you can bring it right in the house. 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, specially designed fiberglass cleaning rods, roof safety equipment, an easy-to-follow handbook with everything from advertising to chimney design, a 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.

Add Profits With Accessory Sales

\$55 to clean a chimney is great money, but a lot of sweeps like to earn even more on a job. That's where Accessory Product Sales come in. As an August West Sweep you'll receive state-of-the art products and technology in the Manufacturer's Sampler Kit included now with each system. Some sweeps claim that they've doubled their income through selling additional fire safety products, and our Regional Workshops around the country will show you how.

Id 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 company with over 5,000 sweeps in our network! You can join us and count on us to help you build a business you can be proud of. We are proud of what we do and the quality of our equipment and service to you reflect our pride.

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 business with flexible hours, low overhead and reasonable start up cost, figure about \$2500 to do it right.

Find out more about what it's like to be a chimney sweep cleaning 25 chimneys or more a week. Just call **TOLL FREE 1-800-225-4016** and ask for extension 477. I'll rush you a detailed information kit with the complete August West Story and your 331/3 RPM record entitled, "Now, Here It From The Sweeps." We urge you to call or write us at no obligation, TODAY.

August West Systems, Inc. 38 Austin Street Box 658, Dept. 4167 Worcester, MA 01601



Call TOLL-FREE 1-800-225-4016 Ask for Extension 477 for full details (In Mass. 617-753-5544) ©1986 August West Systems. Inc.

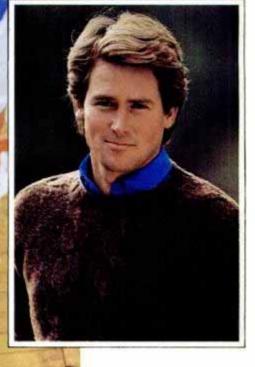
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MENNEN 1986 THE ME





AUGUST 1986

VOLUME 163 NO. 8





ON THE COVER

With a top speed of 300 mph, the Swearingen SX-300 is one of the hottest sets of wings in the sky. We put five of these sports planes through the acid test and found that performance is the last word in this year's crop of homebuilts. See how these new planes—all available in kits you build-stack up in our shootout beginning on page 76. PM photo by Jim Campbell

DEPARTMENTS

34	Audio
37	Aviation
40	Inside Detroit
44	Outdoors
48	House Restoration
54	Minicourse
56	Electronics
58	Photography
60	Home Video
142	Time Machine
	37 40 44 48 54 56 58 60



Then your offices are right smack in the middle of New York City and you need to test and photograph a bunch of motorized water toys, where do you go? That's the dilemma that faced us recently when Boating/Outdoors Editor Tim Cole suggested the story. The solution, we think, was an elegant one. Why not have the wet toys sent to America's premier playground, Walt Disney World, in Orlando, Florida? Good idea, but did Disney World have the facilities we needed? First, we wanted a body of flat, quiet water where we could run the motorized beach toys through their paces. Second, we wanted a photogenic location. As you can see from the article and photos beginning on page 69, Disney World had both in spades. The beautiful lagoon right behind



Cole with guest testers.

the Polynesian Village Resort on the Disney World grounds proved to be exactly the right place. Disney World even provided extra helpers for our test crew. Frankly, though, one of the helpers they supplied was not suitable for this test. His rather large ears kept getting in the way.... I think there's a little aviator in all of us. We've all fantasized and put ourselves in the cockpit while watching movies where John Wayne or William Holden or Clark Gable shoot down the enemy, then return to base in a shot-up plane on a wing and a prayer, 50mission crush hat perfectly in place. Our cover story this month (page 76)

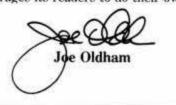
is about five planes you can build yourself, if you're so inclined. All of them can go over 200 mph, with one topping out at over 300 mph. We asked noted aviation writer Jim Campbell to check them all out from the cockpit and give you his firsthand flight impressions. Come along for the ride. . . . Last November, we printed a photo on our cover of a workbench. On the workbench was a half-completed, carved-back dining room chair. Much to the dismay of many of you, the carved-back chair was not among the projects to be found in that issue. You let us know about your displeasure quite vociferously. So finally, by popular demand, this issue contains all the details you need to

make those very beautiful, elegant carved-back chairs. Sorry it took us so long to bring you this much-requested article. . . . Old friend Barry McNulty was in town the other day and bought me lunch. McNulty is the vicepresident of communications for the National Institute for Automotive Service Excellence, or ASE for short. ASE is a nonprofit organization based in Washington that tests and certifies auto mechanics for competency in various repair disciplines. There are now thousands of certified



mechanics all over the country who have taken and passed one or more of the eight tests given by ASE. And while passing a test and wearing an arm patch doesn't guarantee that a mechanic will do a good job on your car, it is a sign that the guy has taken the time and interest to keep up with changing technology and prove his knowledge against national standards of competency. To me, ASE certification is the mark of a true professional in a field long rapped by critics for incompetency and unprofessionalism. When I reminded McNulty that POPULAR MECHANICS encourages its readers to do their own

auto repairs, he made an excellent point: "Not every repair can be made by a do-ityourselfer. Sometime, somewhere, everyone needs an auto mechanic. When that time comes, you stand a better shot of getting a good job if you look for the ASE sign." 'Til next time.





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Letters



No catapult!

can't believe it! After be-ing enthralled flying in an F-18 jet fighter with George Plimpton (Life Begins At Mach 2, page 75, April '86) and making a carrier landing, you leave me on the bridge talking to an admiral. I was holding my breath to read, word-for-word, about George's kick-in-the-behind launch and the trip straight up to 50,000 ft. and 1000 mph. I can't believe you left me on the bridge with Plimpton and a cup of coffeestranded forever.

> G. BURKETT BEEVILLE, TX

Lucky George got to rocket off the deck and make a round trip; we're sorry readers didn't.

Classic Chevrolet

I want to congratulate you on your choice and pick of the 10 best cars of 1986 (page 93, April '86). The Chevrolet Caprice Classic is in my opinion the *best* in the world.

My wife and I are auto nuts. We've owned 71 cars since 1935 (I'm 70 years young): Mercedes, Peugeots, Volkswagens, a Rolls-Royce plus U.S. and Japanese cars. But the prize of them all is that 4-door Caprice Classic. We were amazed that the United States could build such a reliable car. We just parted with our 1983 Caprice, 167,000 miles, and it was still going strong. It's been replaced with another Caprice Classic. We know we will have the same reliability with it. The only thing I can ask is why didn't the U.S. carmakers stick with this type of car over the years instead of switching every minute to



High-flying Plimpton kept takeoff to himself in April story.

the small boxes on wheels?

Incidentally, we average about 22 mpg around town, plus 25 and then some going across country. All this on an overdrive transmission, plus it's a V8.

ROLAND L. GARDNER MANCHESTER, NH

Hot potato

"Tubby!" "A potato with spoilers!" I am hurt to the quick by your unkind remarks (Junior GTs, page 67, June '86).

I turn 50, shed 35 pounds, add a little color to cover the gray hairs, trade in the family station wagon for my great little red Celica GT, and you call it "tubby." Oh, the pain.

Obviously some of your testers have no sense of style, and even more obviously, Lew Wallace ("Beauty is in the eye . . . ") has been proven right again.

I'll forgive you for the insult (and keep reading your excellent magazine) and just agree with your report that it's a great car to drive.

CAROL JORDAN CLEVELAND, OH

Well-rounded reader

In response to your recent reader survey, let me say that I like *Tech Update* best of all. But when it comes to the hands-on woodworking, there's no beating your home and shop projects. I've built several, and have included a photo (right) of a favorite, the small plant stand (page 104, Oct. '81). I like PM, so don't change it too much.

ALAN J. HETZEL TOMAHAWK, WI

The cabriole, or Queen Anne, leg is a challenge for any woodworker, but get a leg up mastering it by referring to our 2-part lathe techniques story. See Become A Woodturning Expert, Part 2, page 98, June '85.

Multiplication tables turned

If Maserati builds a V6 engine with six valves per cylinder, (*Freewheeling*, page 36, May '86), but used only 32, they're going to have very low compression in at least one cylinder. They had better find four more valves. K.M. BISHOP BETHLEHEM, CT

I am very intrigued by the Maserati 6-valve engine. Does it matter which four valves aren't kept in adjustment? T.L. WILLIAMS LOVELAND, CO

On the Maserati V6 you forgot to adjust some of the

Heavy-hauling bird

What a great story about the Gooney Bird! All the facts about the DC-3 were perfectly true (*Sentimental Journey*, page 110, May '86). It could do everything—like

fly trucks over mountains. Here's a photo from 1942 showing us farm boys loading two halves of a truck into a C-47, the military cargo version of the DC-3. It was the only way to get trucks from Port Mores-



Reader Hetzel has mastered the art of the Queen Anne leg.

valves: 6 x 6 = 36, not 32. BOB SHILLIDAY ARLINGTON, MA

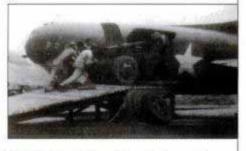
We thought that all our sharp readers with a great sense of humor would have noticed that the Maserati 6valve V6 was on page 36.

Nonmetric drive

In Life in the Fast Lane by Wade Hoyt in the March 1986 issue (page 14), highspeed driving in Germany is discussed without a hint of the fact that they measure speeds in kilometers per hour. The attempt to impose a speed limit of 62 mph should have been accompanied by a 100 km/h equivalent. The United States is virtually alone in using inches and pounds. By ignoring metric, we ignore the future. DR. DON HILLGER FORT COLLINS, CO

by to Dobadura where land forces had secured an airstrip. There, it was welded back together.

HERMAN STOCK COLORADO SPRINGS, CO



WWII, 1942: C-47 swallows half a truck.



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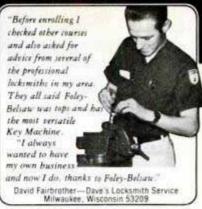
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"I opened my own business, spare time, seven months after I enrolled and made a profit of \$329 for the first week." B. A. Deberry Littleton, Colorado



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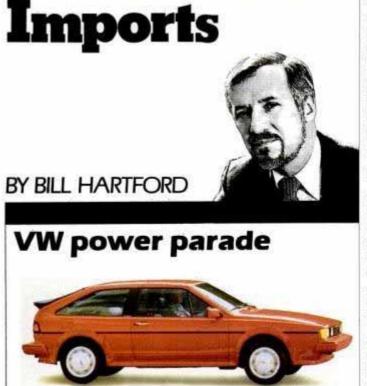
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7



Scirocco 16V, with 122-mph top speed, is VW's fastest car ever.

Back in the good ol' days of VWs (when there was only one model), Beetle drivers had a real kinship with NASCAR's good ol' boys: The only way to make that thang go faster was by picking up a draft. To make time in a Bug you had to fall in behind the biggest, fastest truck on the interstate and let aerodynamics boost your top speed. And it wasn't much better in a Karmann Ghia: bug mechanicals wrapped in a slippery, award-winning shape didn't buy you many more mph. But today there's a VW coming out of the Karmann Coachworks in Osnabrück that'll slingshot up to 122 mph without extra help. The 123-hp Scirocco 16V is VW's fastest and most powerful model to be sold here. The 16V powerplant specs out as a 1780-cc, in-line Four with twin overhead camshafts. The two intake and two exhaust valves per cylinder are sodium cooled, and K-E Jetronic fuel injection, digital ignition and stainless-steel exhaust are fitted. Off the line, VW ticks off 8.1 sec. to 60 mph. The Scirocco engine will draw oohs and aahs for its good-looking layout. All the power is managed through a 5-speed gearbox, which is the only transmis-



Scirocco's 16-valve, dohc, in-line Four is rated at 123 hp.

sion available. Beefed up for the increased hp, it's one of the best boxes around, according to PM West Coast Editor Steve Parker, who got first shot at the 16V at its introduction on the track at Phoenix International Race-



way. He found, too, that the reworked suspension keeps down body roll in high-speed lane changes. And the car's stability at speed—due in part to the rear window spoiler's role in reducing aerodynamic rear lift—is excellent. But that protuberance is a menace to rear visibility. It's easy to see your way clear to meet VW's price of \$12,000, however.

There's also muscle-flexing going on over at Audi. To explore the potential of the Quattro 4-wheel-drive system, a 5000CS Turbo ran the

Alfa show-off

An alfa just isn't the same without a wood steering wheel. Now that the vintage Veloces—the Quadrifoglio, Spider and Graduate—have been modernized right down to new padded steering wheels, we should have expected something like this: a thoroughly contemporary

design from Pininfarina. The lightweight (honeycomb and metalplastic laminated) body can be built as a Spider (as shown

here) or a Coupe when fitted with a transparent dome. Shown for the first time at this year's Turin International Motor Show, the Pin-

Funny car

No, this isn't something from a Woody Allen movie. And it isn't a new ride at Disneyland. It's from the pen of Giorgio Giugiaro, the



Machimoto riders straddle seats.

renown designer of dozens of cars—the Isuzu Impulse, to name one—that beautify our highways. So, nobody laughs when Giugiaro sits down at the drawing board. The Ma-



Hot-rod Audi Quattro: over 216 mph on straights at Talladega.

speedway at Talladega and set a 1-lap closed-course record for 4wd of 206.825 mph. That was with the hp of the Audi Five boosted to 650. A stock 5000CS Turbo Quattro managed only 146 mph.

infarina design could be the next Alfa Spider, if the current classic—also from Pininfarina—ever shows signs of waning. Right now, it's sold here in three versions: the Quadrifoglio at \$20,000, Spider at \$17,000 and Gradu-



Alfa Romeo designed by Pininfarina.

ate at \$14,000. The GTV-6, a racy 2+2, is \$16,500. The Milano 4-door, joining Alfa's lineup for '87, starts at \$13,000.

chimoto is half car, half motorcycle from Ital Design, Giugiaro's company. The front-engine vehicle uses a car-type floor-pan for stability and safety, and a motorcycle arrangement of saddles for seating. Power is from the VW Golf GTI's 16valve Four. Two rows of three saddles each form the

seating area, but there's room for three kids in the rear. On the Machimoto, a whole

family—or two—can go dune biking, holding onto retractable grips. Drive the vehicle like a car with a steering wheel, or fold out hand grips and ride like a biker. Okay, you can laugh now if you want.

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

Motorsports

BY STEVE POTTER

The shape of sports cars

When auto racing was just getting started in the late 19th century, no one built special racing cars. The companies involved in racing raced what they built, or used motorsports as a proving ground for cars they planned to sell to the public. Of course, 90 years ago the automobile wasn't a practical means of transportation, and most cars were playthings or "sports" cars.

Today's racing sports cars are very far removed from road cars and are called Sports/Prototypes. Prototypes contest the international World's Sportscar Championship (WSC) and the International Motor Sports Assn. (IMSA) Camel GT series in the U.S.

In a purely mechanical sense, prototypes are more closely related to the singleseat, open-wheel racers that March and Lola build for Indianapolis than to any passenger machine that ever rolled off an assembly line. Indeed, March and Lola

build prototype sports cars. This new breed of racer doesn't represent the shape of any machines we're likely to be driving down the highway soon. But Sports/Prototypes do have full envelope bodies with fenders over the wheels, a full windshield and a roof over the driver's head. The driver sits on one side of the car, with room-at least in theory-for a passenger. A prototype has headlights, windshield-wipers, a selfstarter, a (2-way) radio and even special provisions for driver cooling.

These exotic cars can't use air conditioning. Instead, most drivers fight the 135° cockpit heat that builds up during a race with a "cool suit"—a vest and cap, worn under the coveralls and helmet, that circulates ice water from an insulated chest.

Although they look alike, the cars that race in IMSA's Camel GT series are quite different from those run in WSC events like the 24 Hours of Le Mans. Until five years ago, prototypes had been banned from world-level sports car racing in favor of highly modified production cars, such as the 911based Porsche 935. But the interest in sports car racing in Europe had been waning, even as it grew in the U.S. In 1981, the Paris-based Federation Internationale de Sport Auto (FISA) wrote new rules that permitted prototypes.

The FISA rules were simple. They set dimension and weight specifications

for the chassis, but permitted any engine configuration—with one hook. A car's fuel consumption was limited to 100 liters (about 28 gallons) per hour. In theory that meant the most efficient cars would be rewarded with the lowest lap times. Most European automakers voiced their approval of the FISA rules.

On this side of the Atlantic, IMSA President John Bishop said he was afraid that the FISA rules, with their open-ended engine regulations, would raise the cost of competition to a point where few of the private entrants who make up his field could afford to compete. He came up with chassis rules that were similar to FISA's with one significant difference. IMSA required that the driver's feet not extend in front of the car's front axle, to provide crash protection. In addition, IMSA came up with a complex engine formula that factored in engine size, cylinder-head



Mazda 757 LeMans entry has a unique 3-rotor Wankel engine (top) rated at 444 hp.

configuration and turbocharger use, along with a sliding weight formula.

FISA and IMSA were never able to resolve their differences on engines. The WSC and the Camel GT have become separate series with dramatic but incompatible cars. The fate of the two series since 1981 has been dramatically different. Although Porsche has been the most successful maker with its 962 model, IMSA's seemingly cumbersome set of rules has promoted close competition among a number of different makers, including Jaguar, Chevrolet, Buick, Ford, Pontiac, Nissan and BMW. Spectator admissions and television exposure of the IMSA series have climbed dramatically.

Only Porsche has strongly supported the WSC, although Lancia and Jaguar have participated. The WSC races have become economy runs, with drivers featherfooting their way around the track. Some races play before deserted grandstands.

Although Le Mans is still the biggest motorsports event in Europe, even that famous race has lost spectators over the past few years. This season several top European teams have decided to contest primarily the Camel GT series in cars that are built to American rules. Some observers wonder how long it will be before the WSC simply disappears.



Porsches (Nos. 14 and 16) and Jaguars (44 and 04) mix it up at an IMSA race at Lime Rock track.

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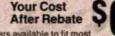
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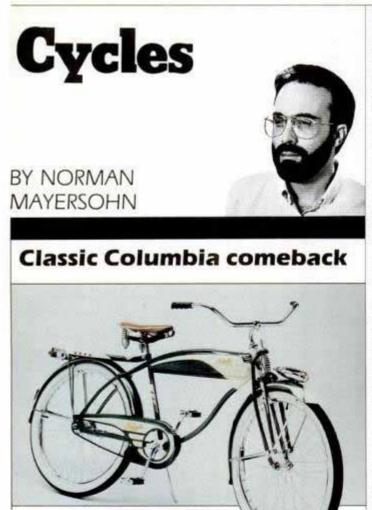
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GASKET



Columbia RX5 is a reissue of 1952 Five Star model, built on the original tooling.

Meaningful relationvintage machinery always turn into confusing affairs. Restored vehicles become such a labor of love that you're afraid to take them anywhere, and to purists, the modern-day replicas are nothing but counterfeits.

Then how about a new/old configuration? From America's first bicycle manufacturer, Columbia, we'll see a summertime reissue of their classic 1952 Five Star Superb. A run of 5000 RX5 models will be built on the original 35-year-old tooling.

Back when the Five Star was introduced as a deluxe offering in Columbia's Midcentury line, it was right up to date with contemporary styling touches like a sweptback frame tank, streamlined headlight and a floating-action spring fork. The reissue model will be slightly different due to the demise of some original component suppliers, but the greenand-cream-painted beauty that is shown above will require a sharp eye to be distinguished from the real Mc-Coy.

Sold originally for around \$80 and now fetching up to \$1500 in pristine shape, you'd have to say that the \$399 price at your local dealer of the RX5 is the opportunity of a lifetime.

A valuable resource for enthusiasts and collectors is the friendly Antique/Classic Bicycle News (P.O. Box 1049, Ann Arbor, MI 48106). since it covers the whole field. For those more inclined toward motorized machinery, we suggest you look into Old Time Cucles (8280 Janes Suite 222A-Ave., 1700. Woodridge, IL 60517). Both publications are enthusiast-produced and print classified sections.

Beginners' bargains

There's no way a longtime motorcycle rider can find fault with the variety of today's showroom offerings, but there are very few interesting models at the beginner level.

Suzuki and Yamaha have both introduced

bargain-priced bikes to remedy this situation. The Savage by Suzuki is a straightforward cruiser-style machine with a 652cc singlecylinder thumper engine. For riders starting out, it offers the simplicity of a 4speed gearbox and the maneuverability that comes with a 360-pound wet weight. Seat height is a low 26 in., and maintenance has been simplified with Suzuki's first application of a quietrunning belt final drive.

The delicious icing on the cake, though, is the price just \$1999! Lest you think that makes the Savage a few years behind the times, consider this: it has a vibrationquelling counterbalancer, 4valve cylinder head, front disc brake and an electric starter.

Yamaha's Radian is a far more sophisticated assemblage, but once again that price tag—\$2399, makes it irresistible. For your money, you get an air-cooled 598-cc Four, 6-speed trans-



Suzuki and Yamaha The Savage is a bargain at \$1999.

mission and dual disc brakes at the front end. Cost of manufacturing has been held down by picking through the parts bins and lifting the engine from last year's FJ600 model, full cradle frame from the 550 Maxim, and body pieces from the Fazer.

From our ride at California's Laguna Seca race course, it was apparent that the Radian will deliver far more than the spec sheet promises. Nonadjustable front suspension and a simple twin-shock rear end are much like the machinery of a decade ago, but continual refinement has brought them up to acceptable 1986 levels.

Radian and Savage both have to be examined in the warm light of history. Neither machine is the leading edge in technology, but both are competent, well thought out and rewarding to ride. When you factor in the rise in prices and the recent fall of the dollar's value, though, both stand out as incredible bargains.



Radian at speed on the Laguna Seca racetrack: A thoroughly wonderful Yamaha Four with an entry-level \$2399 price tag.



4

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When considering a stove or fireplace insert, it's difficult to know what features are important. At Consolidated Dutchwest, our approach to your concerns and questions is very straightforward. We build our stoves without compromise. All the important features are built-in so they will be there when you need them. We start with safety. Each unit exceeds all safety standards. All models, including every fireplace insert, are clean-burning and employ the latest catalytic technology. To very safe operation we add efficiency in a 100% castiron, airtight design with precision controlled combustion. Using our stoves, customers consistently report fuel savings of 50%, 70%, even 90%. You too can expect exceptional savings.

Wood & Coal **Burning Capabilities**

Beyond having a safe and efficient design, our stoves and fireplace inserts are fuel flexible-able to burn wood and coal equally well. Conversion from one fuel to the other is easy, taking barely a minute's time. Many of our customers never burn coal, but the flexibility of design which is essential for coal burning creates the best possible environment for burning wood. An ashdrawer-a requirement for burning coal-is extremely helpful for woodburning. It makes ash removal quick, easy and neat, and lets you clean your stove even while the fire is going. The primary air-located beneath the firebox for coal burning-makes fire starting with wood very fast. Even wet wood starts with our direct primary air.

Our most popular models provide both radiant and convection heat. Heat is egalitarian. It radiates in all directions, including the less productive onesbottom and back. Our convection systems channel warm air from bottom, back, and top through unobtrusive vents on the stove front.

All Cast-Iron, Airtight Construction

Our cast-iron stoves are carefully built from pure, virgin gray iron. They are airtight to the point that even our smallest stoves can hold a fire through the night. With coal, the burning times are even longer. All models have polished cooking tops. Most load from front and side. Ceramic glass windows are standard, as is a screen for openhearth burning.

Federal Period Styling

While concentrating on function, we haven't compromised on appearance. We've employed the simple clear lines of Federal period architecture (1810-1830), as elegant today as they were then, to create a unique and beautiful pattern of raised lines and arches. Our distinctive pebble finish and solid brass trim highlight the classic styling. Our stoves will frequently be sited in living rooms and we've gone to great lengths to assure they belong there. Those of you who eventually own a Consolidated Dutchwest stove will find it is not only an exceptional performer, but an elegant addition to your home.

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Convection Air Outle To encourage everyone to take advantage of the most important advance ever in the technology of safe, clean woodburning Ceramic Glass we are giving away a free Corning Catalytic Combustor with every stove purchased this season. A combustor can Convect increase the efficiency of your stove as much as 50%, while reducing creosote build-up and pollution 90%. It's a must for clean, safe woodburning. With a Consolidated Dutchwest stove, it is yours free.

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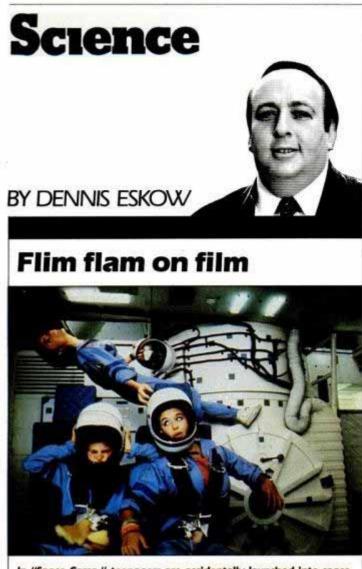
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A Complete Unit

We don't believe in options. Too often they mask essential features which must be purchased to make a stove useable. Our list of options makes quick reading. A Corning Catalytic Combustor-offered free with the purchase of any stove or insert-reduces both creosote build-up and pollution as much as 90%, while increasing overall heat output by almost 50%; a 100 cfm dual speed fan (standard on inserts) to enhance natural convection airflow fivefold; decorative brass rails, and flue adapters. All else is standard, with these elegant, high-efficiency stoves and fireplace inserts.

CATALYTIC



In "Space Camp." teenagers are accidentally launched into space.

Why do you go to the movies? I go to have a good time. Don't educate me. Don't preach to me. Just make me feel good.

The only time I break this hard and fast rule is when the subject is science. Or when it seems to be science. Then I become very critical. Is the science for real? Is the fudge factor so heavy that I can't swallow it?

Two new releases use science as the subject matter. "The Manhattan Project" and "Space Camp," both from 20th Century Fox, are very entertaining. Now, let's talk science.

"The Manhattan Project" (TMP) is directed and cowritten by Marshall Brickman, co-author of the Woody Allen 1970s science-fantasy "Sleeper." TMP presumes that a 17-year-old high school student can steal fissionable plutonium from a secret location. Actually, in the mid-1970s 14 ounces of plutonium were reported missing from the American inventory. Some newspaper reports have suggested the CIA slipped the plutonium to Israel or South Africa. So plutonium might get stolen.

The teenager, played engagingly by Christopher Collet, then builds an atom bomb in his basement. He will enter it in a science fair.

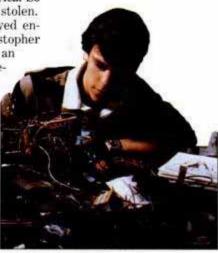
Interestingly, the 1970s brought us a celebrated case in which a college student wrote a paper on how to assemble an A-bomb. It was so accurate that the federal government sought to supress the article. might very well assemble an A-bomb in a basement. The equipment used to build the bomb in TMP is a bit unbelievable. For instance, a small quantity of plastic explosive is to be used as a fuse. But the concept behind the film is believable enough to carry the movie to its exciting conclusion. Go see it and find out for yourself how it all ends.

"Space Camp," made by ABC's Leonard Goldberg, is set in the real-life Space Camp in Huntsville, Alabama. The real camp sits just outside NASA's Marshall Spaceflight Center. For \$400 a week, teenagers from all over America get to play with NASA simulators and other equipment. They even build and launch miniature rockets. What the kids in the real Space Camp never do is get inside a ready-tolaunch NASA vehicle.

That's where the movie challenges the imagination perhaps a tad too much.

In "Space Camp," a team of kids gets launched accidentally into space. I was at Marshall Spaceflight Center when the script was being discussed among NASA officials, and they told me that such a launch is remotely possible in some circumstances. But not at the Space Camp or the Spaceflight Center.

That thought nagged at me as I pored over the story line for "Space Camp." Still, Kate Capshaw and Tom Skerritt are fun to watch.



So, a bright student Teen star assembles his own atomic bomb.

Rice diet for jets

Lockheed-Georgia engineers are working with subcontractors to develop new aluminum alloys called Metal Matrix Composites (MMC). The materials are lighter, stiffer and stronger than traditional aluminum alloys. The strength comes from silicon carbide "whiskers" made from rice hulls. By varying the amount of whiskers in the alloy, the engineers can vary its strength. The rice diet may be given to experimental airframes in the next two years.

Cold truths

Something really cool is going on at the University of Florida campus in Gainesville. They're building the world's largest ultra-lowtemperature physics lab. When the construction is over, physicists will be able to cool materials down to one-millionth of a degree above absolute zero, about 459° below zero Fahrenheit. Cooling any material to absolute zero theoretically brings the atoms inside to a halt. At near absolute zero, atoms can be studied in ways never before attempted. Very sensitive radio receivers are expected to be the first practical payoff of the new laboratory.

In case of emergency

More than half the deaths that occur in hospital emergency rooms could be prevented if those who call for the ambulance knew how to handle the emergency until the medics arrive. That fact emerged at a medical conference held at New York Hospital. After the conference, I came upon a helpful little booklet called *Emergency Care—Helping You Take Care Of Yourself.*

The 15-page guide tells you what to look for, what to do and what not to do in a wide range of emergencies. To get this booklet, send \$1 with your name and address to St. Agnes Medical Center, Dept. B.G., 1900 South Broad St., Philadelphia, PA 19145.

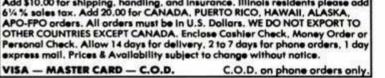
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"I KNEW I WAS AFTER THE SECOND INTO FLAMES. It all started when

my brother, Fred, bought a sight-seeing map from an old man wearing a bone in his hair. Next thing I know, I'm driving a four-wheeler with a roof made out of Granny's kitchen curtains, and we're gunning through a jungle that'd make Cheetah look like a city boy.

The Wrangler radials are tearing up the mud, getting bored with the sweet life, when Fred whips the map out of his grass skirt and says, 'Turn left at the next palm tree. could use a passenger big, mossy rock most folks back home would

call a volcano.

IN A BIT OF TROUBLE PALM TREE BURST

Before I can get little brother out of my lap, old Mauna Loa starts a lean, mean hula, shooting a gusher of red hot lava two hundred feet higher than Fred's I.Q. We're looking like steak that's been chicken-fried by a nuke, meaning, 'Check, please.'

I pull a 180 and let the Wranglers say aloha to a high, rolling heat wave aching to kiss and make up. We're doing sixty, and the steering wheel's hot for an X-rating hen that overgrown pebble blows. Big time. us flying over two miles of smiling tourists waving at a UFO.

Down smack that impression to say ouch. They cruised across that pearly strand right up to the hotel lot where I slipped the wide-eyed attendant a five and asked him if he'd be kind enough to put out the roof before he parked her.

Now, some natives will tell you that Mauna Loa means 'sleeping giant' and wouldn't know how to blow if mama gave it a hankie. But if you're the kind to give that one the time of day, get yourself some Wranglers. And we'll give you a real good deal on a map.



You either have Goodyear Wranglers. Or you need them.

Car Clinic



BY MORT SCHULTZ

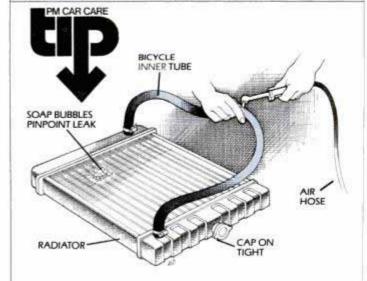
All pumped out

he exhaust emissions air pump on my '85 Plymouth Reliant 2.2-liter engine seized at 1500 miles. A new one the dealer installed (free of charge as per the emissions system 5-year/5000mile warranty) has a sticker on it stating: "Do not service before 1000 miles." The Chrysler-Plymouth service manual says air pumps are not serviceable. Which is right? THOMAS SETLOCK BUFFALO, NY

Air pumps are not service-

able. What the sticker is trying to say is do not replace the air pump if it makes noise during the first 1000 miles. It takes about 1000 miles for vanes in the pump to seat. Until then, they may be noisy as they rotate.

Air pump seizure is not a common problem. Unfortunately for you, you got one that probably wasn't cast properly in production. The new one should serve better. But if it doesn't, you still are protected by that emissions parts warranty.



Air loom

Here's an idea that won the grand prize in a "Tricks of the Trade" contest co-sponsored by *Motor* magazine and Fram. Submitted by Dave Finkelstein, a professional mechanic in Olivette, Missouri, the tip can help you easily pinpoint a radiator leak when the radiator is off the car.

Dave says to cut a bicycle inner tube in half. Slip each end of the tube over one of the radiator hose necks and tighten each with a clamp. With the radiator cap tightly in place on the filler neck, shoot some compressed air into the inner tube through the air valve. The spot where air spurts from the radiator is the spot of the leak. If you have difficulty pinpointing the spot, coat the general area with soapy water and again apply air. Bubbles will reveal the exact location.

Demanding a recount

In response to a question from Doug Fowler of Massena, New York, in the May '86 Car Clinic (page 32), I described a long, tedious procedure for Doug to follow in cleaning pine sap from his car finish. Boy, did my mailbox load up with letters describing "sure-fire, fastacting" remedies ranging from plain water to melted margarine.

Doug stated that the sap had been on his car for 10 or 11 months. No method he tried worked, including alcohol—usually a viable method if sap is treated right away. He had also tried tar and bug remover. Therefore, I stand by what I said—if nothing else works, use the procedure I described.

Caddy oilers revisited

Here's more information about Cadillac's HT 4100 engine. In the May Car Clinic I suggested that the oil problem in John Sullivan's '85 DeVille may be caused by an incorrect dipstick. Recently, I heard from Claude G. Mc-Kinney of Fort Myers, Florida, who was having a similar oil loss problem (one quart every 790 miles) with his '84 DeVille.

A new dipstick didn't remedy the situation and the oil loss was not due to overfilling or obvious leakage, so Claude's HT 4100 was disassembled. It was found that the ends of the rings on each piston lined up with each other, providing a channel for oil to leak into the combustion chambers. The mechanic who did the job told Claude he had heard a rumor that the robots assembling some of the HT 4100s hadn't been programmed to offset each ring 45° from the other, which is necessary to prevent oil leakage. Once the rings in Claude's engine were reset, his oil consumption dropped to less than a pint in 2000-plus miles of driving. Rumor or not, consider this possibility if the reason for HT 4100 oil consumption eludes you.

Housing authority

I own a 1984 S10 Chevrolet pickup truck equipped with a 5-speed manual transmis-The truck sion. went through three new clutches in its first 5000 miles. The truck has now been driven 30,000 miles and I still can't let out the clutch without having the vehicle shake and jerk like there was no clutch at all. Other owners of S10s have told me they have the same trouble. Is there no K.D. GRAHAM solution? FARMERS BRANCH, TX

There may be. The first thing to do is make sure no oil is leaking from the rear main bearing. If it is, oil could be getting on the clutch lining, which would cause the clutch to chatter.

If there is no leak, then you'll have to try installing a new clutch housing. Some improperly machined housings got put into Chevy pickups early in the 1984 production run. Have a mechanic check runout of the clutch housing transmission mounting surface with a dial indicator mounted on the flywheel. A reading of greater than 0.020 in. signals a clutch housing that should be replaced. It's a good idea to check runout on the replacement housing, too, before the mechanic buttons everything up.

