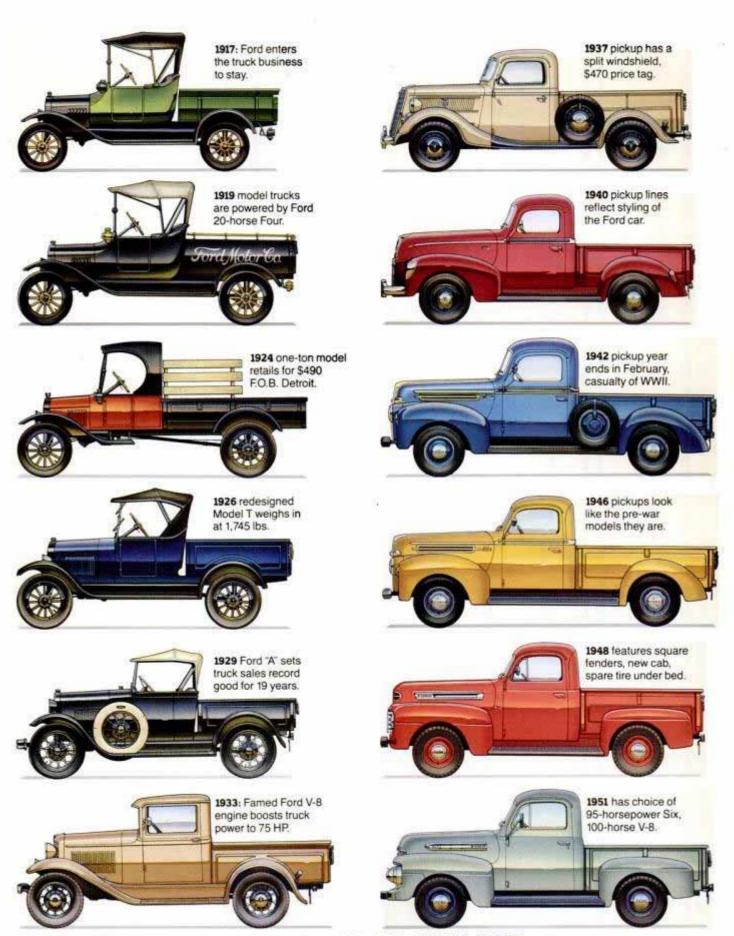
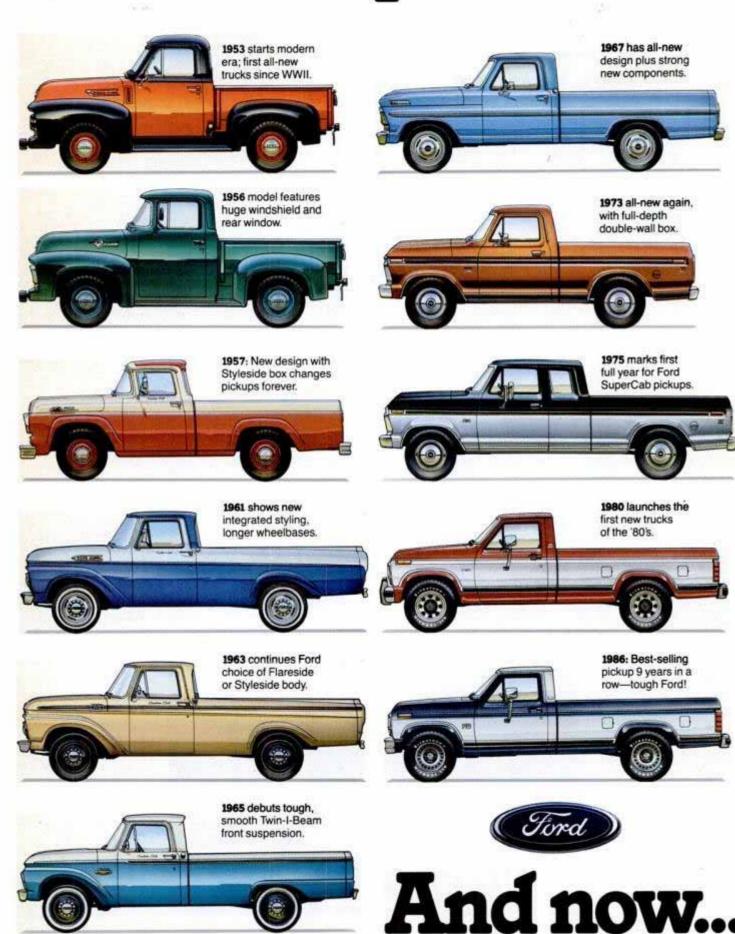


70 Years of



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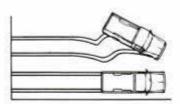
Ford Pickups.



PLEASE TURN PAGE

...announcing the new 1987 Ford pickup. The new shape of tough:

Now, 70 years of Ford truck toughness packed into one terrific new pickup! New aerodynamic design. New fuel-injected power standard. New rear antilock brakes. For '87, America's best-selling pickup* gets even better!

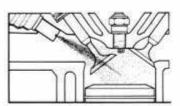


Rear antilock brakes standard.

Now, a major advance in braking control! All big '87 Ford pickups feature new rear antilock brakes—designed to help you make straight, smooth stops when traveling in 2-wheel drive. Only Ford has them. Standard! These aerodynamic Fords not only look new. They change the way pickups stop, go, ride and drive.

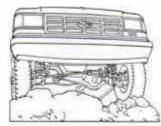
Best-Built American Trucks six years running.

Based on an average of owner-reported problems in the first three months of service of '86 models, and in a six-month period on '81-'85 models designed and built in North America. At Ford, "Quality is Job 1."



Multiport fuel injection.

New electronic injectors beef up Ford's 4.9L Six with 20% more horsepower—standard! V-8's range from the most powerful small V-8, the fuel-injected 5.0L... to the biggest gas and diesel engines in any pickup. You get up to 245 horsepower to move payloads big as 5450 lbs. Or to tow over twice that much.**



Fully adjustable suspensions.

Ford front suspensions have been redesigned for truer tracking, longer tire life. They're also now fully adjustable. And for '87, new gaspressurized shocks contribute to a ride that's smooth on the road yet firm in rough going. Try the ride of a full-size Ford—America's best-selling pickup for nine straight years.*



Luxurious cab interiors.

Inside, you enjoy a new level of comfort and luxury. Behind the sporty A-frame wheel is full instrumentation backed by a dozen labeled indicator lights — all standard. Only Ford offers Regular, SuperCab and Crew Cab.

Lifetime Service Guarantee.

Participating Ford Dealers stand behind their customer paid work, in

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

Buckle up—together we can save lives.

Based on latest available manufacturers' reported retail deliveries.

**When properly equipped and with a fifth wheel.

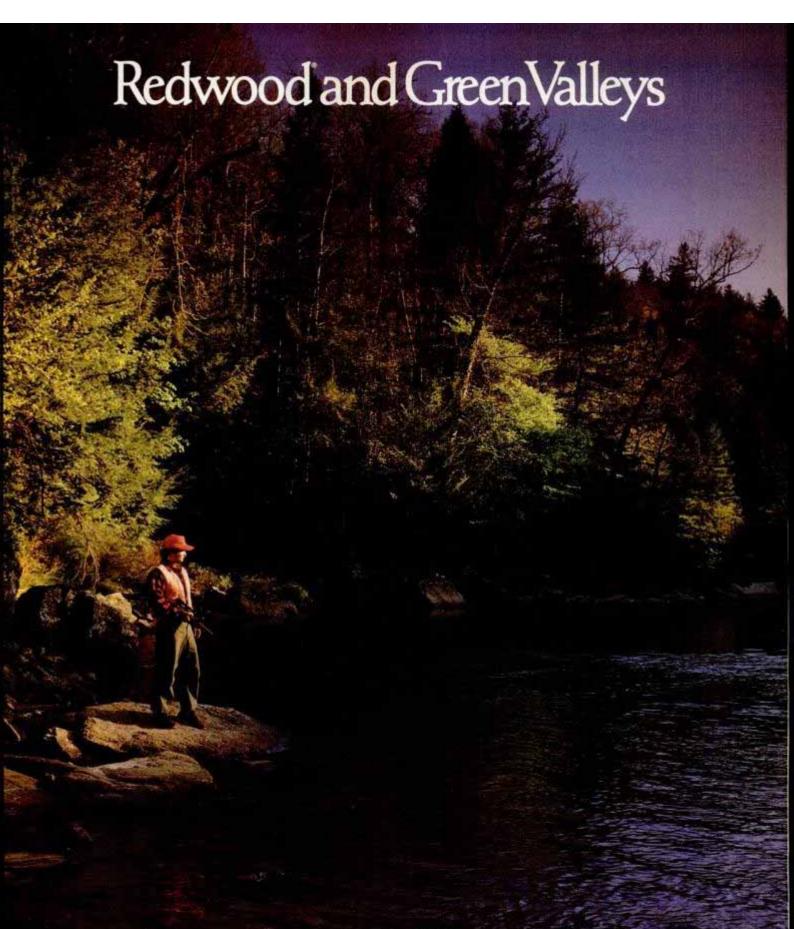


FORD PICKUP

BEST-BUILT AMERICAN TRUCKS







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C 1986 Heime Tobacco Co.

Материал, планивонные антерропом пр.

Popular. Mechanics

DECEMBER 1986

VOLUME 163 NO. 12



ON THE COVER

America's fighting forces are using the latest in outdoor technologies to help them fight harder, longer and more safely. From helmets made of DuPont Kevlar, to load-bearing vests, to unique 1-man shelters that convert into ponchos, the Army is finding new ways to support fighting men in the field. Read about the fascinating new clothing and equipment in the story on page 51.

PM photo by Brian R. Wolff



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55 The Great American Race



71 Molding cutterheads



80 Testing the Wonder Wagons

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demand even higher

demand even higher fidelity from the rest of the hi-fi chain.



TV tech has entered a renaissance as innovation and improvement proceed at an unprecedented rate.

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The right accessories can keep your home electronic equipment out of the repair shop.

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Our future Army will rely on the latest in outdoor technologies to fight harder, longer and more safely.

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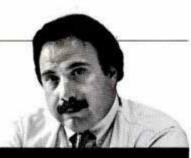
Revolutionary technology being developed for fighter pilots may help doctors travel inside a patient's body.

TECHNOLOGY

125 PM Technology Update

Read about the latest in space, engineering, energy, electronics and the military.

Editor's Notes



The line comes at a crucial point in the movie "Fantastic Voyage." An out-ofcontrol virus is running rampant in the patient's body. Everything else has been tried. "Well, there's only one thing left to do," says Edmund O'Brien, the chief medical officer, to Racquel Welch. "We'll have to miniaturize a nuclear submarine and crew and inject it into the guy's body. Once you're in his bloodstream, you'll have to destroy this deadly cancer." I almost got the feeling



Dr. Thomas A. Furness: Probing the outer limits of computer environments.

that I was in a similar science fiction movie several months ago as Dr. Thomas A. Furness spoke in our conference room. Dr. Furness is chief of the Visual Display Systems Branch of the Air Force Aerospace Medical Research Laboratory at Wright-Patterson Air Force Base in Ohio—and the author of the article in this issue called (what else?) Fantastic Voyage (page 63). Dr. Furness and his staff briefed us about the work going on in the field of computer-generated virtual worlds—worlds that don't exist in reality, only inside a computer and on a Star

Wars-looking face mask worn by the person using the system. It's an incredible story that takes you into the next century, and from a medical operating room of the future to the cockpit of the Air Force's developing Advanced Tactical Fighter. I think you'll agree, after reading the article, that the future holds some unbelievable stuff for all of us. . . . A lot more down to Earth is West Coast Editor Steve Parker's account of his cross-country adventure in a '36 Ford as part of The Great American Race (page 55). What? You haven't heard of The Great American Race? It's a cross-country jaunt from Los Angeles to New York, in a car. Big deal, right? Lots of people have driven from L.A. to N.Y.C. The catch here is that no car can be newer than a 1936 model. Kind of makes things interesting for participants and spectators alike. Our entry, The

Spirit Of Wilkes-Barre, didn't win. But we did finish, and that's what counts when you're pushing a 50vear-old automobile across 3000 miles of the U.S.A. ... And even further down to Earth, Outdoors Editor Tim Cole, Graphics Director Bryan Canniff and photographer Brian Wolfe went camping with the U.S. Army. No, none of them re-upped. But spending the two days in the field with the Rangers at Fort Benning, Georgia, did give

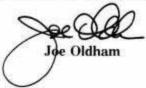


Lean fighting machine: Blackhawk chopper, Rangers.

us some insight into the newest technology that has completely changed the equipment used by, and the face of, today's modern Army (page 51), even compared to the field gear used just 15 years ago in Vietnam. . . . Reading the Teaching Toys article (page 66) reminded me that you'll be reading this right around the year-end holiday season. So I'm going to take this opportunity to

wish you a very joyous holiday season and hope you have a fabulous 1987. Which is exactly what we intend to do here at POPULAR MECHANICS.

'Til next time.



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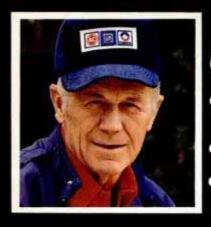
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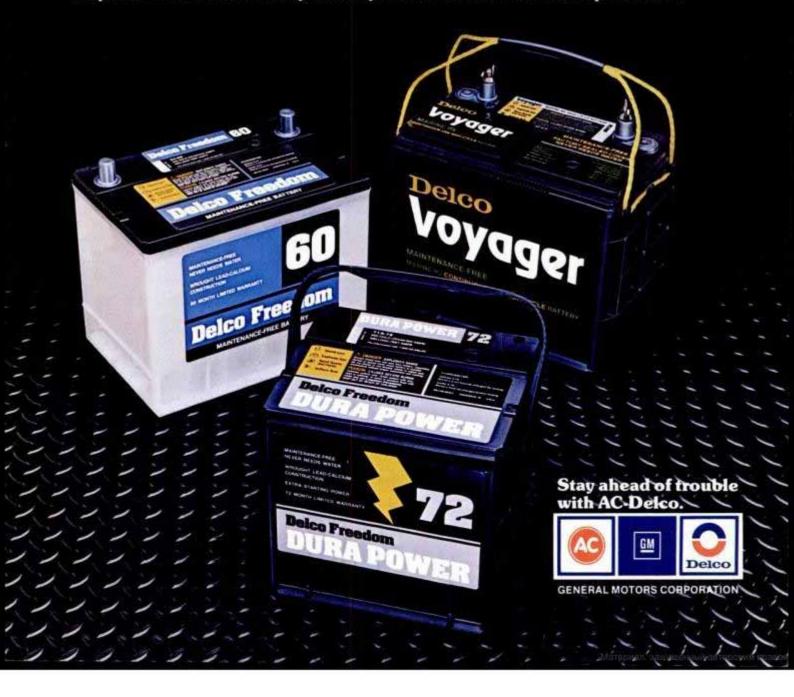
—Test Pilot Chuck Yeager

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Buy a maintenance-free Delco Battery between November 2, 1986, and January 3, 1987, and get a \$5 rebate. This offer's good on Dura Power 72, 60, 50 and 40 batteries, as well as Freedom 60, 50 and 40, and all Voyager batteries.

Just see your AC-Delco retailer and pick up a rebate coupon for details. If you can't find him, just give me a call at 1-800-AC-DELCO.

Requests must be received by January 16, 1987. Offer void where prohibited.



Letters



Ford Fans Fume



Owners of Ford's Bronco II give it a higher rating than PM did.

agree that the GMC Jimmy is the best utility vehicle on the market at first glance (PM Comparison Test: Off-Road Warriors, page 74, Sept. '86). But I gave up on GMC and bought a Bronco II this spring. I'm getting 5 more mpg when towing a boat and the Ford is perfect for off-roading to out-of-the-way lakes. After 10,000 troublefree miles, this is one former GM truck fan who concludes the Bronco II is better than the Jimmy. When I had my '85 Jimmy, it went to the shop twice for engine work and three times for transmission trou-

ble, and needed a complete overhaul after only 28,000 miles. The problems never ended. JAMES W. DeLOZIER CLERMONT, FL

You should recheck your offroad test data and see if you
rated the Bronco II fairly. I
recently bought a Bronco II
after extensive comparison
shopping. The Bronco is
much more comfortable than
the GMC/Chevy twins or the
Japanese imports. And I
can't agree with your comments about "lackadaisical"
acceleration with the 2.9-liter V6.

EVAN HUME

LAWRENCEVILLE, NJ

Lots of letters

I have a slight correction about the letter designations TBF and TBM mentioned in the letter from Richard C. Reed, LCDR USNR (Ret.), in September's Letters column (page 6). The TBM was built by General Motors, not Martin. I should know since I was an engineer on the project and saw the first TBM take off on its trial flight.

PAUL BADER MONTOURSVILLE, PA

As a sidepoint of interest, the General Motors TBMs carried three Browning .50 caliber machine guns, plus a .30 caliber machine gun in the stinger. Most of these guns that I worked with were made by Singer Sewing Machine Co.

A.C. WILSON OTTAWA, IL

We also have to thank the other fliers, engineers and aircrewmen who set us straight on TBM and shared their knowledge and first-hand experience about how American industry met the challenge of WWII.

A toast to PM

Our Sunbeam Radiant Model T-35 Toaster has been in operation since 1960. One morning, when we couldn't get it to accept a slice of bread, my wife said it was time for a new one. But that very night while reading your May issue, I was startled to see the item "Testy Toaster" (Appliance Clinic, page 26). You know the rest.

RICHARD D. COWHER SANDY RIDGE, PA

My Sears washer had the same symptoms as the one in your "Buzzing Washer" item (Appliance Clinic, page 32, Feb. '86). Even though the model number of mine is different, the cure was the same. For less money than a service call, I now have a washer that runs and sounds like a brand-new machine.

MARK R. BREIDENTHALL WARMINSTER, PA

I want to thank Norman Becker for the September column on water-heater safety (Homeowner's Clinic, page 27). After reading the article, I went to check on my pressure-relief valve and discovered that the water heater (installed in 1981) had no pressure-relief valve at all! I've never had any particular interest in plumbing, and never paid much attention to the water heater until I read your article.

Needless to say, I called the plumber right away to install the proper valve.

Thanks again. You may well have saved me from expensive damage or even worse. DAN BLACKBURN

DALLAS, TX

Sawdust in VCR?

You said that a commercially



Kadzan's butcher block table based on PM kitchen cart plans.

available cleaning cartridge is all you need if your VCR is the front-loading type (VCR Tuneup, page 140, Aug. '85). A friend in the business says the highly abrasive cloth in a cleaning cartridge will abrade the heads and shorten the life of my VCR. Would it be better to remove the top of my VCR and do the cleaning by hand?

Also, I've enclosed a photo of a butcher block table I made based on your kitchen cart (7 Expert Ways To Make Butcher Block, page 76, Sept. '84). It was my first experience with this type of woodworking and, thanks to your plans, the result is terrific.

LARRY NADZAN

WARRINGTON, PA

A commercial cleaning cartridge—wet or dry—is the most effective way to clean the heads of a front-loading VCR. But don't use it too often. Don't even use it following anyone's recommended maintenance schedule: Use it only when picture quality has deteriorated.

Counterpoint

Thanks for the article *The Toys Of Summer* (page 69, Aug. '86). You may have encouraged the ruination of more once-beautiful, quiet, clean, little beaches with the roar, stink and oil slick of these monsters. They are to the lakes what ATVs are to the woods. FRANK WALL DOWNERS GROVE, IL

PM starts cars

Thank you for the information about porous Nissan Sentra distributor caps in the July Car Clinic ("S marks the spot," page 40). Our major symptom was a little different: If we started a cold engine, and our first trip was short (1/4 to 1 mile), the car would not restart. The dealer tried to diagnose and solve the problem three times, but never had any success-not until we brought in the pages of Car Clinic with the information about replacing those distributor caps. Thanks again!

AMY AND DENNIS DAVIS ANAHEIM, CA



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Because of our large buying power and agents all over the world, we have unlimited access to merchandise. And after scouring all sources we decided that the XL-29 Watch would be such an irresistible offer, especially if we could "sell" it at a give-away price. The XL-29 is a brand-new advanced model. It has never been featured before. But the predecessor model (XL-27, with lesser features) was listed inour last catalog at \$39.95. At our specialoffer list-building price of \$12.95, the XL-29 must be considered a "steal".

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everything.

It has seven time/date functions: hours, minutes, seconds, month, date, day,

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12 or 24 hour modes, and a.m. or p.m. selection.

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Full chronograph with lap timer function and 1st and 2nd place winners.

■ Full-function calculator performs all "standard" operations. But it also has 4-key memory, performs chain calculations and computations with constants and powers.

The watch, in its black composite case, is very sharp looking, featherlight, and ultra-thin.

The XL-29 is made to the highest quality standards and each watch is individually inspected for flawless performance in

· The XL-29, steered by a superb Japanese chip. is powered by a tiny mercury cell. It will last for at least 18 months then you can replace it yourself. The XL-29 is the most comprehensive timepiece: it does "everything." all functions. We warrant these watches for quality, material, and workmanship for one full year (battery is excepted - you can

New advanced model, with r-melody alarm!

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or 50).

The XL-29 Watch, made to sell for \$39.95, cannot be bought in stores. It's available only through us. And with this special offer, you may order this outstanding watch for just \$12.95.

easily change it yourself, after 18 months

Because this is a list-building promotion, we must limit this offer to a maximum of three (3) watches per household. You may, however, request up to six (6) watches maximum, if you mail your order within 30 days of the publication of this ad. (No exceptions, please!) If you do buy six (6) XL-29 watches, you only pay for five (5) - the sixth one is with our compliments, absolutely FREE! With this offer, only mail orders, accompanied by check or money order (no chargecards, no phone orders!) can be accepted.

Take advantage of this incredible buythis totally unprecedented offer-while it is available. Write your name and address on a sheet of paper, and also write "Code B702." Tell us how many watches you want and include your check or money order. Add \$2.95 postage/insurance for the first watch and \$5.90 for two to six watches. Add sales tax for California delivery.

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BY BILL HARTFORD

New Mercedes Sports Car

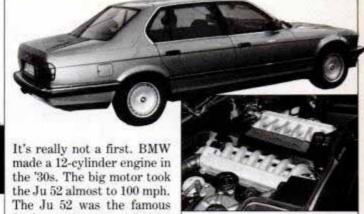


Full-speed ahead for late '80s production is an all-new 560SL.

here's really nothing wrong with a 1987 560SL 2-seater, mind you. It's just that my heart has always been set on the classic body: A '67 250SL would do just nicely. But now, with the word out-and a photo-of a new '88 or '89 SL, the '67 will probably take a jump in price. And, with the '87 SL about to become a "classic," there'll probably be a rush for them, too. It happens every time a new-generation SL nears production. Of course, there's something to be said for a thoroughly modern Mercedes, especially this aero wedge with all the

works. Among the works, if it works, will be something an SL has never had: a roll bar, one that pops up into position only when sensors in the chassis tell it that you're about to roll over. If you don't lose your head over that feature, there'll be more to dazzle you: a ride-height control system to hunker down the car at speed; 4matic system for controlling wheel slip under braking and acceleration; 5.6-liter V8, of course, with your commands transmitted to it by a nonmechanical linkage, known as "fly-by-wire" to jet pilots. Maybe modern ain't so bad.

New BMW V12 7-Series



1988 BMW 750i with new V12 will be much faster, more expensive than the current 735i.

Junkers trimotor—a freight airplane that carried 3 metric tons with its huge, 685-hp BMW powerplants. In cars, BMW has never had anything larger than eight cylinders, and there were very few of them. With its current line, BMW is known as the 6-cylinder car

company-all models have

engines with the same num-

ber of cylinders, but with

But in another year or so, the new 7-Series body (available here around March of next year) will pack a V12. The flagship model, to be designated the 750i, will be considerably more expensive than the current 735i, which is now \$46,675 in its L7 trim.

Other 1987 prices at the top of the BMW line are \$42,475 for the base 735i and \$46,965 for the 635CSi. The 3-Series cars now start at \$21,475, for the 325e.

Little Isuzu's Mister Two



Isuzu COA-2 is mid-engine test bed with intercooled, dohc turbo.

It's Isuzu's "maybe" model. This pretty targa top, if it's ever produced, will be little Isuzu's way of one-upping Goliath Toyota's MR2. The mid-engine, 2-seater Mister Two tested the waters and found them roiling with customers for well-executed, af-

fordably priced, real sports make-believe cars. not sporty cars. The Isuzu COA-2's edge is the way it puts power to the pavement: through all four wheels. And a 16-valve intercooled turbo makes sure there's plenty of oomph to go around.



New Opel Omega claims record-low drag coefficient of 0.28.

GM goes soft

The battle on the European front between Ford and GM will heat up with the introduction of a new Opel to be called Omega. There's not a hard edge to be found on this sedan, which claims an aerodynamic tour de force: 0.28 Cd, a record low

for a car of this class. Designed with flush-fitting side glass and assuming a shape that evolved from months of wind-tunnel testing, the Omega goes up against Ford of Europe's super-smooth Scorpio. Top power, in the Omega 3000, will be 177 hp from a 3-liter Six.



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Материал, зацищенных автороким приво

We'd like to bring up the rear.



Who said never look back? It's where you'll find some of the Civic 4-Door Sedan's best features.

The trunk, for example. Pop it open with a remote release. Then fill 'er up. Groceries for a week or luggage for a week's vacation are an easy fit.

You'll also be happy to know that our backseat doesn't take a backseat. There's plenty of room for adults. Honest.

If your passengers happen to be just a bit younger, you'll find special child safety

features the next best thing to eyes in the back of your head.

Of course, we haven't put everything worth mentioning behind you. The steering wheel is adjustable. The instrument panel is neat. Logical. The view forward is great.

And with a peppy 1.5 liter 12-valve engine, the Civic Sedan is fun to drive. Now that gives you something to look forward to.

Civic 4-Door Sedan

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8

Appliance Clinic

BY STEVE TOTH

Soapy Film On Dishes

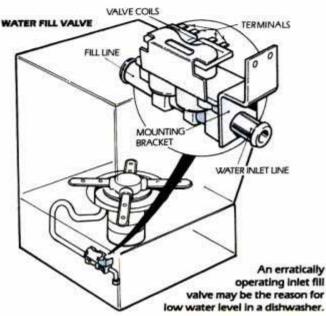
have a Kitchenaid dishwasher, model No. KDS-18, serial No. 221335831. After a complete wash, rinse and dry cycle, the glasses and the dishes below them appear with a soapy film. I've tried cutting down the soap, but this hasn't helped. Also, the soap dispenser is partially full at the end of the cycle. By opening the washer door frequently during a wash or rinse cycle, I noticed the spray arms hardly rotating, although water is spouting from them. Sometimes they move slightly in a clockwise direction. Both dispensers rotate freely by hand. I assume the arms spin by water pressure from the pump. No lack of pressure is noticeable when the pump is removing water from the washer.

D.L. KLEBENOV KNOXVILLE, TN

Sounds as if you're not getting enough water into the wash tub. There could be two reasons for this. It may be due to either a clogged inlet fill valve strainer or a water fill valve that is operating erratically—sometimes it fills the washer and other times it doesn't because of a bad solenoid coil on the valve.

A low water level would affect water pump pressure, preventing the 4-way hydro sweep from turning at the right speed and, in turn, affecting wash quality.

To check for a clogged inlet fill valve strainer, disconnect the power to the machine and shut off its water supply. Remove the machine's lower



front service panel. Once the panel is removed, you'll see the water fill valve on the far left, next to the drain valve. Disconnect the wires from its solenoid coils. Remove the water inlet piping from the valve—be sure to place an old towel under the machine to catch the water that will spill out. Now remove the rubber fill line hose on the other side of the valve which feeds into the wash tub.

Remove the two mounting bracket screws on the plate that holds the valve bracket to the frame. Once the valve is out, remove it from the mounting bracket. Inside the valve you'll see the strainer; pull it out and clean it carefully with an old toothbrush or by rinsing it under a faucet. Put the screen back in the valve body and reinstall it in the washer.

Now plug the machine back in and start it at the beginning of the normal wash cycle. Let the tub fill with water. Once you hear the water valve stop filling, open the door and check the water height in the tub. The water should be up to the outer edge of the stainless steel strainer beneath the hydro sweep (about 6 or 7 quarts).

Next, you should close the door and restart the machine. Let the dishwasher cycle to the fourth or fifth wash position. Open the door and check the water height. Now it should be about halfway over the top of the strainer (about 9 quarts).

If it's not, replace the fill valve, Kitchenaid part No. 242905 (\$23). The kit can be ordered through any authorized Kitchenaid parts distributor in your area.

Worth repairing

My 1966 Maytag washer with suds saver, Model TA606, serial No. 324008BH, has begun leaking when it starts emptying out. A repairman told us the suds saving unit needed to be replaced.

When I went to buy the new unit, I was asked if I wanted just its valve. Given the washer's age, do you think a new valve alone would solve the problem? Is it even worth repairing?

CURTIS FRANKLIN

CLEVELAND, OH

If I were repairing the machine, I would first ask myself if there are any other problems with it: Does the timer stick? Is it noisy during the spin cycle? Is the pump okay? If you haven't had major problems with it, then buy the diverter valve body with flapper, Maytag part No. 2-2504 (about \$16). If the mounting bracket and the solenoid are rusted, then buy the entire diverter valve body, flapper bracket and solenoid, Maytag part No. 2-1168 (about \$46).

Mouse blanket

Is it safe to patch the heating wires in an electric blanket? My blanket is a Montgomery Ward twin-size, single control model. A mouse gnawed through a wire, but I can still get two ends of the wire to touch. I wouldn't bother repairing the blanket, but it's one of a pair and it's only been used three or four times. Thank you for your help.

FRANCES LOWRY ALMONT, CO

Electric blankets are made according to Underwriters Laboratories standards, with electrical components sealed inside. It is neither safe nor recommended that a home repair be made to the blanket or the control. Repairs should be made by an authorized service agency.

Your blanket was made by the Northern Electric Co. for Montgomery Ward. If the blanket is still under warranty, send it and a letter explaining what happened to the company. Include a check for \$14.25 to pay for repairing it, if possible. If it's not repairable, the company will send you a new blanket.

Address your letter to Northern Electric Co., Russell Dr., Waynesboro, MS 39367. Attn.: Service Dept. Manager.

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.

Come to where the flavor is.

Mariboro Red or Longhorn 100's you get a lot to like.

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

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

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Electronics



BY STEPHEN A. BOOTH

Do-It-Yourself Digital

You're probably familiar with the digital audio compact disc and the no-holds-barred musical fidelity it is capable of delivering when the original program material has been recorded digitally.

Digital recording is an expensive proposition comand working prototypes have been demonstrated over the past 12 months.

What's holding up production is financial concerns among hi-fi equipment makers and record producers. Simply, the hi-fi manufacturers are afraid that if we can buy digital cassette decks,



Digital recorder by CompuSonics uses optical discs.

pared to the analog reel-toreel tape decks that have been in use for the past 30odd years. Of the thousands of recording studios in the U.S. alone, only a few hundred are now equipped with digital recorders.

That situation will change rapidly as the price of digital technology drops. And then you can expect to make digital recordings at home—just as you can make analog tapes today on relatively inexpensive cassette decks.

In fact, home digital recording is closer than you think. As I write this, I'm setting off to Japan to look at the new breed of digital audio cassette decks in the making. More to the point, I'll be trying to find out just when these cassette recorders will go on sale. They've long left the drawing board

we won't buy digital compact disc players. That presumes that we'll be able to buy music on digital cassettes. But the record companies are against the idea. They've invested a small fortune in compact disc pressing plants, which have yet to pay for themselves. That's not all: The record companies don't want digital recording ability to fall into the hands of consumers. They're afraid that we'll all go into the business of making perfect digital duplicates of compact discs for our friends and, thereby, cut into Tin Pan Alley's revenues.