Now that your truck is no longer covered by warranty, having Chevy pick up the tab for a new clutch housing may not be easy. Hopefully, you saved the repair orders to show you've been having trouble since the truck was new. If you get no satisfaction from the dealer, contact the zone rep and then Chevrolet in Warren, Michigan. If you get nowhere, go to the Better Business Bureau's Autoline arbitration service.

Deceiving appearance

I have an '86 Maxima and would like to change the oil and oil filter myself, but Nissan won't let me—I mean I can't get at the filter. There (Please turn to page 26)

Motorcraft races with success on Sunday to give you dependable performance every day.

Motorcraft quality parts are tested on some of the world's toughest racetracks on Sunday, so you're not tested during the rest of the week.

High-performance racing cars that generate about 600 horsepower demand tough, quality parts. So does your car. And Motorcraft spark plugs, filters, batteries and motor oil help deliver top performance on the racetrack on Sundays and on the highway every day of the week.

Motorcraft quality parts have been installed as original equipment in more than 35 million Ford, Mercury, Merkur and Lincoln cars and Ford light trucks. But no matter what kind of car or truck you drive, there's only one logical choice. Quality Motorcraft parts from Ford—so you'll know you're getting reliable original-equipment quality replacement parts. Race-proven parts. Trustworthy parts. Motorcraft, of course. Quality parts for all makes of cars and trucks.

Motorcraft from Ford



EXCEEDS THE NEED Buckle up-together we can save lives

CAR CLINIC

(Continued from page 24)

are parts blocking it. Can you tell me how to do this job? BILL RANZAU HAMPTON BAYS, NY

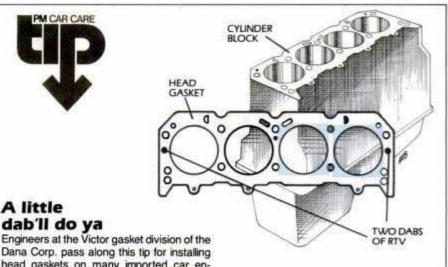
Sure. If your Maxima is equipped with automatic transmission, the shop manual says to get the vehicle up in the air that is, with the four wheels on ramps or jack stands. The car has to be level.

You'll notice a flexible exhaust tube attached to the header pipe. Remove the two bolts and nuts holding this tube to the header and bend the tube aside.

Now, remove the heat shield covering the power steering pressure switch. It's held by two 10-mm bolts. You're now able to reach the oil filter. To remove it, use a cap-type oil filter wrench and bar.

If your car is equipped with manual transmission, the manual says there's an additional step. After removing the heat shield, take off the control and support rods from the transmission to get at the oil filter.

Can you do the job without removing parts? Some mechanics place a 4-in. universal swivel joint and a 3-ft. extension onto the cap-type oil filter wrench, then snake this contraption up toward the filter. If the heat shield gets in the way, they temporarily bend it aside.



Dana Corp. pass along this tip for installing head gaskets on many imported car engines, which do not have dowel pins to hold the gasket in place. As a result, the gasket often slips out of position while the head is being installed. This can make for a real long afternoon. Two small dabs of RTV silicone gasket material, applied to the block side of the gasket where it won't interfere with oil or

Throws down a challenge

I just bought a cream puff '83 Olds 98 Regency sedan (5-liter V8). It's been driven 25,000 miles and is perfect in every respect but one. It has to be cranked at least 30 seconds before it water passages, will hold the gasket tight. Apply RTV sparingly and spread it in a very thin film. Put the gasket on the block and let the RTV cure for 15 minutes.

starts in the morning. Once it gives that shot, it starts at a touch the rest of the day. The guy I bought the car from says it's always been like this. I hope this isn't too difficult for you to solve.

> BOB STUART DELRAY BEACH, FL



How to Tow With Today's Car and save up to ^{\$}15 at U-Haul

New cars are built lighter
 to save gas. So when you tow,
 you want added protection for your car.
 Here are a few tips to follow:

1. THE RIGHT HITCH.

Hitches differ. The wrong one can cause body damage or tear out. U-Haul* Hitch World* provides the hitch to fit your towing needs, using top brands like Draw-Tite and Reese. Each hitch has a nationwide warranty, good as long as you own your tow vehicle.

2. A TRANSMISSION COOLER.



Towing with a downsized car causes heat build-up in the automatic transmission. That can burn the transmission's fluid and shorten its life. Hitch World selects and

installs a transmission cooler, like Hayden, that extends the transmission's life by releasing the towing-caused heat.

3. A TOWING SUSPENSION.

A standard suspension is basically made to carry passengers. Frequent trailer towing can reduce the life of your springs and shocks. Hitch World installs air lifts or air shocks that give your tow vehicle added frame support, and reduce suspension and tire wear.



NOW SAVE UP TO \$15

This coupon is good for \$5 off the price of a hitch, a transmission cooler, and a suspension system (\$15 maximum discount, ofter expires 12/31/86). It's all at your nearest U-Haul Center, Look in the White Pages under U-Haul. Write for a FREE HITCH GUIDE: HITCH WORLD, Dept PM, PO. Box 21503, Phoenix, AZ 85036 Limit one coupon per customer. PM886

More for your money at your U-Haul Center

The problem may be caused by a carburetor that has an internal leak. You may not be able to stop the problem without replacing the carburetor. But before doing that, check the following: Some Rochester 4-barrel carburetors have a plug in the bottom of the float bowl that is prone to leakage. Kits are available that replace this press-in plug

with a tight-sealing threaded plug. Be sure you have the correct fuel filter for the carb and that it isn't installed backwards. If it is, fuel tank vacuum can siphon gas out of the carb bowl. ■ Test the fuel pump to see if the problem is being aggravated by a weak pump. Fifteen seconds of cranking should show if the pump is developing a minimum vacuum of 15-in. Hg. Fifteen seconds with the engine idling should indicate if the pump is delivering a minimum half pint of fuel and is developing a minimum pressure of 51/2 pounds per square inch. If the pump fails any of these tests, replace it.

Update old carburetor parts. A few parts originally used were modified by Olds to improve startup and reduce carburetor heating and resulting fuel evaporation. Ask the guy who sold you the car if he had them installed. They are a choke coil and cover kit (part No. 17110646) and a new carburetor base gasket (part No. 22508038). • Check the float level. Depending on the carburetor part number, it should be ${}^{11}/{}_{42}$ or ${}^{7}/{}_{16}$ in. $\pm {}^{4}/{}_{16}$ in. Consult the service manual to see which spec applies to your carburetor.

See that ignition timing is to specification.

Make sure you're using proper starting procedure. According to the book, this is to press the accelerator pedal to the floor and release it before turning on the ignition. If ambient temperature is zero or below, or the car's been standing idle a couple of days, press and release the accelerator pedal three or four times. Then, with your foot off the pedal, turn on the ignition and crank the engine for a maximum of 15 seconds. If the engine doesn't start, wait 10 seconds and try again.

That's what the book says. I suggest that if starting remains troublesome and the one-accelerator press doesn't do a thing for you, apply the zero-degree starting procedure at all times. If it works, you may have avoided the cost for a new carburetor.

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, NY 10019, While letters cannot be answered individually, problems that are of general interest will be discussed in the column.

SERVICE TIPS

GM says that a spark knock in an '84 or '85 model with 5-liter engine which isn't corrected by "normal diagnostic procedures" may be eliminated with new sparkplugs. They are AC R43CTS (part No. 5613810)—a colder heat range plug than the AC R44TS or AC R45TS plug originally recommended for these engines. Set gap to .045 in.

Before your Lincoln dealer tells you he has to replace air springs in your '85 or '86 Mark VII or Continental because they're losing air, think "temperature." Is air loss occurring only when the car is parked in an area where ambient temperature is 30° or less? If so, the two small 0-ring seals on air spring solenoids may be shrinking. Have new 0-ring seals (part No. E4LY-5312-A) installed as per technical service bulletin (TSB) 86-7-4.

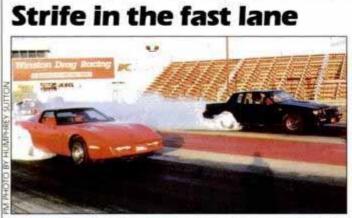
Nissan says to get a quick response to a request for service manuals, you can phone in your order toll-free using Visa or Mastercard. Dial 1-800-325-0517; in California, call 1-800-641-9317.

Oldsmobile owners who want a shop manual for their car can get them from Lansing Lithographers, P.O. Box 26128, Lansing, MI 48909, as we said in our May Car Care Guide (*Be A Bookworm*, page 147). However, the prices quoted in the article are for '86 models only. So don't send a check: Request Lansing's order form for your model and year by writing to them first.

27



BY WADE HOYT



Battle of the gear ratios: Can a Buick really out-drag a Vette?

Who makes the fastest car in America? It all depends on who you ask. Most people give the nod to Chevrolet's Corvette. But not Donald Hackworth, Buick's General Manager. He claims that honor for the Buick Regal Grand National and its high-tech turbo V6.

If you're talking about top speed, it's no contest: the Vette will top 150, and the Buick is limited by its engine-control computer to 124 mph because its tires are rated for "only" 130 mph. But if you're talking acceleration, you've got a real horse race!

When you test prototypes at a company track with a team of engineers standing by to make adjustments, anything can happen. We wanted to test these cars in a real-life situation, to see whether the bulky Buick, even with 235 hp, could outaccelerate the sleek Corvette's 230-hp V8. So we took three cars to Raceway Park in Englishtown, New Jersey: a pair of Vettes (with manual and automatic transmission) and the Regal Grand National (which only comes with automatic).

We asked for "real-life" and we got it: The weather was warm and humid, with a steady headwind, just about the worst possible combination for dragstrip times. The dealer had tried to advance the timing on the stick shift Vette and succeeded only in fooling the computer, so the engine misfired at high rpm.

The automatic Chevy easily out-dragged the Buick across the entire speed range, except for one little blip at 0-60. We ran the test over and over, and each time the Regal zapped the Vette at 60 mph! One explanation is that the Corvette stays in low gear until 5600 rpm—far past its power peak. But good aero helps the Vette at 70 mph and above.

BEST TIMES	(in seconds)
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67 A 21 21 40 40	0-10	0-20	0-30	0-40	0-50	0-60	0-70	0-80	TIME	SPEED
BUICK									14.68 14.47	91.09 96.55

Have I got a question for you!

What modern car was known as The Goat? Who builds a car called the Camargue? What Russian made great contributions to the world of high-performance automobiles? What does the A.J. stand for in A.J. Foyt's name? What year did the Ford Model T have 4-wheel brakes?

If you can answer these and thousands of other questions about automotive history, racing, technology and, yes, trivia, you'll be a whiz at Auto Trivia. The game is

One-volume bet-settler

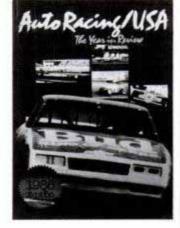
Want to settle a bar bet or just review last year's excitement? Auto Racing/ USA—The Year In Review-Vol. 3 covers the '85 season in ARCA, ASA, CART, IHRA, IMSA, NASCAR, NDRA, NHRA, SCCA, USAC, WoO, IROC, Pikes Peak, Off-Road and Pro Rally racing in words, specs and photos, including maps of major tracks. Its 256 pages measure 9 x 12 in., and it's \$39.95 from HP Books, Box 5367, Tucson, AZ 85703.



Auto Trivia parlor game is great fun for two to 10 car nuts.

available for \$24.95 from A-T West, 1170 Harding St., Escondido, CA 92027.

(Answers: Pontiac's GTO; Rolls-Royce; Corvette designer Zora Arkus Duntov; Anthony Joseph; never.)



Mario Andretti to Dick Trickle are all in this 256-page volume.

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The Chief Executive motorhome lets you take a meeting on the road. This boardroom on wheels is equipped with nine lounge chairs, a galley, video center and executive washroom. Aero styling and Renault front-drive V6 give it 20 mpg fuel economy. It costs \$69,000 and up, depending on amenities, from Zimmer Motor Coach, Boca Raton, FL.

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Homeowners'

BY NORMAN BECKER, P.E.

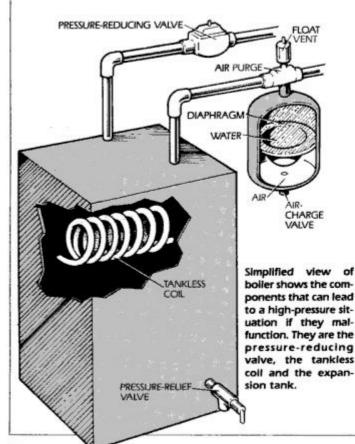
Waterlogged tank woes

The expansion tank on my boiler hot-water heating system is barrel shaped and measures about 12 in. long with a 12 in. dia. It's an Ex-Trol tank and has a red plastic insert at its bottom. How can I remove excess water from this tank? I am losing about one gallon a day through the pressure-relief valve. I have replaced the valve and the new one also leaks. H. PECKER BROOKLYN, NY

The Ex-Trol is a modern pressurized diaphragm expansion tank that is used in many hot-water heating systems. It's manufactured by Amtrol, West Warwick, RI 02893. The tank's weldedsteel body encases a rugged flexible plastic diaphragm that separates the water from the air charge.

The tank is pressurized at the factory to 12 psi and the red insert is a cover for the tire valve used to charge the tank. The Ex-Trol is smaller than conventional nonpressurized tanks because less space is needed for the air.

Unlike conventional tanks, where the air and water are not separated by a diaphragm, the Ex-Trol cannot be recharged once it



becomes waterlogged. It must be replaced.

A discharging pressurerelief valve (assuming the valve isn't faulty) indicates high pressure in the boiler, the cause of which may not be the expansion tank alone. It can be caused by a malfunctioning pressure-reducing valve that steps down incoming water pressure before it enters the boiler.

Also, if the boiler is used to produce domestic hot water, then the cause may be a leak in the tankless coil. Unlike the water in the rest of the boiler, its pressure isn't reduced. A leak in the coil will introduce high-pressure water into the boiler.

A waterlogged expansion tank or malfunctions in either of the other two components can cause a high-pressure buildup in the boiler.

To determine if the tank is waterlogged, remove the insert and depress the tire valve. If water shoots out, the tank is waterlogged. If air comes out, the tank is not waterlogged and the problem is probably caused by a faulty pressure-reducing valve or tankless coil.

Attic vent specs

In the Feb. '86 Homeowners' Clinic (page 24) you mentioned in your discussion on attic ventilation that the total vent opening size for an attic should be $\frac{1}{300}$ th of the attic floor area when there is a vapor barrier below the insulation and $\frac{1}{150}$ when there is no vapor barrier. Would you please inform us of the source of these figures?

> A.C. MACNAUGHTON, P.E. KING CITY, ONTARIO

The figures are from Section 604 of the Minimum Property Standards For One- And Two-Family Living Units by the U.S. Department of Housing and Urban Renewal.

It states, in part, that attic vents are intended to provide natural ventilation to reduce moisture and heat buildup in the attic during the summer months.

The effective vent area

should be $\frac{1}{2}_{M00}$ of the attic floor area when "a vapor barrier having a transmission rate not exceeding one perm is installed on the warm side of the ceiling" or 50 percent of the required ventilating area is provided by vents located in the roof of the attic at least 3 ft. above eave or cornice vents. The balance of the required ventilation should be by eave or cornice vents.

If one of these requirements is not met, the vent area should be $\frac{1}{150}$ of the attic floor area.

Chalky buildup

The outside of my home is covered with wood-grain aluminum siding. In a few areas, the bottom edges of the siding have developed a white chalk-like substance. What exactly is it? Can it be prevented?

PATRICK HERMAN CAMBRIDGE SPRINGS, PA

The chalky substance is a layer of "dead" paint pigments along the bottom edges of the siding.

Over time, the siding's paint weathers, developing a dead pigment layer on the surface. Particles of dead paint are washed off by rain and accumulate along the siding's bottom edges.

The substance isn't harmful but should be treated like any dirty object. The Architectural Aluminum Manufacturers Assn. recommends the siding be washed periodically with a solution of ¼-cup detergent, ¼-cup tri-phosphate (such as Soilax), 1 quart of 5-percent sodium hypochlorite (such as Clorox) and 3 quarts of warm water.

Washing the siding will remove the dead layer and help restore luster.

Do you have a home-maintenance or repair problem? Send it to Homeoneers' Clinic, Popular Mechanics, 225 West 57th St., New York, NY 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, \$2.55 postpaid. Send your order(s) to Popular Mechanics, Bax 1015, Radio City Station, New York, NY 10101.

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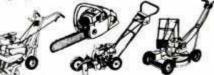
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BY STEVE TOTH

Stingy dispenser

The liquid rinse dispenser on my 1973 Hotpoint dishwasher, Model HDA 771, isn't working. It stays full all the time. What controls this and what can I do to correct it? GORDON DUNN FRESNO, CA

First, check if the liquid rinse dispenser is full of water or rinse. With the door down and the fill cap off the dispenser, poke your finger or a cotton swab into it. Your finger or the swab will be covered by water or rinse when you pull it out.

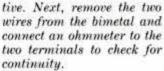
If it's water, you'll need to replace the washer that seals the fill cap. If the dispenser is filled with rinse, the correction is more complicated.

The first step is to check

the bimetal mechanism on the rinse tank inside the door. This mechanism is heated by two electrical leads. It rises as it's heated and pulls up a rubber-tipped valve pin, which releases rinse fluid into the washer.

Unplug the power to the washer. Open the door and remove the outer door panel by removing the two Phillips-head screws at each side of the inner door panel. Close the door. The rinse dispenser is at the upper left side of the panel and the bimetal is above it.

Check the two wires attached to the bimetal to be sure they are making good contact with the terminals. If they aren't, this could render the dispenser inopera-



If there isn't any continuity, replace the bimetal. If it tests okay, and you have good electrical connections, the problem is probably a broken wire or bad contact in either the selector switch or the timer. In that case, I suggest that you contact a GE repairman.

The part number for the dispenser's washer is WD-8X5021 and it costs \$1. The bimetal mechanism is part No. WD-4X5020 and it costs about \$21 at any GE parts center.

Noisy microwave

I have a 1½-year-old JC Penney microwave oven, model No. 5910-00-30. About six months ago it began emitting a high-pitched sound that could only be stopped by unplugging it.

The sound didn't reappear immediately when it was plugged back in, but it has reoccurred on about four or five occasions. What is the cause of the noise and what can I do to prevent it?

> RONALD E. RITCHIE BALTIMORE, MD

You may have a problem with the touch control panel circuit board, which is part of the electronic control panel assembly on the front of your oven.

What is probably happening is the circuit in the panel that controls the buzzer or sound alert has some electrical leakage. This leakage has caused the buzzer to emit a sound at a very low level but at a much higher frequency than normal.

The only way to stop this annoyance is to replace the touch control panel circuit board. Microwave ovens have potentially dangerous high voltage internally. Therefore, I recommend you bring the oven to your local RCA service company—they now service microwave ovens. A repair such as this one typically costs approximately \$150.

Leaking insulation

I have a Frigidaire wall oven, model No. RB6B-335, serial No. 47C96976P. There is white fibrous insulation around the interior oven light.

When the oven light's glass cover is removed particles fall from the insulation into the oven. Is this material asbestos? Is it harmful?

> DON ORTMAN HARTFORD, SD

The insulation used in your oven is fiberglass, according to GE, and should not present a problem. It's used because it's not electrically conductive.

During the 17 years that your oven has been in use, the opening and closing of the oven door has probably jarred loose a little of the fiberglass insulation.

I suggest you remove the glass light cover and wipe around the bulb with a dry cloth to pick up any remaining insulation particles. Replace the cover. If any more insulation falls down, it should be caught by the cover and not fall into the oven cavity.

SERVICE TIP

You'll get better, lint-free service from your washer if you keep in mind the following tips:

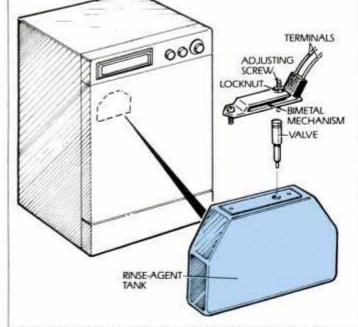
 Don't mix lint-shedding fabrics (towels, for instance) with fabrics that attract lint (permanent press or corduroy).

 Keep the lint filter clean and check it frequently. Use the proper amount of detergent. This keeps the lint in suspension during the wash cycle.

 Don't overload the washer. It may be tempting to pack in the clothes on occasion, but this causes abrasion and linting of the clothes.

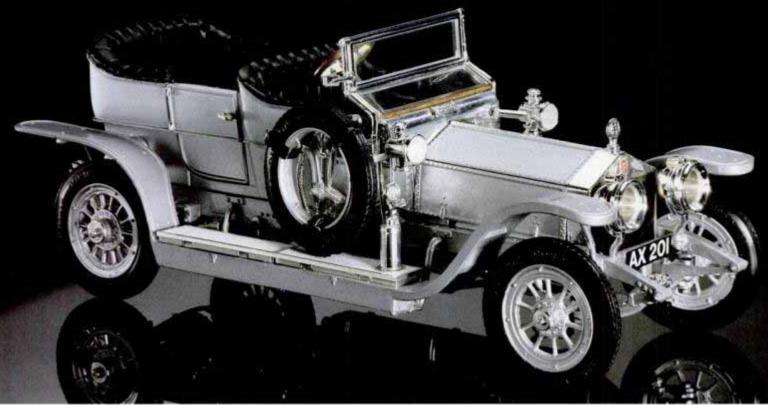
 Don't overwash clothes and don't add too much chlorine bleach, this causes linting. Use fabric softener to reduce static that attracts lint to synthetics.

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, NY 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.



The bimetal mechanism is located on top of the liquid rinse tank. It pulls up a valve pin and releases liquid rinse into the washer.

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Named for its silver-plated trim, metallic-silver paintwork and extraordinary silence, The Silver Ghost offered luxury and performance previously unknown. And the prototype for this diecast model is based directly on first-hand studies of the original.

Steel dies taken from the prototype are used to cast the more than 127 components needed to build a single model.

The elegant Roi des Belges coachwork is painted with metallic-silver automotive lacquer. And the exterior trim is plated with sterling silver --- matching the original exactly.

There are soft tufted seats, doors that open and close, fully operable steering, complete instrumentation—and engine detailing that shows the *two* sparkplugs on each of six cylinders.

What price perfection? A custom model of this quality would cost hundreds or even thousands of dollars. But The Silver Ghost is just \$120, and payable in four installments of \$30 each.

Crafted and imported exclusively by Franklin Mint Precision Models, it's available by direct application only. So be sure to order by August 31, 1986.

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Portable Compact Disc players, once a rarity, are now available from most major hi-fi manufacturers. But one model stands out from among the rest by virtue of its unique, clever styling and impressive list of standard features. That player is the Toshiba XR-P9RC.

What makes the Toshiba player a winner is its attractive and practical wedge shape (when connected to its AC adapter for use at home) and its wireless remote control. In fact, the XR-P9RC is at present the only portable CD player you'll find that offers wireless remote control.

Another impressive item is its \$300 suggested retail price. That includes the wedge-shaped AC adapter, battery pack (it uses six C batteries), wireless remote control handset and detachable sensor, carrying case and strap. Most competing portables also list for \$300but come only with an AC adapter. All you need to add to make the XR-P9RC's package complete is a headphone set.

In use, you'll find the Toshiba player is more at home in the living room than any other portable CD player. That's because its ingenious wedge-shaped AC adapter positions the player ideally for use when it's sitting on a shelf or tabletop. Other players lay flat and tend to move around on the surface when you press their control buttons. Not so with the XR-P9RC. And naturally, remote control is a desirable convenience.

The only drawback in home use is that its remote control isn't nearly as versatile as those that come with genuine home players (it won't operate the player's fast forward or reverse, and you can't program memory playback from the handset). Also, the display is impossible to read if you're more than a few feet away.

Used on the go, the Toshiba withstood more severe shocks than any other portable player I've sampled. It's certainly not intended for use when jogging or horseback riding, but neither is any competing player.

As a portable, the XR-P9RC doesn't score well when it comes to size, weight and ease of use. It's one of the largest personal portable CD players on the market, measuring approximately 5 \times 7 \times 1½ in., and its battery pack adds about another 3 in. in depth.

What's more, the battery pack and carrying case are awkward. The battery pack clips onto the rear of the player and significantly increases the size and weight of the player. Additionally, the soft carrying case blocks some operating controls, prevents the disc door from staying open by itself, and looks decidedly low-tech. It just can't compare with the 1-piece rechargeable battery pack/carrying cases offered by some competitors, notably Sony and Technics.

Despite these shortcomings, the XR-P9RC's flexibility is hard to beat if you want a reasonably priced CD player that works well at home and will travel with you, too.

Rx for tapes: Dolby HX Pro

The audio alphabet is overpopulated with initials that refer not to some bit of circuitry that makes music sound better, but to many so-called "convenience features" that automate tasks nobody ever wanted performed in the first place.

But amid the hi-fi mumbojumbo there are a few developments that do indeed enhance a component's ability to reproduce music accurately. One of these developments comes from Dolby Laboratories, a company well-known for its contributions to better sounding recorded music.

Some years ago, Dolby developed a circuit called HX that improved tape recordings. It was first put in a cassette deck by America's own Harman/Kardon, a manufacturer of audiophilequality gear. Soon after, a Danish audiophile company named Bang & Olufsen made some improvements to the original HX circuit. In conjunction with B&O, Dolby introduced the new HX Pro circuit in 1982.

What HX Pro does is improve your tape's ability to accept high frequency (treble) signals at high volume levels. That's desirable because technical limitations in the recording process make it more difficult to record high frequencies at high volume levels than to record other (bass and midrange) frequencies. The result: high-level signals in low- to mid-frequency areas, but a loss of high frequenciesmaking a dull-sounding tape.

The culprit behind this difficulty in capturing high frequencies on magnetic tape is something called bias. Bias is a super-high-frequency signal you can't hear, but one



HX Pro circuit is built into Harman/Kardon's new \$550 TD392.

which must be recorded on the tapealong with the music-to keep noise and distortion low.

Different types of tape work best with different levels of bias, and that's why your cassette deck has bias-level switches for the different tape types (normal, chrome, metal). Bias presents problems, though, because music rich in high frequencies often acts as a bias signal itself. This self-biasing gangs up with your deck's built-in setting and records a bias level that is too high. The consequence is tape saturation-and the high frequencies that bring brightness to the music aren't recorded at all.

To get around that problem, the HX Pro circuit constantly monitors any bias-level variations. When it detects a rise in bias level caused by self-biasing, it instantly lowers the bias delivered by the recorder so that the tape sees a constant level.

Thus, the problem of overbiasing is avoided. You can record high frequencies more accurately, since there's no need to reduce the record-volume level to avoid tape saturation. The net result of all this is a more natural-sounding tape, with all the snap and sparkle of the original music.

At present, several companies offer decks with HX Pro, mostly in higherpriced models. Unfortunately, it's not built-in as often as Dolby's B and C noise-reduction circuits.

Besides home cassette decks, HX Pro can be used in high-speed commercial duplication to make better sounding prerecorded tapes. That's because self-biasing is more problematic at high speeds-especially on the relatively inexpensive "normal-" or "low-" bias tape (Type I) that commercial duplicators use. HX Pro lets them pack more musical signal on this low-bias stock-and it will do the same for you!

Warner Records was the first to use HX Pro for its cassettes-and you can hear the improvement.

Tape tax revisited

Back in April's issue (page 50), I described proposed congressional legislation that would place a tax on tape recorders and blank recording tape. That legislation is still alive, though in a somewhat modified form.

Specifically, the proposed penny-perminute tax on tape has been dropped from the Senate's version of the bill, S.1739. What remains is a 5-percent levy on audio tape decks-25 percent if the deck is capable of making more than one tape copy simultaneously. The House bill, H.R.2911, is expected to follow similar lines.

If you oppose this tax on recording gear, now's the time to let your elected representatives know.

Dupli-Color turned Stan into an auto touch-up expert



You can do an expert touch-up job, too. It's easy with Dupli-Color's exact original color match and easy, step-by-step instructions Scratch-Fix*-For late model vehicles. Comes with handy Brush-In-Cap applicator. Auto Spray* Touch-Up-Convenient 5 oz. aerosol can for larger touch-up areas. Truck & Van Paint-For pickups, vans and RVs. Great for

always telling me to do this and do that. I wanted to be my

what I was looking for. No big investment. No licensing or franchise fee. No waiting, no training needed. What really appealed to me is that you pay no dues, fees or

royalties-every single penny you earn is yours to keep! "I started out part-time. Jobs started to snowball and

pretty soon I had as much business as I could handle. Before

own boss.

long

went full time.



GUIDE Write: Dupli-Color Products, Dept. 11, 1601 Nicholas Blvd., Elk Grove Village, IL 60007



Earn More Per Day <u>Now</u>... than I used to make in a week.

I started my own business part-time as a Von Schrader Associate . . . got step-by-step help and success beyond my dreams.

How it really happened, by William Turnbow

cleaning, with the only foam machine that cleans and vacuums carpets in one pass. Upholstery cleaning, that quickly résults in bright, sparkling clean upholstery without harmful overwetting. And wall cleaning, almost 5 times faster than bucket-and-sponge, with little effort, no streaking. "Fresh out of the Marines I bought a farm. Unfortunately, it wouldn't support a wife and three growing boys. Next I managed a food store. But I got tired of having somebody *So I answered a Von Schrader message like this one, which opened the door to new opportunity for me. It was just

Our easy-to-follow instructions tell you step-by-step how to operate your equipment. Absolutely no experience or special training is necessary. Our proven sales and servicing methods are backed by over 50 years of experience. You get all the know-how you need to become a home furnishings maintenance expert.

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in a week. Now I have the time and the money to go hunting and fishing all I want. Recently we moved to a new, larger house." How would you like to earn big money, starting out spare	MAIL TODAY FOR FREE BOOKLE VON SCHRADER INTERNATIONAL, Dept. 1067 1600 Junctice Ave., Racine, WI 53403 WITHOUT OBLIGATION send free booklet that tells me how I can have a high-income business in my spare time at no risk to my present job. No salesman will call. (PLEASE PRINT) Name.			

time, like William Turnbow? Be your own boss? Become financially independent? You can start in business for yourself using your home as a base. Everything you need on a job fits easily in your car. As a Von Schrader Associate you can have three money-making businesses in one, if you want! Carpet	Name			
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KLET!

35





Maxair's solo ultralight pioneers experimental plane certification.

Reports about the death of the ultralight industry seem to have been a bit premature. Voluntary licensing and registration programs administered by the U.S. Ultralight Foundation have brought about its rebirth.

The safety record is steadily improving and sales activity is definitely on the rise. Recently, the solo Maxair ultralight design passed the first industry-mandated certification program and ushered in a new era of selfregulation and policing. Many new designs have exhibited some of the best workmanship that this industry has ever offered and pricing ranges from less than \$3000 to about \$10,000. Manufacturers are optimistic.

The 2-seat Buccaneer flies!

The latest prototype of Advanced Aviation's ultralight Buccaneer is not exactly an ultralight. This one has two seats, a 53-hp engine and is equipped with struts. It's said to be a spritely performer and should be ready for sale by Oshkosh. Power is provided by a Rotax 503, 2cycle engine and seating is a side-by-side arrangement with a shared center stick to allow for dual instruction. This amphibian Buccaneer sports a slightly more complicated, but easier to use, retractable landing gear and is built strong enough for unimproved airstrips.

This Buccaneer has to be licensed in the experimental category, but should be legal for ultralight flight instruction by those using the FAA training waiver.

Oshkosh by gosh!

The annual rites of Oshkosh are nearly upon us. The largest sport aviation "happening" in the free world occurs yearly at Wittman Field in Oshkosh, Wisconsin. Nearly a million spectators converged upon this airport last year and this year's event promises to be even bigger.

Oshkosh offers one of the best daily airshows seen on the continent, in addition to squadrons of antique aircraft, warbirds, homebuilts, ultralights and normal storebought aircraft. For a full week, Wittman Field is the busiest airport in the world.

Many new homebuilt designs are due to debut this year including the new 300mph Glassair III, the Velocity, an aerobat designed by Canadian aerobatic champ Gordon Price, and Dick Van Gruensven's RV-6.

Oshkosh also hosts a large gathering of warbirds. During the initial part of the week, it's not uncommon to see several hundred former military aircraft flown by their civilian owner/restorers. Some common sights include B-

Windshear detector

Piedmont airlines is the first U.S. air carrier to be flying with a certificated windshear detection system. This device provides a visual and aural warning of disturbing meteorological activity and will, in the next generation, be able to provide guidance to help a pilot fly out of such conditions. 17's, P-51's, Spitfires, SNJ's and B-25's.

The Experimental Aircraft Assn. hosts this annual event and is the largest organization currently devoted to protecting the rights and privileges of sport aviation enthusiasts. The EAA is responsible for the legal use of automobile pump gas for many makes and models and other programs that have kept the costs associated with private aviation from rising beyond the reach of many members.

The EAA is headquartered at Oshkosh, where it completed a beautiful new museum and administrative complex last year. Many of the world's best known aircraft are housed within and a visit to this facility comes highly recommended.

This year's fly-in, to be held from Aug. 1 through Aug. 8, will also see several sky-diving teams.

Those flying in for the first time should contact the EAA prior to departure in order to get some help in understanding arrival procedures. I'll be hanging around the International Aerobatic Club building. Stop by and say hi!

I had the chance to fly this system recently on Sperry's simulator and managed to successfully fly through the same conditions that brought down three airliners in the past 12 years. Needless to say, I'm impressed. The system is part of a special performance management system built for Piedmont's 727's and 737's.

-Jim Campbell



The amphibious Buccaneer will make its debut at Oshkosh fly-in.

Материлл. задищенный авторо 37, привом

Kiss Your Momma Goodby

No, this isn't some far-off foreign jungle. It's your own state.