This chicken-and-egg dilemma will likely find a solution in the coming months—

Small speaker emits big sound through Bose acoustic waveguide in Zenith TV. stay tuned. Meanwhile, it's now possible for you to do digital recording at home. Actually, it's been possible since 1982. All you need is a decent video cassette recorder and a device called a PCM processor. PCM stands for pulse-code modulation and it's the method by which analog sound waves are digitized. You connect the processor to your VCR then feed the sound-either from live music or a prerecorded source-to the PCM processor.

PCM processors haven't made great inroads among the music-loving public. One reason is their relatively steep price—anywhere between \$1000 and \$2000.

Another reason for their lack of popularity is the inconvenience of "listening" to bulky video cassettes. Though you can put eight hours of tunes on a VHS tape, you can't slip that tape into your car's tape deck or a headphone portable.

Now, CompuSonics of Palo Alto, California, offers another way to perform digital recording at home.

The company's DSP-1000 recorder uses optical discs to store music digitally. Though the CompuSonic discs look like compact discs, they're not compatible with conventional CD players.

The blank discs aren't cheap, either: They'll put you back \$100 for a 1-hour platter, \$175 for a double-



sided 2-hour disc. The DSP-1000 itself is about the price of a small car: \$6995.

Besides the price, the trouble with CompuSonic discs is that you can't play them in your car because the company doesn't offer an autosound version.

In comparison, the digital audio cassette decks now on hold in Japan should cost about \$800 and will be available for cars, too.

TV sound gets bigger

Television manufacturers won't leave the old set alone. We've seen screens get bigger, flatter and squarer. The pictures they display are dramatically sharper. The once dull audio portion is even in stereo.

But now, American TV pioneer Zenith has taken on what has traditionally been one of the weakest aspects of most TV sets, including stereo models: wimpy sound quality.

Four new sets from Zenith employ a radical loudspeaker technology, developed by Bose, to take TV sound where no TV has gone before. All four of these models (SC2793S, SC2793P, SC2747P and SC2749Y—all priced about \$1400) are ultrasophisticated monitor receivers, offering digital circuitry, the ability to receive teletext services, and built-in decoders to receive stereo TV broadcasts.

On the sound side, the sets have small tweeter speakers up front much like any stereo TV. But concealed in the back of the set is the remarkable Bose acoustic waveguide speaker system I reported on nearly two years ago (PM Electronics Monitor, page 14, Mar. '85).

The speaker is a box-like contraption that contains a long, folded tube. A small speaker cone moves air into the tube, producing bass response and clarity you'd only expect to hear in a much larger, conventional loud-speaker. Let's hope other manufacturers take the hint and try to outdo the Zenith/Bose duo.

Only NRI teaches you to service and repair all computers as you build your own 16-bit IBM-compatible micro

Now that computers are firmly established in offices—and in homes, too—the demand for trained computer service technicians surges forward. The Department of Labor estimates that computer service jobs will actually double in the next ten years—a faster growth rate than any other occupation.

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As part of your training, you'll build this highly rated, 16-bit IBM compatible computer system, assemble Sanyo's "intelligent" keyboard, install the power supply and disk drive, interface the high-resolution monitor and dot matrix printer, even expand the memory from 128K to 256K RAM. It's confidence-building, real-world experience that includes training in programming, circuit design, and peripheral maintenance.

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Age

Homeowners' Clinic

BY NORMAN BECKER, P.E.

Peeling Paint Problems

elp! We bought a 30-year-old house with wallpaper on almost every interior wall. We steamed off the paper and painted with a water-base paint. Unfortunately, we painted the kitchen walls without knowing the paint beneath the wallpaper was oil-base. Now every time I wipe finger-prints off the wall or when the water from the sink splashes on it, the paint peels off. Can we strip the water-base paint off the oil-base?

D.J. KIEWICZ BARSTOW, CA

I guess you learned the hard way not to cover oil-base paint with latex and vice versa, unless the area is primed first. Remove loose, peeling paint before refinishing the walls, I would not use a chemical stripper but would sand off loose sections using a pole sander where necessary.

Once all loose paint has been removed, rub down the walls with a damp cloth to pick up the dust. When dry, cover the walls with an oil-base primer-sealer. Once primed, you can top coat with oil or latex paint.

For future reference, test paint by rubbing a small concealed patch of wall with a cotton swab dipped in denatured alcohol. The alcohol will break down the latex so it feels sticky, but it will not do this to oil-base paint.

Chipped bowl

We recently moved into a condominium and noticed our toilet bowl has a chipped section about an inch below the water line. It's not chipped through and there appears to be no leakage. Can we cosmetically repair this?

MICHAEL PHILIPS SHELBURNE, VT

Most toilet bowls are made of china because its glazed surface is nonporous and easy to keep clean. But once the inside of the bowl is chipped, even a patch that's a good color match will discolor in time. You can buy a 2-part epoxy patch kit from your local plumbing supply. The patch will have to be painted with color-matched touchup paint. To patch the area, first drain the bowl. Shut off its water supply, flush it and sponge it dry. Any water left in the bowl should be below the chipped out area. Wipe the chipped area with alcohol to remove any remaining moisture.

Mix the 2-part epoxy patch formula into a heavy paste and fill the chipped area. Smooth it off, let dry then apply the touchup paint. The patch will discolor eventually, but it still should be an improvement.

SERVICE TIP

No house is maintenance free. It's important to periodically check if elements of the house are malfunctioning, damaged or deteriorating. This prevents minor problems from becoming major ones.

The main elements to be checked are foundation walls, roofs and gutters, exterior walls, doors and windows, electrical components, plumbing, heating and cooling, and interior components. To help keep track of these areas, the American Society of Home Inspectors offers a pamphlet, "Maintaining Your Home!" It has a list of things to do and check seasonally and periodically.

For your copy, send \$1 and a self-addressed, stamped envelope to ASHI, 1010 Wisconsin Ave. N.W., Suite 630, Washington, D.C. 20007.

Do you have a home-maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 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, \$2.45 postpaid. Send your order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, NY 10101.

A case of mistaken identity

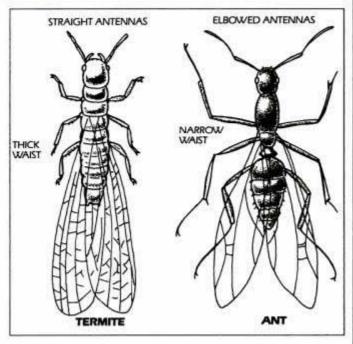
I recently noticed sawdust on the floor below a wood beam in my basement. Is this an indication of a termite condition? DIANE BRESS SPRING VALLEY, NY

No, it's more likely an indication of carpenter ant activity. Carpenter ants, unlike termites, do not eat wood. They merely excavate it to build a nest. The small fragments of shredded wood they generate during the excavation are removed by the ants and deposited outside the excavation.

Termites, however, completely devour wood they are attacking and leave no wood particles behind.

Both carpenter ants and termites have a rigid caste system within their colonies. Reproductive insects from these colonies periodically sprout wings and fly off to set up new colonies (swarming). The two insects look alike but the most recognizable difference between them is that the ants have a pinched waistline.

A carpenter ant infestation can only be eliminated by destroying the nest, which can sometimes be located by watching the ant traffic. Once found, it can be destroyed with insecticide. If it can't be found, individual ants can be controlled with dust or spray insecticides. Remember to exercise caution when using insecticides and follow the manufacturer's directions.



Carpenter ants leave behind sawdust as telitale signs of their excavations. Termites don't; they eat the wood they inhabit.

Материал, защишенный автороким привом

HERE'S A NEW TWIST



ON AN OLD IDEA.





Includes storage / recharging unit and slotted/phillips bit. Other accessory bits available.

What's as simple to use as an ordinary screwdriver but twice as fast? The Skil Twist™cordless power screwdriver.

Its powerful high torque motor lets you drive and remove screws more easily than ever before.

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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 \$6189,* the P'UP you see here is not only the lowest priced Japanese truck, 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.

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

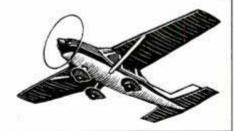
Starting, of course, with ours.

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Aviation



Keeping An Eye On Fuel



Digiflo-L in panel of Piper Aztec N87A shows actual nautical miles per gallon, gallons to destination and gallons reserve.

something. I got a big lesson late one night last summer. We were halfway across Lake Erie on our way between New York and Pontiac, Michigan, in the Aztec N87A I had just bought.

We were at 10,000 ft. in the clouds and the ride was getting rough. Center had a line of T-storms on their screen about 100 miles south, but we were painting some bright precip on the radar pretty close off our left wingtip. Things were getting a little more than bouncy with some speed excursions becoming evident.

It was time to switch tanks and I kept my eye on the gauges.

The right outboards showed about a quarter full, but the left outboards were bouncing off empty. With both fuel pumps on, I had my hand on the left tank selector ready to switch at the first burp. And then it came. I

swung the left tank selector backward to the full inboard tank, but the left engine wasn't the one that burped. Meanwhile, the right engine ran out of fuel flow completely. The plane yawed sharply right and I jabbed the left rudder, attempting to keep things straight and level. With my eyes nailed to the attitude indicator, I pulled the right mixture back to idle cutoff and fumbled for the right fuel selector in the dark. I finally got it swung over to the inboard position. Feeding the mixture back in slowly, the right engine resumed its normal drone.

After we landed in Pontiac, I had the Aztec topped off and checked the numbers. The left outboard, which had been reading empty, had 6 gallons left. The right outboard, which was showing a quarter full, was bone dry.

There are few things in this world that are more imprecise than airplane fuel

gauges. Enter the Shadin Digiflo-L fuel metering unit. Fuel digitizers have been out for a number of years. These devices position a free-spinning wheel in the fuel line just ahead of the carburetor or fuel-injection unit. Each time the wheel makes a complete turn, it breaks a light beam. This information is transmitted via a transducer to a minicomputer contained in the panel-mounted indicator head that computes the spins of the wheel into the amount of fuel burn.

You enter the total amount of fuel in the tanks when you top off. The digitizer then tells you how many gallons (or pounds) per hour the engine is burning, deducts this from the total, and shows you how much you've burned and—more importantly—almost exactly what you have left.

Since the Lake Erie experience and other fuel-consumption cliff-hangers, we had been toying with the idea of installing a fuel metering unit in the Aztec.

We decided on the Shadin unit because of its unique capability of coupling with our Apollo II Loran to compute fuel burn according to groundspeed.

The Shadin Digiflo-L lists for \$1595 for a single and \$1995 for a twin plus transducers and hardware.

We had the unit installed by the IAs at our home hangar at MacDan Aviation in Caldwell, New Jersey, and it took about 15 hours to get the job done. A realistic ready-to-fly bottomline for the Digiflo-L, the way we estimate it, would be about \$2000 for a single and \$3000 for a twin.

How does it work? Superbly. Startup is simple. The Digiflo-L has a nonvolatile memory and remembers the numbers even when it's shut down. So it's unnecessary to re-enter the totals each time you fly. When you top off, you input the new total.

To begin, you push a button and the system utilizes diagnostic software to check itself. On the twin model, the two lower windows show fuel burn at all times. These are especially handy when used in conjunction with the EGT to lean the mixture.

The top window displays four other functions as directed by a rotary switch. With the push of one of two buttons, it will also show gallons of fuel used and gallons remaining.

The system's endurance function shows in hours and minutes how much time the airplane will fly at the current power settings.

The gal. reserve function calculates the amount of fuel which will be left on board, at current power settings and according to current groundspeed, when the aircraft reaches its destination as indicated by the destination waypoint set in the Loran. If that number is less than the endurance to reach the destination, plus fly for 45 additional minutes, the numbers will flash.

The gal. to destination calculates the amount of fuel it will take to reach the destination set in the Loran at current power settings and under current wind conditions. If the fuel on board isn't enough, the display flashes and the amount of fuel short will show, preceded by a negative sign.

The nm/gal. position is the most interesting and useful feature. It shows the most efficient cruise and optimum cruise speed as dictated by headwind, tailwind or nowind conditions related to the groundspeed that was input by the Loran. By selecting the power setting which yields the highest nautical miles per gallon, it will indicate the best range for the fuel onboard.

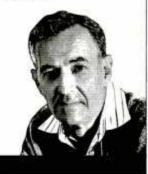
We are thoroughly satisfied with the Shadin Digiflo-L. Next to the Loran unit itself, the new fuel-flow indicator is the most useful addition we've made to the plane.

When a friend spotted the unit in the Aztec's instrument panel, he commented: "New toy, huh?"

"No. Security blanket," we answered.

-Fred Mackerodt

Car Clinic



BY MORT SCHULTZ

Sudden Acceleration

The problem of sudden, unintended acceleration of certain cars has been in the news for some time. Let me update you:

1978-'86 Audi 5000: The National Highway Traffic Safety Administration (NHTSA) began a safety defect investigation into this problem, which involves more than 300,000 cars. Owners have described the condition as a full-power acceleration from a stationary position or while driving at slow speed, usually just after shifting the automatic transmission from PARK to DRIVE or REVERSE. NHTSA claims to have reports of 300 accidents that have allegedly resulted in four deaths and 175 injuries.

Volkswagen of America is installing an automatic shift lock in Audi 5000s to help prevent sudden acceleration. The device makes it impossible to shift into DRIVE or REVERSE from PARK unless your foot is on the brake. If you haven't had the lock installed, call your dealer for an appointment.

1973-'86 GM cars: The NHTSA has announced that it's closing its books on alleged sudden acceleration involving approximately 60 million GM models. The agency claims it hasn't been able to identify any defect that would account for the reported incidents.

The NHTSA investigation "involved extensive field tests that examined all electrical, mechanical and electronic systems that could cause sudden acceleration.

Agency engineers hypothesize that many sudden acceleration incidents in GM cars may be the result of drivers unknowingly pressing the accelerator pedal when they intended to press the brake pedal."

NHTSA's investigation into alleged sudden acceleration problems with the following cars is continuing: 1983-'84 AMC Alliance/Encore, 1984-'86 Honda Accord, 1980-'85 Nissan 280Z and 300Z, 1981-'84 Toyota Cressida, 1980-'85 Volvo.

If your car suddenly shoots ahead, step down

hard on the brake pedal with your left foot even if you think you're already braking with your right. Turn off the ignition, but don't pull out the key. Doing so will lock steering on most cars.

Spacer man

My 1985 Cougar is the hottest four wheels I've ever owned—once I get it started (engine warm), that is. There's never trouble starting the 2.3-liter EFI turbocharged powerplant when it's cold. But hot? Forget it. It cranks smartly, but takes an unacceptable amount of time to fire. My Mercury dealer can't figure it out.

JOE KISH CHARLOTTE, NC

This is one of those conditions that can escape detection if you're not up on the latest info. First, make sure your dealer has checked the usual ignition, fuel and emissions system reasons that can cause this problem. For example, look for dripping injectors that flood the engine, low fuel pressure or ignition circuitry failure when engine is hot.

Then, there's a possibility

that specifically applies to your engine: excessive heating of injectors due to contact with the intake manifold. To check, warm the engine, shut it off and connect an ohmmeter between the body of each injector, in turn, and a ground on the intake manifold. If an injector is touching the manifold, the ohmmeter will show less than infinite resistance. This occurs because metal expands when the engine gets hot, bringing injectors and manifold into contact. The result is overheated injectors that cause fuel to boil and create a vapor lock.

If you or your mechanic find that injectors are touching the manifold, remove the fuel supply manifold/fuelinjector assembly and install a spacer around each injector pintle. It will prevent metal from touching metal. Part number for the spacer is E5PZ-9D905-A.

Hubbub

About 40 days after we got a new 1985 Cadillac Sedan De-Ville with the 4100 engine, the water pump pulley flew off when my wife started the

(Please turn to page 29)



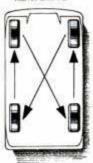
Pattern swapping

There seems to be a lot of confusion among readers about tire rotation patterns. And no wonder—there seems to be a lot of confusion among manufacturers, too. First they told us to cross-switch 'em. Then they said to keep radials on the same side of the car. The official word from the Rubber Manufacturers Assn. gives four different patterns. We'd stick to the "preferred" two, which are the latest word. If the engineers have any new ideas, we'll let you know.

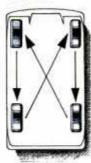
Do not include a "Temporary Use Only" spare tire in the rotation pattern. If you have a regular tire for a spare and use it in the pattern, place the spare tire on the right rear and use the tire that would have gone on the right rear as the spare.

PREFERRED PATTERNS

FRONT- OR REAR-DRIVE

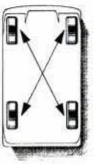


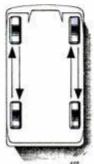
FRONT-DRIVE

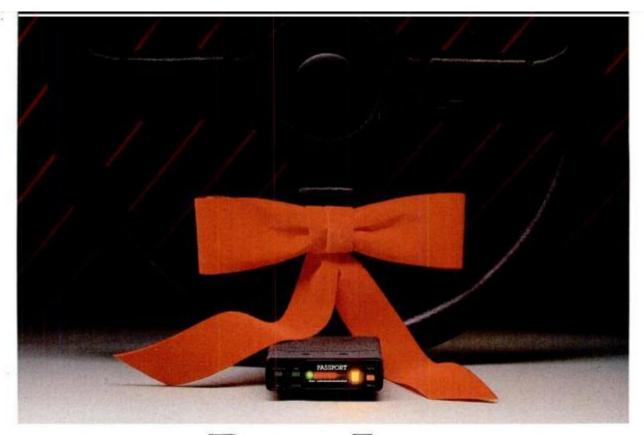


ALTERNATIVE PATTERNS

FRONT- OR REAR-DRIVE







Pure Joy
(And we'll deliver...tomorrow morning)*

Imagine a superbly crafted electronic instrument, powerful enough to protect against traffic radar, miniaturized enough to slip into a shirt pocket, beautiful enough to win an international design award—and advanced enough, thanks to its new Rashid-rejection circuitry, to obsolete the detectors of every other maker.

Then imagine finding one with your name on it.

Pure Joy is a PASSPORT of your very own

PASSPORT has exactly what the discerning driver needs, superheterodyne performance and complete Rashid rejection. On duty, it maintains a remarkably low profile, only 0.75 inch tall. It's about 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. The result is Pure Joy.

Others may put it differently. "In a word, the PASSPORT is a winner," said the experts at Car and Driver. "The PASSPORT is recommended," said Road & Track

The package in which PASSPORT arrives is as impressive as its performance. Everything is included: visor clip, windshield mount, straight cord, coiled cord—even a leather case. Each item is secured in its own foampadded compartment to assure safe arrival. Rather like traveling first class, we think. And this will be the impression when the box is opened.

Installing PASSPORT is as easy as the unwrapping. Just clip to visor or windshield, plug into the lighter, and PASSPORT is on duty.



PASSPORT comes complete with all accessories.

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Материан, этомиченной автороким при

(Continued from page 24)

engine. The car was towed to the dealer, who made a repair that lasted until the other day. Then, the three bolts screwed into the pulley broke off, and the pulley again flew loose. I asked the service manager to secure the pulley with grade 8 bolts instead of the cheaper grade 2 bolts Caddy uses. He said it wouldn't do any good—that he has had quite a number of other customers with the same trouble, and no matter what method he tries, these pulleys keep coming off. What's the solution?

C.E. JORDAN KEYSER, WV

Cadillac says it has come up with the solution. Your dealer should have gotten the "word" in Product Campaign Bulletin (PCB) 85-C-1 and 1A. Different bolts won't help, because bolts only hold the pulley to the hub. The hub is pressed onto the water pump shaft. The trouble comes about because the hub separates from the shaft—not the pulley from the hub. The bolts on your pulley may have broken when the pulley hit something after it flew off the hub. There are a couple of procedures described in PCB 85-C-1 and 1A. Most important is the installation of a new water pump (part No. 3634606) that will hold the hub in place. Don't take

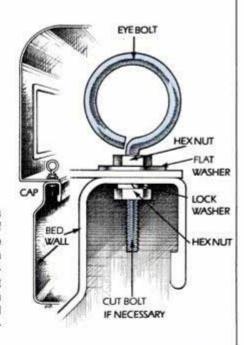
SERVICE TIPS

- Don't let anyone tell you cold-start stalling or sagging on acceleration is "the nature of the beast" for a 1986 Caravan, Voyager or Ram Van with a 2.2-liter engine. According to TSB 18-31-86, a new emissions package has been issued to defang this animal. The part number for vehicles with manual transmission is 4419410; automatic, 4419411.
- If your early-built 1986 Toyota Celica has an annoying droning noise at higher speeds, possibly accompanied by a vibration or buzzing from the instrument panel, show your dealer how smart you are by telling him the problem is originating outside the car—with the way the catalytic converter is supported on rubber donut-type hangers. The whole story is recited in TSB 011 (Engine) dated 8/1/86.
- Premature clutch wear on 1984-'85 and some early-built 1986 Pontiac Fieros may be traced to a clutch master cylinder that isn't fully releasing, so the clutch stays partially engaged. Ask the dealer to shim the cylinder using a 2mm spacer (part No. 10046516) as detailed in TSB 86-7-34.
- The American Petroleum Institute says that continuous contact with used motor oil has caused skin cancer in mice. Although the effects of oil on humans has not been established, why take chances? Wear rubber gloves when draining oil; if any gets on your skin, wash all of it off immediately.



Rope 'em cowboy

"Pickup trucks equipped with caps generally don't have a means of securing loose objects carried in the truck bed," says W.E. Power of North Hero, Vermont. "I solved this problem by replacing the fasteners that hold the cap to the lip of the bed with eyebolts of the same diameter and length. The eyes make perfect hitches for tie-down straps or rope."



your time getting the car to a dealer to have this work done: There's a definite time limit on this Product Campaign. After it expires, you revert to the 48month/50,000-mile warranty now in effect for this engine. When those limits expire, the repair cost is your problem, not Caddy's.

Yammer about camber

My 1985 Nissan 200SX is on its second set of rear tires, shooting for No. 3, in only 37,500 miles. Inner tread wear is unbelievable, and repairs by my Nissan dealer can't seem to stop the problem. The front tires, which you'd expect to wear out faster, are still the original. You're my last hope—also my cousin's. He has the same model.

BOB BLUM MORRISVILLE, PA

Even if you've had the alignment of this independent rear suspension system adjusted recently, check it again. Without anyone in the car, but with a full complement of gas, oil, coolant and tire-changing tools stowed in the trunk, rear-wheel camber should be between -1°15' and +0°15'; rear-wheel toe-in should be between -0.08 in, and 0. If toe-in cannot be set to this specification, you should look for a bent rear suspension arm.

Judging from your description of the tread wear on your Nissan, I'll bet that rear-wheel camber is exceeding the specification to the negative side. The main reason for excessive rear-tire inner tread wear on the Nissan 200SX has been too much negative camber.

If camber doesn't stay within the correct range after adjustment, remove and discard the rear springs and upper and lower spring seats.

You should install a new set of seats and brand-new rear springs that were specifically designed to keep camber within proper specification.

The part number of this spring for all models except the 1984 Nissan 200SX turbo is 55020-04F02. The part number of the spring for the '84 turbo is 55020-04F03.

Rotten eggs

My 1986 Mercury Sable gives off a strong sulphur odor from the exhaust. The dealer says 17 percent of all Sable and Taurus models do this, but he hasn't been able to do anything about it. How can Ford get away with producing and selling this model?

> FRANK ATTILI NEW HARTFORD, NY

It isn't. I just learned that those cars having trouble can have a new catalytic converter installed, free of charge. The unit will deodorize the exhaust and get rid of the sulphur smell.

This information is so new I don't even have the part number for the new converter, but it will be contained in upcoming technical service bulletin (TSB) 86-18.

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. Freewheeling



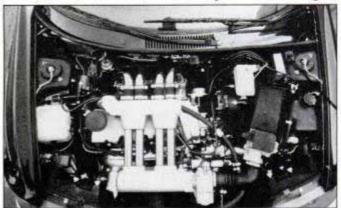
BY WADE HOYT

Ingenuity Is Job 1



ars of the future are usually long, low and sleek—like Ford's Probe V, shown in our October issue (Driving The Future, page 76). They're also a bit short on practicality. So, when we saw a short, high and bulbous future car from Ford of Europe, we were intrigued. Called the ELTEC (for

Electronic Technology), it's a 5-door front-drive hatch-back with a continuously variable transmission (CVT) and computer-controlled engine, suspension and brakes. A joint project of Ford's Research and Design departments in Germany and England, ELTEC was developed in an amazing 18



Dual long-and-short intake runners widen maximum torque band.

months, compared to the four to five years usually required to sort out a fully operational prototype.

The 1.3-liter, overhead cam, aluminum 4-cylinder engine has three valves per cylinder (two intakes and one exhaust) plus Americanstyle computer controls for the new European antipollution laws. The extremely lean-burn engine runs on an air-fuel ratio of 20:1 rather than the normal 15:1.

The 79-hp engine develops high torque over a broad, flat range, thanks to a dual intake manifold system with long runners for maximum low-speed torque and short runners for high-speed punch. A "drive-by-wire" electronic throttle control eliminates the usual mechanical throttle.

A low-volume cooling system keeps engine temperatures high for maximum fuel efficiency at low speeds. At



Instrument pod moves with the adjustable steering wheel.

higher speeds, low air pressure beneath the front of the car pulls open five rubber flaps to exhaust hot air from the radiator area. A computer-controlled water pump varies coolant circulation with engine temperature.

ELTEC's self-levelling air spring suspension is also computer-controlled to firm up the handling at high speeds and soften it for comfort at lower speeds.

A humidity sensor closes the sunroof at the first drop of rain, whether the driver is in the car or not. The car can be parked with its roof louvers open for ventilation without worrying about changes in the weather.

Suppliers from many nations contributed, including a run-flat tire from Continental that eliminates the spare, and a low-cost antiskid brake/anti-wheelspin acceleration system from Kugelfischer.

Quality is Job 11

A survey by one of the Big 3 automakers shows that U.S. car quality still lags behind most imports. During the first three months of ownership, Toyota owners experienced an average of 1.5 problems. Audi, BMW, Honda, Mazda and Mercedes owners each had 1.8 problems, Nissan 2, Subaru 2.4, VW 2.7, Volvo 2.8, Ford 2.9, Chrysler 3.3, GM 3.4, AMC 4.6 and Yugo owners 8.4 problems.

Big dummy tests goosebump index

This spooky-looking mannequin—known as Voltman to the fun-loving Swedes who invented it—is used to ana-

lyze in-car climate of Volvos. Hooked up to a pair of computers, the big dummy measures the amount of energy needed to maintain a steady temperature in all parts of its "body," despite drafts or solar hot spots. Using such innovative but objective measurements "Equivalent Livingroom Temperature"

percentages," Voltman helps to qualify what was a highly subjective area—human comfort.



(ELT) and "complaint Voltman mannequin evaluates comfort.



Inexpensive. And built to stay that way.

Outdoors



BY TIM COLE

Advances In Ski Tech



Jacques Eymard prepares to blast off in the new French-designed turbine skis.

You remember the French. They're the people who like to windsurf across the Atlantic, who like to race Gran Prix autos through narrow, winding streets, who aren't happy unless they're holed up in some wadi between Paris and Dakar in a rally car.

This peculiarly French appreciation for the dangerous and the bizarre now extends to the ski slopes, where inventor Bernard Gervason continues to put the world's first turbine-powered skis to the test.

Gervason's system, modeled here by pilot Jacques Eymard, includes two tiny turbine engines that attach to the skis behind the bindings, and fasten to the skier's upper calf. The engines are a miniaturized version of the type you might find aboard your average cruise missile.

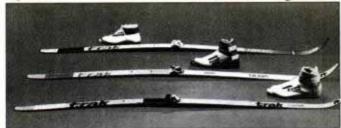
The skis themselves are unique. They have a pair of vertical stabilizers

fore and aft to keep the arrangement tracking properly. The skier wears aerodynamic accessories that reduce parasitic drag, including a teardrop helmet and a pair of handheld spoilers. When Eymard assumes the tuck position, his whole body becomes an aerodynamically efficient projectile as he zips across the snow.

Gervason is gratified with the system's speed record to date—100 km/hr, or 60 mph. Tests this winter will try to boost that top end into the 200-km/hr range.

What will the French think of next?

Specialization for cross-country



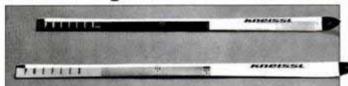
Trak's new cross-country skis are designed for different skiing styles.

Trak has been the name in cross-country ski gear for quite a while. Not content to rest on its considerable laurels, Trak set out to develop cross-country systems for skiers with individual tastes and skiing styles.

The Trak Aerobic (top) is a general touring ski for lighter skiers. Along with Trak's aerodynamic CS200 boot, it features an asymmetric base and wood-laminate core in sizes from 180 cm to 215 cm. The Trak Nova has a new polyethylene base and is considered a general recreation ski used in con-

junction with the CS500 boot, a versatile medium-cut rear-entry boot suitable for a wide range of skiing styles. The Trak Skater (bottom) is a new, high-performance cross-country ski weighing only 500 grams. It incorporates carbon fiber with a honeycomb core for torsional rigidity. The Trak CS505 boot is considered the state of the art in high-cut, highperformance skating boots, boasting light weight, yet maximum support. Contact Trak at Tri-Star Sports, 475 Smith St., Middletown, CT 06457; (203) 632-2000.

A ski for beginners



Kneissi Preflex skis offer beginners easier turning. The tips and ends raise slightly upward when the skis are loaded.

The toughest part of learning to ski is learning how to turn. Kneissl addresses that problem with a new ski design called Preflex.

Instead of skis that camber upward at rest unloaded, Preflex skis rest flat on the ground, with tips and ends that raise slightly upward when loaded. For the beginning skier, the raised ends mean greatly reduced turning resistance. The Preflex design also lets skiers move up in length without sacrificing control. Skiers can progress to longer skis more rapidly and good technique is encouraged. For more information, contact Kneissl at Tri-Star Sports, 475 Smith St., Middletown, CT 06457; (203) 632-2000.

Ski boots going soft



Nava soft-boot system uses a control arm.

The complaint we hear most often around the ski chalet pertains to how uncomfortable ski boots have become. Nava, an Italian company that makes motorcycle hel-

mets, has come up with a unique soft boot and binding system that's easy on the feet while permitting multidirectional release. The boot is also warm and comfortable on and off the slopes, as I discovered last spring.

At the heart of the system is a soft, 2-piece boot that has a hard, quick-lacing inner liner inside a soft water-proof outer boot. The inner boot—which permits the wearer to stand upright—is

lined with Thermofil foam for warmth and comfort. The outer boot is chafe- and water-resistant.

A revolutionary "step-on" binding accepts the soft boot. Leg movement is transmitted to the ski with a control arm that extends from the binding up and around the leg, providing

(Please turn to page 34)

32

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."

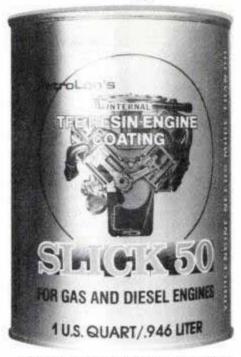
"Dune Buggies & Hot VWs" magazine
April 1983 issue records the results of their
one year testing of Slick 50. "We can indeed
say scientifically that Slick 50 does work,
and that it does reduce engine wear! . . . for
the price of one treatment when compared
to engine rebuild, we feel that you'd be
money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

- 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. 12 (in California 1-800-233-9559) or send to: Progressive Energy Corporation, 255 South Bent Avenue, #B-1, Dept. PM126, San Marcos, California 92069.