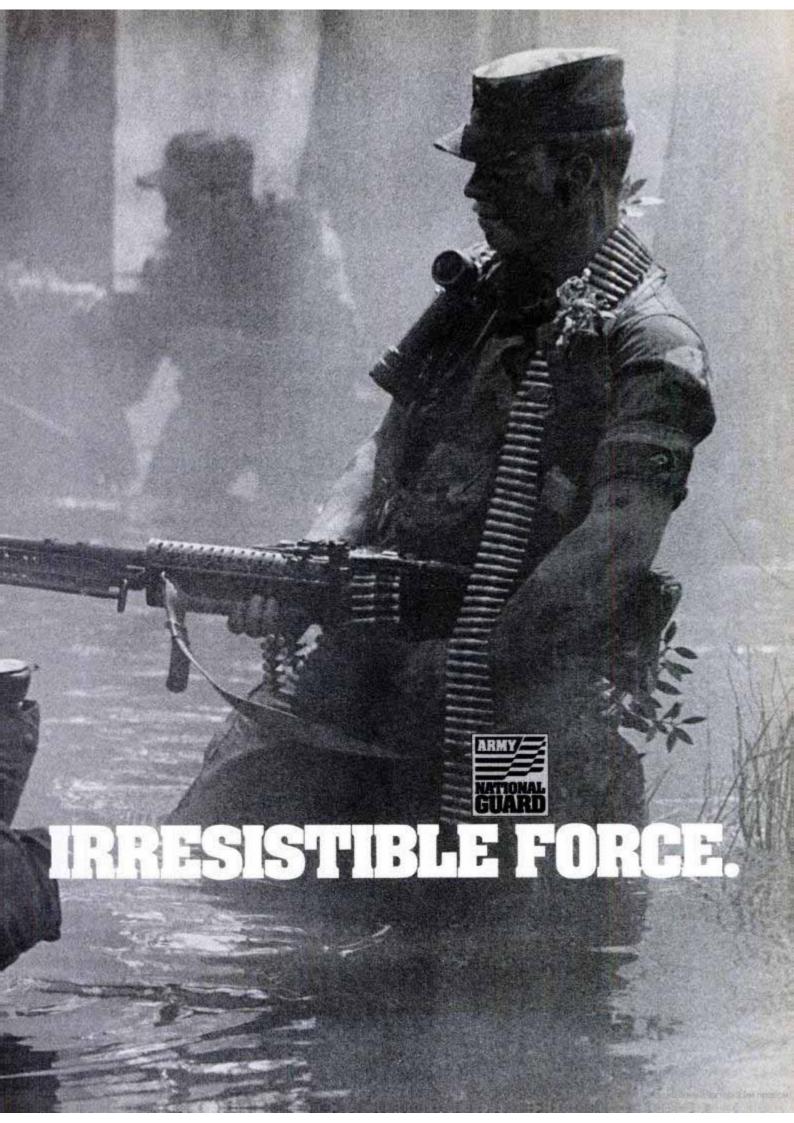
your own state. But these are your buddies. The guns are real. And so is the adventure. You're part of the 450,000-man backbone of American resolve: The Army National Guard. You work part time. The pay is good. True, duty in the Guard won't be the easiest way to spend a Saturday afternoon. But it will make your momma proud she raised a man

a man.

Call 800-638-7600* or mail to: Army National Guard P.O. Box 6000, Clifton, NJ 07015

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Inside Detroit

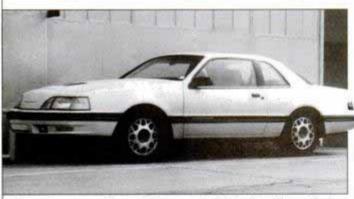


BY JIM DUNNE

Turbo Bird improved for '87

Ford will continue to build the turbocharged Thunderbird, despite the demise of the SVO Mustang. In fact, Ford is ready to increase its efforts in backing the Turbo Coupe. More power is one. Ford will add an intercooler to the 2.3-liter 4-cylinder turbo and boost horsepower to about 200. Zero-to-60 time should drop to 7.5 seconds. That will put the Turbo in a class with some of the quickest musclecars.

Special styling for the grille and hood will set the Turbo apart from standard T-Birds. Other performance hardware will include 4wheel disc brakes with ABS skid control, 16-in. wheels and high-performance tires, plus adjustable suspension.



New aero nose with no grille separates Turbo from lesser Birds.

Daytona facelift

Dodge will smooth out the appearance of its 1987 Daytona coupe by adding concealed headlights similar in appearance to those on the Fiero. At the rear, a slight lip will be added to the rear edge of the hatch, while taillamps will stretch the full width of the car and wrap around the sides slightly. The new taillight is set so high that the center stop light sits at its top edge.

Carroll Shelby is said to have a 16-valve cylinder head, designed by Hans Hermann, up his sleeve for this model. Shelby is talking about a hyperperformance Daytona with 16-valve heads, 4-wheel ABS disc brakes and a 5-speed Getrag gearbox. It could be hot.

AMC ambitions

American Motors will make another attempt to crack the American car market with a Renault import next January. This time it will be a version of the R21, a compact sedan and wagon that has been in production in France since early this year. AMC will call the car Medallion. Bigger than the Alliance, the Medallion will compete with Tempo, Grand Am and Lancer-type sedans. competitors. Seat comfort, in the French tradition, is first rate.

The Medallion is part of AMC's attempt to cover about 70 percent of the U.S. car market by late next year. Also joining the AMC lineup are two other models based on Renault designs. The biggest car will be an Americanized version of the Renault 25, code-named X58. It is in the Audi 5000 class and will be built in AMC's Canadian



Renault 21, to be called Medallion here, will be imported by AMC.

The front-drive 4-cylinder model sells in France for \$15,000 fully equipped. But prices in the United States are expected to start at just under \$10,000.

On a 1000-mile drive in Europe, I found the R21 is much like the compacts sold in this country. Fuel economy at a steady 60 mph is 31 mpg. Zero-to-60 acceleration times are in the 12-second range. At 90 mph, wind noise and road rumble are no problem; the low hum of the engine running at 4000 rpm is the loudest sound. The 5passenger interior seems roomier than those of its plant near Toronto. A Giugiaro design, the X58 will be a 4-door, with production set for the fall of 1987.

The Alpine, a sleek 2-seat sports car, should be here shortly after the Medallion, though its introduction has already been delayed once. The new models join the Alliance/Encore among AMC's Renault-connection lineup. Meanwhile, the Jeep line looks complete with the addition of the Wrangler to the strong Cherokee and Comanche series.

Slimming down

GM's five car divisions will cut slimmer wedges of their model pie in the next three years. Under orders from the top brass, the divisions will pare their lineups by dropping certain models. Olds, Buick and Cadillac, for example, may get partly out of the small-car business. Look for Cimarron, Firenza and Skyhawk to be in jeopardy. Cimarron will be replaced by a car from Opel, but the other two will not be replaced.

Chevy and Pontiac will (Please turn to page 42)



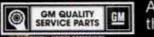
Another recipient of an '87 nose job is the Dodge Daytona coupe.

Training Table.

The training never ends for Mr. Goodwrench.

As cars change, he changes. To keep up with the latest developments, he does his homework. Studies GM Service Bulletins. And chooses from 119 specialized courses at GM's Regional Training Center. Courses in turbocharger technology. Electronic instrumentation. Multi-port fuel injection. And more.

Sure, there are other things he'd rather be doing. But tonight, he's in training. Because he's Mr. Goodwrench. And tomorrow, customers out there will be depending on him. No one knows your GM car better than Mr. Goodwrench. No one. He has the genuine GM parts your GM car needs. Including GM Goodwrench Brake Shoes and Disc Pads.



Ask for them.



CHEVROLET • PONTIAC • OLDSMOBILE • BUICK • CADILLAC • GMC TRUCKS

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ENUINE GM PARTS

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INSIDE DETROIT

(Continued from page 40)

also have to make decisions on which car lines will die. The move at GM is aimed at cutting the cost of building so many different models, and at cutting down duplication among the different GM divisions.

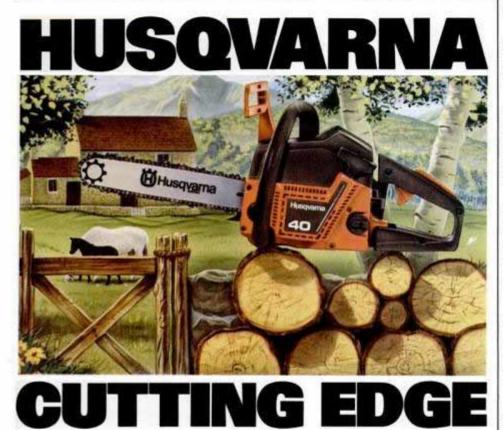
SVO not dead

Ford's SVO department is not dead, even though the SVO Mustang has been discontinued. The Special Vehicles Operations is "still going full steam," according to Ford officials. Right now it is leading Ford's 2-seat sports car project. This Corvette-fighter will be out in 1988 and finally put Ford in the high-performance 2-seat business for good.

Details of the SVO plans are sketchy, but a midship, large displacement, nonturbocharged engine are the main parts of the package. Like the Cadillac Allante, bodies and chassis will be assembled in Europe.

You'll pay

New tires coming out for high performance cars will have low profiles, larger diameters and hefty price tags.



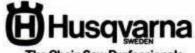
Husqvarna's newest Model 40 gives you the edge in a weekend pro chain saw for only \$249.95*

This sleek middleweight powerhouse gives you the edge in performance-with faster acceleration and more low end torgue than any weekend saw in its class.

It gives you the edge in engineering-with chain brake standard, a near perfect balance .Manufacturer's suggested list price.

between power and weight, an excellent vibration dampening system. And you won't find a quieter saw in its class. So when the job's finished you're not.

And now your Husqvarna dealer gives you the edge in dollars and cents. See him today for great values on Husqvarna's complete line of weekend pro saws.



The Chain Saw Professionals.

For more information contact Husqvarna Power Products Company, P.O. Box 300, Itasca, Illinois 60143. 1-800-GET-SAWS. In Illinois call 1-312-773-2777 or consult your Yellow Pages.

That's the outlook at Firestone, where performance tires like the new Firehawk GT are set to give Goodyear and Bridgestone some stiff competition. A 16-in. tire, for instance, that is rated for sustained speeds over 130 mph will sell for \$180 to \$200. Fifteen- and 14-in. diameters rated for under 130 mph are in the \$120 range.

In a year or two, you will see even bigger, 17-in. tires. Look for Corvette, Porsche and other high-performance cars to use them.

Ford—or Mazda?

You'll need a scorecard to help tell who designed or built the small cars Ford has planned for the future.

By this time next year, Mercury will be selling a new Lynx model that has a Mazda 323 engine and chassis, but American styling. The car will be built in Mexico at a Ford plant.

Three years later, Ford will introduce a completely new Escort that will also be based on the 323. That car will be different from the Lynx in styling, and the engine will be a Ford product. Three U.S. assembly plants now making Escorts will build this car.

In the fall of '88 a new front-drive Mustang III will be built in Mazda's Flat Rock, Michigan, plant. It will have U.S. styling, but use a Mazda 626 platform and chassis. A carryover Mustang GT, with V8 and rear-drive, will sell side by side with this model for at least one year.

As for the Capri, "It's kaput," as one Ford insider describes it. "Lincoln-Mercury can't peddle that car. They can hardly peddle the Lynx. They can sell richer cars, but have a hard time selling smaller ones."

Rubber band effect

First, they got shorter. Now, they'll get longer.

That's the scenario for deVille, Electra and 98. The big GM passenger sedans, built on a common chassis, were the most drastically reduced in size when fuel economy programs demanded smaller, lighter-weight bodies. The deVille shrank from over 221 in. long in 1977 to 195 in. now.

The other two models lost comparable hunks over the same period. But it seems GM overstepped itself. Now, because of buyer resistance to the small size, the cars will go in the other direction. A 3-in.-longer wheelbase is set for the '88 deVilles, Electras and 98s. That will leave more rear-seat room inside and give the car a more impressive stance. Overall length will be extended 7 in., with most of the addition going to the trunk. What you will see is a longer, huskier, more luxurious appearance; one in keeping with the \$20,000-plus price tags these cars carry.

Half of this ad is painted wood. Half is Restoration[®] Vinyl Siding. The only way to tell the difference...



... is to wait five years.

Introducing Restoration® Vinyl Siding from Wolverine.

Our apologies to Mother Nature, but, as you can see, our new Restoration solid vinyl siding not only looks like real wood, it's actually better. It lasts longer. It never needs painting. And it costs substantially less.

Restoration solid vinyl siding comes in seven beautiful colors. The color is actually part of the vinyl, so Restoration

will never peel or blister. Never. That's one of the reasons we guarantee it for life.*



As seen on This Old House."

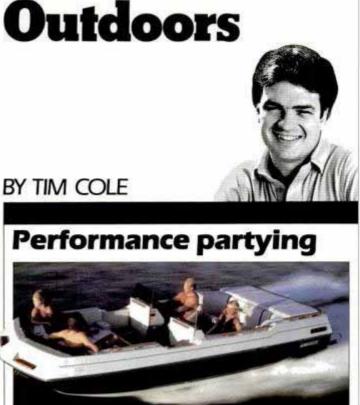


For more information on the entire Restoration Collection, a family of

solid vinyl accessories designed to accent and beautify your home, call Wolverine Technologies at 1-800-356-8722 (in Michigan, call 313-386-0800) for a free color brochure. But don't tell Mother Nature.



*A copy of the warranty is available by writing Wolverine Technologies Inc. 1650 Howard Street, Lincoln Park, Michigan 48146. © 1986 Wolverine Technologies Inc.



Plenty of deck space characterizes the Deck Boat design philosophy, typified here by an entry from 4-Winns.

We live in an age when fast means fun, so it's not surprising that the laidback pontoon boat, omnipresent on the nation's lakes and rivers, is beginning to share the waterways with a new kind of party boat. They're called Deck Boats, to be precise, and they represent the performance side of America's truly Olympian capacity to have a good time on the water.

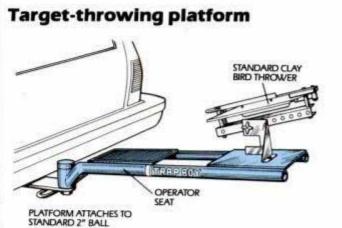
Smokercraft, Hurricane and Chris-Craft, along with 4-Winns and Harris (pictured), have developed variations on the Deck Boat theme. Swift cathedral hull forms allow these machines to scoot along at speeds ap-

proaching 45 mph. Topsides consist of sunpads, wrap-around bench seating and conventional loungers-all designed to enhance the Deck Boat's primary mission: to offer speed and conviviality to as many people as prudence allows. You get bow-riding conversation pits, tables, gear pockets, water-ski stowage, coolers and food lockers. But you also get enough sterndrive muscle-available in 190 to more than 250 hp-to haul skiers, blast home through the rain or generally extend weekend range.

A little performance goes a long way in creating the partyboat for the '80s.

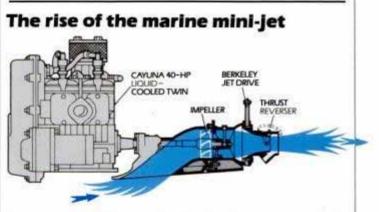


Heim station is farther forward on the Harris FlotDeck, which means a smaller bow rider area but correspondingly larger aft deck.



Shoot'n Easy's Trapboy attaches to your trailer hitch, providing a safe, stable platform for your clay-bird thrower.

Controlling those finicky spring-loaded target throwers is the hardest part of informal trapshooting. But along comes Trapboy, a sensible means to stabilize mechanical clay-bird throwers. Mount your thrower on the Trapboy's heavy-gauge steel platform, then attach the Trapboy to the trailer hitch on your sport vehicle or station wagon. The thrower's operator sits on the Trapboy, and has access to a bird supply in the back of the car. For more information, contact Shoot'n Easy Inc., 46 South Seventh St., Kansas City, KS 66101.



Cayuna engine and Berkeley jet drive join forces to create a solid, economical power package for small boats and wet toys.

The story on motorized beach toys in this issue (page 69) highlights an important factor in their manufacture. Marine jet propulsion is a compact, safe and increasingly popular means of powering these fiberglass playthings. And while Suzuki and Kawasaki are turning out state-of-the-art powerplants for Wetbikes and Jet Skis, the made-in-America combination of Cavuna engines and Berkeley jet drives creates a durable, spritely and cost-effective entry in this competitive field. The Fastrac 400 and the L'il Jet, for instance, use thé Cayuna 40-hp liquidcooled Twin coupled to a

Berkeley Model 6J jet. The easy-to-service Cayuna uses corrosion-fighting stainless external fasteners, tough aluminum cylinders and a special down-draft carb with Coast Guard-approved flame arrestor. Attached to this tough little bantamweight is Berkeley's smallest jet pump. The driveshaft from the Cayuna engine turns the internal Berkeley impeller. A clever, simple thrust reverser makes backing easy and increases maneuverability. The Cayuna/Berkeley package highlights an important concept on the water: A system doesn't have to be complicated to be unique. (Please turn to page 46)

POPULAR MECHANICS . AUGUST 1986

Build Your Own Kitplane!"

The recent development of inexpensive homebuilt kitplanes makes it easy for you to build and fly your own airplane. Here's where to get all the facts before you buy and fly. The rest is up to you!

Yess Now you can build and fly your own airplane... from a kit. For the low price of a motorcycle or used car, you can own a real airplane—a kitplane. Manufacturers all over the country sell everything from "no-license-required" ultralights, to replica fighterplanes.

The new book, The ARV (Aircraft Recreational Vehicle) Kitplane Encyclopedia, tells you what they're all about. And, to keep you abreast of latest developments monthly. Kitplanes Magazine is filled with the facts, photos, drawings, and descriptions you want and need most to get airborne.



Fly without a license in this ultralight kitplane of the famous Piper Cub. Cruises 60 mph.

Be the envy of all your friends in a replica P-51 Mustang. Imagine yourself zooming along over the countryside at over 300 mph, above traffic congestion. Use an auto engine and regular gas!

See everything from economical snowmobile-engined ultralights, to high performance, auto-engined machines. The pages of both publications are jam-packed with the details of all the new planes. All sell for a mere fraction of the cost of "factorymade" airplanes. Many require no special tools or mechanical ability to assemble. Most can be folded and stored at home!

Having your own plane will enable you to go places and do things you otherwise couldn't. Fly to the beach for the afternoon. Visit friends and relatives who are too far away by car. Many kitplanes are seaplanesfish from your cockpit. The ARV Kitplane Encyclopedia and Kitplane Magazine reveal models you won't find anywhere else.



Build your replica of the Red Baron's WWI Fokker Triplane fighter for open cockpit excitement.

Many people enjoy local flying, while others prefer to go places. Ultralight kitplanes give you recreational flying for one fun-filled, local flying. Some of the heavier kitplanes provide seating for you and up to three of your friends. You'll cruise in fast, cross-country transportation, with comfort. The ARV Kitplane Encyclopedia and Kitplane Magazine are not theoretical. They contain only practical "how-to" information you can easily use. Just picture yourself in the cockpit of your own plane, as you shovein the throttle and takeoff! These authoritative, up-to-date publications give you the information you need to make intelligent decisions. They're designed to inspire and guide you every step of the way. Let them help you make your flying dreams come true.

Build

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New & Used 12 Times Kitplane Info 12 a Year

Kitplanes Magazine is your monthly hotline to the kitplane industry. Aviation's newest magazine brings you construction details, pilot reports, and news from the exciting world of homebuilt aircraft. Learn how the experts do their best work. Discover how it feels to fly the fastest, slowest, biggest, and smallest designs. Also features articles on new materials and techniques to make kit building easier and more fun. Each 100 page issue is illustrated in brilliant full color, with pictures and plans.



SPECIAL 28% DISCOUNT WHEN YOU ORDER THE NEW ARV KITPLANE ENCYCLOPEDIA

Get the kitplane news as it happens. Take advantage of this special introductory, discount price sale. When you order both *Kitplanes Magazine* and *The ARV Kitplane Encyclopedia* you pay only \$29.95 (a \$41.95 value—you save \$12.00!). Ordered alone, *Kitplanes Magazine* sells for \$24.00/year (12 issues), while *The ARV Kitplane Encyclopedia* sells for \$17.95. It makes sense to order both and save. Everyone does! As a bonus you'll also receive a FREE copy of the official *Ultralight Rating & Price Guide*.

NO RISK GUARANTEE If, for any reason, you are not 100% delighted with any of our publications, simply return them within 30 days for a prompt refund.

Build your own replica of the beautiful WWII P-51 Mustang fighter from the new kit. Power it with a Ford or Chevy V-8 and go over 300 mph.

A few of the outstanding features of this massive new Encyclopedia include:

 All the Manufacturers and ALL the ARV Kitplanes
 Complete Specifications, Performance and Technical Data
 Informative Articles and Pilot Reports
 Replica, Aerobatic, Canard, Ultralight, Gyrocopter, Racer, Seaplane, and Military Designs
 Two and Four-Cycle VW and Snowmobile Engined Designs
 Complete FAA Forms to Register your Kitplane
 352 Information-Packed Pages
 Almost 200 Photos, Drawings, Charts...and much more.

A Special Limited First Edition!



OUTDOORS

(Continued from page 44)

Packing the mule

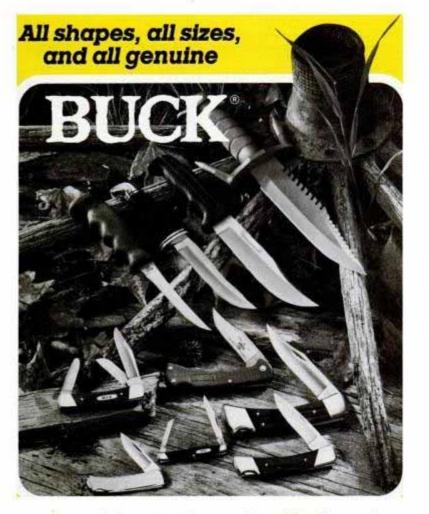
All-terrain vehicles are being appreciated more and more for their ability to haul gear. So Amacker Products Inc. (602 Kimbrough Dr., P.O. Box 1432, Tallulah, LA 71282) has stepped in with a variety of add-on racks and accessories that assist in this all-important ATV function. Cargo capacity is increased with heavy-gauge, abrasionresistant baskets and racks fore and aft. Brush guards fend off saplings.



All-terrain vehicle equipment now includes stern racks, gun mounts and towing devices for increased cargo capacity. And handlebar brackets are designed for more specialized utility, like carrying a hunting bow and arrows.

No sitting duck

A year ago, inventor Garry Hoyt and Harken/Vanguard produced a pedalpowered playboat called the Waterbug. This year they've extended the Waterbug's smooth-running, heavy-displacement design philosophy to a larger vessel called the Mallard, a pedalboat intended for outdoorsmen. The Mallard has the same characteristics as the Waterbug. But it can handle up to three



America's Favorite Knives!

A "Buck Knife" to many people is our famous Folding Hunter. To others, it's one of our great fixed-blade sheath knives. To all of them, Buck is the knife that holds an edge! Yet a lot of folks don't realize just how many knives we handcraft. There's one for almost any purpose you can imagine: hunting, fishing, shop, woodcarving, emergencies, "gentlemen's" knives, gift knives, presentation knives, custom knives, and many more. All with these traits in common: great steel in the blade, proud craftsmanship in the making, and a lifetime guarantee to back it up. No wonder *Buck* is now, more than ever, America's favorite!

For more information about knives, and your free full-color catalog, write: BUCK KNIVES Dept. PM-886, P.O. Box 1267, El Cajon, CA 92022

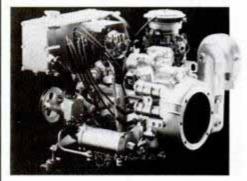


There's plenty of room for gear and passengers in the Hoyt/Vanguard Mallard.

people, or an equivalent amount of gear. For more information, contact Hoyt at One Harborview Dr., Newport, RI 02840.

A rotary engine for marine use?

Mazda is considering the possibility of marinizing its 13B RX-7 rotary powerplant, citing vibration-free revving and a favorable power-to-weight ratio.



Mazda is exploring the possibilities of using an RX-7 rotary engine for marine use.

Mazda says its rotary is lighter than a conventional piston engine of similar displacement and that acceleration and top-end performance theoretically increase. Suzuki and Yamaha are already major forces in the marine market. Don't be surprised to see Mazda enter the fray with larger sterndrive or inboard applications.

POPULAR MECHANICS • AUGUST 1986

Save Gas, Save Engine with "POLY"

The following introduces one of the most fully tested and proven gas saving, friction-reducing engine treatments ever to reach the market!

The Secret is "Poly"

"Poly" is short for polytetrafluoroethylene (TFE), the slipperiest substance known to man. (1981 Guiness 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.

Years of Testing and Use Have Proved it True!

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."

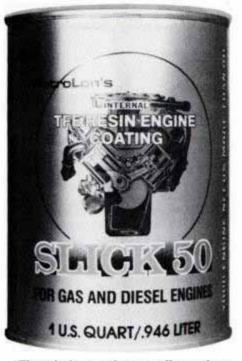
"Dune Buggies & Hot VWs" magazine April 1983 issue records the results of their one year testing of Slick 50. "We can indeed say scientifically that Slick 50 does work, and that it does reduce engine wear! . . . for the price of one treatment when compared to engine rebuild, we feel that you'd be money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

The Federal Aviation Administration has fully accepted a similar product for aircraft— Slick 50 Aircraft Piston Engine Treatment (F.A.R. #33.49). This FAA endurance test simulated 1400 hours of engine use.

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!

It's Easy to Treat Your Engine

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.

Only One Treatment Necessary

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.

Works with Most Oils

Slick 50 will work with all petroleumbased oils and all synthetics compatible with petroleum-based oils with the exception of graphite oils. However, once an engine is treated, you can go back to a graphite type if desired.

4 Ways Slick 50 Saves You Money

Your actual percentages may vary depending on your driving, vehicle condition, weather and geographic location, but no matter what your conditions, Slick 50 can: 1. Increase mileage

 Increase horsepower (small economy cars and large RV's really need this)

- Reduce operating temperatures, thus increasing the lubrication and life of the oil and engine
- Minimize or eliminate costly overhauls by reducing engine wear

Up to 90% of the engine wear on a car can be caused by lubrication starvation cars experience when first started before the oil begins to circulate. Slick 50 can eliminate this problem for less than the cost of two tanks of gas.

Slick 50 Will Not Affect Your Warranty

Slick 50 is suspended in an excellent grade of petroleum oil which meets or exceeds every manufacturer's engine warranty requirements. In addition, this oil carries an American Petroleum Institute service classification SF-CC-CD.

There's No Risk with Our Money Back Guarantee

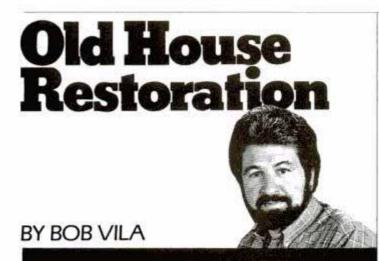
Use Slick 50 for 3000 miles. If you don't notice an improvement in engine performance, return your invoice with a short note telling why, for a prompt full refund — no questions asked.

Profit from Selling Slick 50 Yourself

Here's an opportunity to make handsome profits. Having such solid test results from major institutions make Slick 50 easier to sell than many other products. Free dealership information is sent upon request.

For purchase or further information call toll-free 1-800-525-8624, ext. 8 (in California 1-800-233-9559) or send to: Progressive Energy Corporation, 255 South Bent Avenue, #B-1, Dept. PM886, San Marcos, California 92069.

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Get to know your roof

f you have to step outside to remember the color of your roof, you're not alone many homeowners rarely think twice about what goes on over their heads, until something happens to catch their attention.

Unless those raindrops start falling on your head, it's understandable why you might take your roof for granted. But even if you don't notice any immediate problems, it's wise to make roof inspection a regular part of your home's exterior maintenance program.

Roof damage can arise from a variety of sources. But many homeowners plant the seeds of roof deterioration from inside the house by not installing adequate insulation, vapor barriers and ventilation in their ceiling or attic. This permits warm moist air to rise to the under-



The asphalt shingle roof above needs replacement. Its mineral surface has worn off and the shingles are chipped, cracked and cupped—making them prone to leakage and wind damage.



These wood shingles are showing signs of advanced weathering and should be replaced. Note how many of the shingles are split, cupped or have been blown off altogether. side of the roof. Condensing there, it can cause the rafters, and eventually even the roof deck, to decay. It also damages the roofing itself. In other cases, roofing materials simply suffer wear and tear from constant exposure to the elements.

For a thorough roof inspection, both in the spring and the fall, the only tools you'll need are a flashlight, screwdriver, putty knife, binoculars and a ladder.

After a hard rain, grab your flashlight and go up to the attic to examine the underside of the roof deck. Poke with your knife and screwdriver to locate wet, darkened or deteriorating wood on the ceiling beams and rafters. If you find any, trace the moisture path back to its origin. This may be tough; the steeper the roof's pitch, the farther the moisture can travel from its entry point to where it collected. Next, turn off your flashlight and attic lights and look for pinholes or cracks of daylight in the roof surface. When you find the leak, measure its location in relation to a reference point, like a chimney or vent stack. This will help in locating the leak again when repairing it from on top of the roof.

Aside from checking the shingles, you should also inspect the flashing and rain gear. Flashing is the thin metal bands that form a watertight seal where chimneys, vents, dormers, skylights and vertical walls meet or enter the roof. Rain gear-the roof's downspouts and gutters-channels water from the roof to the ground. In doing so, it prevents water stains on siding, trim and masonry and reduces the chance of decay and ice damage to those parts. Rain gear also reduces water dripping from the edge of the roof and eroding soil where it lands. In the process, it prevents the wa-

Contributing Editor Bob Vila is host of public television's "This Old House," funded by Owens-Corning Fiberglas. ter from leaking into the home's basement.

While standing on the ground, search the roof with your binoculars. Look for obvious trouble spots, like missing, cracked or warped shingles. Then, search for loose flashing or rust stains on the flashing caused by corroding nails. Pay especially close attention to flashing around chimneys, vent stacks and in roof valleys. Check for cracks in the roofing tar that is often used with the flashing or that has been applied over leaks. Unclog gutters if necessary.

Different types of roofing show characteristic signs of wear. Asphalt shingles may crack, warp or show bald spots where mineral granules have worn away. Wood shingles and shakes often cup and become brittle by exposure to the sun. Tile and slate frequently chip, crack or come loose. Built-up roofs can reveal bare patches from blown-away gravel or curled roofing felt.

Once you find the source of trouble, how do you decide if it needs a quick patch up or professional attention?

If your exterior inspection turns up a few missing, loose or split shingles, defective flashings or clogged gutters, you can probably handle it, providing the roof isn't too steep or too high.

But you may discover decayed rafters or large-scale deterioration of shingles. In these cases, I recommend calling in a qualified roofing professional to assess the damage.

When putting on a new roof, you have a few decisions to make. First, you must choose a style and color that best suit your home's architectural style. Also, you must consider cost, durability, fire resistance, ease of maintenance and the manufacturer's warranty.

Here's a look at some of the different types of roofing: Asphalt shingles are used on more than 80 percent of American homes. There are two main types of asphalt shingles, organic (Please turn to page 50)





earned \$7,700 from my first Pace order...plus financial security in my own business.

1st person story by Tedd Mainwaring

"I worked on an oil drilling crew out west. We drilled 11 wells one year, every one a gusher! But did I strike it rich? Not on your life—I was paid by the hour and struggled to feed a growing family. That started me to thinking, 'Why should I do all the work while someone else gets all the gravy.'

"About that time I got injured and ended up having to move my family to a different area to take a job as a maintenance mechanic. That idea of controlling my own destiny kept gnawing at me. By now I had five children with extra expense of about \$2,400 a year sending the oldest one to a speech and hearing center.

"How could a guy like me save up enough money to start my own business? To get into most businesses you have to own a corner of Fort Knox. If I could only ease into a business without giving up the regular salary I had to count on to put food on the table. And without making any investment. As long as I was dreaming, wouldn't it be great to find something where every single spare time order could bring in *really big* extra money.

"Sound like the impossible dream? Well, I had seen a Pace Products story about a man who earned \$4,154.65 on just one Seamless Spray order. And he didn't have to invest a penny. I sent for the free information. Believe me, when I received their literature and saw how easy their field-tested sales kit made everything—I knew it could all be more than just a dream. I decided to become a Pace distributor. And it was the best decision I ever made.

YOU NEED ABSOLUTELY NO EXPERIENCE

"Now I haven't mentioned anything about Pace—I've saved the best for last. As you know, it costs a fortune these days for schools, hospitals, plants and other commercial buildings to have roof contractors repair or re-do their roofs. Pace saves them that fortune—by-passing the contractor. The building owner uses Pace's Seamless Spray process to apply Pace Roof Renewal Sealant right over the old roof. The cost is so low, the proven results so satisfactory for such well-known firms as General Motors, American Airlines, Holiday Inns and hundreds more, that there is little if any sales resistance.

"Pace ships the Pace Seamless Spray equipment on Free Loan. The customer pays only for the roofing products from Pace. His own men apply it. And the clincher—I would get my big commissions up front. Paid in advance. Weekly.

"With my mechanic's job, I was able to start out with Pace in my spare time. I didn't know a thing about roofs, but Pace told me everything I had to know. They showed me how easy it is to set up a business and keep it running profitably. So all I had to do was go out and find somebody with a leaky roof, and tell him about Pace products.

"Quite frankly, my first prospect didn't buy. But I made a call for a school building with a roof the size of a football field. They called it the "Bucket Leaker," because every time it rained they had to put out buckets—in classrooms, hallways, even the cafeteria—to catch the water. I got the job and made \$7,700 on it.

"That school building is now leak-free for the first time in 25 years, so they had me do five other roofs with Pace's Seamless Spray. I was on my way. Today my family and I are enjoying a life we never thought possible before—all thanks to my accepting Pace's invitation to return that little coupon in the ad I read."

MAIL COUPON TODAY FOR FREE FACTS-NO OBLIGATION

Would you like to earn big money, starting out in your spare time, like Tedd Mainwaring? Would you like the freedom and independence of your own business? It can be yours. Let us mail you the facts. Simply send in the coupon below and we'll rush you all the details. There's no obligation. No salesman will call.

Our field-tested sales kit gives you all the know-how you need to get into the Pace business. There's no waiting, no training needed. And no investment required. You can get into the Pace business that offers a way to make \$1,000 or more on one sale—even up to \$7,700 like Tedd Mainwaring—and more!

This is your once-in-a-lifetime opportunity. Get all the facts. Study them in the privacy of your own home and then decide for yourself. But don't delay. Mail the coupon now.

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PRODUCT WARNING AND RECALL Smith & Wesson 9mm Semiautomatic Pistols

This warning is issued for Smith & Wesson 9mm Semiautomatic Pistols which were shipped from the factory between May 1, 1983 and February 26, 1986. Included are Models 439, 459, 469, 539, 559, 639, 659 and 669 but only with serial numbers in the following ranges:

A745000 through A865000 and

TAA0001 through TAL9999.

When the hammer of some of these pistols is in the half-cock notch, the manual safety (decocking lever) cannot be depended on to return the hammer to the "at rest" position. The manual safety may not go fully into the "safe position" and the safety mechanism will therefore not be engaged. If you pull the trigger when the pistol is in this condition, the manual safety may return to the "fire position" and the pistol may fire. If the muzzle is not pointed in a safe direction, this could cause serious injury or death.

THE PISTOLS WITHIN THE SERIAL NUMBER RANGES LISTED ABOVE MUST BE INSPECTED FOR FUNCTION FROM THE HALF-COCK NOTCH. The safety mechanism will function in a perfectly satisfactory manner in many of these pistols, as well as in all pistols with serial numbers outside these ranges and in all pistols shipped from the factory after February 26, 1986.

Every one of these models bearing a serial number within the ranges listed above

OLD HOUSE RESTORATION

(Continued from page 48)

base and fiberglass base. The organic kind have a base of felt mat made from wood and paper. They cost about \$40 to \$50 per square (a square is 100 sq. ft. of roofing) for standard-grade shingles and \$50 to \$80 a square for premium grade. They are attractive, widely available, durable and easy to install.

Fiberglass-base shingles are as economical and as easy to use as the organic-base variety, but they can last five to 10 years longer because their base doesn't absorb water, so they resist warping and cracking better.