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- 3. A Rowing Machine
- 4. A Shuffle-Type Ski Exerciser

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 because NordicTrack has inertial resistance not available on a Shuffle-Type Ski Exerciser.

Other ski exercisers use less efficient frictional resistance with a resulting calisthenics-like feeling. NordicTrack's unique flywheel resistance for a life-like feeling of smoothness and continuity is matched only by real skiing.

Burns Up To 600 Calories per 20 Minute Workout

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800-328-5888

Nordic rack

141PM Jonathan Blvd. N., Chaska, MN 55318

OUTDOORS

(Continued from page 32)

lateral support. The spring-loaded control arm is hinged on a small, gas-filled damper housed in the base of the binding. The system effectively shifts the burden of lateral support directly from the leg to the ski. Under normal conditions, leg action must first be imparted from the leg to the boot and ultimately to the ski. According to Nava, eliminating the boot from this series of steps translates leg motion directly into immediate edging power.

I gave the Nava system high marks. It seems to balance comfort and control without compromising one or the other. I was particularly surprised at how easy the binding is to use. You can lean well back against the control arm, and your feet feel well supported, yet liberated from the solitary confinement traditional plastic boots offer.

Perhaps most gratifying is the steep learning curve the Nava system offers. Bad habits and accumulated rust seem to disappear. Contact Nava Leisure USA, 49 Riverside Ave., Westport, CT 06880; (203) 227-5151.

Boot tech

Once, leather laceups and galoshes were the only boots worth considering when looking for ways to protect your feet in a harsh environment. But lately, bootmakers in Europe and North America have created special boots to meet special needs. Mountaineering in high altitudes demands strength, support and maximum protection from cold and wet. Deep snow requires a wide, flat sole and good insulation all the way up the leg, with a proper drawstring seal at the top to keep out snow. Hiking and work boots should provide some protection from the cold and wet, but should also be durable and flexible.

PM's recent test excursion to Iceland—where we photographed and wore boots designed to handle the aforementioned requirements—left one very clear impression: Synthetics and modern manufacturing have developed remarkable boots capable of withstanding unbelievable climatic extremes. But don't discount those old insulated leather laceups for warmth, support and flexibility.

On the high-tech side, European boot makers Kastinger and Koflach have fashioned rigid plastic mountaineering snow boots in the ski boot tradition. Both manufacturers use a seamless outer plastic shell that cants forward and back for flexibility. Both also use a leather, felt-lined inner boot with a light rubber sole for warmth and chaferesistance that can be worn around camp. Rest assured your feet will stay warm and dry in a pair of these well-

made marvels. But, they are stiff. That can be an advantage if you're interested in adapting these boots to a pair of ski bindings—currently under consideration by U.S. Army mountain forces—but their rigidity can work against you if you plan on performing movements that demand some flexibility. And while Kastinger and Koflach have gone the extra mile in protecting against chafe, stiff ankle support tends to rub you the wrong way.

The Canadians, on the other hand, have come up with a smart solution for winter warmth. Sorel, and the Ski-Doo clothing accessory division, insist that the way to keep feet comfortable in winter is to cloak them in a removable felt liner, inserted in a reinforced rubber lower boot, with a nylon upper to keep out snow. Both Sorel and Ski-Doo manage to balance warmth, flexibility and support. Sorel's version borrows its design from the traditional Eskimo mukluk. Ski-Doo's version-widely popular and offering plenty of warmth for the dollar-has a shorter upper and a buckle tie-up. After wearing both off and on over a period of days, I decided that they're equally as warm, but I question the need for the Sorel upper to be as high as it is.

The **Technica**, also known as the "moonboot," has an abundance of insulation and warmth, and a wide, reinforced sole helps in traversing deep snow. But an almost total lack of ankle support limits the Technica significantly. I found that most cold-weather outdoor activity demands at least some kind of support.

Vasque represents the classic "hiking-boot" side for more temperate footwear. This all-rounder combines Goretex with leather on the outer shell for maximum support and scuff protection. Socks provide the insulating properties with this kind of arrangement. Yeti gaiters from Denali—the warmest model has a Goretex shell and a Thinsulate lining—fit snugly over the Vasque hiking boots to add upper-leg insulation and to keep out snow.

Despite some pretty interesting advances in the field, the best all-around solution for multiseason footwear still might be the leather laceup. Northlake and Timberland have made significant strides in insulation and durability. Redwing's new Irish Setter model, which we used with some success in the Icelandic interior, uses a silicone treated upper that sheds water and a Thinsulate lining for warmth.

You might want a plastic shell boot from Kastinger or Koflach on K2, a Sorel or Ski-Doo in Montana's deep snow, and a Vasque hiking boot on the northern reaches of the Appalachian Trail, but traditional designs still provide multiseason function.



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

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EXCEEDS THE NEED

Buckle up-together we can save lives.

Home Video



BY JAMES B. MEIGS

Light And Magic Shows



RCA's VMT400 digital VCR lets you create exciting tapes.

ovie producers Stephen Speilberg and George Lucas don't have a monopoly on elaborate special effects any more. A few electronics manufacturers now offer video products that let you create some pretty remarkable effects at home—without a Hollywood studio budget.

Whether you want to jazz up movies you've shot with your own video camera, or simply edit together a "greatest plays" tape from the current football season, today's special effects generators (SEGs) give you the power to take charge.

I recently got a chance to try out JVC's JX-W9 (\$350), a full-featured SEG typical of the genre. (Other companies offering high-powered SEGs include Akai, Showtime and Sansui.) It can't create interstellar battleships, but it will produce some pretty dazzling effects. Even if you're not interested in creating light-and-magic shows, the SEGs simplify the process of editing home movies. For example, the JX-W9's rear panel has enough inputs and outputs to handle up to three VCRs. You can easily take scenes from two playback VCRs and edit them onto one cassette in your record VCR.

It would take a small book to describe all the functions of this gadget, but three of the most important are WIPE, FADE and EFFECT.

The wipe function allows you to replace a video image with a sliding field of color. The SEG gives you a half dozen colors to choose from as well as a wide variety of different wipe patterns and speeds. The fader performs a similar function, allowing you to fade the sound and picture down to nothing.

Using both the fader and the wiper, it's possible to edit together a polished production with a clean wipe or

Special effects generators such as JVC's JX-W9 let you take control. edit between each major scene. The SEG even has a special function, "auto cross input," that lets you switch from one source to another (say, from VCR-1 to VCR-2) automatically, while disguising the transition with a wipe. But the real fun of JVC's SEG comes when you switch the mode selector to EFFECT. Then you're able to engage any of the five effects: defocus, negative, B & W, colorize and paint.

The colorize and paint controls are the most exciting: They let you turn any image into a shimmering palette of color. These effects are also adjustable: You can set them low to lend a slightly exaggerated tinge of color to a scene, or crank them up all the way to create an almost totally abstract effect.

A few words of warning are in order, however. With all of its options, the JVC JX-W9 can be quite complicated to use—and the owner's manual isn't much help. This isn't a product for the person who just wants a simple way to edit home movies. But if you like fiddling with electronic gadgets, and don't mind spending some time figuring out how they work, this high-powered SEG can be a lot of fun.

SEGs aside, it's possible to build special effects circuits into other productsincluding VCRs. In fact, 1987 might be the year of the digital VCR. RCA, Toshiba and NEC already have digital VHS models in stores. The digital models available so far use computer memory chips to enhance freezeframe and slow-motion. They also permit picture-inpicture. Each company has its own twists on the digital

concept. For example, RCA's VMT 400 adds some interesting picture effects that can make the image look like a tile mosaic or a colorized poster.

Holiday gift tips

If you're stuck trying to think of holiday gift ideas for your favorite video buff, a trip to a good electronics store can help. Here are a few suggestions:

- For the video enthusiast whose coffee table is crowded with remote controls, GE recently introduced an updated version of its popular Control Central universal remote. Like the Control Central, this handheld remote can learn the functions of your existing remote controls, letting you retire the remotes that came with your VCR, TV and other products. Priced at \$100, Control Central 3 is a simplified version of the original, handling up to three products in its memory.
- As many people using 8mm camcorders have discovered, it's especially important to keep 8mm video heads clean. Several accessory companies including Bib and Nagaoka have recently introduced 8mm head-cleaners that will do the trick. And they don't take up a lot of room in a stocking.
- Another practical item for home moviemakers is an accessory lens kit. These are available from Ambico and other companies. Some of the add-on lenses for video cameras and camcorders include wide-angle and telephoto attachments. Used properly, these lenses can lend remarkable versatility to a camera's built-in zoom lens.



BUILD THE BEAUTIFUL BLUENOSE II

It's A Relaxing Hobby

In today's hurried, harried world, everyone needs a relaxing hobby. Model ship building – the world's oldest hobby – is the surest way to wind down and enjoy a creative outlet. You need no special skills. Just some spare time, patience and a desire to build something worthwhile. As you see your ship model approaching completion, you'll take pride in your creative efforts and newly acquired knowledge of how great sailing ships were built.

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Even if you've never built a model before, you can build the Bluenose II. Like a shipwright of old, you'll build this schooner

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Of course, nothing this beautiful and well detailed can be built in a day. Expect to spend 50 to 100 hours building this magnificent schooner. Hours of enjoyment and immense satisfaction. Our clear instruction booklet and giant plans make every stage of construction simple.

You'd expect to pay over \$100 for such a high quality kit. But to introduce you to ship modeling, we're offering it at the special low price of \$69.95. A small price to pay for a finished model which should be worth many times the cost of the kit.

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Built in 1963, the Bluenose II is the last of the Tall Schooners. She paraded in the Tall Ships ceremony at OpSail 1976 and again sailed proudly at the Liberty Weekend OpSail on July 4, 1986. She's an exact replica of the original Bluenose, a Canadian fishing schooner that outraced New England's fastest fishing vessels in

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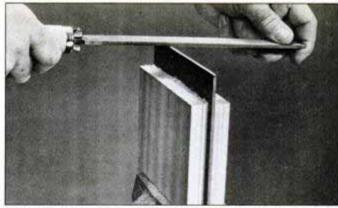
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Workshop Minicourse

BY ROSARIO CAPOTOSTO



When filing long, thin edges that can't be clamped close to the vise jaws, sandwich the workpiece between two pieces of scrapwood to keep the file from chattering as it cuts.

Using Files: Part 2

ast month, we discussed files in general and touched on how to use them. This month, we'll take a closer look at filing technique.

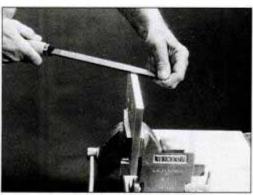
To begin with, the workpiece should be held at elbow level. However, there are exceptions. For heavy filing, the work is held lower than elbow level. Conversely, fine, delicate filing requires that you sit at the bench and keep the work at eye level. There are three basic ways to file: straight or cross filing, draw filing and lathe filing.

When straight filing, hold the file diagonal to the workpiece and starting with the file's point, advance it forward and laterally across the surface, finishing the stroke at the file's heel. This technique requires a file about one-third longer than the area being worked.

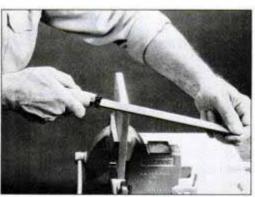
Draw filing is slower than straight filing, but results in a smoother surface. Use a single-cut bastard file, gripping it at the point and handle while holding it perpendicular to the work. Push and pull the file over the workpiece with even pressure.

Lathe filing is often used for fine fitting of a turned workpiece. You can buy a lathe file with rows of teeth at an oblique angle to its length, but a single-cut bastard file also works.

Next, we'll conclude our series with tips on specialized filing.



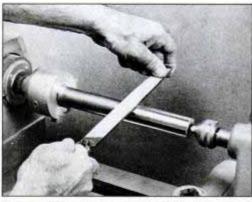
In straight or cross filing, clamp the work firmly. Hold the file level and diagonal to the workpiece. Begin the stroke at the file's point.



Advance the file forward and laterally, keeping it at the same angle. Use even pressure. You should end the stroke at the file's heel.



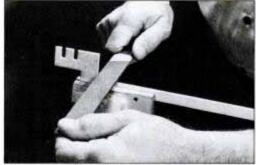
To draw file, use a single-cut bastard file. Hold it level and perpendicular to the surface. Push and pull the file along the workpiece.



In lathe filing, set spindle speed at moderate to high rpm. Use a single-cut bastard or lathe file and stroke it in a forward and lateral motion.



Many files are available with "safe" or uncut edges. This edge permits filing in tight spots without cutting into an adjoining surface.



Here, a safe-edge file is used to square up an inside corner. Note that the work surface is secured as close as possible to the vise jaws.

New Home Security Device Stops Burglars

Introducing the best bargain in low cost home security! Now you can protect your home and family in minutes.

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Law enforcement officials will tell you a dark house is like an invitation to a burglar, and that leaving your lights on when you are away from home is one of the best ways to make it look occupied. But leaving the lights on all the time costs money and rarely fools the professional criminal.

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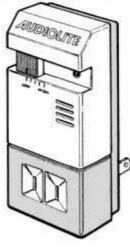
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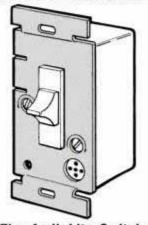
Three Easy Ways to Protect Your Home in Minutes



The AudioLite Socket is as easy to use as screwing in a light bulb. This is the AudioLite created for outside flood lamps, driveways and walkways. Works with up to 150 watts.



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The AudioLite Switch turns on ceiling lights. It's terrific for dark stairways, hall-ways, entry ways, basements and garages. It installs quickly and easily in place of your present light switch using just a screwdriver. It takes only a few minutes, even for a novice. Works with up to 200 watts. (incandescent)

Inside Detroit



BY JIM DUNNE

Olds 2+2 Hangs Tough

oldsmobile probably will not produce this sleek, low 2+2 coupe. Chances are that the car-as yet unnamed, but already assigned GM code letter O-will be scrapped along with the whole Olds Touring Coupe concept.

The latest report from Olds headquarters, which will not reveal any details of the car, is that the "Touring medium-priced 4-door of the Audi 5000 type to Olds.

The decision, if true, sounds the death knell for this prototype. However, GM watchers remember that the Fiero was officially killed not once but twice during its prototype stage. One of the things that saved the Fiero was its attractive styling, which was seen by many inside and outside of GM



Oldsmobile Touring Coupe may rise from its own ashes Fiero-like.

Coupe is not a viable project at this time." The car was to be priced in the \$20,000 range.

Still, as the photograph above shows, development work on the car continues even after GM management has put its official kibosh on the whole business.

The story making the rounds in Detroit is that General Motors bigwigs feel the corporation has more enough specialty than coupes in the lineup-Allante, Corvette, Fiero and soon-to-be-announced Reatta-so Olds should look elsewhere for its specialty car. That leads GM's big thinkers to assign a

(through a variety of "spy" feature. Perhaps the same scenario will take place with this Olds. From the continuing development work documented in this photo, it appears those in charge of the project are hoping it will.

Even if the Olds Touring

photos) as a highly saleable

Coupe does not get into production, its design gives an inkling of GM's planning for future car models.

The recessed door handles are a first for a car built in the United States, even though the hidden design has been used in Europe and Japan for years.

The grille shape and detail continues a trend that started at Oldsmobile with the Calais, and can be seen in the Toronado and next year's

Lincoln follows Taurus

This final prototype of the 1988 Lincoln Continental (below) shows heavy influence from the Taurus in its styling. Side sheetmetal is rounded, and glass is set almost flush against the window frames. Oversize plastic bumpers wrap around the corners and extend to the wheel openings, following a design that seems to be reaching just about every



Lincoln Continental will share front-drive Taurus platform in '88.

Cutlass Supreme. Bumper and grille are rounded in the plan view, and the grille detail consists of horizontal strips, to appear much like the Toronado.

The windshield wiper is also innovative for North American cars. The single wiper arm is similar to those used on older Sciroccos plus current Mercedes 300s and some Subarus.

While the windshield wiper design is a slight moneysaver, since one blade and arm are used in place of two, the bigger attraction is its novelty. No other General Motors car has such a design yet, though reports from inside GM indicate that a future Riviera is being tested with the single wiper sys-

new car model. The nontraditional Lincoln grille is lower and wider, but it still carries the Lincoln cue of vertical bars.

Biggest changes are set for the chassis. Front-drive replaces rear-drive, a 3-liter V6 engine replaces the 5liter V8, and the suspension is independent on all four wheels. Ford is positioning this model against the Cadillac Seville, but at an expected lower price, perhaps even below \$25,000.

Big-car lovers need not worry. The new Continental does not replace the reardrive V8 Lincoln Town Car. That model will continue in production indefinitely, riding the recent wave of popularity for the older, more conventional designs.



No, it's not an Olds, but the rear end of the 1988 Ford Crown Victoria. Next year is a "freshening" year for the big Fords, with new grilles,

(Please turn to page 45)

Face (and tail) lift will give the '88 LTD an Oldsmobile look.





THIS WAGON CHALLENGES EVERY REASON FOR NOT OWNING A WAGON.

Every year, the Sports Car Club of America holds a series of races with a class dedicated to performance sedans.

But in '86, Volvo gave the race a larger dimension: the 740 Turbo Wagon. The first wagon to ever compete in this SCCA series.

The results? In the first five races, the 740 recorded the fastest qualifying times twice. And led one endurance

race for five out of six hours.

More important, though, is that the 740 finished every race it started. A statement some of the performance sedans can't lay claim to.

And one that may make the 740 Turbo Wagon something unique among performance cars. The get-up-and-go that gets you where you're going.

A car you can believe in.

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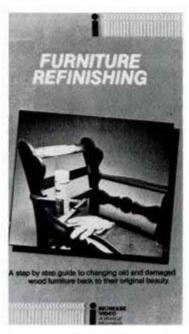






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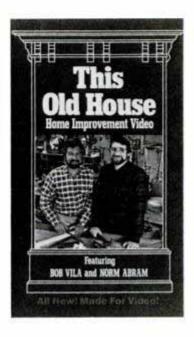
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Now you can take that old piece of furniture and make it look brand new. Furniture Refinishing helps you do an expert job by providing a first-hand look at the materials and techniques. You'll learn the three main steps of refinishing: stripping away the old finish and stain, preparing the wood for the new finish, and finally, applying the new stain and/or varnish finish. With the aid of this videotape, you can restore your old wood furniture, even cabinets, and bring out the glow of its original beauty. (VM-1003-\$29.95)



If you're new to doing your own auto repair or want the perfect gift for someone who just bought a car, this one-hour tape of 20 common repairs is for you. Last Chance Garage shows you ways to save money and do the job right, from oil and filter replacement to flushing a radiator to lubricating the suspension. All procedures are clearly explained and demonstrated, and a clever on-screen numbering system lets you quickly fast-forward to any topic. You'll even learn how to change your alternator and replace shock absorbers. (VM-1002-\$24.95)



Based on the award-winning public television series of the same name, This Old House shows you in 60 minutes how easily you can do home repairs. As on their television program, hosts Bob Vila, a regular PM contributor, and Norm Abram skillfully demonstrate projects you can do. The setting is a typical house in need of basic repairs and enhancements. Among the 14 topics: trimming a door, fixing a faucet, glazing a window and installing track lighting. Even advanced projects will seem easy. such as building a deck, installing a brick patio and refinishing a floor. With the cost of home repairs and improvements these days, you'll save a lot by doing them yourself. (VM-1001-\$24.95)

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Go for the guts and grit. Go for Centura.



INSIDE DETROIT

(Continued from page 40)

bumpers, deck lids and lights. The chrome steel bumpers will be sheathed in plastic end covers that blend in with the rear fenders. And the trunk will have a key lock at the lower right corner. Doors, fenders and all sheetmetal above the beltline are unchanged from 1987, while the powertrain and suspension is carried over intact.

Opels to U.S.?

Yes, and Lotus too, if GM goes through with a plan to create a new group of dealers for its European imports. Look for three lines of Opels and perhaps three Lotus models to be the backbone of the new dealers' showroom hardware. There's also a chance that Corvette would be part of the deal, so that the dealership could specialize in highperformance or European-type sporty cars. Biggest reason for the plan: Get GM's Opel line on sale in the U.S. to compete against the growing demand for midrange European sedans. But GM sees the Opel name-the sound of the name, not the reputation-as one of its biggest drawbacks.

Back to France

American Motors may stop its produc-

tion of the Alliance/Encore in the U.S. and import the economy sedans from France instead. Poor sales of the two lines, plus a plan to build larger cars in North America, are the reasons behind the thinking. AMC will continue to build the Alliance/Encore through 1989. But after that, their future is uncertain. The company wants to make its highly successful Jeep lines even more profitable, which could signal a move of assembly lines-Jeep going to Kenosha, Wisconsin, where the Alliances are now built. The larger cars, which AMC plans to build in Canada, are the Premier sedans, based on the Renault 25.

Caddy full of changes

Cadillac will keep the Cimarron as the entry-level car in its lineup for the time being, and not import an Opel as originally planned. The decision is partly based on another plan to bring in three Opel models and create a group of dealers separate from those currently handling GM cars. Cimarron is scheduled for a minor facelift in the 1989 model year, but the line could be dropped out of production in 1992. Cimarron's mission is completed anyway. The car was originally brought into the Cadillac lineup to give dealers a fuel-efficient small model they needed at the

height of the fuel crunch in 1981. Never a big seller at Cadillac, Cimarron nonetheless is now sold to a steady group of about 20,000 buyers a year.

Chrysler '88 plans

Chrysler's version of the aerodynamically shaped sedan will make its appearance next year when new Plymouth and Dodge midsize models are introduced. Like the Taurus, the new Chryslers will have only four doors to start. And like Taurus, rounded shapes will dominate the sheetmetal, while glass will fit almost flush with the body and doors. These cars will be slightly bigger than the LeBaron and Lancer, but will be less sporty in appearance. Later, a 2-door will be added to each nameplate.

Chrysler's tall wagon

Look for Chrysler to try to extend its lead in passenger van sales with the introduction of a "tall station wagon" in 1989. This model will be a Mitsubishi product that could be built in the U.S. at the Diamond Star plant Chrysler and Mitsubishi are jointly building in Illinois. Modeled after the popular Honda Civic wagon, the new wagon will cover the lower end of the passenger van market and keep Chrysler at least one step ahead of its domestic competitors in minivan offerings.



Old House Restoration

BY BOB VILA

Fixing Plumbing

here's a lot a homeowner can do to keep a handle on home plumbing by learning how the system works, how to recognize its malfunctions, and how to repair them before they become more serious. And with some professional plumbers charging \$50 an hour, there's an even greater incentive to learn plumbing basics.

Main shutoff valve

If a serious leak occurs and you are unable to locate its source, shut off the water flow to the house with the main shutoff valve. Test this valve periodically and label it with a big tag. Make sure that every household member knows where it is.

Pipes

Every house has two sides to its plumbing: the water supply system and the DWV (drain, waste, vent system).

The water supply system delivers hot and cold water to the various fixtures and appliances. Its pipes are usually made of 1/2- or 3/4-in.-dia. iron, copper or plastic.

The DWV system carries out waste water. It also vents potentially harmful gases to the outside. These pipes are wide (11/2 to 4 in. dia.) and are typically of cast iron, steel, copper or plastic.

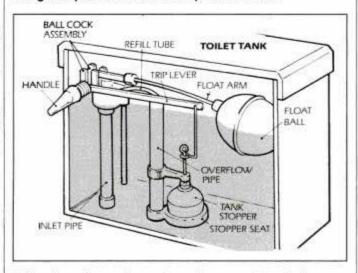
You need two primary

Contributing Editor Bob Vila is host of public television's "This Old House," funded by Owens-Corning Fiberglas.

skills for pipe repairs: measuring a run of pipe and assembling a joint. You'll also need to choose from a very wide selection of fittings. So unless you're well versed in this kind of work and have the right tools, you might

HANDLE HANDLE SCREW SPOUT HANDLE FAUCET PACKING NUT SEAT **ESCUTCHEON** VALVE THREADS & WASHER WASHER C CENTRAL VALVE SEAT SCREW COMPRESSION WASHERLESS FAUCET SINGLE LEVER

The compression faucet (left) is prone to leaks from being closed too hard. This damages the valve seat, ruining the watertight seal. The washerless faucet (right) is more reliable, but doesn't have interchangeable parts like those for compression faucets.



Malfunctions in a toilet tank can be caused by misalignment between the stopper and seat or an improperly set float ball.

want to call a professional.

Plastic pipe offers some advantages. It's lightweight, simple to join and fit, noncorrosive, self-insulating, clog resistant and inexpensive. However. plumbing codes do not yet agree about where and how plastic piping may be used.

Simple problems

Fixing a leaky faucet usually is simple. The method you use will depend on what category it falls into: compression type, washerless or single-handle faucet.

The most common abuse of compression faucets is shutting them too hard. The metal lip around the washer begins to grind into the valve seat, ruining the seal. Water leaking from around the stem of the handle indicates a defective o-ring or packing that wraps the stem. Replace all the faulty parts.

Unlike washer-type faucets, washerless faucets do not have interchangeable parts. Take the whole assembly (it's easily removed) to the plumbing supply store.

Single-handle faucets are of three types: tipping valve, rotating ball and cartridge. They do not have washers or diaphragms. If leaks develop, buy a repair kit made by the faucet's manufacturer.

When a sink, lavatory, shower or bathtub drains slowly or not at all, the usual cause is an accumulation of hair, grease or debris. One of biggest causes of plugged kitchen sinks is pouring grease down the drain, where it can cool and congeal, forming a gooey blockage. In bathroom sinks and tubs, the leading cause of clogs is hair.

A removable plastic drain basket can catch many of these substances. But if the blockage is not in the drain opening, the problem lies in a trap or waste pipe. You may be able to clear it by pouring three or four pots of boiling water down the drain to soften the clog, then let-

ting the hot water run. If this doesn't work, you have three options.

First, you can use a plunger. If this fails, try a chemical drain cleaner. If neither works, then you have to use a drain snake. Many sinks have a clean-out plug on the bottom so you won't have to remove the

whole trap.

According to my associate on "This Old House," plumber Richard Trethewey, the most effective tools for clearing a clogged toilet are a plunger and a toilet auger. Chemical cleaners generally aren't strong enough to penetrate a toilet trap completely. Select a plunger with a fold-out or extra brim. If several minutes of vigorous pumping doesn't do the trick, use the auger. Aim it into the trap area, turn the handle and keep moving the auger up the trap. Hook the blocking matter and pull it out or break it up, rather than push it in deeper.

Toilet tank troubles

After a flush, if water flows into the tank but the tank never fills, the tank stopper probably hasn't returned properly to the stopper seat. This allows water to perpetually flow into the bowl because of misalignment of the lift-rod guide or bent lift rods. You can straighten either with your hands or a pair of pliers. If the stopper is falling on the center of its seat and water still keeps running out of the tank, check for dirt or sediment on the seat. If the seat is clean, the stopper may be worn and need to be replaced. If problems persist with the ball and lift-rod mechanism, you may want to replace it with the more efficient rubber flapper.

If the toilet tank refills after a flush but the water fails to shut off, the tank ball float may be set too high. To check this, lift up the float ball. If the noise and incoming water flow stop, it means the ball isn't rising enough to trip the ball-cock assembly. Bend the float arm down. If this doesn't do the trick, then replace the inlet valve.

If not enough water flows into the bowl for proper flushing, chances are you don't have enough water in the tank. Raise the float arm about 1/2 in.

Noisy pipes, frozen pipes

Banging noises that occur when a faucet is closed are called water hammer. It's caused by water slamming against the end of the pipe. The remedy is to install a cushioning device called an air chamber. This is a vertical length of pipe, capped at the top and connected to a water line at the bottom.

To thaw pipes, apply heat slowly, starting at the faucet or valve end. Make sure the valve or faucet is fully open. You can apply heat with a torch, but it's safer to wrap the pipe in rags and pour boiling water over it.

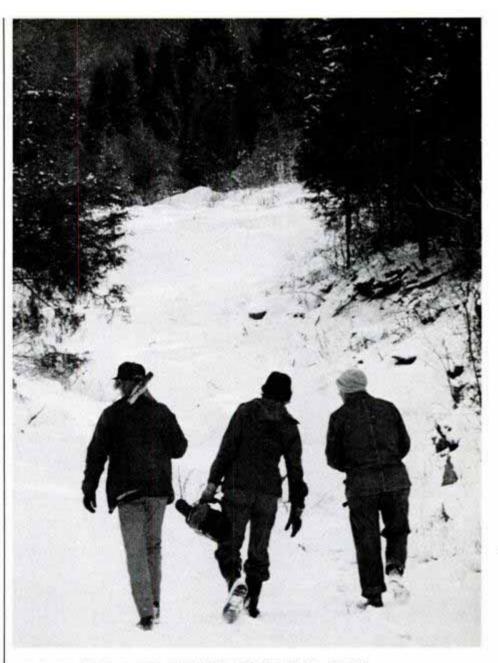
To prevent pipes from freezing, reroute them to a warmer location. But as a stop-gap measure, you can use electric heating cable. Equipped with a thermostat, it turns on whenever the pipes are at risk of freezing. The cable can also thaw frozen pipes.

Low water flow

Often, low water flowage is caused by rust or deposits clogging pipes. To test for this, open a cold water faucet at a laundry tub or washing machine and at a bathroom or kitchen sink. If the flow is low at the second fixture, the pipe connecting the two is constricted and will have to be replaced.

Water heater failure

A water heater can fail from unheeded tank corrosion. You can defer corrosion and help the heater operate more efficiently by draining about a pail of water from its tank on a monthly basis. PM



AT JACK DANIEL'S DISTILLERY we never have to go too far to find our Christmas tree.

The woods around our part of the country are full of them. So getting a good one is never a problem. We hope you won't have to go to

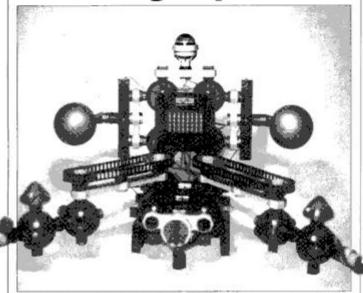
too much trouble getting ready for the holidays either. So you can sit back and enjoy this happiest of all seasons with your family and good friends.



CHARCOAL MELLOWED FOR SMOOTHNESS



A 'Moving' Experience



Capsela Computer Remote Control set is a snap to put together.

Well-meaning relatives are forever buying "learning" toys as Christmas presents for children. Such toys more often than not wind up on a shelf, a monument to the power of boredom. But this year's New York Toy Fair yielded a toy that teaches without pretending to do so. It's just plain fun. The Capsela Computer Remote Control building set by Play Jour is a 17-function, motorized construction system. The parts snap together in a variety of configurations to become robots, spaceships, earthmovers and what have you.

My 6-year-old daughter Rachel and my 15-year-old son Simon had the \$150 set for an hour before they were able to put together the robot shown above. It has flashing lights, a buzzer and a set of reduction gears that work in a seethrough modular capsule. How drive systems work becomes quickly apparent to the user as this set comes together.

Lasers give medicine new vision

A Harvard Medical School team led by Lloyd Aiello reports a high rate of success with lasers in controlling one of the major effects of diabetes. Roughly 20 percent of long-term diabetics suffer damage to blood vessels in their eyes. The damage usually widens blood vessels, allowing larger than usual molecules to get through. This puts pressure on eye nerves and causes partial blindness.