Wood roofing, although time con-suming to install, is naturally beautiful and can give your home a rugged "outdoor" look. There are two types: shingles and shakes. Shingles are usually sawn and have a smooth, finished appearance. Shakes are usually split first and then sawn to a taper on their back. Because they are split, they have a rough-textured face. Prices for wood roofing are reasonable, about \$60 to \$100 a square. But the biggest worry here is flammability. Fire retardants can help reduce, but don't eliminate, this danger. Untreated wood shingles are prohibited in certain areas. Check building codes before installation.

should be carefully inspected by the owner for this special condition. To determine if your pistol has this condition, do the following:

1. Point the muzzle in a safe direction.

Completely unload the pistol. Check both magazine and chamber to assure they are empty of live rounds.

3. With your finger off the trigger, operate the manual safety with the unloaded pistol fully cocked and fully uncocked so that you can recognize how the manual safety looks and feels when it is **fully** in the safe position. The hammer will fall from the fully cocked position into the "at rest" position when the manual safety is moved down toward the safe position. When you are thoroughly familiar with placing the manual safety fully in the safe position, place it up in the fire position.

With the manual safety in the fire position, place the hammer in the half-cock notch:

For the Model 439, 459, 539, 559, 639 and 659, put the hammer of your pistol in the half-cock notch by pulling the hammer to the rear slowly until you hear the first click and then releasing the hammer so that it catches between the full cock and the "at rest" position.

For the Model 469 and 669, put the hammer of your pistol in the half-cock notch by inserting an empty magazine and slowly pulling the trigger until you hear the first click and then releasing the trigger so that the hammer catches between the full cock and the "at rest" position.

5. With the hammer in the half-cock notch, push the manual safety down toward the safe position. If you can push the manual safety fully into the safe position and the hammer falls into the "at rest" position, your pistol does not require modification. If you cannot push the manual safety fully into the safe position or the hammer does not fall into the "at rest" position, your pistol is being recalled for modification free of charge.

Recalled pistols should be sent promptly to a Smith & Wesson Warranty Service Center for modification. If you do not have a list of Warranty Service Centers, call **800-633-0164** for the name and location of the one nearest you or for answers to any questions you may have. Law enforcement departments who have pistols which exhibit this condition should contact the Smith & Wesson Service Department (**800-633-0164**) to arrange for modifying the pistols. Individual law enforcement officers whose pistols have this condition should contact the nearest Warranty Service Center or contact the Smith & Wesson Service Department.

Since States Sta

Tile roofing made from concrete and clay is very popular in the West and Southwest. It's used on many Mediterranean and Spanish-style homes. A wide range of shapes and colors are available, making tile increasingly popular in contemporary as well as traditional homes. Tile is relatively inexpensive too, costing only about \$50 to \$90 per square. Its major drawback, though, is weight. Tile roofing is three to four times heavier than asphalt shingles. Your roof framing must be strong enough to handle this increased load. And tile's high shipping costs could make it prohibitively expensive if you live far from the manufacturer.

Slate is fireproof, attractive and extremely long lasting. But its high cost, \$275 to \$350 per square, generally puts slate beyond the budget of most homeowners. Slate also requires an especially strong roof framing.

Where the roof has a very low slope (less than 2 in. of rise for every 12 in. of run), drainage is all important. Materials such as aluminum or steel panels (\$50 to \$200 per square), asphalt roll roofing (\$20 to \$25 per square), and tar and gravel (\$35 to \$45 per square) are all designed to produce the additional waterproofing needed.

Regardless of the type of roofing you choose, always consider cost vs. durability and warranties—some provide material replacement only while others cover labor. Availability of materials should be considered, too. If you order from a distant source, shipping charges may price you out of the market. Finally, the type of roofing must be appropriate for your climate.

Replacing a roof yourself is, at best, a dangerous job. Unless you have done the job before, leave it to a professional roofing contractor. The best way to select a good contractor is to ask friends and neighbors for references. Or you may want to call the National Roofing Contractors Assn. toll-free hotline, 1-800-USA-ROOF, for a list of local roofing contractors. Get written estimates from at least three contractors.

Everything pertaining to the project should be specified, including the types of materials used, work the roofer will perform (flashing, cleanup), and a timetable stating the job's starting and completion dates. Job cost and a schedule of payments should be included. The contract may make mention of the roof's warranty, but if the roof is improperly installed, the manufacturer's warranty could be voided. Finally, make sure the contract includes a waiver of mechanic lien rights to protect you from subcontractors' claims if the contractor fails to pay them. PM

NRI Trains You At Home—As You Build Your Own IBM-Compatible Computer

GET THE KNOW-HOW **TO REPAIR EVERY COMPUTER ON THIS PAGE.**

Learn the Basics the NRI Way-and Earn Good **Money Troubleshooting Any Brand of Computer**

The biggest growth in jobs between now and 1995, according to Department of Labor estimates, will occur in the computer service and repair business, where demand for trained technicians will actually double.

You can cash in on this opportunity-either as a full-time corporate technician or an independent service-person -once you've learned all the basics of computers the NRI way. NRI's practical combination of 'reason-why" theory and "hands-on" building skills starts you with the fundamentals of electronics, then guides you through advanced electronic circuitry and on into computer electronics. You also learn to program in BASIC and machine language, the essential languages for troubleshooting and repair.

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No computer stands alone . . . it's part of a total system. To really service and repair computers, you have to understand computer systems. And only NRI includes a complete computer system as part of your training, preparing you for the real world of computer servicing.

You start with the step-by-step assembly of the highly rated, IBM compatible Sanyo 550 Series computer. You install and troubleshoot the "intelligent" keyboard. Then you assemble the power supply, install the disk drive and extra memory to give you a powerful 256K RAM system. Finally, you interface the highresolution monitor and dot-matrix printer and begin to use the \$1,000 worth of software that's included. You're learning about, working with, servicing and troubleshooting an entire

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computer systemmonitor, keyboard, computer, disk drive, power supply, and printer-all the essentials you'll meet every day as a professional computer service technician.

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We'll Give You Tomorrow.

Minicourse



BY ROSARIO CAPOTOSTO

How to use wood fillers



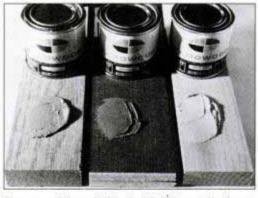
Front, left to right: Plastic Wood, Famowood, DAP and Elmer's (center) are ready-to-use fillers. Savogran and Durham brands (rear) are mixed with water. Minwax is mixed with a hardener.

There are many brands of wood filler on the market these days, but they are all designed to do essentially the same thing: make minor repairs on wood stock, such as filling holes and building up an area to match the surrounding surface. When applied correctly, as shown here, these patches are almost undetectable.

Wood fillers fall into two basic groups: the premixed, ready-to-use variety and the powdered type that must be mixed with water or a specific hardening agent. Readyto-use types now come in a variety of colors to match specific woods as well as the traditional neutral shade.

If you are planning to paint the repaired surface, any product will work. But if you plan to apply a clear finish, the color of the filler must match the color of the wood. The easiest way to do this is by using pigmented fillers. The color match tends to be good and the products are very workable. They do, however, cost more than the unpigmented types.

To color the latter, you'll have to experiment by adding small amounts of waterbased stain to the filler before putting the filler on the wood. Often this will require a combination of several stains to get the best match. Be sure to test any colored filler on a scrap of the same wood before making a final repair. Keep in mind that no filler will take stain in the same way as the surrounding wood. PM



Famowood is available in 16 different shades to match the wood being filled. Left to right: oak, mahogany and white pine shades.



Slightly overfill holes and then sand or shape the filler flush, as at right, front and back. Otherwise filler will shrink as it dries, left front.



Use water-based stains to color powdered fillers. Add a little vinegar to increase the time it takes the filler to harden. Measure with an eye dropper.



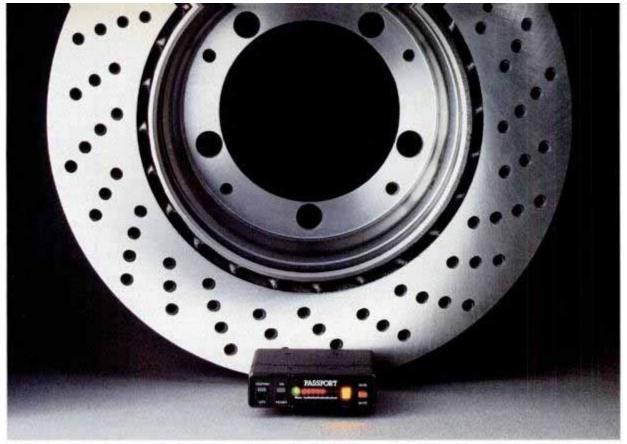
Be sure to use only a small dab when filling porous woods (bottom left) to prevent material being left in pores after sanding (top right).



Drill holes at opposing angles in a deep cavity, then drive nails into them to provide "keys" for the filler. Fill the cavity and sand flush.



Stripped-out screw holes can be repaired with filler. First, enlarge the holes by boring them out, then fill them in and clean off excess.



Small Wonder It's here, *pocket-size* radar protection.

Imagine a superbly crafted electronic instrument, powerful enough to protect against traffic radar, miniaturized enough to slide into a shirt pocket, beautiful enough to win an international design award.

Small means nearly-invisible protection

That could only be PASSPORT. It has exactly what the discerning driver needs, superheterodyne performance in a package the size of a cassette tape.

This miniaturization is possible only with SMDs (Surface Mounted Devices), micro-electronics common in satellites but unprecedented in radar detectors. It's no surprise that such a superlative design should be greeted by superlatives from the experts.

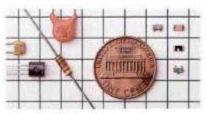
"In a word, the Passport is a winner," said *Car and Driver*.

The experts report excellent performance. Simply switch PASSPORT on and adjust the volume knob. Upon radar contact, the alert lamp glows and the variable-pulse audio

Small means the size of a cassette tape

begins a slow warning: "beep" for X band radar, "brap" for K band. Simultaneously a bar graph of Hewlett-Packard LEDs shows radar proximity.

As you get closer, the pulse quickens and the bar graph lengthens. Should you want to defeat the audible warning during a long radar encounter, a special switch provides silence, yet leaves PASSPORT fully armed for the next encounter. A photocell adjusts alert lamp brightness to the light level in your car. PASSPORT was designed for your protection *and* your convenience.



In PASSPORT, 102 SMDs (right) do the work of ordinary transistors, resistors and capacitors. PASSPORT comes with a leather case and travels like a pro, in your briefcase or in your pocket – to the job for trips in the company car, on airplanes for use in far-away rentals. Just install on dashtop or visor, then plug into the lighter. PASSPORT keeps such a low profile. It can be on duty without anyone noticing.

Small means an easy fit in the briefcase

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Isn't it time for a PASSPORT of your own?

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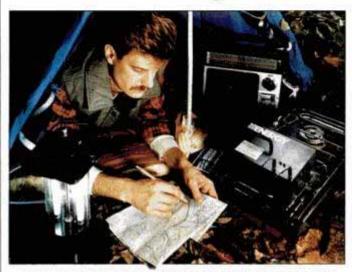
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Power on the go



Generator on stove converts heat to electricity for lamp, radio.

n last month's column (page 36) we discussed a new superchip, from Energy Conversion Devices, that might power a future generation of flat-screen TVs. For the here-and-now, however, the Ovonic ThermoElectric division of ECD offers a power source that's a boon for outdoors activities.

It's called the Compact Silent Generator (CSG) and produces electrical energy from any heat source. According to the Troy, Michigan, company, it provides enough juice to power a lamp, radio or small televi-sion. You can even recharge batteries from the CSG. It puts out 5 watts at 6 or 12 volts, or 6 watts at 9 volts. The unit is equipped with multiple outlets to let you operate up to three light electrical loads at once.

For power on the go, campers can place the CSG on a portable stove or even

on a grate over a campfire. For boaters, the galley stove supplies the heat source. The CSG even has uses in the home: Should electrical power fail, you can warm the unit on a gas or wood stoveor even a can of Sterno.

The CSG weighs 5 pounds and measures 6 x 9 x 3 in. It sells for \$150 to \$200 in a variety of stores.

Kodak power

Kodak is in the canned-power business with its Ultralife line of lithium cells.

According to Father Yellow, the 9-volt lithiums provide twice the juice of highperformance alkalines, and boast a 10-year shelf life compared to alkaline's 2- to 3-year lifespan. The Ultralife cells also will cost you nearly twice as much.

Meanwhile, in the economy department, Kodak also is offering alkaline batteries called Supralife.

Satellite safety

Summer's here, and that's prime time for electrical storms. These tips on protecting your antenna and satellite electronics against lightning come from Gil Hodges, director of satellite engineering at Pico Prod-ucts. The Liverpool, New York, company offers a wide variety of satellite TV gear including a rectangular dish called The Kid.

Try to install your dish near a taller structure that's outfitted with a lightning rod.

If your dish must stand alone, ground it. Run No. 10 copper wire from the unit's grounding block to either a water-supply pipe or to a grounding rod that complies with the National Electrical Code. Most building- or electrical-supply stores sell these.

Use No.10 copper wire and GRB-1 or GRB-2 copper grounding clamps to attach the outdoor LNA (low-noise amp), motor drive and discharge unit to the antenna and its grounding system. Protect the cable that con-

More emergency power

Ever have the nagging suspicion that the batteries you've salted away for emergencies might lose their punch by the time they're needed? You're right to be uneasy: Batteries do have a shelf life, and they've probably been sitting on the shelf for some time before you bought them. Even rechargeable batteries offer little consolation when the lights go dark and you need to use a flashlight. If the electricity's out, there's no power to recharge the cells.

A San Luis Obispo, California, company called Ultimate Survivor of America believes it has the solution to this problem. Its R20 power cells, size D, don't become active 'til you twist their tops-and they're impervious to power-sapping hot or cold storage conditions. Consequently, USA guarantees the R20 cells for 10 years.

According to USA, the

nects your dish to your inhome electronics by enclosing it in a grounded metal conduit or pipe.

If you've got a microprocessor-based receiver, protect it by using GRB-AR arrestor ground-blocks on any attached coaxial cables. The blocks will buffer sudden power surges.

 Ground all indoor components with 3-wire grounded receptacles or twin-wire polarized power receptacles. Surge-suppressors installed between the components and the power source provide protection against electrical spikes that travel up the power line.

Play it safe during extremely severe electrical storms by unplugging your costly electronic components and appliances.

Currents

The future for electronic photography and moviemaking looks brighter than ever. Kodak has just unveiled an imaging sensor chip with 1.4 million picture elementsthree times more than what's been available.

R20-D is 30 percent lighter than a comparable heavyduty battery and 50 percent lighter than an alkaline. The company also claims the cells will power a flashlight longer than standard zinc-carbon batteries. The R20-D comes in a 2-pack for \$6. DM

Power on demand: R20 cells have indefinite storage life.



POPULAR MECHANICS • AUGUST 1986

IF YOU DON'T THINK THE VISE-GRIP TRADEMARK MAKES A DIFFERENCE, THINK AGAIN.

C

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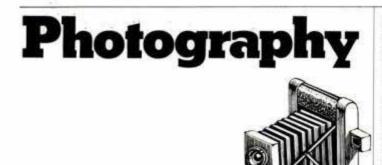
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BY STEPHEN A. BOOTH

Hands-on: Nikon N2020

Nikon took a year before introducing an automatic-focusing 35-mm SLR to compete with Minolta's three Maxxums and Canon's T80AF (35-mm Camera Shootout, page 148, Jan. '86). After lots of shooting with the new N2020, I believe that for most people, it's the best choice among the current bunch. That's because the N2020 combines the most attractive and

practical benefits found in the Minolta and Canon cameras, while dispensing with some features of limited value.

For example, the N2020 lacks the superfast 5 frames per second

film advance of the top-ofthe-line Maxxum 9000 Professional. But it does give you the 9000's continuousservo autofocus. This means the N2020 will keep a moving target in constant, steady focus as you fire off pictures at a rate between 1 and 2½ fps.

Meanwhile, the N2020 joins the Canon T80AF in versatility and economic common sense. Maxxum cameras work only with special Maxxum lenses. Canon gives you a bioting with special AF-series lenses or manual focus with most conventional Canon lenses. Nikon goes one better.

Besides the 13 AF-Nikkor autofocus lenses available for 'he N2020, you can mate



it with the optional TC-16A teleconverter to get autofocus operation from 30 manual-focus Nikon lenses. Moreover, the N2020 provides "focus assist" with 60 conventional Nikon lenses. Though you'll rotate the focusing ring manually, flashing red arrows in the N2020's viewfinder show you which way to turn for perfect focus. A green light and an audible beep tell you when you're on target.

I've put the N2020 through its paces and can tell you it lives up to Nikon's claims. With an AF-Nikkor lens, the continuous-servo autofocus tracked just fine whether I was drawing a bead on a cornering car or on a train approaching head-on at high speed. Ditto for a conventional Nikon zoom mounted on the TC16A teleconverter—though the fo-

> N2020's flash lets it focus automatically in the dark. Teleconverter (below right) lets normal lenses autofocus.



cusing was a bit slower. And the N2020's "focus assist" did help a conventional lens home-in on a subject.

Some vital statistics on the N2020: The body costs \$463, plus \$106 for a 50-mm f/1.8 AF lens and \$180 for the TC16A (a 1.6x-magnification teleconverter). Its SB-20 AF Speedlight flash (\$200) emits a guide-beam that enables the N2020 to focus automatically in total darkness.

The N2020 features three automatic exposure programs. One selects the best shutter speed and aperture. Another favors fast shutter speeds for stop-action shots. A third program chooses between the normal or highspeed program according to the lens in use. There's also an aperture-priority mode and manual exposure. Shutter speeds range from 1 sec. to 1/2000 sec. It handles

> ASA-12 to -5000 film. Four AAA cells power the camera for 1000 auto exposures.

Flash!

You've still got a chance to enter Canon's 35-mm Photo Contest. Deadline is Aug. 31. Get details from any Canon dealer.

PM Photo Album—Tips For Better Pictures

Overcast days provide soft, even illumination for perfect outdoor portraits, but bright sunlight causes harsh, contrasty shadows that obscure your subjects' faces. You can use your flash to fill in those shadows and render more pleasing results.

With adjustable cameras, use the manual exposure mode. Set the shutter speed to the flash-sync speed (marked X) and adjust the aperture to the f/stop indicated by your camera's light meter. Then set the flash (if adjustable) to an aperture that's one



larger (one f/stop below) than the one being used on the camera. Don't set your flash to the same f/stop. This will wash out the shadow completely, leaving a flat, lifeless image lacking in texture and depth.

Many auto-everything compact 35-mm cameras have a fill-flash or some other feature to compensate for shadows. Check your operating manual.

Both these photos were shot at 1/60 sec., f/11. You'll see more detail on the left, shot with flash set at f/8.—Armand Ensanian



58



Kings: 10 mg "tar," 0.8 mg nicotine — 100's: 12 mg "tar," 0.9 mg nicotine av. per cigarette by FTC method. Smoke Contains Carbon Monoxide.

Home Video



Summer's here and the Stime is right for shooting

in the streets. But the very

things many of us go on vaca-

tion to find-sun, surf, ad-

venture-can be rough on

video equipment. Before you

hit the road with your video

gear, even if it's just to the

beach, take a look at these

pointers for safe summer

der bag (or better yet, a

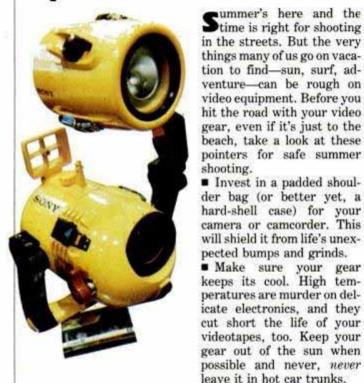
Watch out for humidity.

especially near the beach

shooting.

BY JAMES B. MEIGS

Tips for outdoors video



Sony's Marine-Pak keeps 8-mm Handycam safe when diving.

Hollywood goes 8-mm

If you've invested in the miniature 8-mm video format, you'll soon have more to watch than your own home movies. Some of Hollywood's biggest hits are soon to appear on the new format. When you vacation with your camcorder, you can use it to play rental movies if you've got access to a TV.

Paramount Home Video recently released 15 popular movies, including "Witness," "Beverly Hills Cop" and "Star Trek III." Para-



mount says it will release future titles in 8-mm as well. From Home Entertainment comes 46 movies-including "Blade Runner," "Kiss of the Spider Woman,' "The Emerald Forest" and "The Cotton Club." Priced at \$30 each, they're available at movie rental/sales stores.

"Witness" arrives on 8-mm tape.

with its salt air. Keep a few silica gel packs in your equipment case to soak up moisture. When entering an air-conditioned room after shooting outside, give your gear an hour or so to adjust to room temperature before using it. Internal condensation could harm your recorder and tapes.

If you're traveling to foreign countries, make sure your battery charger can function with other types of current. Fortunately, many can. But even so, you may need plug adapters to fit foreign sockets. These are available from electronics, hardware and travel stores. Video gear isn't waterproof or even water-resistant. If you plan to dive deep, invest in a hard-shell, watertight housing. Less expensive underwater bags will do fine for moderate



Neutral-density filters help sunlit shots.

depths-and keep your camcorder dry and buoyant when you're above the surface. You'll find these protective coverings at photo and electronics stores.

 Bright sunlight can take some of the punch out of your summer video pictures, causing the photographic equivalent of overexposure. Use a neutral-density filter (available in most photo stores) to reduce the amount of light entering the camera lens. With the light level reduced, your camera will have an easier time reproducing accurate colors.

Watch prerecorded 8-mm movies away from home with camcorders such as Canon's Canonvision 8.



Camcorders make good traveling companions. JVC's Video-Movie is an alternative to 8-mm and conventional VHS models.

You heard it here

In April's column (page 43) I griped about the confusing way so many manufacturers label their products. I was particularly concerned about the new HQ (High Quality) circuitry for VHS VCRs.

The problem is that some HQ VCRs may have as many as four HQ circuits, and deliver the best picture, while others have as few as twovet all are labelled HQ.

In my earlier column I predicted manufacturers

would come up with still more names to designate different types of HQ: "I can see it now, soon we'll have VCRs carrying the label 'Super HQ,' 'HQ Plus' and more." I was close. Toshi-ba's new M-4200 VCR, which has all possible HQ circuits, carries the

tag "HQ Pro.'

Tape tax update

Congress has exempted videotape from the proposed legislation that would tax audio tape and recorders. In my March column (page 43) I noted that because videotape can be used for hi-fi audio recording, it too might be taxed. PM

We can't name everyone who owns an ESCORT, but we can tell you why they do.



RADAR WARNING RECEIVER

Steve Templeton Dick Guldstrand

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Because radar is a problem, that's why. And ESCORT is the one detector they trust. Over a million motorists now concentrate on their driving and leave the radar worries to ESCORT.

Unsolicited Testimonial

In a test of all competing brands, the experts at Car and Driver magazine concluded that ESCORT "Is clearly the leader in the field in value, customer service and performance..."

Chances are pretty good you know someone who owns an ESCORT. We've been around since 1978, which is an eternity in this business. So we'll stand on our reputation. Ask around.

Check Our References

We'll bet the first thing our customers will tell you is that ESCORT works. It finds all kinds of radar: X band, K band, over hills, around curves, moving mode, instant-on ambush. Whatever the trap, ESCORT finds it. And this long-range detection is followed up with a full report on the radar's strength. You can read this report on the analog meter. You can hear this report on the audio warning, pulsing slowly when the radar is weak, quicker as it strengthens, then constant as you approach range.

ESCORT even uses a separate warning tone for the two radar frequencies, "beep" for X band, "brap" for K band. The two radars behave differently. Trust ESCORT to keep you informed.

No False Moves

The second thing our customers will tell you is that ESCORT doesn't cry wolf. Our special ST/O/P™ (STatistical Operations Processor) circuitry recognizes and rejects the most common source of false alarms, the ones that set off less-sophisticated detectors up to a mile away.

A Dutch Uncle

The third thing our customers will tell you is that we make shopping easy. We sell direct from the factory only. Just dial toll free. No traffic delays. No parking hassles. No waiting for a salesman. Why wait for him anyway? He won't understand how radar works, so he can't be of much help with your problem.

Our sales staff are trained radar experts. They don't sell cameras and calculators too.

Don Swavely Bobby Rahal Anatoly Arutunof Rocky Aoki David Hobbs Skip Barber Yoshizo Shimano Lyn St. James Chris Mather John Buffum Grayden Obenour Michael Kranefuss Bob Sinclair Hurley Haywood Scott Hughes Bill Mitchell Reeves Callaway Jon Lowe Jim Fuller Robert Redford Bob Sharp Bill Scott Ron Forth Vasek Polak, Jr. Dave Wible Jerry Wolf Larry Shinoda Jerry Galvin Paul Naberhaus Jim Trueman William Hopkins Don Knowles Herb Adams

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ALERT

1. 24

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ARMY RESERVE OFFICERS' TRAINING CORPS



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Robert Bright, Junior University of Idaho

PIVITECHNOLOGY UPDATE 8/86

Space robot

Part programmable robot, part space derrick, and with its own toolshed, space station robots like this may be man's workmate in the sky. Rockwell has design

concepts such as the garagesized robot shown above. In this scene, supervised by an astronaut on a section of the U.S. space station design, a solar panel is being installed quickly by a machine. Robots will be used to allow humans to perform safer or more complex tasks. Duplicate assembly, tightening, inspection and other tedious or repetitious assignments can be performed with onsite supervision or monitored from the station's central control through the robot's video system. Once the space station is completed, these robots will remain important for space manufacturing and repair.

Editor: Dennis Eskow Assistant Editor: Tim Snider Contributors: Ken Sanders, John Dornberg, Mike Fillon, Irena Scott, Jack Grazier, Tim Cole



SPECIAL REPORT

With NASA on hold, other space agencies prepare for space race

The series of disasters that has left NASA in a holding pattern is taking on even more serious implications as other nations' space agencies speed ahead with launch programs. China recently announced it will launch two communications satellites originally scheduled to go on the U.S. Space Shuttle. But the most serious competition is coming from the French space agency and the Soviet Union. Both have speeded up preparation for major launches of new vehicles.

The rocket lifting off in the photo below is an Ariane IV. Following a series of test launches, the French vehicle was pronounced ready for business earlier this year. Loss of control of an Ariane III in May stopped the French briefly. But the program was expected to resume in the fall. Ariane IV can carry an 8000-pound payload into geostationary orbit 22,000 miles above Earth. Some American customers may switch from the Shuttle to Ariane if they can't launch communications satellites on schedule.

Superior French launch site

The Space Shuttle cannot get up to geostationary altitude, and space officials in America are worried that customers will quickly get used to the French launch vehicle. Another advantage of the French program is the location of its launch facility in Kourou, Guyana, close to the equator, making it ideal for geostationary launches.

England is working on its own space vehicle, a shuttle that takes off horizontally. A prototype is expected to fly in the 1990s.

The Soviets, meanwhile,

have completed test flights of their prototype space shuttle. The final version of the vehicle, still under construction as this story was going to press, bears a chilling resemblance to the U.S. Space Shuttle. The Soviet vehicle's main differences are that it is smaller and that it returns to Earth under jet engine power. Our Shuttle returns as a glider.

Soviet space officials are pointing to the jet-assisted landing feature as a major safety device. The Soviet shuttle will have more landing options, and will have more time to switch options in the event of a problem during the re-entry phase. No American Shuttle has had a major problem on reentry. But assurances of safety from space officials may carry less weight than they did in predisaster days.

In-flight launch possible

The concept art showing a Soviet shuttle being launched from an MYA bomber indicates another possible advantage of the Russian vehicle's jet engines: in-flight launch.

In recent months, the Soviets have been talking with Third World customers about switching from the U.S. Shuttle to the Russian version. In the early stages of testing, potential customers were begging off because the Soviets would not allow them on the launch pad in the preflight phase. But several Pacific basin countries are hot to launch communications satellites and may reconsider if the American program remains grounded too long.

The Soviets this year have made a number of important successful moves in the space race. Early in the



year, Russia launched the Mir space station, an updated version of the long-orbiting Salyut station. Technicians, shown working on the Space Station at the Tyuratam launch site in the photo on the facing page, worked around the clock to prepare Mir for what is expected to be a record for a manned space lab. Two cosmonauts launched to the Mir station were expected to spend more than six months in orbit with help from Russia's Progress cargo rocket, designed to deliver supplies to the orbiting cosmonauts every six weeks.

An upgraded mission control facility, shown in the far right photo on the facing page, is handling the Mir station and is expecting to control the Russian shuttle.





New Russian cargo pod

The Russian vehicle's cargo bay is designed to carry a 120-ft.-long cargo pod. In that configuration, the shuttle would have no flight crew and would return to earth by remote control. Clearly, it will become an important asset in the building of extensions to the Mir space station. With preparations for launch of the manned Russian shuttle moving ahead at a quickened pace, it is possible that the Russians are planning to build a huge space station around the Mir unit, giving them an orbiting



platform as big as the planned American Space Station scheduled for 1992 operation. If the Russians can get their shuttle into operation this year or early next, they likely will be operating a large-scale station by 1990.

Space business worldwide

is expected to generate more than \$100 billion in revenue over the next five years, according to a European Space Agency study. Thus, the pressure from foreign nations with new launching capabilities is not just a matter of national honor. Now a bottom line's involved.

TECHNOLOGY UPDATE 8/86

MARINE

Sub poptop saves lives

Nothing could be more terrifying to a submariner than to be trapped inside a crippled vessel. While there are rescue systems, most operate only in shallow depths, or suspended from surface ships. A new escape pod, developed by the West German military, would allow a crew to safely abandon ship if the submarine ran aground or began to sink. Constructed of special steel for high strength, and with bouyancy tanks in the collar, this sphere can hold 40 persons and has air for nine hours.

PHYSICS

Superpower generator

At least 100-trillion watts of power could be generated by this huge machine. The 108ft.-dia. fusion reaction particle beam accelerator, the first of its kind, is at Sandia National Laboratories. Thirty-six pulsed power modules arranged around the hub (right) deliver the high power in bursts, starting the fusion process. The first burst (far right) lasted only 50 billionths of a second. The pho-

ENERGY

Electrifying sea breezes

Vacationers go to the shore for the cool breezes, but homeowners in Ebeltoft, Denmark, derive even greater benefit from the wind with the first onshore wind farm. It takes 16 Nordtank wind generators and 40-ft.-dia. blades to produce 1 megawatt, enough for the energy needs of 600 families. With the data from this experimental installation, oth-

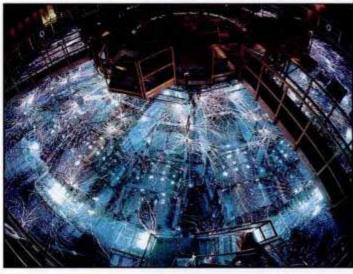


to shows the high-powered electrical discharges lighting up over their electromagnetic fields. Longer future shots will allow scientists to study how to use and operate such high power.

er communities in Scandina-

via will decide whether to

install wind farms.



FORE TO AFT CROSS SECTION

MEDICAL

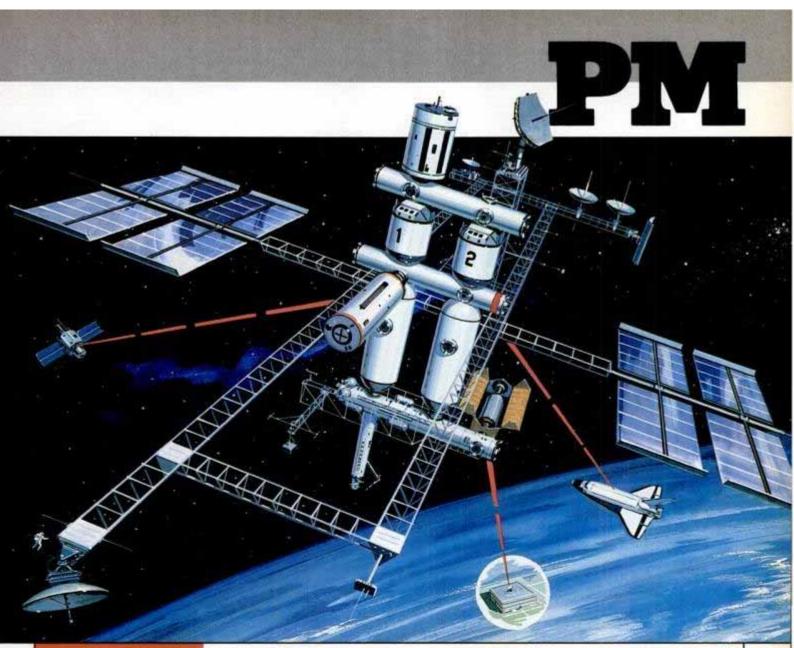
A nonsurgical look inside

PLASTIC

Doctors will soon be able to look inside the body using a technique developed at Ohio University called Magnaspectrometry. The patient will not risk surgery, X-rays or other hazards. An 8½-ton electromagnet creates a visual image that can be transmitted onto a computer screen. The image (like the brain at right) can be analyzed spectrographically or



just monitored for normal functions, all without the distortion of drugs, radiation or surgery. This data can be studied with other stored information for better or quicker solutions.



COMMUNICATIONS

'Hi' in the sky

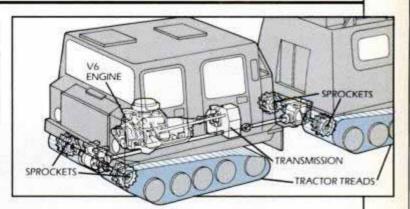
The communications network for NASA's space station in the 1990s will be like a TV network, air traffic control, metropolitan telephone exchange and large computer installation all in one. Designed by Harris Corp., the 300-mile-high network will provide more than 60 com-

munications links, using 30 antennas. It'll keep in touch with satellites, shuttles and NASA control centers on Earth. Communication with ground will allow scientists on Earth to observe and interact with experiments in space. Expected to last 30 years, this space network will provide improvements in Earth communications and new devices to lower technology costs.

TRANSPORTATION

Hauling it everywhere

The Bearcat from Hagglunds AB in Sweden is the newest concept for transport or rescue in any terrain. Its greater mobility derives from all four rubber treads being powered by a V6 gas engine or optional turbodie-



sel. A unique gearing system allows one engine to power all treads and still pivot or articulate. With options for cranes, truck beds and fire pumps, the Bearcat can do almost anything. In snow, ice or mud, and fully amphibious for swamp or river, it can go anywhere.

"Light my Lucky."