New laser cauterization of eye blood vessels in diabetics has reduced the blindness rate to 10 percent. Tests are continuing with this method.

Higher IQs

A group of us were gathered around Raj Ready, head of the robotics institute at Carnegie-Mellon University in Pittsburgh. He was explaining the value of the personal computer in artificial intelligence research. "Parallel processing" was the term for the day. And it has become the biggest hope among scientists trying to make machines as intelligent as human beings.

In parallel processing, more than one computer is used to solve a complex problem. Each of the peripheral computers takes one chunk of the problem and works on it, then dumps the solution to a central processing unit. Carnegie-Mellon and several smaller institutions are working on the technique today and expect to come up with highly intelligent systems within the next two or three years. Such systems might operate a mass transit line, or monitor the progress of a postoperative patient.

The problem is being attacked at several fronts. The most progress has been made in the area of "expert systems." These are programs that contain all the data available on one small subject. For instance, there might be a single program dedicated to the mitral valve of a human heart. This program would contain data on the valve's construction, operation and history, based on thousands of case studies of normal and diseased valves. A heart surgeon considering an operation on a mitral valve might put an expert system disk on his computer and tell the computer his present patient's blood pressure, pulse, heart history, weight, disease history and other data. The computer would then produce the patient's profile suggesting several diagnoses. Such consideration might ordinarily take a team of doctors days to generate. Working with IBM, Raj and his colleagues have embarked on a 3-year study to develop expert systems.

Space factory

The Challenger Shuttle disaster has changed a lot of the discussion going on about our future Space Station. Many politicians are saying the station should be used for pure scientific and military purposes only. But there is a groundswell toward dedicating much of the Space Station's area to factory use when the system goes into orbit in the 1990s.

Reliance Electric's Robert Dannenfelser Jr. helped focus the support last month in a paper released at a NASA conference. Dannenfelser predicts that space manufacturing has a sales potential of upward of \$100 billion a year within the next 20 years. Pharmaceuticals and metal alloys, he predicts, will be the leading items.

The major element needed is electronics. Everything working in a space factory will have to be automated. Dannenfelser says microcomputers can be programmed to run a factory of 2500 cu. ft. or less. That footage is in keeping with current plans for Space Station modules.

Also, control devices that have parts capable of generating or receiving electric currents are already being made. This dual capacity means that all the mechanisms needed to run a space factory would take up a very small fraction of the area.

As we get back into the launch mode with our space program, Americans should demand the system be used with manufacturing in mind. It's time to bring something back from space besides moon rocks.

Student scientists

When the American Association for the Advancement of Science holds its annual meeting in Chicago in February, hundreds of research papers from high school students will be presented. High school students and teachers interested in this program should send a self-addressed envelope to me, and I'll rush you details on how to participate.

Материал, защищенный авторский правом

If the world were a perfect place, you wouldn't need a Buick.

The real world includes long stretches of traffic. terrible weather and serious demands on your car. So, may we suggest that you consider a car intelligently designed to handle the real world? We're suggesting you consider Buick LeSabre. Not because it's perfect, but because it is so good at the things that really count. For example...

For adults

Those of us who have graduated to adulthood appreciate certain significant accommodations to reality. A glance at LeSabre's interior tells you it's rich and handsome. Sit in it and you find something even better: true support combined with deep luxury. And the available 6-way power control seat puts a wide range of adjustments at fingertip control.

While you're sitting in that seat, do another reality check and you'll find another surprise: room. You have to stretch to reach the far side. Clearly.

Buick is an automobile built for adult pleasure.

In the long run

The real world is not kind to automobiles. Rain, rocks, potholes, mud, salt, ice and humanity all take



their toll. Buick is prepared to fight.back.

mental as the paint. The LeSabre finish starts seven layers down. First, the body is immersed in a phosphate cleaning solution. Then it is electrically charged to provide a magnetic attraction for paint. Only then does the first primer coat go on. After the primer coat is wet-

Take something as funda-

sanded by hand, a platoon of robots applies two separate layers of color enamel, dancing and whirling to cover every surface evenly and completely.

Finally, two coats of clear acrylic enamel are added to provide a deep, lustrous finish to keep your Buick handsome through vears of life's abuses.

When all is said and done, the real test of satisfaction with a car happens behind the steering wheel. And Buick is just what the driver ordered.

LeSabre's big 3.8-litre V-6 with sequential-port fuel injection is there to do the job quietly, easily, reliably. Fully independent suspension not only smooths the ride but also grips the road in a highly sporting manner.

Until the world we live in perfects itself, may we suggest that you buckle up and see your

Buick dealer for a test drive in an automobile that can make

reality enjoyable. Really. For more information. a brochure or a test drive, call 1-800-87-BUICK (1-800-872-8425).





Where better really matters.













BIVOUAC 2000 New synthetics and design hit the ground running for the soldier of tomorrow. BY TIM COLE, Outdoors Editor Photos by Brian R. Wolff

he time is the future and the place is a distant battlefield. Cobra gunships and Apache attack helicopters secure a landing zone and a fleet of UH-60A Blackhawks, dangling in the air like a parade of insects, prepares to disembark the army of the 21st century.

The threat from an opposing land force is real, but so too is the threat from prolonged exposure to the sun and rain, rocks and undergrowth, wind and snow. To sustain soldiers in this harsh environment—to keep them fighting harder, longer, more safely—the Army has developed an array of protective clothing and equipment that relies on the latest in outdoor technologies. From helmets made of DuPont Kevlar, to unique 1-man shelters that convert into ponchos and

Spec. 4 Jack Braden of the U.S. Army's Third Ranger Company exits a Blackhawk transport. He's wearing the Army's latest battle dress uniform and carries a Squad Automatic Weapon.



compress to tiny 5-pound bundles, the Army is finding new ways to support fighting men in the field.

Much of the work is being conducted by the U.S. Army Research, Development and Engineering Labs in Natick, Massachusetts. Natick technicians either modify commercially available materiel to suit a rigorous Army environment, or create entirely new gear that

who don various types of prototype clothing and equipment and perform inside weather-simulation tasks chambers. Wind machines, moisture makers, heaters and air conditioners can duplicate desert or winter conditions down to precise humidity and wind-chill levels. Subjects walk or run on treadmills that vary in speed and inclination while scientists monitor their heart rate, respiration and temperature. Prototype gear is also tested in the field at Army installations like Fort Benning, Georgia, home of the infantry, and in Alaska. The theme is

objectives.

Begin with the battle dress uniform. or BDU. The olive drab jungle fatigues of the Vietnam era are being phased out in favor of BDUs sporting specially designed camouflage patterns that can defeat Starlight night-vision scopes. Camo designs are available for desert terrain or for the tropics. Camouflage makeup is also becoming a standard item, and Natick is working on camo paint that doubles as an insecticide.

The Army has also given priority to eye care, and soldiers of the future will be issued "ballistic eye protection" orig-



Here, Ammel demonstrates the Army's new extreme cold-weather clothing system, or ECWCS (Inset far right). It consists of layers of synthetics like polypropylene, fiber pile and moisture-permeable fabric. They're worn underneath camouflage overwhites (right). New equipment for traversing snow and ice (bottom) consists of collapsible skis, climbing skins, ski poles, magnesium snowshoes, crampons and vapor barrier boots. Silvretta step-in bindings (inset below) accept Kastinger plastic shell mountaineering boots and cant upward to ease hill climbing.



CRAMPONS

COLLAPSIBLE

SKIS

BIVOUAC 2000

inated by engineers at Gargoyles. The bronze color shields against harmful UV rays and the impact-resistant polycarbonate lenses have an outer coating of silicon.

The lightweight, bullet-resistant Kevlar helmets and flak vests introduced to the public during the Grenada invasion are being augmented by new pack and load-bearing gear called the integrated individual fighting system, or IIFS. Heart of the concept is a redesigned web harness used to carry ammunition, grenades, canteen, entrenching tool and sidearm. The harness is called a tactical load-bearing vest (TLBV) and distributes weight to the upper torso instead of to the waist and lower back. The TLBV is also designed to be worn tight, enhancing a soldier's freedom of movement.

The big advantage of the tactical load-bearing vest is the way it works with the remaining two elements in IIFS. Soldiers on extended bivouacs use an internal frame alpine knapsack, heavily modified by the Army from the Lowe Alpine pack, to include a smaller "patrol pack" attached to the top. The patrol pack detaches from the larger alpine pack and snaps to the tactical load-bearing vest for short-duration recons. The infantryman is thus free of excess bulk and weight during tactical situations, yet has the advantage of sufficient short-term storage.

Predictably, the new backpack also has a compartment for a stuffable synthetic sleeping bag. The Army's latest cold-weather bag was developed from the North Face Big Foot. Materials consist of an all-synthetic inner bag insulated with Celanese Polarguard. An outer cover is made of a moisture vapor permeable synthetic, like Goretex, and the whole arrangement is shorter and wider than sleeping bags found in the marketplace, conforming to the size and shape of the 95th-percentile soldier.

Multipurpose tent

The cold-weather bag fits inside the Army's new pup tent, or IMPS, which stands for individual multipurpose shelter. Conceived by Ecotat, IMPS converts from a single-man tent incorporating an insect-proof screen liner to a hammock, ground cloth or calf-length poncho capable of covering a soldier's alpine pack. Two IMPS zip together to form a 3-man shelter.

To nourish the soldier of tomorrow, personnel at Natick labs have continued to improve infantry rations, now dubbed MREs, or meal, ready-to-eat. Replacing the meal, combat individual, or MCI, rations, which were based on canned food technology, MREs come in laminated pouches of polyester fiber, aluminum foil and polyolefin. Food is

sealed and sterilized externally with heat. MREs weigh less, take up less space and store flat.

Members of Natick's food engineering lab are proud of the variety MREs offer—entrées of beef stew and chicken à la king, for instance, and desserts of chocolate brownies and cakes. A soldier can heat water in a standard-issue canteen cup using a trioxane fuel tablet, and warm up food inside individual pouches to 150° F in three minutes. A typical MRE also contains matches, gum and snacks (but, alas, no cigarets).

There are many challenges in maintaining an effective fighting force in the temperate zones of the world, and the warm-weather gear just described goes a long way in satisfying the infantryman's basic needs. The challenge of living, moving—and fighting—in coldweather zones is exponentially greater. Natick has met the challenge with the



Battle dress uniform of the Vietnam era, just 20 years ago: Note steel-pot helmet, ALICE pack with external frame, solid OD jungle fatigues and old-style combat boots.

extreme cold-weather clothing system, or ECWCS, that adopts the "layered" approach outdoor clothing makers use to fight sub-freezing temperatures.

ECWCS is effective from 40° above zero to 60° below zero Fahrenheit and begins with an inner layer of polypropylene, considered the state of the art in cold-weather underwear. The zippered top and stretch-waist bottoms maintain warmth and wick perspiration away from the skin. A polyester fiberpile shirt and matching bib overall come next, followed by coat and trouser liners of polyester batting.

Tough cold-weather field trousers—laminated and moisture permeable—are worn on the outside in conjunction with a specially designed moisture permeable camouflage parka. The Army has built into this unique overcoat special ventilators, inner and outer pockets, and a custom internal snow-shedding skirt. Nomex mittens and balaclava protect hands and face.

Insulated white vapor barrier boots complete ECWCS. They're equipped with a special valve that bleeds off air expansion during high-altitude airborne operations. The next generation vapor barrier boot (pictured in black) has a reconfigured sole and is being made compatible with ski bindings and snowshoes. Familiar "overwhites," a baggy linen 2-piece suit, are worn over ECWCS to provide camouflage.

Compact skis

A laboratory at Natick is responsible for developing "oversnow traversing equipment," and the result is light, durable and compact. For instance, the skis currently being tested disassemble into two pieces so they can be carried easily by a paratrooper, who reassembles them on the ground by fitting together a carefully machined dovetail joint that's tapered on one end. A clevis bolt keeps the skis together.

Skis are designed to be worn with high-tech plastic-shell mountaineering boots from Kastinger. They come equipped with a leather and wool lace-up insert that can be worn around camp and provide enough support for a variety of strenuous wintertime activities like skiing. They're particularly suited to mountaineering and ice-climbing when worn with special articulating crampons developed by Chouinard.

The Army has improved a soldier's skiing performance by using Silvrettra step-in bindings, which cant upward during uphill climbs. Fatigue factor is greatly diminished. And when the Army's new portable Mylar "climbing skins" are attached to the bottom of the skis, a new-tech twist on the old mohair trick cross-country skiers use, all-terrain performance can be achieved. Add to the Army's new skiing system a pair of twist-lock telescoping ski poles—also collapsible for airborne operations.

An Army-developed, magnesiumframe snowshoe with plastic-coated stainless steel webbing can also be worn with the vapor barrier boot.

The TLBV is worn outside the overwhites (a compromise in access to ammunition over absolute concealment) and Natick is working on a new type of canteen for extreme climates (pictured), that has greater insulation for very cold, or very warm, weather.

All of the gear developed by Natick will someday join on the museum shelf the various styles of battle dress that the U.S. Army has relied on for over two centuries—from the blue coat and tricorn hat of Valley Forge, to the fanciful Zouave fez and breeches of Bull Run, to the steel pot and OD fatigues of Da Nang. But until something better comes along, Natick is serving the fighting man with the ultimate in clothing, food and shelter.



*** THE GREAT AMERICAN CHASE

PM toughs it out on America's side roads.

TEXT AND PHOTOS BY STEVE PARKER, West Coast Editor

hat type of person can part with up to \$7500 in entry fees, spend thousands more in expenses, and race a car he may have paid hundreds of thousands of dollars for in grueling, cross-country competition? Check out the 96 entries from all over the world in the Great American Race (GAR). Professional rallyists, wealthy business people out on a lark, just plain folks who happen to



PM's entry braves the rain on the flatlands of Indiana (top), while a 1935 Ford has clear salling (above) to take third overall.

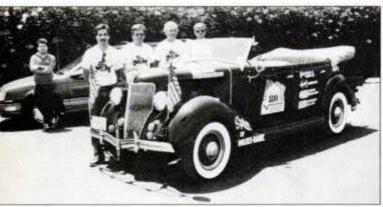
love cars . . . they were all there. And so was POPULAR MECHANICS.

The GAR is a time/speed/ distance rally for cars, trucks and motorcycles that are more than 50 years old. Starting in Anaheim, California, and winding up 11 days later in New York City, drivers get to see the nation, develop rally skills, have a lot of fun, and maybe even win a lot of money.

There are some truly exot-

Ragtop on Phaeton (right) provided minimal protection. Standing behind the PM entry (below, from left) are navigator Jim Edwards, mechanic Gary Evans, owner/driver Durland Edwards and mechanic Fritz Hady. Sable support vehicle and author Parker are at rear.





ic entries, as well as a gaggle of more ordinary cars. Starting with Europe, we find a 1935 BMW Roadster piloted by two German counts currently living in England. From Italy, there's a supercharged Alfa-Romeo. England provides a rare 1936 Jaguar SS-100 and a 1922 Rudge-Whitworth motorcycle. Japan offers a 1936 Datsun modeled after Austin cars of the time, with a top speed of 32 mph and an all-Japanese crew. A 1907 Thomas Flyer was the winner of the great race around the world from Paris to New York in 1908. This is the car's second race in 80 years. Fleshing out the entry list are an assortment of Fords, Chevys and other fascinating antique cars and trucks.

PM chose to support a 1936 Ford Phaeton—The Spirit Of Wilkes-Barre—owned and piloted by Durland Edwards, 55. His 27-year-old son, Jimmy, served as navigator. Edwards runs a restoration shop near Wilkes-Barre, Pennsylvania, and felt there should be a local entry. After all, Wilkes-Barre was the next-to-last stop and would host the celebration at the end of the event, which tied in with a 4-day July 4th celebration called, appropriately enough, the Great American Festival.