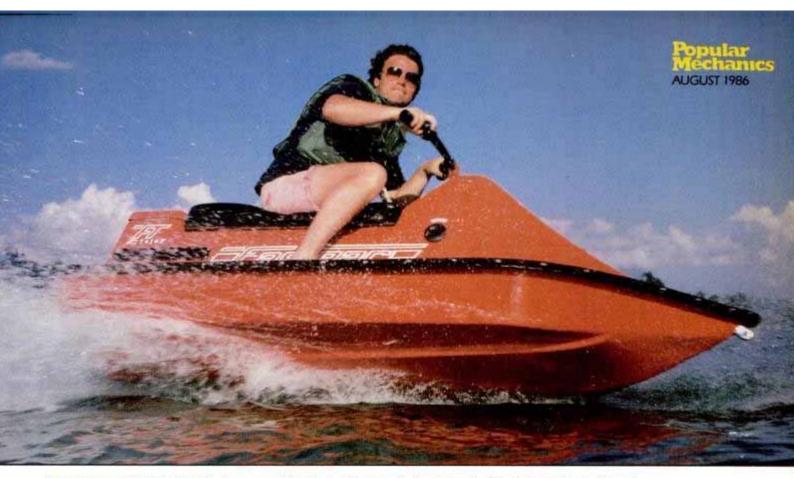
SURGEON GENERAL'S WARNING: Smoking Causes Lung Cancer, Heart Disease, Emphysema, And May Complicate Pregnancy.

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LUCK

LIGHTS

ONLY Brig TAR





THE TOYS OF SUMMER

Welcome to Disney World for a wet 'n' wild rendezvous of jet boats, hovercraft and mini runabouts.

BY TIM COLE Boating/Outdoors Editor Photos by Skip Gandy

orget about necessity. Water has been the true mother of invention ever since Noah's welldocumented experiment in backyard boat-building. Give the average nautical innovator an open stretch of river, lake or ocean and he'll usually figure out a way to make a splash. These days, you'll find this unquenchable inventiveness in the form of motorized beach toys, ranging from 4-stroke jet sleds to

2-place, go-anywhere hovercraft. Propulsion comes from a wide array of mini twincylinder inboards, jet pumps, prop fans and outboards. Most are capable of brisk top-end speeds and snappy cornering, and have tough reinforced fiberglass construction that can withstand jumps and spins.

All of them represent a broad and growing field, so PM gathered 11 of these contemporary beach-burners for a showdown on the lagoon at Florida's Walt Disney World. They were chosen with variety in mind, and are placed in order here by the "degree of agility" required to drive them.

PM testers decided that the Surfjet 236SS (715 Raymond Ave., St. Paul, MN 55174) made the most "initial" demands on the operator, followed by a steep learning curve as one approached a state of grace.



Wet fun comes in all shapes, sizes and power options. The Aquapro Fastrac 400 (top) represents the saddle-andhandlebar variety. The Parker L'II Jet (top left) represents most fully enclosed types. The operator stands on the Kawasaki Jet Ski [far left] or skims over the water in Hovercraft Industries Sunrider II (left).

69



But starting out and making those first tentative turns were the tough part. As we learned from our tests, though, machines offering early challenges sometimes offered greater rewards.

The Surfjet, with its manageable 7-ft., 9-in. length and 120-pound heft, is shaped like a surfboard with a square engine box grafted on the after end. A tiny Subaru 2-stroke twin lurks beneath the cowl and powers a jet pump designed by Surfiet. You stand on the board (capacity is 300 pounds) and grasp a tether/hand throttle. Steering is accomplished by leaning from side to side, with really sharp turns possible the harder you lean. Fun factor (on a scale of 1 to 10) of this \$2350 machine: 6.

The Kawasaki Jet Ski (2009 East Edinger Ave., Santa Ana, CA 92705) really got the wet toys business rolling more than five years ago. Jet Skis now dominate the market, and serious racing on a national scale has sprung up among the youthful, no doubt attracted by the competition and the Jet Ski's amazing capacity for performing tricks. You can literally make these things fly, given the proper conditions.

They come in two models, the 300 and the 550. Both are just over 7 ft. long and under 25 in. wide. The smaller JS300 (\$2099) weighs 222.7 pounds and is powered by Kawasaki's own vertical single. Heavier riders will need the 251-pound JS550 (\$3249), which relies on a beefy 32.3cu.-in. vertical twin.

Each has a steering yoke that elevates to driver level during stand-up operation, and directional control is gained by aiming the yoke and leaning. Straight-on running is easy, but turning, especially in a chop, can be dicey. Kawasaki has replaced the righthand finger throttle lever with a thumb throttle, which, particularly in hard right turns, requires some pretty novel contortions. Fun factor: 7.

Wetco's Wetbike (9811 Independence Ave., Chatsworth, CA 91311), like the Surfjet, requires some getting used to, but familiarization breeds delight. You climb over the back of the machine, sit astride the saddle, plug in the emergency stop switch, hit the starter and go. Stability accompanies speed, and you can achieve low-level, but nonetheless exhilarating, jumps. Maybe the nicest part about this \$3495, 330-pound machine is the way the 60-horse Suzuki powerplant pitches it around corners. Lay it over like a motorcycle and it'll carve turns in the water re-



gardless of the chop. Fun factor: 8.

The Fastrac 400 (P.O. Box 947, Springfield, MO 65803), while scarcely taxing athletically, offered something that none of the other machines had: instant gratification. The combination 40hp Cayuna twin-cylinder engine/Berkeley jet drive is superbly balanced inside the Fastrac's red planing hull. Steering response is immediate and positive, and you can spin this little wonder within its own length at top speed, performing action-packed 360s with merry nonchalance. The \$4500 Fastrac is designed for the casual athlete and requires far less

agility than the Surfjet, Jet Ski or Wetbike, which may disappoint those looking for more strenuous diversion. But that's more than compensated for by the sheer exhilaration of driving it. Fun factor: 10.

The Castoldi Wave Rider (BSC Mosa Inc., P.O. Box 1739, Matthews, NC 28105) is a larger, more stable cousin to the Fastrac. It would take a minor tsunami to upset the Castoldi's ultra-stable hull form. Two adults and a child can ride this \$5995 machine with peace of mind. A Fiat Firejet 1000-cc engine—the same powerplant you'll find in some smaller Fiat automobiles—drives a Castoldi hydrojet, which pushes this 661-pound unit along at a respectable but hardly memorable pace. A thrust reverser—like the Fastrac's—adds to dockside maneuverability. Fun factor: 6.

Hovercraft International's Sunrider II (11352 Space Blvd., Orlando, FL 32821) was the least athletically demanding of the lot, but we increased the "degree of agility" required to drive this machine because of the mental stimulation it offers. This 740-pound, \$11,255, 2-place flying machine is powered in typical hovercraft style by a lift motor providing a cushion of air beneath its neoprene-coated nylon skirt, and a thrust motor driving a ducted 5-blade prop. The arrangement pushes the unit along at a top-end speed of 31 mph with one occupant. Hardly breathtaking, but the interesting part comes when you coordinate the lift and thrust throttles and the joystickcontrolled twin rudders aft. Rudder response is slow, so there's a lot of sliding and overcompensating at first. The fun starts when you're able to feel the machine flying underneath you and anticipate its reactions. For this kind of cerebral challenge you're offered a ma-(Please turn to page 126)

71

AMERICA'S ORIENT EXPRESS

Manager & Baser V Street Vote

Within the next 10 years, we may be able to fly from New York to Tokyo in about two hours.

BY GEN. CHUCK YEAGER, USAF (Ret.)

UNITED STATES

Proposed Orlent Express plane will skip the atmosphere using huge scram-jet power plant.

Sitting in the cramped confines of the Bell X-1 at 42,000 ft., I felt every shake, rattle and roll, and then the sonic boom that announced man's first encounter with Mach 1. It was thrilling. We were crossing an unknown barrier.

ERICA

That was 1947. Today, thousands of airline passengers fly at Mach 1 and more every week aboard the Concorde. Somebody asked me what happens to a man at Mach 1. Nothing. How about Mach 2? Nothing still. How about Mach 25? The answer is still nothing. And I'm sure man can push himself all the way to the speed of light, sitting comfortably inside a well-outfitted aircraft. That's why I was not at all surprised earlier this year when President Reagan announced his support for the X-31, the aircraft of the future he calls the Orient Express.

Within a decade, we will have a plane that can fly the route from New York to Tokyo in about two hours. And, if the airlines think they can sell seats economically, there is no reason why we won't have scheduled flights from coast to coast running less than an hour. In fact, Northwest Orient airlines, the largest U.S. carrier to the Pacific, has already announced that it would be a customer.

The Orient Express is President Reagan's word for

what the Air Force, Defense Department and NASA have for several years called the space plane. All the technologies to build a Mach 5 plane immediately, and a Mach 25 plane before the turn of the century, are in place. The pieces just have to be put together. That will happen over the next five years as we develop the X-31 test plane. It will be used to demonstrate new propulsion technologies, advanced metals and aerodynamic designs.

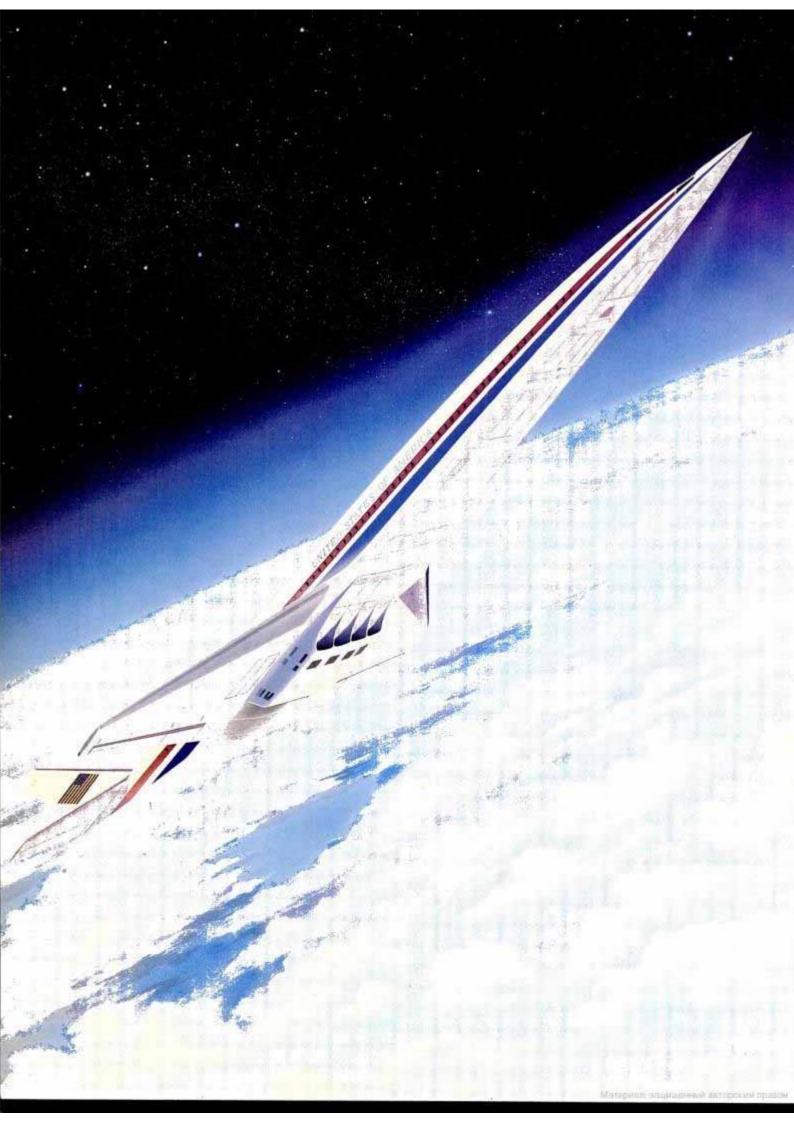
Until recently, the chief barrier keeping us from building an Orient Express was the powerplant. In the 39 years since the sound barrier was broken, we've flown above Mach 3 with jet aircraft. The fastest jet plane in the air is the SR-71. It flies a little faster than 2000 mph, which is Mach 3. To get beyond that speed, a new technology—tested in ground-based labs, but not yet in the air—may provide the first important leap forward. It's called the air turbo-ramjet. Aerojet Techsystems has one that has been ground-tested successfully. The air turbo-ramjet burns hydrogen fuel. The exhaust powers a turbine that drives a compressor. Air forced into the system is relatively cool, so there's no danger of the turbine blades breaking up.

McDonnell Douglas has taken a keen interest in this engine technology, and aerospace engineers feel it could

PM ILLUSTRATION BY JOHN BERKEY

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73



The scramjet engine will take up much of the underbody of the Orient Express plane, as shown on the facing page. The engine will operate in different phases, from a jet on takeoff to a rocket in flight. McDonnell Douglas is working on a concept using needlenose dynamics (right). A Lockheed concept for the Orient Express (below) resembles the U.S. Space Shuttle.

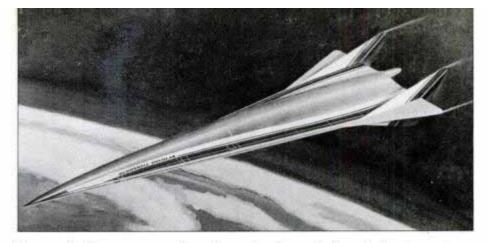
FACING PAGE ILLUSTRATION BY MARK MCCANDLISH

be the first Orient Express engine. It would provide enough power for Mach 5 flight at atmospheric altitudes. Several other aerospace firms are looking at variations to the theme, and General Electric has lately indicated an interest in developing this next generation jet. If McDonnell Douglas started work on its Mach 5 plane today, it could be flying passengers in 1992.

Meanwhile, NASA researchers are working on a next-generation Orient Express engine called the scramjet. Various designs have been proposed, but the point of any scramjet is always the same—to shape shock waves. The scramjet engine, to keep a plane flying at Mach 8 and beyond, would have to withstand intolerable temperatures. The engine could be kept at a steady cool temperature, however, if air moving at supersonic speed could be forced through the system.

Of course, air moving at supersonic speeds produces shock waves. The way around that problem is to have a very broad inlet to the scramjet, and build its insides shaped to accept shock waves. NASA, Air Force and McDonnell Douglas concepts of a scramjetpowered plane call for the entire underbelly of the aircraft to be an intake. The design has worked in computer simulation. Now it has to go to the technical demonstration phase.

Ideally, the Mach 25 plane of the next decade would take off in a simple tur-



bine mode, bypass to an air turboramjet mode, get into the upper atmosphere in the scramjet mode and leave the atmosphere as a chemical rocket. The multipurpose engine will give the pilots options in different weather conditions and at different altitudes.

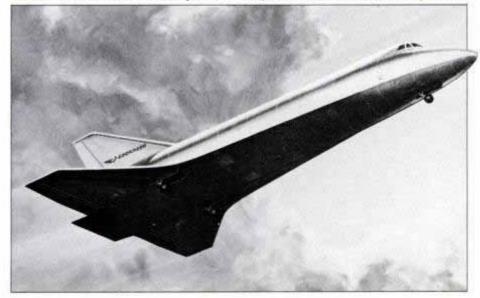
As we move toward Mach 25, major changes will have to be made in airframes. They will have to be as lightweight as possible, but also be able to take extreme stress from temperature, pressure and gravitational forces.

Inside the Orient Express, be it a Mach 5 craft or a Mach 25, I foresee no major changes. The basic design of today's aircraft would be comfortable at any speed. Although the Orient Express will be traveling at dizzying speeds, the passengers inside will be standing still in relation to the aircraft.

It is likely that a future Orient Express, in operation by the late 1990s, would operate as a Trans-Atmospheric Vehicle (TAV). It would take off horizontally, like an ordinary aircraft, sweep up into the high atmosphere at Mach 8 or so, leave the atmosphere and speed up to Mach 25, then slow down as it made its landing.

The flight of a TAV, like the typical New York to Washington shuttle jets of today, would be mostly takeoff and landing. Less than half the trip would be spent in level flight.

One technology which is lagging today and which will have to improve in



POPULAR MECHANICS • AUGUST 1986

the future is that of airport construction. The Orient Express probably will operate only out of major cities. There's no time, or need, to go Mach 8 on a flight from Las Vegas to Los Angeles. So only a few specialized airports would need to be built.

I can envision a new floating airport built on an artificial island off New York City. And the Japanese already have such an airport planned for the Tokyo area. The main reason for a new airport for the Orient Express is that it would need more landing strip than today's airports have. International airports give today's jets nearly 2 miles for takeoffs and landings. The Orient Express likely will need a landing strip of about 3 miles.

The building of new airports for these aircraft will enable us to explore a technology we have ignored—building airports that make sense. Today's airports take almost as much time just to get to as the flight itself takes. That makes no sense. Many of the current airports don't have enough runways. New airports for the Orient Express can address that dilemma as well. And new airports, especially offshore projects, could be more environmentally sound, too.

The technology to develop the X-31 aerospace plane is available today. Within five or six years, that plane will be running what amounts to shakedowns of the engine and airframe technologies.

Somewhere between now and the first flight of the X-31, I expect the airlines are going to take a serious look at the possibilities. Whatever they decide at the present, we will have to push ahead with the research. Consider the ground we lost when Congress can-celled the U.S. SST a decade ago. Today the French are building a second-generation SST. We still have none. Last year, Congress finally came to the conclusion that we should have continued research into commercial supersonic flight, and it authorized NASA to research a potential American SST. With the coming of the Orient Express, the French SST should become obsolete. And the Orient Express will become the leading edge of a new aerospace revolution. PM

SWEARINGEN SX-300

We flew these five hot new homebuilts ourselves, and now we're believers. You can push a sports plane to 300 mph.

TEXT AND PHOTOS BY JIM CAMPBELL

uilding your own sports plane from a kit is just half the fun. The moment of truth comes when you clear the trees and climb into the skies. We put five new kit-builts to the acid test this year, and they were the hottest things on wings.

things on wings. Performance is the last word in this year's homebuilt shootout, and the five models we selected as standouts handled like true sports planes at speeds exceeding 200 mph. Experimental Aircraft Assn. President Paul Poberezny tells us that amateur aircraft builders constructed more aircraft in 1985 than all airframe manufacturers rolled together. See why the numbers are growing.

SWEARINGEN SX-300

The handling of the SX-300 was swift, responsive and sometimes demanding. The craft stalled at 73 mph with the flaps down and at 85 mph "clean," so only experienced pilots are going to fly this mini-missile. The SX-300 from Swearingen gets its name from the 300-

The SX-300 from Swearingen gets its name from the 300hp engine. However, power is just the tip of the iceberg. The top speed is 300 mph, a surprise for a pilot of lightweight kit-builts. With 66 gallons of fuel, an 800-pound load and 70 pounds of baggage, the SX-300 tends to climb at

NEICO LANCAIR

LANCAIR

We expected the controls of the tiny Lancair to be overly responsive. But as soon as we got off the flight deck, we were surprised by the smooth handling. Lancair's 125-hp engine gave us 210 mph. Another surprise: It has a good stall speed in the 50-mph range.

Neico Aviation's 2-place Lancair is an all-composite pocket rocket with retractable landing gear. It leans heavily on such composites as Du Pont Nomex Honeycomb and High-Temp Divinycell. A novice can put together this kit in 600 to 800 hours. Without engine, prop or instruments, the Lancair kit sells for \$15,500. Low-speed handling is excellent. And the cabin room, spacious for a light aircraft, makes it very inviting. Structural integrity has been certified at a hefty 9 Gs. A pilot on a tight budget will also like the Lancair's relatively low fuel consumption.

a rate of 2450 feet per minute. With two folks aboard, the SX-300 should be able to streak 1000 miles or so in less than 3½ hours.

NJODSX

The kit is well-detailed, with very thorough documentation, and uses nothing but the best in materials. Still, this is not going to be an "erector set," and prospective builders are advised to seek more information from a local EAA chapter. (That's good advice for most aircraft building projects.) Dreaming about flying this speed demon is free, but the sticker price for the kit is \$37,500. Engine, prop and instrumentation are optional.



GLASSAIR FT



We couldn't resist rolling Stoddard-Hamilton's new Glassair FT. Swift control response and above-average performance on takeoffs and landings are reasons why more than 700 older Glassair homebuilts have been sold.

Glassair's new FT comes with fixed tricycle gear. With a 160-hp engine, the plane can be coaxed to over 200 mph. It could be built to go 260 with a high-horsepower kit. Complete kits, without the usual options, are available for \$14,000. The real strength of the Glassair FT plane is simplicity of construction. It can be ordered as a single kit or as four subkits if you want to build one on the finance-asyou-go program. Glassair is in the process of upgrading the FT kit to cruise at approximately 300 mph. When that is completed, the SX-300 may have to move over and give first place to the 2-place Glassair FT. For now, the Glassair is simply a great plane to build.

PRESCOTT PUSHER



The Prescott Pusher's slightly swept wings and aft prop gave us breathtaking visibility. Our heart literally leaped as we climbed above the clouds. The Pusher hopped off the deck on takeoff, something that took us a few flights to get used to.

In the Prescott Pusher we have the first kit plane

designed and manufactured with Computer-Aided Design/ Computer-Aided Manufacturing techniques. The Pusher will carry four people at speeds of more than 200 mph.

Two basic kits offer fixed gear (\$20,000) or retractable gear (\$36,500). However, when you put together a Prescott Pusher, you get more than just a kit.

You get instructional videotapes, comprehensive manuals and extensive prefabrication. The aircraft itself is quite unusual, with a curvy fuselage, T-tail, pusher prop, internal engine and clamshell doors.



PRESCOTT PUSHER

FREEDOM MASTER FM-2



Seaplanes are usually trucks with waterwings. But Freedom Master's FM-2 felt like a floating hot rod. Smooth takeoffs and landings were followed by responsive handling and a roll rate that made flying it a thrill.

This is a 4-place aircraft with superior aerodynamic design and a nearly flawless composite surface that cuts drag sharply. POPULAR MECHANICS got to fly the FM-2 before it was shown to the rest of the world. We clocked it at 207 mph true air speed at 6500 feet. Supercomposites used in the body help it handle the punishing demands of water landings.

The homebuilt sports planes of 1986 are nothing short of amazing. But now we're off to Oshkosh, Wisconsin, to get a look at the future, which we're told includes 6-place lightweight aircraft that top 200 mph.



HOUSE INTELLIGENCE

ou return home after a long day to find the roast already cooking in the microwave. Music from the stereo and glowing lamps make the house seem occupied, but nobody's home.

Next morning, the TV news wakes you to the aroma of freshly brewed coffee. The clothes washer kicks on as you leave the house. Though the temperature soars throughout the day, you won't come home to a hotbox. Instead, you phone the house and program the air conditioner to begin cooling before you return.

Sound like the house of the future? If so, the future has arrived. These are just a few of the mundane

tasks that today's intelligent home-management systems can accomplish. Tomorrow's will be smarter still.

The systems you can buy today vary in their capabilities and levels of complexity. You have to add them to your household—and most run on already-installed AC wiring. One system soon to be available requires hardwiring with coaxial

cable. Coax (and possibly fiber-optic cable) will be the electronic highway of the future, when home control systems are built into new homes, ready for smart appliances that will perform commands issued from a central master control panel.

For the time being, the home management systems that use AC wiring depend on switching modules to operate utilities and appliances. You plug the appliance into a module, then plug the module into an electrical outlet.

The brains behind the system are a timer and some sort of front-end controller. You program the controller to execute commands—at the times you determine—for each individual appliance or utility. When the time comes, say to turn down the lights or turn up the thermostat, the controller transmits the command through the electrical wiring. The command goes to the specific outlet module that's addressed.

All these house-wiring devices, including the Sears Home Control System, Radio Shack's Plug'N'Power, Heath's Smart-Home and X-10's Powerhouse, function in the same general manner. They differ primarily in the number of things they control, how many commands they'll execute and the way you program the front-end controller.

For example, Radio Shack's system will control up to 16 items, turning them on or off twice a day. The timer/controller itself has numbered buttons keyed to each module. You designate the same number to the module that will operate a specific appliance.

At the other end of the programming spectrum is the X-10 Powerhouse. It lets you control up to 72 modules, and it's capable of 128 timer events. A timer event is any time a command is executed, no matter how many devices receive a command. If you pro-

gram the TV, kitchen lights and electric percolator to turn on at 7 a.m., all that is just one event.

Besides the number of items the X-10 will operate, its method of programming is also quite different from other systems. You program the system through a home computer—Apple, Commodore or IBM. After you connect the Powerhouse to a computer and

TV monitor, it guides you through the programming with a series of pictures showing rooms, appliances, thermostats and what-not. You designate a code for each device, such as A-1 for the foyer light, then assign the same code to the outlet module that will operate the light.

Once you've programmed the system, you disconnect the computer from the Powerhouse. This leaves the computer free for other chores while the Powerhouse goes about its business. A backup battery will retain the programs in memory for 100 hours should a power failure occur. You may reprogram or alter the program any time by reconnecting the Powerhouse to the computer and TV.

You can get a wide variety of modules for the X-10 Powerhouse. These include plug-in modules for lamps and appliances, wired-in receptacles and wallswitch modules, even thermostat controllers and heavy-duty versions for 220-volt utilities. Besides these, there's an alarm system interface that will flash your household lights on and off when something trips an existing alarm system. Finally, a

eable) will be the TV monitor, it gu en home control with a series of pi ready for smart thermostats and v ds issued from a each device, such

The smart home is coming. You'll

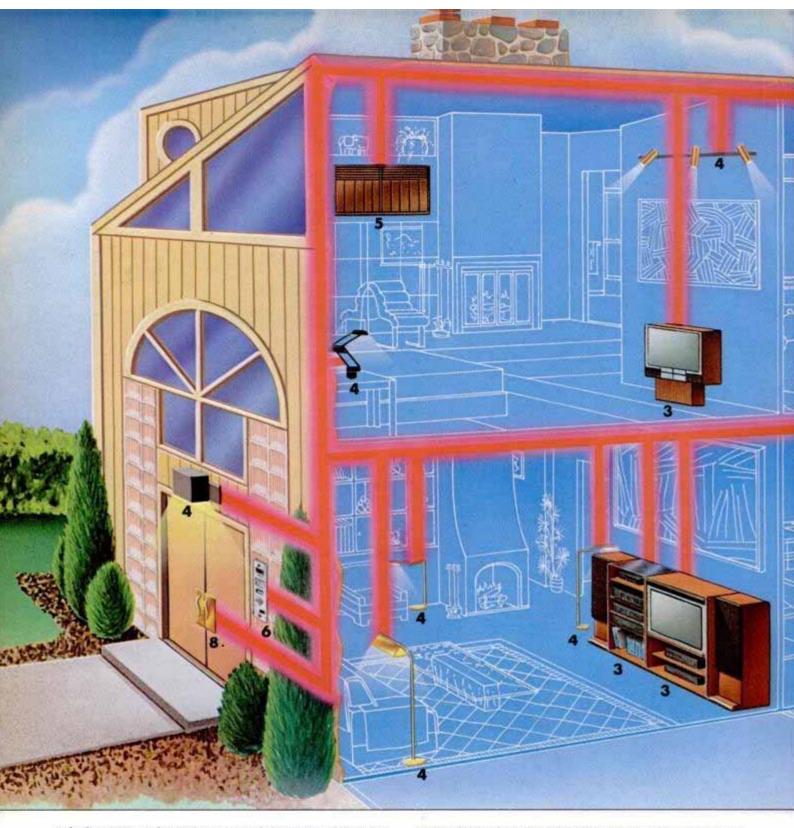
control utilities, appliances

and security from another room

or another continent. Best yet,

some of the future is here today.

BY MARTHA DOWNING



telephone responder lets you control things remotely from any Touchtone phone. By the way, you always retain manual control over appliances and utilities.

Computerless control

The X-10 Powerhouse won't do you much good if you don't own a computer. And as nice as it is to cool the house or illuminate the driveway by phone, you still have to memorize those device and function codes, or carry them with you. But before long, issuing commands will be as easy as saying "Open, sesame!"

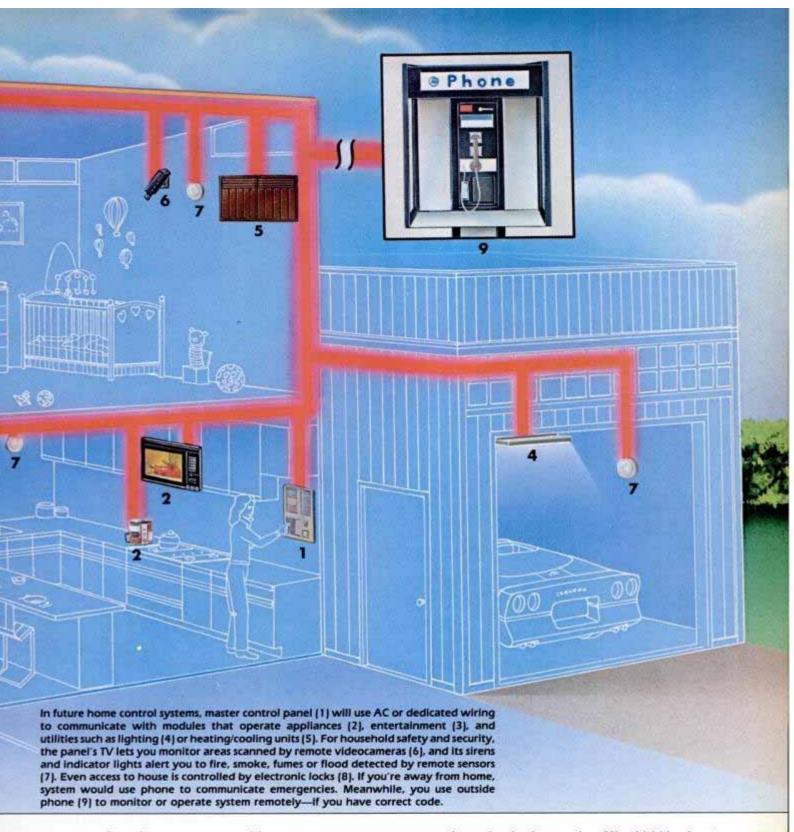
Audec Corp., a leader in voice recognition technology (*High-Tech Phones*, page 87, Sept. '85), has developed a home management system you can program by voice, even over telephone lines. All you'll have to remember is your own personal security code. The system not only accepts your spoken commands, but also confirms them—in your voice. Other systems acknowledge your order with a beep.

Because the Audec system responds vocally, it can give you a status report on its programming. Let's say you're on vacation, and can't remember whether or not you programmed the night lights. A quick call to Audec system will let you know. While you're on the phone, you can make any program changes you like.

Home control systems can deter intruders by making an empty house look lived in. But if the trick doesn't work, somebody's got to holler for help.

One smart electronic watchdog is the KeepSafer Plus system from Schlage Lock Co. You can outfit it with many wireless sensors for break-ins, fire or smoke. Should any of these trip, KeepSafer Plus automatically telephones a central security office (operated by Schlage), which immediately summons emergency services.

KeepSafer Plus won't operate the thermostat for you,



any more than the current crop of home management systems can report a break-in. But before this decade's out, you'll see comprehensive artificial intelligence systems that will tie together and manage appliances, utilities, household security and communications. Such a system won't merely operate the dishwasher for you. It would phone you at work if the dishwasher floods.

Totally wired

Virtually every electronics and appliance company has research in progress toward these total-control systems, while industry committees draft standards so that each company's products will function with the others. Because of the amount of activity that will be going on behind your walls, these systems will use coaxial or fiber-optic cable.

You won't have to buy a new, pre-wired house to enjoy these systems. In fact, you'll be able to retrofit your

POPULAR MECHANICS • AUGUST 1986

current home for the future when Mitsubishi begins marketing its Housekeeping System. The system will perform a mind-boggling variety of functions. Everything is programmed and operated from a master monitor-control panel, which you might locate in the kitchen.

Besides the usual on/off modules, security sensors and climate control units, the system accommodates some unique accessories. These will open and close curtains, lock doors and windows, and take photos of anyone approaching the front door. You can install videocameras in the baby's room and backyard, and monitor these areas from a TV screen built into the panel. Because the system's tied into your telephone, intercoms let you communicate with the outside world as well as the garage workshop. Afraid you left the basement door unlocked while you're away? Call the system and lock it electronically by telephone. Just don't be surprised if the system calls you first!



Build our Chippendale-inspired dining room chair to beautify your home.

BY ROSARIO CAPOTOSTO, Contributing Editor



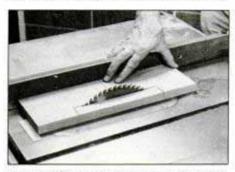
e received a lot of mail recently from readers who were intrigued by the partially carved chair back pic-

tured on the cover of our November '85 issue. In response to those letters, we present easy-to-follow instructions and plans for building this cherry dining room chair.

Inspired by classical Chippendale styling, the chair features a handcarved back that exhibits graceful scrolls and interlacing straps. The back panel, known as the splat, is joined to a top rail that has two scrolled ears. If you have not attempted wood carving before, don't be intimidated by this project. The moderate relief carvings shown are relatively easy and all that's required are a few basic carving tools and a little patience.

The chair is made of cherry hardwood, except for the plywood seat panel. It's assembled using dowel-reinforced butt joints. The seat frame is strengthened by four corner braces screwed to the frame members.

Splat and top rail assembly Start by cutting the splat and the top



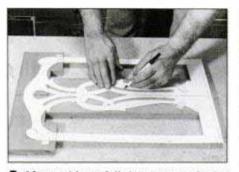
 Notch top rail by elevating blade slowly through workpiece. Then, make two cuts into the edge to drop out waste.

rail to the oversized dimensions given in the materials list. Cut a 1¼-in.-deep x 8¼-in.-long notch in the top rail (photo 1). Next, transfer a full-size pattern of the finished splat and top rail assembly from the drawing to heavyweight paper. Use a sharp knife to cut out the paper pattern. Place the pattern on the assembly and trace the cutting lines onto the workpieces (photo 2). Also, make centerline marks on the assembly to indicate dowel-pin locations.

Next, bore four ¹/₈-in.-dia. dowel-pin holes in the top rail—two for joining the splat and one dowel hole for each rear leg—and two in the top edge of the splat. Then, join the splat to the top rail using yellow carpenter's glue and two ¹/₈ x 1¹/₂-in.-long dowel pins (photo 3).

After the glue has dried, rough-cut the splat/top rail assembly to size on a band or scroll saw. Next, bore holes in the splat and top rail, as shown on the drawing, to establish the limits of the interior cutouts. Carefully cut away the interior waste areas on a scroll saw (photo 4). A portable saber saw fitted with a narrow blade could also be used.

Color photo: J. R. Rost Black and white photos: Rosario Capotosto Technical art: Eugene Thompson



2 After making a full-size pattern of splat and top rail, use a ballpoint pen to transfer pattern's shape to workpieces.

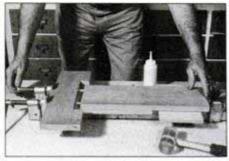
Then, use various shaped files and 100grit sandpaper to remove saw-blade marks from the surfaces of the interior cutouts and from the outside edge of the assembly.

Here's a time-saving trick that I used to effectively remove saw blade marks: Place a small file in the lower chuck (blade clamp) of the scroll saw and power-file the surfaces smooth (photo 5). If the file has a tapered tang, grind it straight to fit it into the chuck properly.

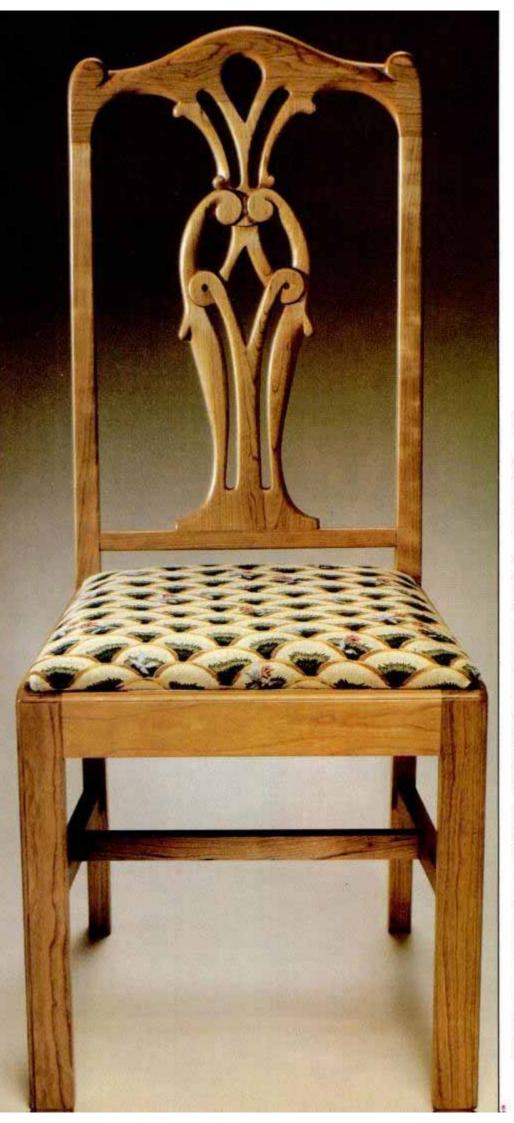
Carving

Pencil in the outlines of the scrolls and interlacing straps. Next, use a sharp knife to make stop-cuts along the lines that separate the "raised" areas from the surfaces that will be carved to a lower plane (photo 6). Using a gouge, make shallow back-cuts up to the stopcut lines (photo 7). Be careful not to cut deeper than the stop-cut lines, otherwise, you may split the wood beyond the pencil outline.

Use a skew or gouge to deepen the stop-cuts, then execute more backcuts. Repeat this procedure until you've reached the desired depth. Once the specific details have been roughed out, use a wide, shallow gouge or a



3 Use a doweling jig to bore %-in.-dia. dowel-pin holes in the splat and top rail. Glue, dowel and clamp the parts together.



straight chisel to make long, sweeping cuts that form rounded, convex edges.

As the carving nears completion, aim a lamp with a clear bulb across the work at a low angle (photo 8). This will highlight any areas that need additional work. The lamp is also helpful when making the final smoothing cuts with a gouge and bent chisel.

Finally, use 100-, 120- and 220-grit sandpaper to sand the assembly smooth. Flexible emery boards are handy for sanding the shallow outside curves of the scrolls.

Rear legs

Make a full-size paper pattern of the rear legs from the drawing. Then, trace the pattern onto the workpiece and cut out the two legs on a band saw (photo 10). Note that the section where the side rails join the rear legs must be perfectly flat. Smooth these areas on a stationary belt sander (photo 11). Remove blade marks from the remainder of the legs with a spokeshave, belt sander and sanding drum (photo 12).

Another area of the legs that must be kept flat is 1½ in. of the upper back edge. This is necessary in order for the doweling jig to sit parallel to the



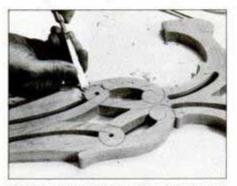
4 Scroll saw provides the easiest and most accurate means of making the cutouts in the chair back. Holes provide blade access.

straight front edge. Position the jig as shown (photo 13), and bore a %-in.-dia. dowel-pin hole in the top of each leg.

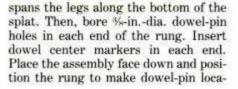
Next, dry-assemble the rear legs to the splat/top rail assembly. Cut the rung (part D in the materials list) that



5 A file in lower blade clamp of scroll saw smooths away saw-blade marks. Tapered file tangs must be ground straight.

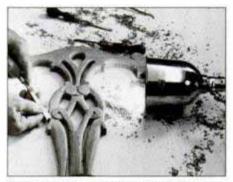


7 Use a gouge to make shallow back-cuts up to the stop-cut lines. Don't cut deeper than the stop-cuts or splitting may occur.





6 Outline the details of the carved splat using a sharp knife. These stop-cuts separate raised surfaces from the lower areas.



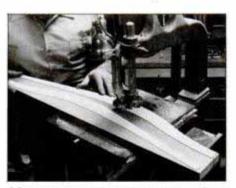
8 Shine a light across carved surface to highlight rough spots that need additional work. Then, finish-sand the piece.



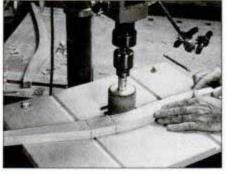
9 Tools used to carve chair back (left to right): knife, skew, two gouges, spoon bit and bent chisels, files and sandpaper.



11 Sand flat the area where the side rails join the legs. Be sure that the sander's table is perpendicular to the sanding belt.



10 Trace a full-size paper pattern of the rear legs onto the workpiece. Then, roughcut both of the legs to size on a band saw.



12 Finish-sand the rear legs using a sanding drum fitted in a drill press. A portable belt sander could be used, too.

tion marks on the inside of each leg (photo 14). Now bore dowel-pin holes in the legs where indicated by the dowel centers.

Seat rails

Next, cut the back rail and the two side rails. The front rail isn't cut until the front legs have been dry-fitted. Tilt the table-saw blade 7° and crosscut miters on each end of both side rails. Be sure that the mitered ends of each rail are parallel. Also, rip some scrap stock to make two thin 7° wedges. The wedges are needed to position the doweling jig parallel to the mitered ends of the rails. Tape the wedges to the rails as shown (photo 16), and bore dowel-pin holes. Be sure to locate the holes so that the dowel pins won't interfere with the back rail dowel pins or with the seat rabbet that will be cut later.

Install dowel pins in the ends of the back rail, bore holes in the legs and dryassemble the back rail to the rear legs. Next, rip a 1-in.-wide x 7° chamfer in a 1 x 3 x 5-in.-long scrap wood block. Clamp the block to the outside of the rear leg as shown (photo 17). Bore $\frac{3}{5}$ -in.-dia. holes in the end of the side rail and insert dowel centers. Then, use the chamfered block as a guide to make dowel-pin location marks. Hold the side rail against the chamfered face of the block and slide the rail down to make hole centermarks in the rear leg.

Front legs and stretchers

Cut the two front legs to length, then locate dowel-pin holes using a 7° wedge as shown (photo 18). Bore the holes, insert dowel pins and dry-assemble the chair parts.

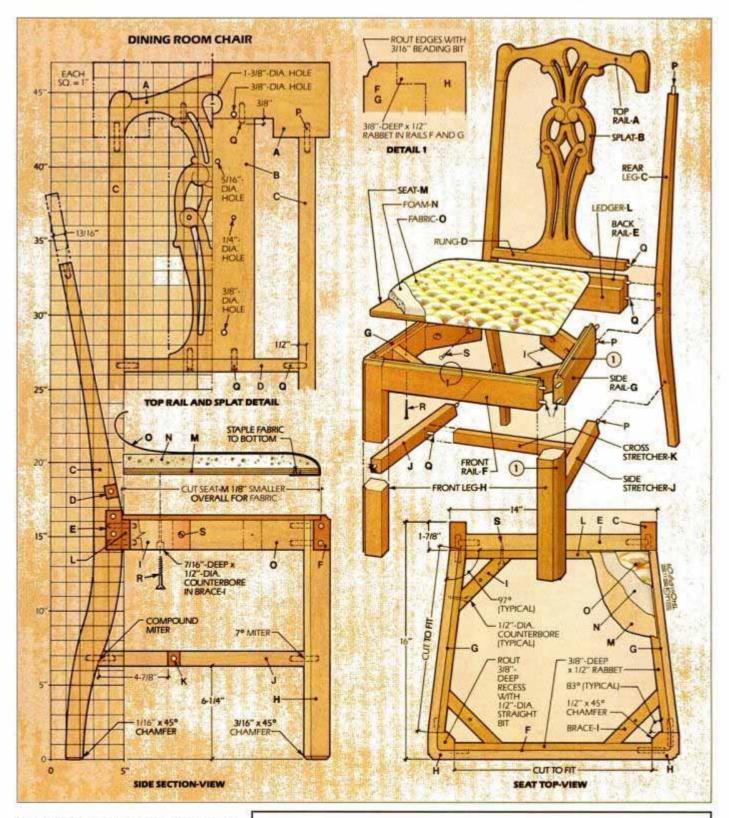
Next, measure the distance between the front legs and cut the front rail to fit. Attach the front rail to the assembly and cut the stretchers (J and K) to fit. Note that the rear of the side stretchers require a compound miter cut.

Now disassemble the chair parts. Rout a ³/₈-in.-deep recess in the top of each front leg with a ¹/₂-in.-dia. straight bit to accept the plywood seat panel. Also, chamfer the inside corners of the front legs. Next, cut a ³/₈-in.-deep x ¹/₂in. rabbet in the front rail and the side rails for installing the seat panel. Then, rout the decorative edge on the seat rails and front legs with a ³/₁₆-in. beading bit (see drawing detail 1).

Final assembly

Assemble the chair in two stages. First, using yellow carpenter's glue and %-in.-dia. dowel pins, attach the rung to the splat. Glue and dowel one rear leg to the top rail, connect the rung and back rail and then add the second leg (photo 20). Clamp the assembly together and allow the glue to dry.

During the second stage of assembly,



it's advisable to use slow-setting hide glue so you won't have to rush. Glue and dowel the front legs to the side rails. Next, join the side stretchers to the cross stretcher and attach this Hshaped assembly to the front legs (photo 21). Then, glue the entire front leg assembly to the rear legs (photo 22). Tap the joints closed with a plastic or wooden mallet.

Clamp the chair using five bar clamps (photo 23) until the glue dries. Also, glue and clamp the ledger (L) to the inside of the back rail to provide sup-

MATERIALS LIST-DINING ROOM CHAIR

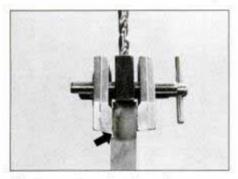
Key	No.	Size and description (use)	M	1	½ x 14 x 16"* hardwood veneer ply-
A	1	¹³ / ₁₆ x 5 x 16"* cherry (top rail)			wood (seat)
A B	1	$\gamma_{16} \ge 6 \ge 164$ (splat)	N	1	1 x 14 x 16"* foam rubber (cushion)
C	2	11/16 x 5 x 331/2" cherry (rear leg)	N	1	20 x 22" upholstery fabric
D	1	1 ¹ / ₁₆ x 5 x 33½" cherry (rear leg) ¹³ / ₁₆ x ¹³ / ₁₆ x 11 ¹ / ₈ " cherry (rung)	P	18	3%"-dia, x 2" hardwood dowel pin
D E F	1	1 ¹ / ₁₆ x 2% x 11%" cherry (back rail)	Q	16	36"-dia, x 11/2" hardwood dowel pin
F	1	11/16 x 23% x 131/4" cherry (front rail)	Ř	4	2" No. 12 fh screw
G	2	1 ¹ / ₁₆ x 2 ⁵ / ₈ x 12 ⁹ / ₁₆ " cherry (side rail)	S	8	11/4" No. 12 fh screw
H	22421	134 x 134 x 161/2" cherry (front leg)	Misc.: Carpenter's and hide glue, 100-, 120- and		
1	4	¹³ / ₁₆ x 2 x 5" cherry (corner brace)			abrasive paper, oil-based cherry
J	2	"The x 1 x 15"* cherry (side stretcher)	stain, satin polyurethane varnish. The chair seat fabric shown (pattern name: Caleb/green) is available through interior decorators.		
K	1	¹³ / ₁₆ x 1 x 14"* cherry (cross stretcher)			
L	1	1/2 x 2 x 111%" cherry (ledger)		im to	

port for the seat panel. When the glue is dry, glue and screw the four corner braces in place.

Cut a ¹/₂-in. hardwood veneer plywood seat panel to fit in the rabbeted recess. Make the panel about ¹/₈ in. smaller on all edges to allow for the fabric. Lay the fabric face down on a clean surface. Put the 1-in.-thick foam rubber padding and the seat panel on top of the fabric. Apply pressure to the panel until the padding is 1/4 in. thick (photo 24). Then, staple the fabric to the panel. When pressure is released,

the foam will expand and puff out the fabric. Screw the seat cushion in place after finishing the wood parts.

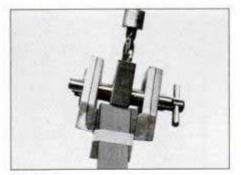
Apply three coats of satin polyurethane varnish. Sand lightly between coats. I tinted the first coat with a little oil-based cherry stain.



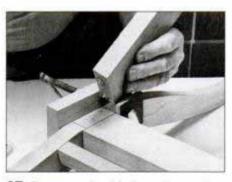
13 For the doweling jig to sit square on top of the rear legs, the back (arrow) must be cut parallel to the front surface.



14 With the legs dry-fitted into top rail, cut the horizontal rung to fit. Then, mark the legs to indicate the rung's position.



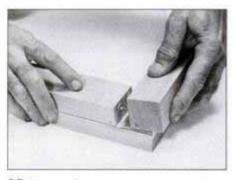
16 To bore dowel-pin holes in side rails, use two 7° wedges to hold doweling jig perpendicular to the mitered end.



17 Clamp a guide block to the rear leg when transferring hole centers for the side rail. The guide block has a 7° chamfer.



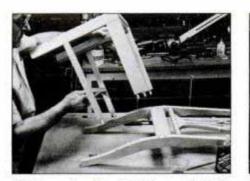
15 Bore holes in the rung's ends and insert dowel centers. Transfer hole positions to the legs using a guide block.



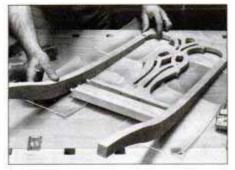
18 To transfer dowel hole centers from side rails to front legs, place a 7° wedge under leg, as shown, for proper alignment.



19 Dry-assemble chair and then scribe the side stretchers for a perfect fit. Cans and blocks support stretchers at 6 in. high.



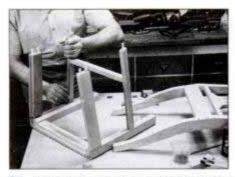
22 Once glue has dried thoroughly, join the two main assemblies. Use slow-setting hide glue to gain more working time.



20 Start the final assembly by attaching the rung to the splat. Then, install one rear leg, the back rail and the second leg.



23 Clamp the final assembly together with five bar or pipe clamps. Use two Cclamps to hold the ledger to the back rail.



21 After joining the side stretchers with the cross stretcher, install this H-shaped piece to the front legs/seat rall assembly.



24 An auto jack is used to compress the seat cushion before stapling the fabric. The 2x4 is braced against a ceiling joist.

Материал, зацищенный авторокий правом

POMER BORE Here's how to get the most

Here's how to get the most out of your most versatile power tool—the portable electric drill.

TEXT AND PHOTOS BY ROSARIO CAPOTOSTO Contributing Editor

power tool. According to the Census of Manufactures, over 4.8 million drills were shipped by tool manufacturers in 1982. That's about \$157 million worth of drills!

The reason for the tool's popularity is threefold: A drill is easy to operate, relatively inexpensive and superversatile. Also, an electric drill is usually the first power tool purchased by the active homeowner.

If a drill could only bore holes it would still be an indispensable tool. But with the wide variety of accessories available, it can also sand, polish, grind, buff, wire-brush, saw holes, cut dowel plugs and drive screws and nuts.

Drills are sized according to the chuck capacity—that is, the maximum diameter drill bit shank that the chuck can accept. Drills are commonly available in three sizes: 1/4, 3/8 and 1/2 in. Generally, the larger the chuck capacity the more powerful the drill and the lower the rpm. Smaller drills provide less power, but their higher rpm is a desirable feature for certain operations such as boring small-diameter holes in wood, sanding, polishing and wirebrushing. A typical ¼-in. drill has a noload speed of about 2000 rpm. The top speed for most ¾- and ½-in. drills is about 1200 and 600 rpm, respectively. For the average homeowner, a ¾-in. drill provides the right combination of power and speed.

Favorable features

Of the many special features available on today's drills, the most desirable ones include variable speed, reverse switch, trigger lock and double-insulated construction.

Variable speed offers full control of the drill's speed—from 0 to maximum rpm—via finger pressure on the trigger. This permits slow-turning, lowrpm starts that prevent the drill bit from skipping and wandering. It also makes it easy to drive screws and nuts.

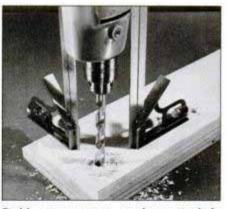
Some drills have a variable-speed control button on the tool's trigger that can be preset to the desired rpm. Simply squeeze the trigger all the way there's no need to adjust finger pressure.

The trigger lock eliminates finger pressure entirely. This feature is especially helpful when sanding and polishing. A reverse-rotation switch is invaluable for backing out jammed bits and removing screws.

To ensure protection from electrical shock, check the drill's nameplate to be sure the tool is double-insulated. A grounded tool, identified by a 3-prong plug, also provides shock protection.

Many tool manufacturers now offer drills with electronic circuits that maintain the selected speed while the tool is under load. For the ultimate in portability, try a cordless, battery-powered drill. Most models operate on a 9.6-volt nickel-cadmium rechargeable battery pack. A 1-hour recharge is typical.

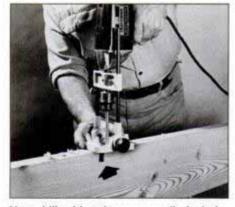
Two other tools worth noting are the hammer-drill and the screwdriver-drill. A hammer-drill combines rotary and percussion action for fast, effective boring in masonry. A screwdriver-drill



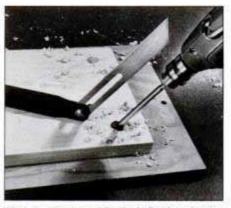
Position two squares, as shown, to help bore perpendicular holes freehand. Align the drill bit with the blades of the squares.



Make this simple guide to bore holes square to the work surface. Bore several holes in guide to accept different diameter bits.



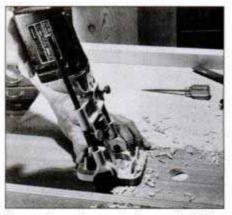
Use a drill guide to bore perpendicular holes in narrow edges. Removable anchoring pins (arrow) center the tool on the workpiece.



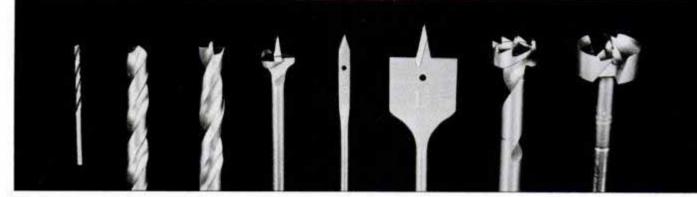
When boring an angled hole freehand, use a sliding bevel square as a guide. Adjust the square to the desired angle of the hole.



Make a wood-block guide to bore angled holes. Align centerlines on block with hole centers to position the bit accurately.



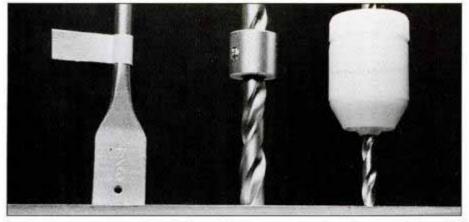
The most accurate way to bore angled holes is with an adjustable guide. Here, a Forstner bit bores shallow, flat-bottomed holes.



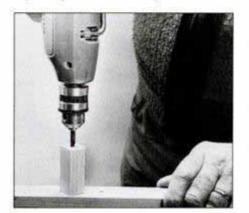
This lineup of various common bits includes (from left to right) a small- and large-diameter twist drill for metal- and woodworking,

brad-point, a Stanley Power-Bore bit, small- and large-diameter spade bit, multispur and a large Forstner bit.

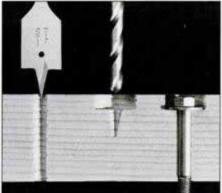
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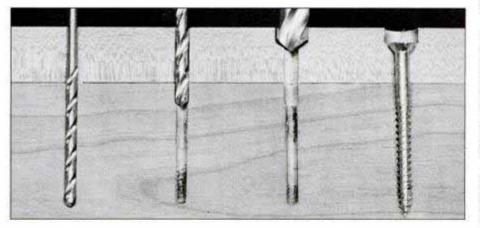
Three ways to control drilling depth include (left to right) a simple masking tape flag, a metal depth-stop collar and an adjustable collar for drills from V₁₆ to V₄ in. dia.



A scrap wood block with a through center hole makes an excellent depth-stop. Cut block so the bit projects the desired amount.



When counterboring, first bore the large hole and then the bolt hole (center). Do not bore the bolt hole first as shown at left.



This sequence shows how to counterbore a wood screw using twist drills [left to right]: bore pilot hole, screw-shank clearance hole and, finally, counterbore the screwhead.

features a positive-clutch mechanism that allows you to drive screws without stripping the heads. The hammer action and the screwdriving features can be disengaged so the tools can be used for standard drilling operations.

Bit basics

Drill bits are available for boring holes in a variety of materials, including wood, metals, plastics, masonry and glass. Technically, metal-cutting tools are called drills while all others are known as bits. Twist drills are designed for metalworking, but they are also used for boring holes in wood-especially in diameters smaller than 1/4 in. Since the flutes of a twist drill don't expel wood chips very effectively, it's important to withdraw the drill frequently to prevent chips and dust from clogging the flutes. Also, keeping the hole free of chips will enhance the drill's cutting action and prevent overloading the motor, which could cause burnout.

Use economical spade bits for general wood boring, particularly for holes larger than ½ in. dia. These bits tend to cut a little rough. For the best performance, operate spade bits at about 1500 rpm. For finer work that requires precise, smooth-cut holes, use a multispur or Forstner bit. These bits have shallow center points that permit boring deep, flat-bottom holes without breaking through the backside of the workpiece.

Multispur and Forstner bits also feature rim-guided cutting heads that make it easy to bore angled holes, overlapping holes and any portion of a hole in the edge of the stock. For the best results, use rim-guided bits in a drill that is fitted with a drill guide accessory. A brad-point bit and the Stanley Power-Bore bit will also bore smooth, true-diameter holes.

For times when neatness *doesn't* count, try the fast-cutting hollow spiral bit. This bit is used primarily to bore holes through house framing in order to run electrical wires. The bit's great length—usually 18 in.—provides extra reach and deep-boring capabilities.



Here are some not-so-typical, but very useful, bits (left to right): screw-point hollow spiral, carbide-tipped glass bit, carbide-tipped

masonry bits, screw countersink, adjustable collar counterbore, countersink, plug cutter and a finishing nail spinner. To cut large holes up to 4¼ in. dia. in wood, plastics and thin sheetmetal, use a hole saw. There are hole saws for cutting ceramic tile and masonry, too. A small-diameter center-pilot bit, usually ¼ in. dia., guides the hole saw and keeps it cutting on course.

As shown, there are three basic types of hole saws: interchangeable bell-type, nest of saws and a carbidetipped saw. The common bell-type hole saw is available in high-speed steel and with long-lasting carbide-tipped teeth that are especially effective for cutting abrasive materials such as fiberglass, plastics and cast iron.

A nest of saws comes with different diameter hole saws (usually seven) and a backplate/mandrel fitting. One advantage of this type of hole saw is that you can install two saws in the backplate at the same time and cut out ringshaped pieces in a single pass.

The latest in hole-saw design features a rigid housing fitted with a single carbide-tipped tooth. The maker, Enduro, claims that this saw will last 50 times longer than conventional hole saws. And, unlike many hole saws, the Enduro saw can cut entirely through 1½-in.-thick stock in one pass. For details, contact Omark Industries, 2765 National Way, Woodburn, OR 97071.

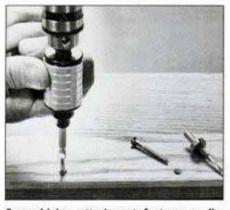
Ensuring accuracy

Obtain drill-press accuracy from a portable drill by using various guides and jigs. One of the most popular accessories is the adjustable-angle drill guide. The guide attaches between the drill and the chuck. The guide locks at 90° for boring perpendicular holes and adjusts for angled holes between 45° and 90°.

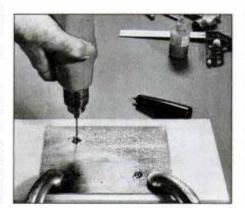
Additional features include a built-in depth stop, V-shaped blocks that hold round stock securely and anchoring pins that center the guide on narrow edges. The drill guide shown is manufactured by General Hardware, 80 White St., New York, NY 10013, and is available at hardware stores for approximately \$20.

Any one of the many types of doweling jigs available can also be used to bore perpendicular holes accurately. Note that some doweling jigs are selfcentering while other types can be adjusted for boring off-center holes.

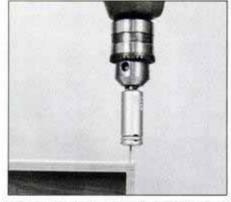
The two wood-block drilling guides shown are easy to make and easy to use. To ensure accuracy, bore the holes in the guides using a doweling jig or a drill press. Bore four or five differentsize holes in the perpendicular guide to accept commonly used bits—typically ¼, ⁵/ıs, ¾s, ७/ıs and ½ in. dia. To make the angled drilling guide, first bore a perpendicular hole in the block. Then, use a sliding bevel square to mark the desired angle on the side of the block. (Please turn to page 127)



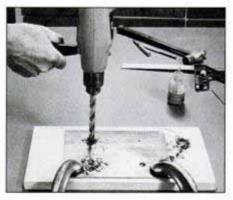
Screwdriving attachment features a slipclutch that disengages under high torque to prevent cam-out and damage to screwhead.



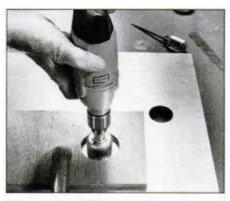
When drilling a large-diameter hole in metal, start by drilling a small pilot hole. Be sure that the workpiece is clamped securely.



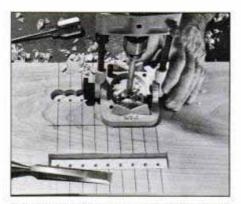
Nail spinner allows you to drive finishing nails in thin stock without fear of splitting the stock. No pilot hole is needed.



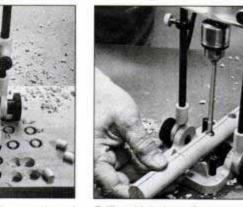
Then, bore the larger, desired diameter hole. Note the use of an auxiliary sidemounted handle for greater control.



Hole-sawing sheetmetal can be very dangerous if metal starts to spin. Clamp work securely between plywood, as shown.



To speed mortising jobs, use a drill guide to bore uniform-depth, overlapping holes. Then, chisel the mortise to the finished size.



Cut wood plugs to conceal counterbored screwheads using a plug cutter and drill guide. Guide stabilizes tool for a clean cut.

000

Drill guide's base features two V-shaped blocks that hold round stock securely for centerboring. Bore holes on centerlines.

HOW TO PICK 'EM, FIX 'EM, DRESS 'EM UP BUYER'S GUIDE • SERVICE AND MAINTENANCE ACCESSORIES • NEW PRODUCTS

Popular Mechanics

SPECIAL REPORT

PLUS: Enter Our New Contest And Win A Nissan Pickup!

PM PHOTO BY RICH COX

WE JAPANESE HAVE FINALLY DEVELOPED AN ECONOMICAL ALTERNATIVE TO THE AUTOMOBILE.

At a time when Japan's car engineers are acknowledged as being among the best in the world, we'd like to acknowledge some who may be even better.

Isuzu's truck engineers.

For starters, consider price. At \$6159,* the P'UP you see here is not only one of the lowest priced Japanese trucks, it's also priced about \$3,000 lower than the average price of a Japanese import car. † Or consider economy. The EPA rates it at [25]MPG City and 31 Highway.** Two numbers that a number of Japanese economy cars have trouble matching. Or finally, consider practicality. This Isuzu P'UP not only carries three in comfort, it gives you a cargo bed that'll carry practically anything.

Buckle up - for life!

So before you rush out and buy a Japanese car, perhaps you should stop for a moment and consider your alternatives.

15170

Starting, of course, with ours.

"Manufactured" suggests during proc. P.S. H. accordance for district strategies of survey and supply. This is compared to the survey of POS data by Nove S. and Proc. Manual and Post. When the PDN formers is a comparison of November processing of the data and the survey of the data and the A Accord Longer 2005 rule (Comparison of the Section of Sec

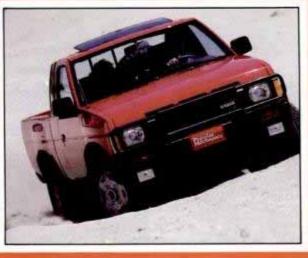
THE FIRST CAR BUILDERS OF JAPAN.



WIN THIS TRUCK! ENTER OUR NEW CONTEST

magine yourself at the wheel of a new Nissan "Hardbody" pickup truck. Specifically the 4x4 King Cab SE, with its powerful V6 engine, worth over \$12,700. The dream can become a reality if you win this latest PM reader contest.

Two years ago, we gave away the PM Forest Ranger pickup truck. Last year, a lucky reader towed home the PM Water Sportster speedboat. This year's prize may be the best yet—Nissan's brand-new pickup, in top-ofthe-line trim and equipped with a 140-hp version of the 3-liter overhead-cam V6 that drives Nissan's famous 300ZX sports car.



This Nissan 4x4 King Cab SE could be yours if you're the winner.

The prize

Nissan created the small-truck market in America 25 years ago, and drew on that quarter century of experience when it planned the all-new 19861/2 model lineup—the first Japanese trucks designed in America to specifically meet the needs of American pickup truck enthusiasts. The new Nissan design center in California is responsible for the innovative styling of this slick line of trucks that manages to look aerodynamic and macho at the same time. By sloping the hood and the windshield, Nissan Design International created more interior space, improved aerodynamics and could win an all-expense-paid trip to New York City and drive home in this dream truck!

The contest

To win this super truck, all you have to do is tell us how you'd like to customize it. Everybody likes to personalize his truck to suit his special needs. Tell us what you'd do to improve on Nissan's good idea, and you could be driving this truck by winter. You don't have to actually customize

(Please turn to page 118)

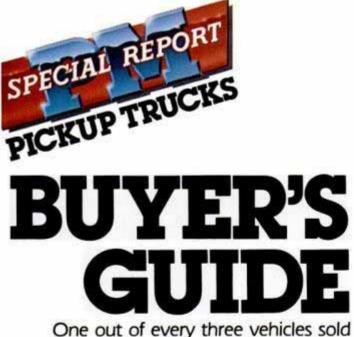
The 4x4 King Cab SE is the top of the '861/2 Nissan line. Standard equipment includes 4-wheel drive with a 5-speed manual transmission and a new integral transfer case, the 140-hp fuel-injected V6, P235/75R15 radial tires, pop-up chrome cargo tie-downs, improved rust-proofing, 15.9-gallon fuel tank, Gross Vehicle Weight rating of 5100 pounds with a 1400-pound payload, 73.4in.- long x 59.8-in.- wide cargo box, 116-in. wheelbase and 190-in. overall length.

took conventional truck de-

sign one giant step into the

future.

All the 86½ Nissan trucks have more interior room than the typical Japanese or American mini pickup. You



in America is a light truck. The reason is their versatility.

BY STEVE PARKER, West Coast Editor

CHEVROLET FULL-SIZE

To make it simple: Chevy Cseries trucks are 2-wheeldrive models, and K-series vehicles are 4wd. GVW ratings vary by engine from 6100 to 10,000 pounds.

Gasoline powerplants include the 4.3-liter V6 as well as a 4.8-liter inline Six and 5-, 5.7- and 7.4-liter V8s. A 6.2-liter diesel engine has a 50,000-mile warranty. A va-

Long considered the Cowboy Cadillac, the El Camino offers useful hauling space, maximum carlike comfort up front and spiffy performance to match.

The El Camino has 35.5 cu. ft. of cargo capacity and a 1250-pound payload. Properly equipped, it can tow up to 5000 pounds, including trailer, cargo and equipment. riety of 3- and 4-speed manual and automatic transmissions are available.

Bed lengths range from 6.5 to 8 ft., and you can order 4-door Crew Cabs.

Sometime in 1987, Chevy will start phasing in new trucks with flush windows and injected engines. Stepside models (shown) will feature fiberglass outer walls.

CHEVROLET EL CAMINO

There's a new 4-speed overdrive automatic transmission available, and you can get it with the standard 4.3-liter V6. A 3-speed automatic is standard. Both transmissions are available with the optional 5-liter V8.

El Camino has a 117.1-in. wheelbase and is available in three trim levels—El Camino, Conquista and SS.

CHEVROLET S-10

Heavy-duty, off-road and 5000-pound trailering options help make Chevy's small trucks popular. Bed choices are 6 or 7.3 ft.

Part-time 4-wheel drive is available on all models, and Insta-Trac gives you "shifton-the-go" ability.

Engines include the standard 2.5-liter fuel-injected Four. Throttle-body injection on the optional 2.8-liter V6 offers 125 hp. Internal changes squeeze out more power and mileage.

The 4-speed manual is the standard transmission; a 5speed manual and a 4-speed automatic with overdrive are also available. Payload choices include a 1625-pound option on 2wd conventional cab models. The most popular "car" in America is a pickup truck! Ford and Chevrolet each sell more than 400,000 a year, with GMC, Nissan and Toyota each good for more than 100,000. The only car model made in greater numbers is the Chevy Cavalier. One of the reasons pickups are so popular is their versatility: You can use one to commute, on the job and for recreation. Want to go off-road to that remote fishing cabin, bring fence posts home from the lumberyard, tow a trailer or transfer a load of compost to the back forty? No problem! Try that in your Cavalier!

The toughest job for a pickup buyer is choosing the one to buy. Import or domestic; 4-wheel drive or 2; gasoline or diesel; two seats or six; mini, compact or full-size; bare bones or limousine luxury? Use our guide to zero in on the truck most suited to your tastes and needs. Remember that gross vehicle weight (GVW) is the total of a truck's weight and payload, and that payload includes passenger weight.



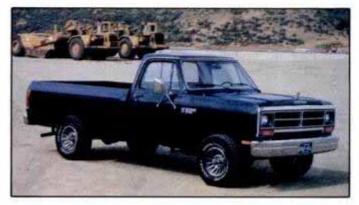




POPULAR MECHANICS

AUGUST 1986









POPULAR MECHANICS • AUGUST 1986

DODGE DAKOTA

Placed between the small, imported Ram 50 and fullsize Ram trucks is the new American-made Dakota.

The 2-wheel-drive Dakota is powered by the 2.2-liter Four or a new 3.9-liter V6. The 111.9-in. wheelbase model offers a 78.1-in. box, while the 123.9-in. longbed has a 96.6-in. box. Both have a maximum payload of 2550

New models feature new

grilles, headlight bezels and

bumpers, plus standard tinted glass. D models have 2-

wheel drive, W models 4wd.

els are available with 115- or

131-in. wheelbases and total

payloads (including passen-

gers) of 1499 to 2429 pounds.

D250 and D350 models come

with 131-in, wheelbases and

These sporty 2- and 4-wheel-

drive minitrucks pack a long

list of standard equipment,

including 5-speed manual

transmission, tinted glass, double-wall cargo box, pow-

er brakes, radio and exterior

cargo box light. Ram 50s are available in two trim levels

and a Premium package that contains chrome wide-spoke

wheels, raised white letter

F-series trucks (150, 250 and

350) come in three configura-

tions: regular cab with 3passenger bench seating,

SuperCab with an additional

folding bench seat, and 4-

door Crew Cabs with six

seats. Standard powerplant is a 4.9-liter V6. Optional V8

engines include 5-, 5.8- and

7.5-liter gasoline models and a 6.9-liter diesel. GVWs go

pensive 2-wheel-drive price

leader is a 2-liter Four (2.3-

liter in California and high-

altitude areas). The standard Ranger is available in

short or long wheelbase with

The XL and XLT series

come with a 2.9-liter V6. The

STX sport truck option, pre-

viously sold in the west, is

the 2.3-liter Four.

The D100 and D150 mod-

DODGE FULL-SIZE

payloads ranging from 2749 to 4607 pounds.

pounds. Five-speed manual transmission is standard

with either engine. A 3-

speed automatic is optional

pinion steering and a load-

sensing brake proportioning

valve. The Dakota has a tow-

ing capability of up to 5500

pounds. Look for shift-on-

the-fly 4wd in '87.

This truck has rack-and-

with the V6.

Engines include a 2.7-liter Six plus 5.2-liter and 5.9liter V8s. Transmission choices include 4-speed manuals and 3-speed automatics.

Total payload allowed on the 4wd W models ranges from 2233 to 3949 pounds, increasing with wheelbase and engine size.

DODGE RAM 50

tires, extra gauges and cloth bucket seats.

The base engine for the trucks is the 2-liter Four, but the Ram 50 Sport and Power Ram 50 4wd models come with a 2.6-liter Four. Both engines can be ordered with an automatic transmission. Both Ram 50 models have 81.5-in. beds on their 109.4-in, wheelbases.

FORD FULL-SIZE

as high as 18,500 pounds with the 7.5-liter V8.

Standard 2wd transmission is a 3-speed manual; a 4speed manual comes on the 4wd models. A 4-speed overdrive and a 3-speed automatic are available.

For 1987, look for fuelinjected engines, antilock braking for the rear wheels and a new aero nose (shown).

FORD RANGER Base engine for the least ex- now avail

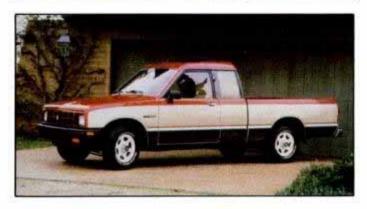
now available nationwide.

A 5-speed manual transmission is standard, a 3speed automatic optional.

The SuperCab is available with a 125-in. wheelbase and compact 6-ft. bed. It has nearly 17 in. of extra cab length. Ranger also sports the new "Touch Drive" electric transfer case to shift into and out of 4wd.











GMC FULL-SIZE

Different paint and trim treatments separate GMC and Chevy trucks.

The C-series 2-wheeldrive and K-series 4-wheeldrive trucks will eventually be replaced by the new "R/V" series (shown) scheduled to appear as 1988 models when they hit the showrooms late in 1987. Engine options are the same as

GMC's version of the S-truck is available with 3-passenger bench seating or bucket seats. There's a longer-cab Club Coupe with 18.4 cu.ft. of lockable storage behind the front seat. Rear jump seats are available.

Order your S-15 with 4wheel drive and you get Insta-Trac—GM's "shift-onthe-fly" system that allows

The most obvious new twist at Isuzu is the Spacecab (shown), an extended cab available only with Deluxe and LS trim levels.

P'up wheelbases come in 104.3-in. short and 117.9-in. long versions. Bed lengths are 73 and 90.2 in., respectively. The Spacecab trucks have 73.7-in. beds.

A 1.9-liter gas Four is the

JEEP COMANCHE

Unibody construction and a solid front axle are found on Jeep's first foray into the mid-size pickup market.

Both the 2wd and 4wd versions have a long 119.7-in. wheelbase, a 7-ft., 4-in. box and a maximum payload of 2205 pounds. In '87, look for a 6-ft. short-bed model, a standard 117-hp, 2.5-liter, throttle-body fuel-injected

If you're looking for changes on Jeep's 4wd full-size pickups, you'll have to look at the new instrument panel and steering wheel. The J-10 and J-20 have 130.7-in. wheelbases and are sold in base and Pioneer trim levels. Front discs, freewheeling front hubs and power steering are standard.

The 4.2-liter Six is stan-

Chevrolet's. With GVWs ranging from 4900 pounds for the base C-1500 model to 9200 pounds for the 4wd K-3500, bed lengths from 6.5 to 8 ft., power ranges from 115 to 230 hp and a Bonus Cab configuration that comes with 55.8 cu.ft. of locking stowage space, GMC trucks have something for every application.

GMC S-15

shifting in and out of 4wd HIGH at any speed. You have to stop only to get into or out of LOW-range 4wd.

Payloads on 2wd S-15 go from 1000 to 1625 pounds; 4wd models come with 1000or 1500-pound payloads. Conventional box length is 73 in., longbed 89 in. You can tow up to 5000 pounds with a specially equipped model.

ISUZU P'UP

standard powerplant, but a new 2.3-liter engine is optional on 2wd and standard on 4wd trucks. On the diesel side, Isuzu's proven 2.2-liter model is available plain or turbocharged (the turbo is standard on 4wd trucks).

A 4-speed manual is standard. The 5-speed manual is optional with 2wd but standard on 4x4s.

MANCHE Four, an optional 170-hp, multipoint fuel-injected, 4-li-

multipoint fuel-injected, 4-liter Six and an 85-hp, 2.1liter turbodiesel Four.

There are three transmission choices: 4- or 5-speed manuals or a 3-speed automatic.

With the 4wd option, you may choose the Command-Trac part-time or Selec-Trac full-time transfer cases.

JEEP J-10, J-20

dard on the J-10. A 5.9-liter V8 is optional on the J-10, standard on the J-20 model. A 4-speed manual is standard, while a 3-speed automatic is optional on the V8.

GVW is 6200 pounds on the J-10, 8400 pounds on the J-20. Both trucks come with part-time Command-Trac 4wd. Selec-Trac is optional on the J-10.



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MAZDA B2000 onsists of The only powertrain is an

The B2000 lineup consists of 2wd trucks only. The Cab Plus model has space behind the seat for two jump seats or extra storage. The shortbed B2000 has a 6-ft. box on a wheelbase of 108.7 in. The longbed version has a 7½-ft. box on a 117.5-in. wheelbase. The Cab Plus model uses the shortbed on the long wheelbase.

There's only one cab version

of the Mighty Max (see photo

of Dodge Ram 50), but the

truck is available in three

trim levels as well as 2- and 4-wheel drive. Wheelbase is

109.4 in. with a cargo box

are powered by a 2-liter Four, while the high-level

SPX comes with a 2.6-liter

Two-wheel-drive Mitsus

81.5 in. long.

MITSUBISHI

Four; 4wd versions have the larger engine only. A 5speed manual is standard. A 3-speed automatic is available on some upgraded models. Payloads range from 1435 to 1620 pounds.

80-hp 2-liter Four with a 5-

speed manual transmission.

Four trim levels range from Standard to "LX with Con-

venience Package," which

includes everything from

FM stereo radio to cruise

control and a tilt steering

wheel. Coming up are a 4wd in '87 and a rotary-powered

pickup for '88.

The macho '87 Mighty Max Sport (shown) makes its first official appearance in September at Mitsubishi and Dodge showrooms.

NISSAN

King Cabs have the long wheelbase and short bed. Base engine is a 2.4-liter Four, with a 140-hp 3-liter V6 optional.

Five-speed manual transmissions are standard on 2wd trucks, with 4-speed automatics available on highgrade versions. Four-wheeldrive Nissans are available with the 5-speed only.

SUBARU BRAT Subaru has beefed up the dard, as

dard, as are the T-top roof panels, which give the BRAT the fresh-air feel of a custom convertible pickup.

BRAT is a mini El Camino that offers carlike comfort, shift-on-the-run 4wd, a reasonable hauling limit and options such as 13-in. alloy wheels, air conditioning, cruise control, fog lights, grille guard and roof bar.

TOYOTA

Toyota offers no fewer than 19 pickup models for your perusal. All payloads hover around 1500 pounds, except for the 2wd One-Ton, which can haul 2555 pounds.

payload of the BRAT to 1255

pounds. It's also taken the

seats out of the cargo box,

BRAT comes standard

with a 1.8-liter 4-cylinder en-

gine and a 4-speed dual-

range transmission, and tips

the scales at 2205 pounds. The bed length is 63.4 in. Four-wheel drive is stan-

increasing stowage space.

The standard-bed 2wd truck has a 75-in. box and 103-in. wheelbase. Most other models share a 86.4-in. bed and 112.2-in. wheelbase. The Turbo SR5, Xtracab Sport SR5 and Xtracab Sport trucks have a 112.2-in. wheelbase but a 75-in. bed.

Engines are based on a 103-hp 2.4-liter Four. An optional version is fuel injected for 116 hp; another both injected and turbocharged for 135 hp. A variety of 4- and 5speed manual and 4-speed automatic transmissions are available.

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BY PAUL STENQUIST; Color photo by Bill Ashe; Illustrations by Hank Iken

ickup trucks are built to shoulder a lot of abuse. Equipped with heavy-duty suspension, rigid ladder frames and beefy chassis components, they can shrug off the kind of lousy road conditions and heavy chores that would

Change air filters often on trucks driven in dusty areas. Also check the PCV filter on the air cleaner housing.

send a passenger car straight to the bone yard. And, because today's light trucks offer far better rust protection than pickup trucks of just a few years ago, their life can be extended almost indefinitely if maintenance jobs are performed on a regular basis.

Tuneup

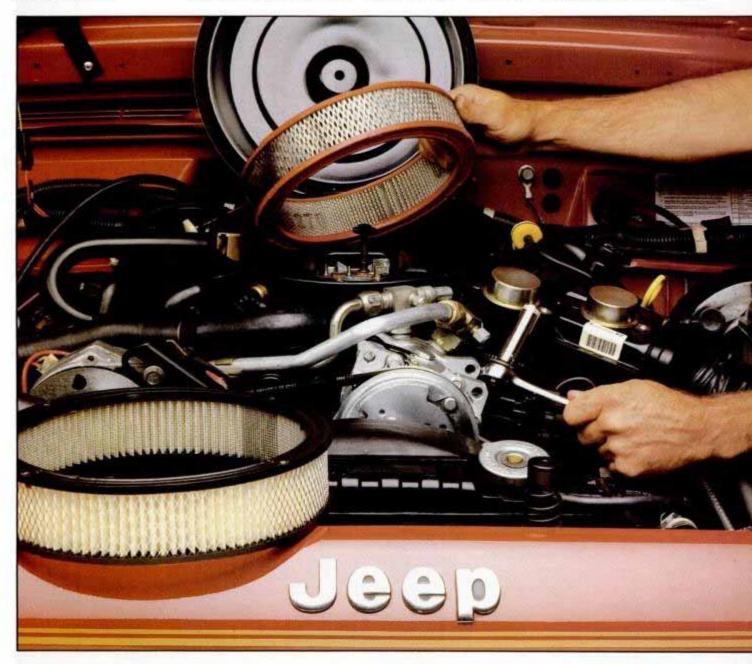
Because working trucks are exposed to water, dirt and a

wide variety of nasty stuff. some tuneup parts like air filters, PCV filters and plug wires should be replaced more frequently than those on passenger cars.

For the truck that works hard every day, 15,000-mile maintenance tuneups are a good idea. If the truck idles extensively or is subjected to overloading, go with a 10,000-mile interval. If conditions are very dusty, the

air filter and PCV filter should be checked even more often.

The tuneup should include inspecting the sparkplugs, distributor cap, rotor and plug wires. Plugs should be replaced if erosion or fouling is evident. The cap and rotor should be replaced if the contacts are more than slightly corroded, or if cracks or carbon tracking are evident. Small amounts of corrosion





can be removed with a knife. On computer-controlled engines, the special electronic grease that covers the contacts must be replaced if the cap and rotor are cleaned.

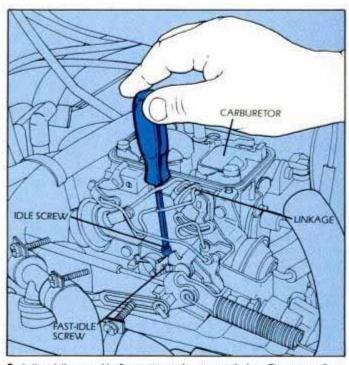
The PCV valve and fuel filter should be replaced at every maintenance tuneup. Check the torque of carb or throttle-body mounting bolts and—on carbureted trucks—inspect the choke system components for proper operation. Adjust idle speed (see Fig. 1) and, if applicable, idle mixture, following the directions on the emissions information label found under the hood.

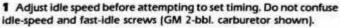
Check all the systems that can affect engine operation, just as you would on an automobile, including the idlestop solenoid or dashpot, the air cleaner hot-air system, the manifold heat valve, the exhaust gas recirculation (EGR) system, the evaporative emissions canister, the early fuel evaporation (EFE) system, the air injection system plus the battery and charging system. Change the filter on the air injection system at 30,000mile intervals. If your truck is equipped with a thermostatically controlled fan, make sure it can be turned by hand when the engine is cold and not running. The throttle-return control system (TRC), found on most trucks over 6000 pounds GVW, holds the carburetor's primary throttle plates open a preset amount when the throttle is released above a certain speed. If the system fails, backfiring may occur and exhaust system components will overheat and wear out prematurely.

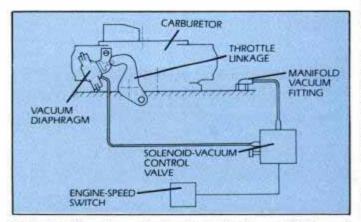
To check the TRC system on GM trucks, make sure that vacuum hoses are in good shape and wires are intact and connected at the distributor, speed switch and control valve. To make sure the system works, connect a digital tach, accurate to 10 rpm, to the distributor's TACH terminal. Start the engine and advance the throttle to 1890 rpm. The throttle lever actuator should be extended at this speed. Release the throttle until the speed drops to 1700 rpm. The throttle lever actuator should retract.

If the actuator doesn't operate within this range, the speed switch should be replaced. If the actuator doesn't operate at all, or remains extended at all speeds, further diagnosis is necessary. Complete instructions are in the manufacturer's service manual.

Once all engine wear parts have been checked and replaced if necessary, check engine timing and adjust it to the specs on the underhood label. Once initial tim-







2 The throttle-return control system on trucks over 6000-pound GVW (GM system shown) should be checked at tuneup time. The system keeps the mix from going over-rich on deceleration.

PHOTO FROM CUSTOM FAB MEG. INC

ing has been adjusted, make sure that timing advances as engine speed increases. On engines with vacuum advance, timing should retard when the vacuum hose is disconnected at idle. On engines with centrifugal weights, check for corrosion, sticking or worn-out springs.

Cooling system

Every time you perform a maintenance tuneup, check all V-belts for cracks, fraying, wear and proper tension (Fig. 3). Adjust or replace if necessary. If the belts still look good after three or four years of use, replace them anyway.

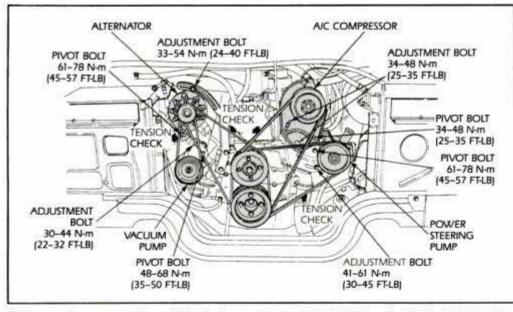
Check hoses for swelling, soft spots, cracking or other visible signs of deterioration. Look for black flecks in the coolant that indicate hose deterioration. Replace as necessary or at 3- to 4year intervals.

Check the radiator for debris at every maintenance tuneup or after serious forays in the outback. Leaves and bugs jammed in between the fins of the radiator will seriously restrict heat dissipation.

Once a year flush the cooling system completely, pressure-test it, and refill with a 50- to 70-percent solution of antifreeze and water. If your truck has any aluminum engine parts, make sure that you use antifreeze intended for use in aluminum engines.

Lube service

Engine oil and filter should be changed at 3000-mile intervals for normal use; 2000mile intervals for severe use (Fig. 4). Change oil every



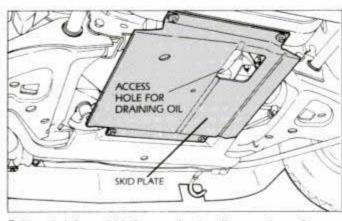
3 See your shop manual schematic for tension specs on complex belt drives like this Ford 6.9 diesel.

two months if mileage is limited. This is particularly important if the truck is left idling for extended periods. If severe blowing dust is encountered, change the oil and filter immediately.

Lubricate all grease fittings in the suspension, steering linkage, slip yokes (Fig. 5) and universal joints every time you change oil and filter. Check brake fluid level and top off with fresh DOT 3 or better fluid. Use a squirt can full of engine oil to lube the transmission and transfer case shift linkage, the hood and door hinges, the parking brake cable guides, the clutch linkage and the brake and clutch pedal springs. Apply some light grease to the hood latch mechanism. Lube the clutch cross-shaft lever everv 36,000 miles.

If you pull a trailer frequently, drive in hilly terrain or in heavy traffic when the temperature is above 90°, or if you use your truck for delivery service, its automatic transmission fluid and filter should be changed every 15,000 miles. Since most trucks see service that is more severe than comparable passenger cars, professional mechanics usually recommend fluid and filter change at 30,000-mile intervals, even if it's not subject to the severe uses listed above. Check transmission fluid at every oil change.

Manual transmission, rear end and transfer case lube should be checked (Fig. 6) and topped off when the engine oil and filter are changed. If your truck is equipped with a locking differential, change the lube after the first 6000 miles and every 12,000 miles thereafter. If you tow a trailer or operate under dusty condi-



4 Most 4x4s have skid plates under the oil pan and transfer case. You must work through access holes to check or change the oil.

tions, change the rear end hube every 6000 miles. With a standard differential, change the fluid every 24,000 miles under normal conditions or every 12,000 miles with the severe use described above.

If your truck has 4wd, check transfer case and front axle lube level every time you change oil and filter. Check the vent hose at the front axle and transfer case for kinks and proper installation. If your truck is operated extensively off road, change transfer case and front axle lube every 6000 miles, or as indicated in your owner's manual.

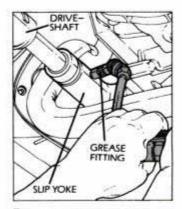
Every 12,000 miles, the front-wheel bearings should be cleaned and repacked with heavy-duty bearing grease. Shorten the interval to 6000 miles if you constantly subject the truck to wet and dirty off-road conditions. This is a simple job on 2-wheel-drive trucks, but on 4x4s you have to remove the locking hubs to gain access to the wheel bearings. On most full-size 4x4s you'll need a spanner wrench for the front-wheel bearing outer locknuts. You'll also need a large hex socket-2%-in. for many trucks-to remove the wheel bearing adjusting nut. For complete instructions see your factory service manual.

GM 4x4 minitrucks have permanently lubed wheel bearings that are part of a 1piece hub and bearing assembly. If the bearings fail, the entire assembly must be replaced.

When lubing wheel bearings, make sure you force grease all the way through the cage. You can do this by using a grease packing tool, available in most auto parts stores, or by pushing the side of the bearing cage into your grease-filled, cupped hand. Rotate the bearing cage in your hand until it is completely lubed all the way around.

Under-truck inspection

Every time you change oil and filter you should inspect the front and rear suspension parts and steering linkage for damage, loose or missing parts, and indications of wear. Make sure that power steering lines and hoses are free from bind-



5 Most trucks have grease fittings on the driveshaft slip yoke; 4x4s have 2 slip yokes.

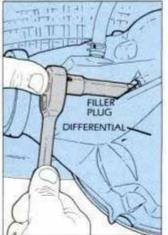
ing, leaks, cracks or chafing. See that manual steering box seals are not leaking. Check all axle shaft seals and shock absorbers for leakage. Check for bent shocks and make sure they're securely attached (Fig. 7).

Inspect the fuel tank, cap and lines for leaks or physical damage. Remove the fuel cap and examine the gasket. The imprint on the gasket should indicate that it's sealing all the way around. If not, replace the cap.

Carefully examine all exhaust system components. Make sure all hangers and clamps are tight and in place. Look for splitting seams, rust-through or badly bent pipes. Pipes that have been







6 Remove the plug in the differential(s) to check lube level. Fill to plug hole.

hammered out of shape by off-road obstacles can cause excessive backpressure, affecting engine performance and economy. Check the floor pan and other components near the catalytic converter for heat damage.

Many 4x4s have a hydraulic steering damper that looks like a shock absorber. Attached to the tie rod, the damper helps eliminate wheel shimmy. Inspect the damper for fluid leaks or a bent shaft. If it leaks excessively or its shaft is bent, replace it.

Check ball joints at 12,000-mile intervals in normal use or every 6000 miles with heavy off-road use. If your truck is equipped with wear-indicator ball joints, checking them is simply a matter of making sure that the collar surrounding the grease fitting has not sunk into the joint. If it has, the joint is worn out.

On trucks without wearindicator joints, you can make a simple visible check by rocking the tire in and out while the vehicle is supported in such a way that the load of the spring or torsion bar is removed from the control arm or axle. Watch for sideto-side movement of the balljoint studs. Check for vertical looseness by trying to raise each wheel with a pry bar. Any easily noticeable movement in either direction indicates excessive wear.

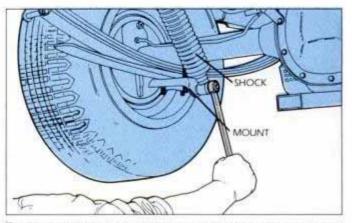
On Ford trucks, you only

have to check for side-to-side movement of the ball joint. Just watch the gap between the spindle and axle jaw while rocking the tire in and out. More than $\frac{1}{32}$ -in. movement is excessive.

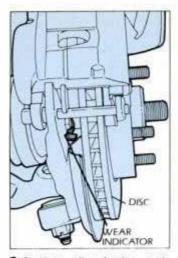
If you use your truck offroad on a regular basis, it's important that you remove clumps of mud and other sediment from the underside every time you have it up in the air for inspection. If you don't, premature rusting is certain. After dislodging large hunks of muck, wash the underbody with plain water. For trucks that are not driven off-road, flush the underbody every spring,

Tires, wheels and brakes

Truck tires are expensive, and if you want them to last as long as they should, rotate them after the first 7500 miles and every 10,000 miles thereafter. When you rotate, check wheels for runout by spinning them with a



7 Be sure to check the tightness of all suspension, shock absorber and steering fasteners each time the oil is changed.



8 Replace disc brake pads when the wear indicator comes within ¹/₁₆ in. of the pad.

sighting reference placed next to the outer edge of the rim. Replace any wheels that run out over $\frac{1}{16}$ in. Check for out of round in a similar manner. Tires that are more than $\frac{3}{16}$ in. out of round should never be used on the front of the vehicle. They can be used on the rear if they're otherwise in good condition and don't have a bad effect on ride quality. When reinstalling wheels, make sure the back of the wheel and the hub are clean.

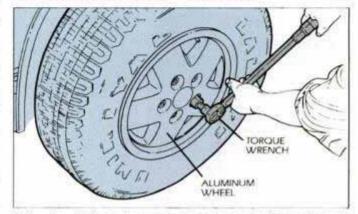
Keep a close watch on front tires for signs of abnormal wear like cupping, uneven tread or tread distortion. If you find unusual wear patterns, professional wheel alignment service is called for. Abnormal edge wear on rear tires is usually due to excessive cornering speeds with no load in the bed. Improper tire inflation has a detrimental effect on tire performance and life, so check air pressure at every other fill-up or as often as necessary.

While the wheels are removed for rotation you can check all brake system components. Make sure all brake fluid lines and hoses are properly attached and not binding when the wheels are turned. Visibly inspect them for leaks, cracks or chafing.

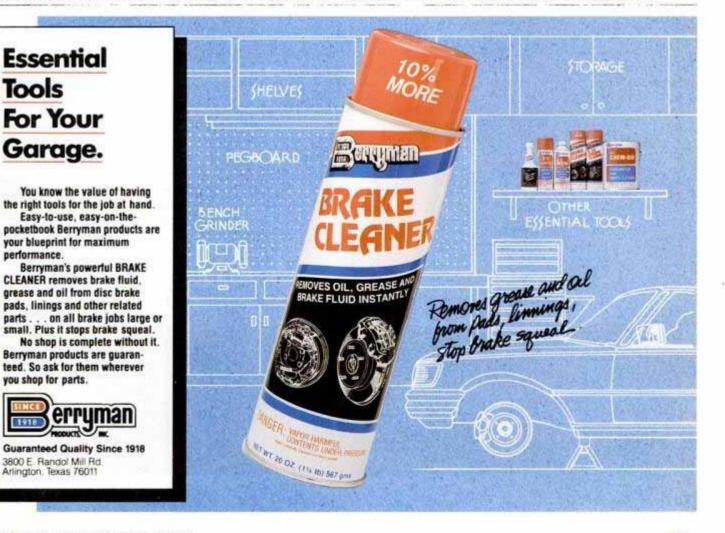
Make sure that disc pads are not excessively worn. Check by eyeballing them through the caliper inspection hole or the sides of the caliper. The pad friction material should be at least as thick as the backing plate. If you can't see both pads, or if you have riveted brake pads, you'll have to detach the caliper and lift it from the rotor to check. Don't allow it to hang from its hose. Hold onto it or tie it to the chassis with a coat-hanger.

Nonmetallic riveted pads must have more than $\frac{1}{16}$ in of material above the rivets. Semimetallic pads must have at least $\frac{1}{32}$ in. If the rotors are heat-cracked, scored, discolored or otherwise damaged, they must be replaced. On trucks with disc brake wear indicators, replace the pads when the wear indicator comes within $\frac{1}{16}$ in. of the brake disc (Fig 8). Don't wait for it to scrape the disc.

Never install an aluminum wheel without torquing the lugnuts to the specified tightness (Fig. 9). Overtightening can crack the wheel. Tighten lugs gradually, using a criss-cross pattern to avoid distorting brake discs.



9 You should always torque the lug nuts on aluminum wheels to the manufacturer's specifications to avoid damaging them





Accessories can help you spruce up or mess up your truck. Here's what's hot and what's not.

BY JAY KOBLENZ

he only place you see a plain, box-stock pickup truck these days is in fleet service or at a con-struction site. The reason virtually every privately owned pickup truck in America has been accessorized or modified is because of the pickup's most universal feature: versatility. You can turn your truck into a sports car, a heavy-load hauler, an off-road racer or a flashy showpiece just by adding the right parts. To determine the best accessories to add to a truck, all you have to know is what you want to do with your truck, and your budget-the one finite limit that binds us all.

The most popular truck

accessories are those that improve off-road capability. Just remember that the majority of trucks that go off road spend about 90 percent of their life *on* the road. Leave some room to enjoy commuting and highway travel when setting up your off-road truck.

The first step to improving off-road performance is usually changing the factory tires and wheels. Stock tires are aimed at highway comfort. A more aggressive tread is a good way to improve traction in mud, sand and snow. This same tread will also make your highway ride harsher and noisier, a point to keep in mind.

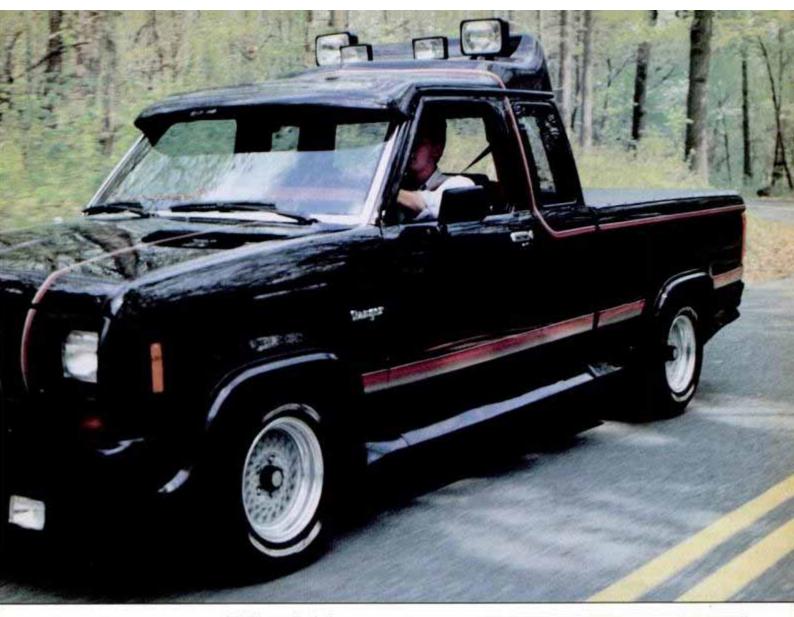
Wheels are often chosen

Lowrider look (right) is the latest fad in pickup fashion, made possible by aftermarket kits such as this one from Aerosport Trucks. Spoilers are a flexible nylon-urethane mix with high impact resistance. Truck looks low, but suspension height is not altered.



popular, and can be practical if done within reason. Small trucks should not be raised more than 3 in., or use tires bigger than 33 in. Big trucks should be limited to 4-in. lifts and 36-in. tires. Light bars provide more show than rollover protection. Custom Cab stretch job (left) offers extra seats and storage space—for a price: stretch cab is \$3700, dualwheel off-road package \$2760, from Custom Fab Mfg., Hemet, CA.

PHOTOS FROM CUSTOM FAB





Working trucks require practical options like step bumpers and bed liners (left). Liners protect the cargo box from nicks and scratches that can lead to rust, but may interfere with light bars or other accessories available from dealers or on the aftermarket. Chrysler's Direct Connection performance people built this hot rod Dakota lowrider (right).



for appearance only. Remember that off road, wheels will get muddy. Pick a design that's easy to clean. If you're going for a larger wheel/tire combination, the wheel offset is critical. Taller tires require a negative offset to widen the track of the truck. Too much negative offset, however, puts additional stress and wear on the spindles and suspension.

Larger tires raise the vehicle for better ground clearance and improve your angle of attack for climbing slopes. It is possible to go to slightly larger tires than factory specifications without significant modification. Bigger tires can cause problems, however. The extra weight alone puts more stress on your suspension, brakes and drivetrain. Stiffer shocks might be needed and a steering damper is useful if your truck didn't come with one. By going to taller tires, you raise the final drive ratio and put extra stress on the clutch and transmission.

If you plan to add bigger

tires, buy your truck with the lowest gear ratio available. Adding a heavy-duty clutch is also a wise idea. Big tires will make the speedometer read low. See if optional speedometer drive gears are available from the truck's manufacturer.

To gain clearance for very large tires, many owners raise their trucks significantly. It's possible to safely raise a truck somewhat, but there are both sane and legal limits, the first often being the more stringent. Legal limits vary from state to state and are in flux. There is a formula for determining the safest height increase developed by SEMA, a trade association that includes aftermarket manufacturers of suspension components: The front track divided by the frame's height from the ground should not be less than 1.80 for vehicles with a wheelbase over 100 in. and not less than 2.00 for vehicles with a wheelbase of less than 100 in. These figures are the result of tests con-

TOP PHOTO BY HUMPHREY SUTTON, AEROSPORT TRUCK FROM FAULKNER FORD, LOWER PHOTOS FROM CHRYSLER



ducted by the University of Michigan.

The formula, however, does not address the serious issue of how you raise the truck. On new trucks, any modification that raises the height of the truck could also void the warranty. According to Brad Moore, chief engineer at Rancho Suspension, a properly engineered lift package takes into consideration such factors as suspension oscillation-1.8 cycles per second is recommended for off road use vs. a stock movement of 1.5 cps. The largest height gain Rancho offers is 4 in. for a full-size truck with a tire diameter no larger than 36 in. For a minitruck, the company recommends no higher lift than 3 in. over stock and a 33-in. tire.

Even that modest lift is not recommended for vehicles with independent suspension. Trucks with solid axle suspensions are more adaptable to lifting since it's a matter of adding a leaf or changing to taller springs. One of the worst ways to lift a vehicle is with extended-link shackles between the leaf spring and frame. This puts too much stress on the U-bolts in turns and could lead to failure of these critical suspension mounting points.

Most minitrucks have independent front suspension and many owners are cranking up the tension on the torsion bars to gain lift. This is a good solution only if you don't mind the loss in suspension travel, which reduces off-road effectiveness and ride quality. Tom Cepek, president of Dick Cepek Inc., a major off-road supplier, notes that custom seats are popular for such modified minitrucks since extra padding often is needed to ride in them.

Ford's I-beam front suspension doesn't lend itself to ease of lifting. Some owners simply add spacers to the mounting points, which are then subject to heavy stress. To do the job properly, you would have to replace most of the suspension components.

Recommendations for raising vehicles? Stick to kits made by known and experienced manufacturers and stay within the limits of 3 to 4 in., depending upon the size of the truck. When you raise height, also increase track width through wider tires or additional wheel offset to regain lost stability.

Lights and bars

After wheels and tires, the next most popular accessories are lights and what used to be called roll bars, but are now called anything from light bars to sport bars to whatever else the lawyers allow. Cepek notes that, while the better bars do afford some protection in a rollover, unless they are mounted to the frame (a custom job done in a race shop), they can't be sold with any guarantee of extra safety. If you plan to add a lot of candlepower to your light bar, make sure you get the most potent alternator available.

Most trucks come without rear bumpers. An assortment of tube and step bumpers are available, depending on your needs and tastes. A winch is an expensive item, but if you travel in areas where 4x4s get stuck, it could be invaluable. Be sure the winch is mounted solidly to the frame rather than hung on the bumper, where it merely becomes a bumper remover.

Some accessories are practical only in certain applications. Running boards are popular, but tend to get banged up in heavy off-road use. Cargo nets, used in place of a tailgate, aid slightly in aerodynamics and fuel economy.

Improving handling

Sport trucks are at the other end of the spectrum. Here, the goal is to make the truck handle well and look fast. Nothing you can do will ever make a pickup truck handle like a Porsche, but you can improve handling if you're not concerned with carrying heavy loads.

The black Ford Ranger in our opening photo features a complete customizing package from Aerosport Trucks, Rt. 303, Blauvelt, NY 10913. It includes a 1-piece roof spoiler and sun visor with mounting pads for the KC lights, aero grille, a front air dam, fender flares, full side spats, graphics package, Koni shocks, antiroll bars and 245/60SR14 B.F. Goodrich Radial T/A 60s with the same rolling radius as the stock 195-14 tires. The whole package is a soundly engineered revival of the '50s lowrider look. However, actual suspension height has not been altered.

A tonneau cover helps the appearance, reduces aerodynamic drag and keeps things hidden, but also makes it more difficult to get to the cargo bed. Other popular options include bed rails (a good place to mount tiedown straps) and toolboxes for lockable storage.

Planning should be the byword of anyone about to customize a vehicle. Set a clear goal. Write down what you want to add, then plan the order of installation. For example, if you want a bed liner, put that in before you add a light bar or other accessories that must mount on top of the liner. Make sure you have the proper mounting brackets for extra lights. If you're going to get a winch, you'll need a bumper that allows room for it.

Take measurements. That beautiful triple light bar may take up so much room your dirt bike won't fit in the truck anymore. Those great off-road tires might not clear your wheel wells in turns. The grill guard could cover up your headlights. A spare tire rack might not close after you bolt on that tubular bumper. A little planning goes a long way toward happy truckin'. PM

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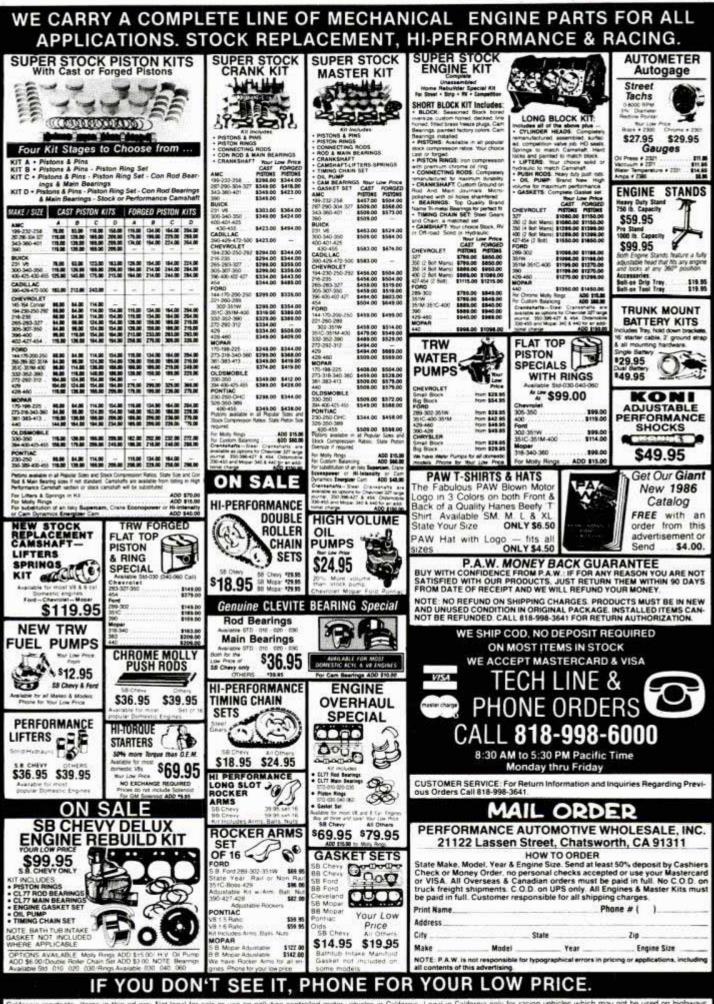
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Bed mats stop rust source

Bed mat of Nyracord rubber protects bed against the scratches and dings that start rust. Costs less than a full bed liner. Custom mats fit import and domestic pickups; a utility size fits stepsides. Raised-rib design helps cargo move easily. The mats sell for \$99.95 at accessory outlets. They're made by Rubber Queen, 438 Cambridge Rd., Coshocton, OH 43812.

Window shades for cool truckin'

These pre-cut window tinting panels fit the window shapes of 55 domestic and import pickups and 4-wheel-drive vehicles. It's scratch-resistant and comes in four shades of gray and three shades of bronze. Prices range from \$10,98 to \$51.98. Kits are available from Sun Busters, One Spring Buck, Irvine, CA 92714.



Headache rack

The All-American cab guard/ window grille prevents a shifting load from crashing into the cab window. It fits into the stake sockets on big-bed trucks, or is secured through attachment holes in the top rails of minitrucks. They come in steel (\$84.95) and anodized aluminum (\$124.95) and are available from accessory outlets and Bloomfield Mfg. Co., P.O. Box 228, Bloomfield, IN 47424.

Stabilizer shock

Four-way stabilizer shocks control pitch, dive, body lean and yaw. Each unit consists of a shock absorber core, tempered steel spring and aluminum connectors. They're \$59.95 each from 4-Way Suspension Products, \$760 Chesapeake Court, Suite B, San Diego, CA 92123.



Tough juicer

Designed to resist vibrations, the Rough Neck line of Titan batteries uses an Ancor Lok system to glue the plates in place. Batteries are available with 550-600 CCA and 120-130 minutes of reserve capacity. They're \$74.95 and up at Independent Titan distributors. Made by General Battery, Box 1262, Reading, PA 19603.



POPULAR MECHANICS • AUGUST 1986



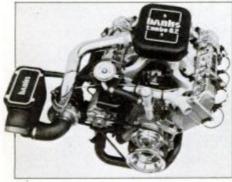
Big rig look

The Kolb Kab Aero Top is a 1-piece roof spoiler and sun visor that also incorporates light pods. Mounting materials and rear running lights are included in the \$298 price. Driving lights are optional. Kits fit Ford Ranger and F-Series, GMC and Chevy miniand full-size pickups. From Aerosport Trucks, Dept. PM, Rt. 303, Blauvelt, NY 10913.



I see you coming!

Computer-designed variable-radius curved mirrors give a wider field of view with less distortion than simple convex mirrors, virtually eliminating blind spots on pickups, vans and campers. Self-adhesive mirrors mount over stock units on popular imports and domestic trucks. They're \$29 to \$34 each and are available from Multivex Corp., P.O. Box 42375, Detroit, MI 48242.



Oil-burner boost Turbocharger kits for big-block Ford and Chevy (shown) diesel V8s provide a muchneeded performance boost plus 10 percent Jump in mpg. These and other kits are available from Gale Banks Engineering, 546 Duggan Ave., Azusa, CA 91702.



THE FIRST STEP

Independence!

117 Материал, защищенный авторским правом

PICKUP TRUCK CONTEST AMERICA'S (Continued from page 95)

the truck if you win it, but if your ideas are good enough to win the contest, we'll share them with PM's readers in an upcoming issue.

On the entry blank below, and on as many sheets of paper as necessary, tell us exactly what you'd do to the 4x4 King Cab SE to improve its appearance, performance and/or utility. Be specific about each change you think will make the Nissan better.

Tell us briefly why you'd make each change, even if it's just "hairy looks." Drawings or other illustrations are not necessary to enter the contest, but you may find that they will help you to clarify your thinking and to make your point more impressively.

You must be of legal driving age in your state to enter (see official rules and entry form below). PM's Auto Dept. will screen the entries, and the final winner will be selected by POPU-LAR MECHANICS Editor-In-Chief Joe Oldham.

If you're the winner and you live outside the New York area, we'll fly you to New York where you'll be our guest at a luxury hotel for the night. After breakfast the next day, you'll come to the POPULAR MECHANICS offices, meet our editors and take possession of your prize. The winner's name and photo will appear in a future issue of POPULAR MECHANICS. PM

OFFICIAL CONTEST RULES

1. On the entry blank printed below, or on a separate sheet of paper, give us your suggestion for customizing the Nissan 4x4 King Cab SE pickup truck. Tell us briefly, but exactly, what you would do to the truck to improve its appearance, performance and/or utility. Detail changes you would make to the suspension, engine, drivetrain and/or bodywork (keep them legal), as well as any optional or aftermarket equipment you'd add. Tell us briefly why you'd make each change. Illustrations or renderings are not necessary to enter the contest, but they'll help you make your point. You will not be asked to modify an actual truck. Just tell us what you'd do to one and why.

2. You must be of legal driving age in your state to enter. All entrants must sign the entry blank and verify that they are of legal driving age in their state.

3. While there is no limit to the length of your suggestion, please be to the point and as brief as possible

4. All entries become the property of POPULAR MECHANICS and cannot be returned.

5. Entries will be judged on originality, imagination, practicality and usefulness.

6. Preliminary judging will be done by the automotive department editors of POPULAR MECHANICS. From initial selections, the final winner will be selected by POPULAR MECHANICS Editor-In-Chief Joe Oldham.

7. The decision of the judges is final. No correspondence or telephone calls regarding the contest will be accepted or entered into.

8. The winner will receive a 19861/2 Nissan 4x4 King

Cab SE pickup truck equipped with the V6 engine and 4-wheel drive. The Nissan King Cab will be turned over to the winner in as-is condition at the time the prize is awarded. All taxes, licenses, insurance and other fees are the responsibility of the winner. If applicable, we will provide coach travel with a commercial air or rail carrier to New York and provide one night's accommodations in order to accept the prize.

9. No cash payment will be made in place of the prize.

10. The contest is open to anyone residing in any of the 50 United States except employees of The Hearst Corp. and their families

11. Entries should be mailed to: Nissan King Cab Contest, Popular Mechanics, 224 West 57th St., New York, NY 10019.

12. Entries must be postmarked before midnight Dec. 1, 1986, and received by Dec. 8, 1986

13. The winner will be notified by Jan. 30, 1987, and may be asked to execute a qualifying affidavit.

14. After the winner is notified, POPULAR MECHANICS will provide the winner's name to anyone who wishes it and who sends us a stamped, self-addressed envelope with the request

15. The winner must agree in writing to be photographed with the Nissan King Cab truck and various members of the POPULAR MECHANICS staff, and consent to his name and photos being used in conjunction with this contest and its results in a future issue of POPULAR MECHANICS and for all media, advertising and/or trade.

16. This contest is void where prohibited.

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Here's how I would customize the Nissan 4x4 King Cab SE:

Name		
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	ss State	Zip

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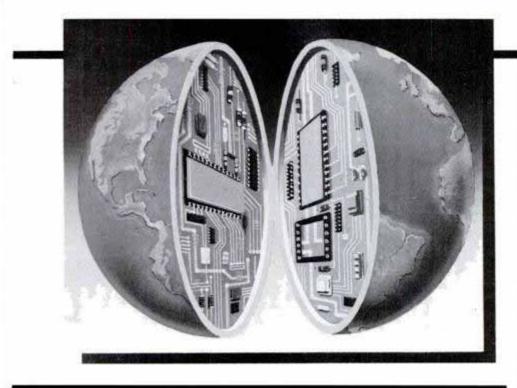
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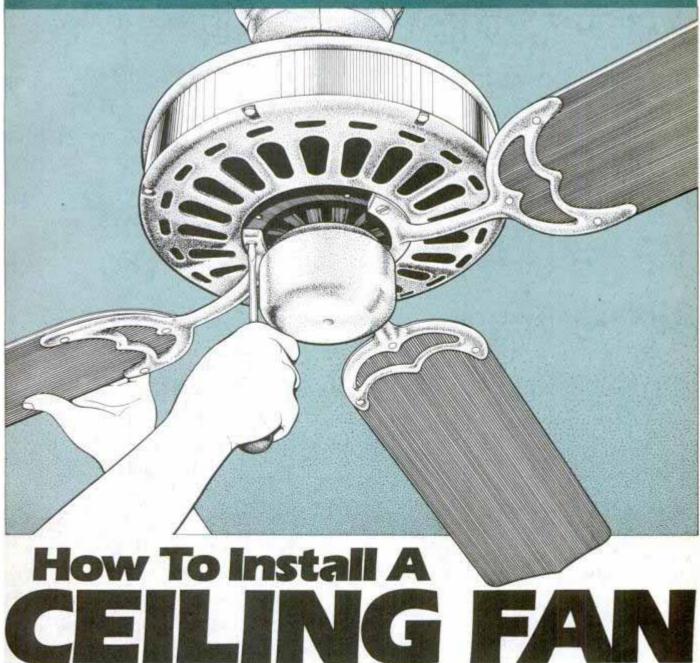


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THE BETTER HER ALE



ith such dramatic increases in energy costs over the years, people have been forced continually to look for new energy-saving devices. These may be high-tech problem-solvers like some solar components or low-tech solutions like adding more insulation to your home. But in between exists one of the oldest and most dependable ways to stretch your energy dollar: the ceiling fan.

These units have come a long way

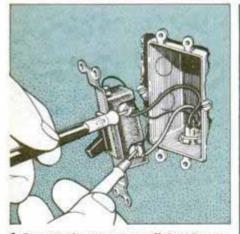
BY NEAL BARRETT AND PAUL BARRETT Illustrations by George Retseck

since spinning over Ingrid Bergman's head in Rick's Cafe. They are available in many different sizes and styles and they're more efficient and affordable than in days gone by. Despite these improvements, the mechanism still works in the same basic way. It simply circulates the air already inside a room: It brings down the warmer ceiling-level air during the winter and brings up the cooler floor-level air in the summer. Without some means of moving this air you end up paying to heat or cool air that you never really feel.

To this end, all of the fans we examined had reversing switches with at least three different speeds. Depending on the model, fans can be controlled by means of unit-mounted pull-chains;



REPLACEMENT INSTALLATION



 Remove fuse or turn off breaker to proper circuit. Remove switch plate, pull out switch, check for current with tester.

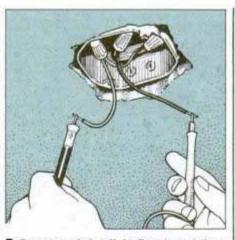
rheostat switches that control fan speed; remote control switches that turn the fan on and off *and* select speeds from anywhere in the room; and electronic wall switches that control fan speed and direction as well as light intensity on optional light fixtures.

Ceiling fans can be installed in nearly every area of the home. With the variety of mounting systems available, you can hang a fan from a flat 8-ft, ceiling or a 20-ft, cathedral ceiling. The minimum clearance height, however, is 7 ft, from the floor to the blades. And the tip of the blades should be at least 18 in. from the nearest wall. Never hang a fan where high humidity could damage the electrical functions or warp wooden blades, such as in a bathroom. And, of course, don't position the fan above the swing of a hinged door.

Installation is a reasonably straightforward job, particularly if the fan replaces an existing light fixture. For this story we did just that, choosing a fan with a light so the owner lost nothing by the conversion.

Choosing a fan

It's important to choose the unit that's most appropriate for your situation. As mentioned before, there are many sizes and styles from which to choose. Get a feeling for what is available locally. Compare warranties and service as well as design and operating features. All of the residential fans we examined were fitted with light kits for a modest additional cost. But the method of control is a more complicated decision. It will determine how you operate your



2 Remove existing light fixture and then check white and black pigtails for current. If tester lights, current is present.

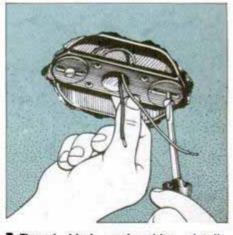
fan and, to some extent, the ease of installation.

If you are replacing a light fixture with a fan or fan/light combination, you can switch the fan on and off using an ordinary light switch. Then, the fan speed and light fixture are regulated with pull chains. The fan direction can be changed by means of a slide switch located on the fan housing.

If you would like to control the fan speed also from a wall switch, you can install a rheostat switch. Then, only the light fixture requires a pull chain. Of course, this arrangement can be reversed to control the light fixture with a rheostat and the fan with a chain.

All of these options are available without changing your fixture wiring.

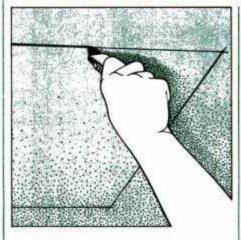
NEW INSTALLATION



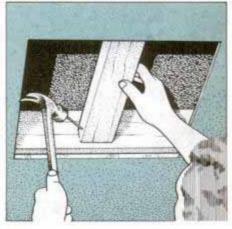
3 Thread black and white pigtails through hole in fan's mounting bracket. Then attach bracket to outlet box.

However, if you want to control the fan speed and the light from a wall switch, then you can install a double rheostat. But you will have to run an additional electric cable between the ceiling and switch boxes for this function. Before deciding on your operating system, consult your owner's manual for specific instructions on the fan you have.

One very attractive alternative—and the one we chose—is to purchase a "computerized" wall control. Sold with some models of the Casablanca Fan line, this unit offers the greatest control over the fan and light. Included are automatic light shutoff, random light patterns for home security and full control of speed and direction, all without changing existing fixture wiring.

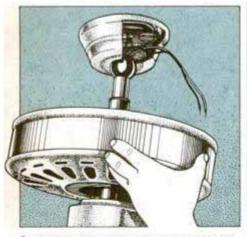


7 Determine location of fan and position of joists on either side. Cut hole in celling from center to center of joist edges.



8 Cut 2x4 block to fit between joists and position it so bottom of outlet box will be flush with ceiling. Toenail in place.



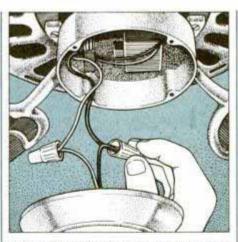


4 Attach canopy to mounting bracket, then hang fan from canopy. Using wire nuts, join black wires then white wires.

Where to begin

Begin work by switching off power at the breaker panel, or unscrewing the appropriate fuse for the proper circuit. Next, remove the switch-plate cover and the screws that hold the switch to the box. Grasp the switch by the metal ears at the top and bottom and pull it out of the box. Place one probe of a circuit tester on one of the switch terminals, and the other probe to the second terminal. If the light on the tester does not light, the power is truly off, and the switch is safe to handle. Loosen the screws holding wires and remove the switch.

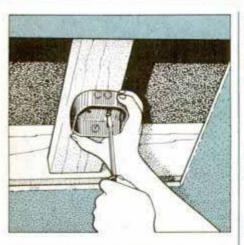
Next, loosen the center post nut or screw that holds the light fixture and lower the fixture to expose the wiring.



5 To attach optional light fixture, remove covering plate on fan, and join pigtails with wire nuts. Screw fixture in place.

Carefully remove the wire nuts and test the wires as before to be certain the line is not "hot." Completely remove the fixture by undoing splices.

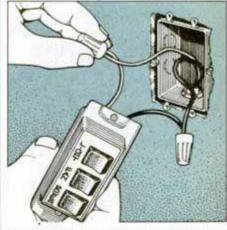
Now, determine how firmly the electrical box is anchored to the ceiling framework. Though the fan we installed weighed 24 pounds, the owner's manual recommended a 50-pound test weight on the junction box. To see if our box could take this, we wired together several old window weights until they totaled about 50 pounds. We then attached the mounting bracket that came with the fan to the electrical box. When we hung the weights from the bracket, we detected no movement in the box. It was solid. Of course, you can substitute any heavy object for the window



Attach outlet box to bottom of support block using two 1½-in. No. 10 rh screws. Box comes with prebored mounting holes.



10 To gain access to wall cavity for running power cable, carefully pry baseboard from wall under new switch location.



To attach fan control unit to switch box, Join pigtalls with wire nuts, and screw unit to box. Attach face plate to unit.

weights. (If your box also withstands this test, then you can proceed as shown in drawings 1 through 6. But if the box starts to pull away from the framework, you will have to reinforce it. To do so, follow the directions shown in drawings 7, 8 and 9.)

Replacement installations

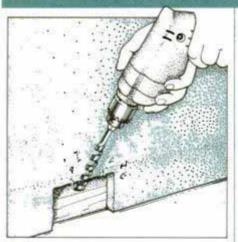
Temporarily remove the mounting bracket so you can feed the power wires through its center hole, then reattach it. Next, attach the escutcheon canopy to the mounting bracket. Keep in mind that some manufacturers may require preliminary assembly of certain fan parts. Consult your owner's manual for specific instructions.

Install the fan hanger system first. Run the fan wires through each piece, taking care not to damage the insulation on the wires. Hang the fan from the escutcheon canopy, then connect the ground wire from the fan motor to the ground wire—or wires—from the power cables in the box. Make the connection with a proper size wire nut.

Connect remaining wires together; black to black, white to white, using proper wire nuts to hold them securely. There may be an extra wire in the fan to provide a separate circuit for light control. We had no need for this because the control unit we used separated the functions internally. If you have no need for this wire, cap it with a wire nut and tuck it away. If you do need the wire, follow the manufacturer's wiring diagram supplied with the fan.

Next, attach the fan blades to the blade holders, then the blade holders to





11 Cut out small section of drywall behind baseboard. Then bore hole through bottom wall plate and floor for new cable.

the fan. Spin the fan gently to make sure the blade path is unobstructed and all the mechanical connections are secure. Keep in mind that fan blades are matched and balanced at the factory, but you may have to switch the position of the blades to fine-tune the fan.

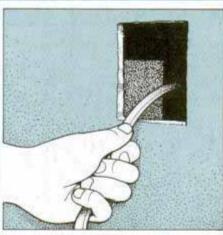
To add an optional light fixture, simply remove the cover plate on the bottom of the fan and install the fixture according to the manufacturer's instructions. Complete the job by wiring the control unit into the switch box.

New installation

If you don't have an overhead light fixture, you can still install your ceiling fan. It just takes a little more work. First, determine the location. Then trace the junction box on the ceiling and cut a hole in the ceiling at this point.

This hole provides a way to measure the distance to the adjacent ceiling joists and to determine in which direction they run. With this information established, draw a rectangle on the ceiling that spans the distance between the center lines of the adjacent joists. Joists most commonly fall on 16- or 24in. centers. But in older homes, they can vary. Make the rectangle about 20 in. long in the other direction for working ease. Then cut out the opening with a utility knife or compass saw. Cut a 2x4 block to fit snugly between joists, approximately 11/2 in. above ceiling height. This will allow for the depth of the outlet box, which should hang flush with the finished ceiling. Toenail the 2x4 to both joists using 8d common nails. Then attach a 4x4 octagonal box using two 11/2-in. No. 10 rh screws.

Next, determine the position of the wall switch on the partition-not outside wall-nearest the fan. At the ap- box by nailing new drywall in place.

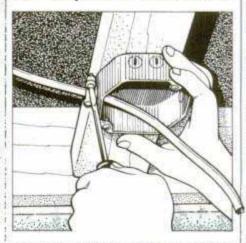


12 Trace outline of new switch box, then cut hole. Feed cable through wall cavity from below, then through hole.

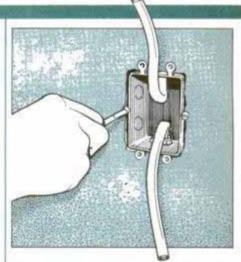
propriate height, trace the outline of a "cut-in" switch box on the wall. (These boxes are called by different names, and some work differently than the one we show. All, however, are designed to be mounted inside a precut hole without requiring additional support framing between the studs.) Carefully cut along the outline and remove the waste.

Then, using a flat pry bar, remove the baseboard from the wall directly under the switch location. Next. cut away the wall material behind the baseboard as shown in drawing 11. The bottom wall plate should now be accessible. At a point directly beneath the wall switch, bore a 1/4-in.-dia. hole through the plate and floorboards into the basement. This hole provides access for the power cable coming up to the switch from the service panel.

If you live in a 1-story house, running the cable to the fan outlet box is a simple matter. Just go up to your attic, locate the position of the box and re-



14 Feed power cable into ceiling box and tighten connector. Patch ceiling around



13 Slide both cables into special cut-in box. Then push box into wall hole. Drive both side screws to tighten clamping ears.

move a section of flooring-if it's in place-and some insulation. Once a path is clear from the box to the switch wall bore a hole down through the top plates on the wall. Now you should have a clear path from the panel box to the switch and onto the fan box.

If you live in a 2-story house, however, the process is a bit more complicated. First, remove the baseboard on the wall directly above the first-floor switch wall. Again, remove the wall material behind the baseboard, this time in a strip that is at least 10 in. wide. Next, using a reciprocating saw or a compass saw, cut out a 4-in. wide section of the bottom plate and subfloor. This should give enough room to reach down into the cavity between the floor joists. It should also yield enough room to bore a hole through the top plates on the wall below.

With the wall plate and flooring cut out upstairs and the hole bored in the top plate, you should have clear access from your service panel to the switch and the ceiling box.

Once this is complete, simply string cable from the service panel to the switch, then another piece from the switch to the ceiling box. Be sure to leave about 5 ft. of cable at the service panel, and another foot at each end of the cable that enters the switch and ceiling box. Don't forget to check your local building codes for the gauge wire required for such installations.

Note: We strongly recommend hiring a licensed electrician to install the cable in the breaker or fuse box, and to make the individual connections inside the switch and ceiling box. But, if you've run the wires between the fixtures, the charge should be much less than if you had the electrician do the whole job. PM

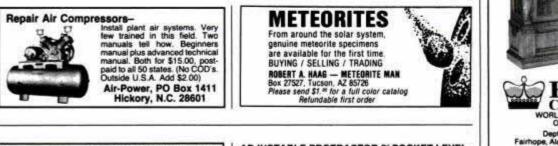


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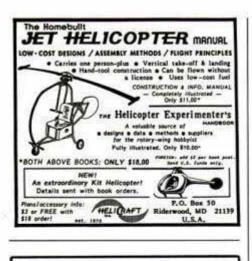
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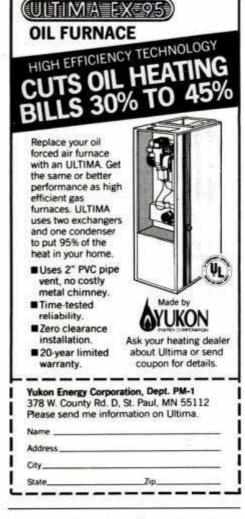


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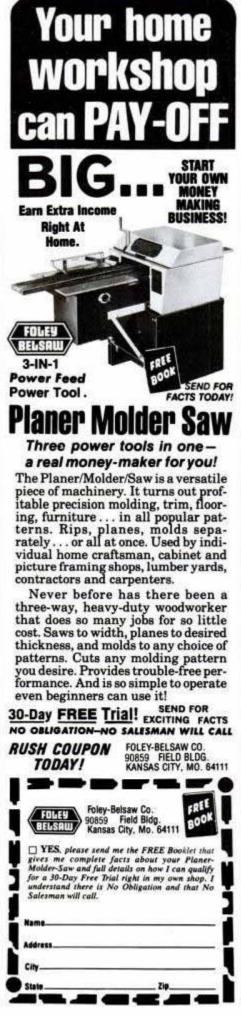






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THE TOYS OF SUMMER

(Continued from page 71)

chine that skims across water and shallow grades. It's fun, but it's also extremely noisy. Ear plugs are advised. Fun factor: 6.

Cougar's MerCub (1076 Cozy La., Oshkosh, WI 54901) is a mini APBAsanctioned race boat for teenagers, with strong support from Mercury Marine. A maximum horsepower rating of 25 means it's fast, fun and relatively inexpensive at \$4995. The hand-grip racing throttle takes some getting used to, but it's a tight little machine. The racing program can only add to the excitement and resale value. Fun factor: 7.

The Parker L'il Jet (15 Crane Dr., Henrico, NC 27842) uses the same Cayuna engine/Berkeley pump combination found in the Fastrac. And, like the Fastrac, this 10-ft., 2-in., 280pound machine accelerates, spins on a dime and reverses with remarkable *esprit*. A sophisticated hull design means it's virtually impossible to turn over with any kind of high-speed radical maneuver (and we tried). This \$4495 runabout absorbed all kinds of abuse and still offered safe, responsive enjoyment. It's a winner for kids over 10. Fun factor: 9.

Zamco's Jet Lark and Sport Lark (16233 Wausau, South Holland, IL 60473) are at the low-price, low-performance end of the wet toy spectrum. The 8-ft., 2-in., 440-pound Cayuna/Berkeley Jet Lark (fun factor: 4) sells for \$3450. The Sport Lark (fun factor: 3), based on the same 8-ft., 2-in. hull form, costs \$1700 less outboard.

Whatever the price, the wet toys of today are a testament to man's capacity for well-intentioned frivolity. And if you lay aside the fun, you'll find some sophisticated designs, high-tech construction and state-of-the-art drive systems. Most builders, it seems, take their fun pretty seriously.



The operator stands atop the Surfjet 236SS and grasps the throttle/hand grip.

POWER BORE

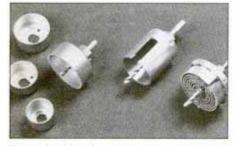
(Continued from page 92)

Saw along the line and cut the top of the block flat to create a clamping surface.

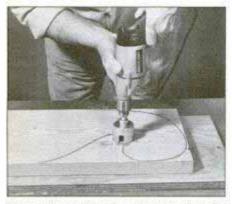
Metal methods

Drilling in metal requires a slightly different approach than boring in wood. First, for the drill to start cutting without wandering about the surface, you must strike a starting point with a centerpunch. Then, bore a small-diameter pilot hole followed by the larger. desired diameter drill. This 2-step procedure is necessary because the small dimple created by the centerpunch won't prevent a large diameter drill from wandering.

When a twist drill breaks through the backside surface, it often grabs and



Three basic hole-saw styles are (left to right): interchangeable bell-type, Enduro single-tooth saw and a 7-in-1 nest of saws.



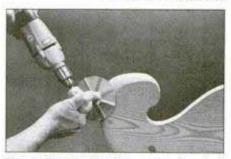
The quickest way to cut large-diameter holes is with a hole saw since it doesn't cut away all the material within the hole.



A right-angle drive head permits working in confined areas. The gear ratio is 1:1, so there is no change in the tool's rpm.

snaps, tears the workpiece from its clamps or pulls the tool out of your hands. To avoid these dangerous situations, it's important to release pressure on the drill just before it breaks through. Keep a firm, 2-handed grip on the tool and apply light pressure to complete the hole. Many drill models accommodate an auxiliary side-mounted handle that provides additional control of the tool.

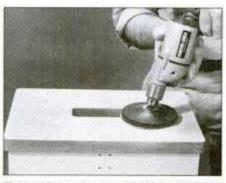
(Please turn to page 128)



Use a disc rasp for fast, aggressive stock removal. Here, it's shown with a right-angle drive head for additional control.



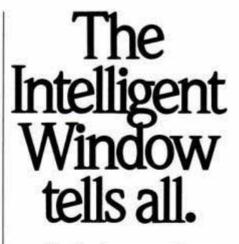
Smooth and shape inside curves with a sanding drum. Advance the drum against its rotation for the most aggressive cutting.



Flat sanding pad has a pivoting shaft that keeps the pad in full contact with the work to prevent sanding low spots and gouges.



Take a shine to your car using a cordless drill and a right-angle drive head fitted with a side-mounted handle and polishing bonnet.



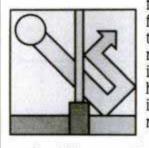
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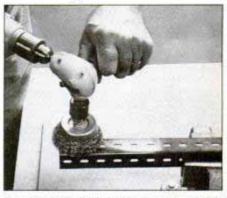


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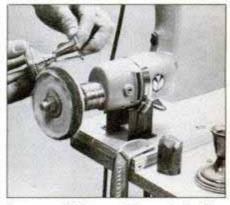
POWER BORE

(Continued from page 127)

Drilling metal with a ¼-in.-dia. highspeed steel drill requires a tool speed of about 1000 rpm. A ½-in.-dia. drill requires about 500 rpm. Cast iron, copper and brass are drilled dry—no lubrication is needed. But wrought iron and steel should be lubricated with oil. Lubricate aluminum with kerosene or turpentine. *Caution:* It's important to wear eye protection when operating *any* power tool. This is especially true when drilling metal.



Remove rust, grime and paint from steel with a cup-shaped wire brush. Wear eye protection to avoid injury from wire strands.



Turn your drill into a stationary tool with a horizontal drill stand. Here, the stand is clamped to a bench for buffing silver.



Drill glass with this carbide-tipped bit. Make a dam of putty or modeling clay to form a reservoir for the kerosene lubricant.



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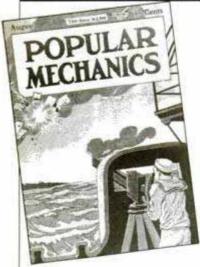
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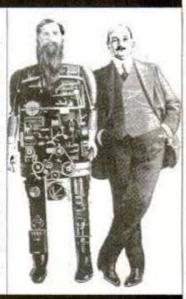
Early anti-aircraft tests.

Big guns

In recognition of the military potential of airplanes and dirigibles, the U.S. Army and Navy scheduled tests to determine the feasibility of shooting down the craft with ground- or ship-mounted artillery. Only heavy artillery was scheduled for testing. Three-inch guns firing 150pound shells started the tests. Planes were represented by mammoth kites with dummies inside; dirigibles were large gas bags or airships directed and steered by seamen in small naval vessels following them.

Lifelike robot

This mechanical man, made by a Berlin engineer, was claimed to be the most natural appearing and manlike ever constructed. Complete with a beard, the "remarkably realistic man-made man" not only walked and moved in a lifelike fashion, but could speak, whistle and sing. It even answered questions and obeyed spoken commands. But, as the article pointed out, it "would do so even though its master forgot to ask the questions or give the commands," making it even more human.





Trans-oceanic luxury.

50 YEARS AGO: August 1936

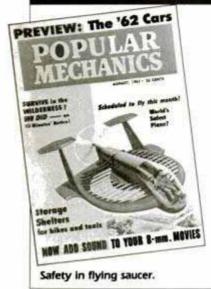
Double-decked flyer A fleet of 29 new flying boats, each handling 24 daytime passengers with berths for 16 was being built for service between England and Australia on Britain's Imperial Airways. Each plane had a smoking compartment and promenade saloon and was constructed with two decks: the upper one housing crew and mail. Each plane had four aircooled supercharged engines, rated at 740 hp each. These supercharged engines



Giant airship's flight Inaugurating commercial air service between the United States and Germany, the 813-ft.-long zeppelin Hindenberg completed its first Atlantic crossing. Roundtrip fare on the airship was \$720. The Hindenberg later crashed, halting passenger airship traffic for 50 years.

Quickest crash boat

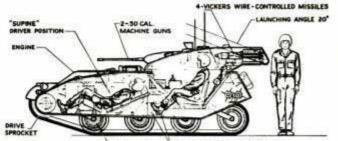
Designed especially to rescue wrecked planes at sea, a new high-speed crash boat (left) built for the Navy combined the functions of rescue, salvage and hospital boat. The V-bottomed 48footer reached a speed of 45 mph in official tests. The crash boat was fitted with a bow-mounted derrick for securing sinking planes. It even had a well-equipped hospital below decks to supply medical aid to persons it would pick up. The 21-ton boat was powered by four 300-hp engines.



Safe flying saucer

25 YEARS AGO: August 1961

When 40 engineers pooled their know-how to make the world's safest plane, the result was the Rotavion XR-62 (for experimental rotor, design 62). It was really two craft in one: the saucershaped fuselage contained two sets of rotor blades, capable of lifting the Rotavion vertically, or landing safely with a dead engine. For cruising, louvers at the top and bottom of the duct closed to provide an airfoil, and a rear-mounted prop pushed the plane at 175 mph. It was too expensive to build.



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While most tanks introduced since World War II had emphasized firepower and improved armor, a British subcompact design took the opposite tack. Light enough to be carried by a helicopter,

this 2-man model featured a compact car engine, aluminum armor and a reclining driving position. Only 5 ft. high, it made a difficult target. Light tanks are used by the U.S. Army today. PM

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