Although Edwards enjoys working on other people's old cars, it had been his dream since the event began three years ago to swing an entry in the Great Race. Not many people can afford to enter an event that requires driving and trailering across the country twice, with a 50-year-old car, support vehicle and crew. So our media entry, worth \$7500, went a long way, and local businesses covered expenses like gas, hotels and meals. But Edwards purchased the car himself, and spent months preparing. Ford's Los Angeles office provided a Mercury Sable chase car for PM and a news team from the Wilkes-Barre *Times Leader*, which filed daily reports on the home team.

The GAR isn't really a race, but a time-distance rally. The object is to arrive at the checkpoints at exactly the right time, not just in the least amount of time. No odometer is allowed, but a speedometer is, and only one analog stopwatch and analog wristwatch can be kept in the car. Several modifications are allowed, including improvements of braking, cooling and fuel systems. On our Ford, Durland installed a high-capacity radiator and an extra fan in front plus an electric fuel pump to overcome vapor lock.

Route instructions are given to the drivers every morning. Those coming closest to perfect time at the end of each day win. Hidden checkpoints scattered along the route keep careful watch over each car. Experienced rallyists can finish an entire day less than 20 seconds off a perfect time.

Having extra people in the car, creeping up to checkpoints, keeping notes on unauthorized note paper, even the filing of written protests can all add up to heavy time penalties. Daily winners get \$5000, second place \$2000 and third \$1000. On the final day, closest-to-perfect time garners a cool \$100,000.

It's a grueling event for car and crew, and since the Edwards had no previous rally experience, we hardly expected them to beat the pros in the field. Just getting to Manhattan by July 5 would be reward enough.

Day 1—Disneyland to Palm Springs

The competitors parade down Main Street of Disneyland, and the cars are right at home on the turn-of-the-century cobblestone paving. But the beauty of a southern California morning turns into a hellish late afternoon in the desert. Some 12 cars do not finish (DNF) the day, victims of the heat. Palm Springs registers 98° F at midnight.

Day 2—Palm Springs to Grand Canyon

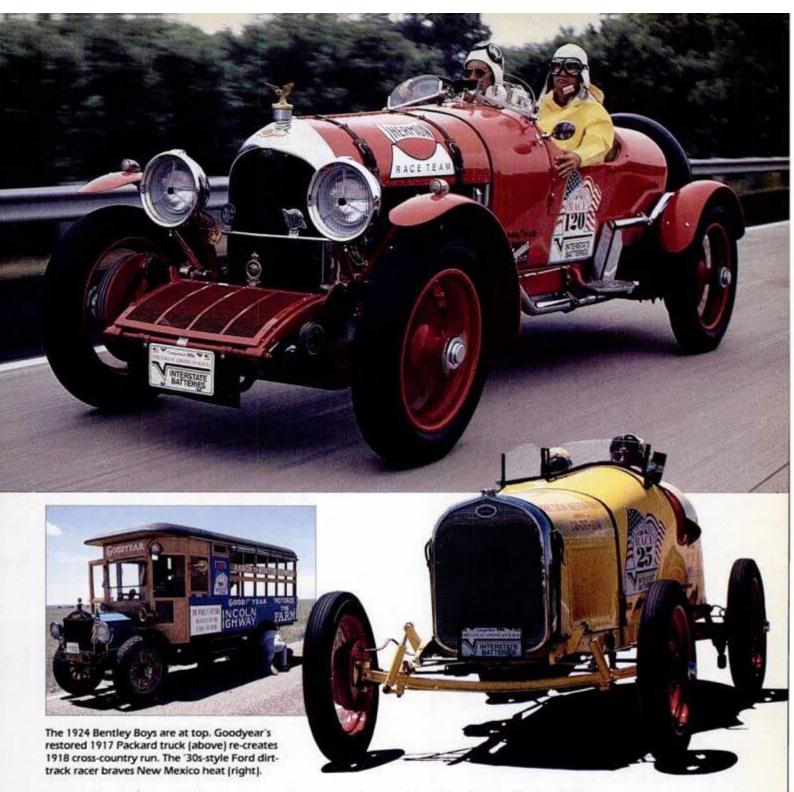
Desert Center, California, has never seen anything like it. The tiny town in the middle of the Mojave is a designated gas stop, and the local 2-pump owner can't remember the last time a 1916 Crane Simplex limousine filled 'er up here. At noon we enter Needles, California, where the outside temperature gauge on our Sable registers 117°! After a stop in Seligman, Arizona, we hit the final stretch of the day to Grand Canyon, arriving at sunset, when the Canyon is most spectacular. Our climb in altitude has dropped temperatures into the high 80s, and the nighttime sky over the Grand Canyon is full of more stars than anyone can remember seeing at one time.

Day 3—Grand Canyon to Albuquerque

The Monument Valley morning run is inspiring enough, but fades in comparison to the sheer majesty of the meadows in the high country of Arizona and New Mexico—wooded,



Pit stop: This 1935 BMW isn't likely to find anything except gas and munchies at this rural service station in California.



grassy plains that stretch forever, rimmed by mountain peaks. We're following U.S. 40, but as much as possible the rally cars are directed off the main highway and onto service roads. Through Gallup, New Mexico, and across the Continental Divide we forge on, arriving at Albuqueque about 5 p.m.

Day 4—Albuquerque to Amarillo

People are starting to pay attention to timing sheets, as the GAR computer sorts itself out from some initial confusion. We in the *Spirit Of Wilkes-Barre* are just happy the car is still running. However, the first day out we garnered a respectable 45th position, and the next day a 37th. The team improves with practice. Pulling into Albuquerque with a busted speedometer, we finished 14th on day three. Today at Amarillo it's 29th place, but team manager Lee McDonald cautions us to stick to the race plan of merely finishing each day, worrying about position second.

Day 5-Amarillo to Tulsa

McDonald's admonition is well-founded. *The Spirit* breaks down just a few yards beyond a checkpoint outside Clinton, Oklahoma, with an overheated coil. The car is loaded into a trailer and hauled into Tulsa. We DNF for the day, the low point of the trip. During the night, the crew repositions the coil to a cooler spot under the hood.

Day 6—Tulsa to St. Louis

We pull into St. Louis in the middle of a spectacular summer lightning storm. After a week of four hours nightly rest, the summer rain feels especially refreshing.

Day 7—St. Louis to Indianapolis

Torrential rains mark this day of competition. We make do without windshield wipers, and only rain gear provided by one of the sponsors makes the trip bearable. We drive into (Please turn to page 108)



MAGORIS

We test eight new high-tech station wagons that could put minivans on the trailer.

Popular Mechanics

NISSAN MAXIMA







were already light-years ahead of the old dinosaurs. There's not a tail-wagger in the group.

We identified eight of these wagons, starting with the futuristic Audi 5000, which started the high-tech wagon trend. We had to include Ford's lookalike Taurus and Chevy's nimble Celebrity Eurosport. Volkswagen's 4wheel-drive Quantum Synchro is about as high tech as you can get-an Audi in VW clothing. Peugeot's 505 Turbo is a surprising performer, and Volvo actually races its 740 turbo wagon in the Showroom Stock class because it's faster than the equivalent sedan. Nissan's Maxima is a perennial favorite. Toyota's Cressida wagon is being replaced with a new upscale wagon version of the Camry.

To see for ourselves which of these wagons is truly most wondrous, we tested them at Raceway Park in Englishtown, New Jersey, and over the road outside Princeton.

Volvo 740 Turbo

Volvo's 740 Turbo is about the ultimate refinement of the conventional front-engine/rear-drive station wagon. Compared to the sleek Taurus, the frumpy Volvo is distinctly old-fashioned looking. On the other hand, the Volvo package works better than other cars that look better on the spec sheet. And Volvo's 160-hp, turbocharged, intercooled 4-cylinder is the most powerful engine in this class, not to mention one of the most technically advanced.

In the quarter-mile, the staid Volvo walloped the competition by half a second and 5 mph. Mid-pack finishes in every other test, plus an embarrassing last place in braking-probably due to brakes that hadn't been properly bedded-in before we started-dropped the Volvo to third in our track ranking. But, don't be misled. As our track test driver summed up: "The Volvo is the most stable and secure wagon you can buy. And it goes!" Even with a \$22,000 price tag, the 740 Turbo is the stripper version of this car. Our testers were disappointed to find a manual sunroof and manual mirrors on a car this expensive.

Features our testers specifically liked include the convenient pushbutton overdrive switch atop the shift knob ("handier than a FIFTH speed"), the driving position ("really like the big steering wheel and nice instrument layout"), and the ease of maintenance ("a snap to service").

The Volvo's balanced performance and overall ambience are what made it a winner. Every tester mentioned the marvelous handling and acceleration ("passing is a joy"). and the Volvo's "air of solid self-confidence."

Peugeot 505 Turbo

The most pleasant surprise of this test was Peugeot's opulent 505 wagon. The curvaceous Pininfarina look is back in style in our Aero Age, and still handsome after all these years. The white paint job on our test car was flawless, the blue leather interior hedonistically extravagant.

Compared to past Peugeots, the current 505 has terrific ergonomics, with logically laid out controls and comfortable chair-height seats. The interior doesn't measure any larger than the competition, but it feels more spacious.

At the track, the 505 performed remarkably well. Thanks to its all-new turbo 4-cylinder, it was the only wagon besides the Volvo to break 17 seconds for the quarter-mile. It was also second on the skidpad and securely near the top in our other tests. It even holds more grocery bags than the

Produced by PM Auto Dept.: Text by Rich Taylor, Photos by Humphrey Sutton

CAR	BASE PRICE	PRICE AS TESTED	ENGINE	TRANS- MISSION	WHEEL- BASE (in.)	LENGTH (in.)	WEIGHT (lb.)
Audi 5000S	\$20,625	\$23,040	110-hp SOCH 2.2-liter Inline-5	5-speed manual	105.8	192.7	2954
Chevy Celebrity Eurosport	9546	15,622	125-hp OHV 2.8-liter V-6	3-speed automatic	104.9	190.8	2850
Ford Taurus LX	13,921	16,246	140-hp OHV 3.0-liter V-6	4-speed automatic	106.0	191.9	3165
Nissan Maxima GXE	16,699	16,909	152-hp SOHC 3.0-liter V-6	4-speed automatic	100.4	184.6	3269
Peugeot 505 Turbo	20,800	21,315	150-hp OHV 2.2- liter Inline-4 Turbo	5-speed manual	114.1	198.9	3230
Toyota Camry LE	14,168	16,063	115-hp DOHC 2.0-liter Inline-4	4-speed automatic	102.4	183.1	3010
Volkswagen Quantum Synchro	16,645	18,340	110-hp SOHC 2.2-liter Inline-5	5-speed manual	100.4	183.1	2535
Volvo 740 Turbo	21,355	21,675	160-hp SOHC 2.3- liter Inline-4 Turbo	4-speed manual + overdrive	109.1	188.4	3104

Best speed while weaving through seven cones placed 100 ft. apart; the higher the speed, the better the transient handling. G-forces generated during steady-state cornering around a 200-ft.-dia. circle; cw=clockwise, ccw=counterclockwise. The number of standard-size grocery bags that will stand upright (1-in. crush space permitted) in trunk with rear seats up.

Cubic footage in cargo area with rear seats down.



TOYOTA CAMRY

competition, a holdover from its commercial van origins.

Toyota Camry LE

We originally asked Toyota for a Cressida wagon, but Toyota's people talked us into trying the new Camry, which they're obviously grooming to move up-market as the dollar drops against the yen. As it turns out, the Camry actually won our track test-mostly because of an unbelievably spacious cargo area and a fuel-sipping engine.

Our testers liked the basic Camry package, with the exception of the "horrid Datsun 810 taillights." The conservative, slab-sided body is beautifully put together, and unless you put them side-by-side, it's hard to tell the difference between the Camry LE and the older Cressida.

Inside, our testers praised excellent ergonomics and great controls. Even with all-season tires and the smallest engine in this group, the Camry was a mid-pack performer at the track. With Toyota's 5-speed instead of our test car's 4-speed automatic, the performance would have been better. Indeed, the most criticized feature was this balky transmission, with ratios too widely spaced.

The Camry outperforms the Cressida—not to mention most of the cars in this group-but we could never shake the feeling that the Camry was in over its head. The Cressida feels like a big luxury car. The Camry feels like a compact. We'd say Toyota's marketeers will have to work hard if they expect the Camry to replace the Cressida in upscale American driveways.

Volkswagen Quantum Synchro

For thousands of dollars less than an Audi 5000, VW will sell you a wagon that is not only more fun to drive and just



TEST I	RESULTS									
GAS MILEAG EPA city/ PM test)	E ¼-MILE (sec. @ mph)	BRAKING (ft.) (60-0 mph)	SLALOM ¹ (mph)	SKIDPAD ² (cw/ccw)	TRUNK SPACE ³	CARGO VOLUME ⁴ (cu. ft.)	INTERIOR SPACE INDEX ⁵	TEST TRACK RANKING ⁶	ROAD TEST RANKING ⁷	OVERALI RATING
17/17.09	17.36 @ 77.12	152	59.78	.73/.74	20	48.5	128.82	4	7	6
18/15.23	17.25 @ 77.37	176	58.24	.75/.77	19	51.0	123.62	6	8	8
20/15.62	18.01 @ 76.12	166	57.55	.71/.73	19	52.8	131.67	7	2	5
18/14.85	17.54 @ 78.79	153	58.09	.73/.76	18	49.0	114.52	8	5	7
18/15.88	16.95 @ 79.85	167	57.76	.78/.78	23	56.2	128.05	2	4	2
25/22.50	17.50 @ 79.01	150	58.03	.74/.77	21	60.6	143.71	1	6	3
19/18.43	17.10 @ 78.01	140	56.51	.78/.79	17	48.7	119.94	5	3	4
20/15.87	16.57 @ 84.64	177	57.51	.75/.78	20	72.5	128.62	3	1	1

Front-seat width × headroom × legroom + rear-seat width × headroom × legroom + 1000.

hidden storage well (5).

^{6.} Points are awarded from best (1) to worst (6) in each category. Fewest total points ranks first, and so on.

7. Subjective ranking on the road by a team of testers; cars are graded by "feel," independent of test track results.

8. Average of Test Track and Road Test ratings. Road Test score breaks ties. Bold numbers show best performance.

WONDER WAGONS

as comfortable, but fitted with the same full-time, 4-wheel-drive system used in Audi Quattros that cost nearly twice as much. Unlike most 4x4s, the VW/Audi system is always engaged, but you can choose to lock the rear differential and the center differential if conditions get really slippery.

The Quantum Synchro is a variant of the Audi 4000 CS Quattro sedan. In either guise, this is more a classic European sports machine with "throwable" handling, precise steering, excellent midrange acceleration and an effortless cruising speed—all the things you'd want in a German road car.

The VW was tops on the skidpad, third in acceleration and near the top everywhere else. Even locked in 4wd, it returned the second best fuel economy behind the Camry. A relatively small interior and limited cargo room lowered its score at the track.

It's not perfect. The basic Quantum/ Audi 4000 has been around for years, and it's beginning to seem dated. One tester said: "Tacky op-art interior is terrible!" Another added: "Sciroccobased seats have been a VW pain in the butt for years. When will they change?" But overall, our testers voted the Quantum the most fun to drive.

Ford Taurus LX

As you may already know, the Taurus (and its identical twin, the Mercury Sable) have been runaway sales successes for Ford. The Taurus looks like a spaceship, but it drives like an American car. That's a compliment, not a criticism. The Taurus is a good American car. It's comfortable, predictable and easy to drive. At the track, it was last or nearly so in every test. But track numbers are not what this car is all about.

Our testers called the Taurus elegant, strikingly pretty and the bestlooking wagon ever. Surprisingly, the Taurus interior doesn't match the exterior. Our test car was upholstered in a fuzzy gray fabric that looked like mouse fur, and more than one in the group complained about assembly techniques that left trim screws exposed and unsightly gaps between pieces.

Among the features our testers criticized were the column shifter in a sporty car, the fake woodgrain dashboard, and the optional digital instruments. Most people who buy this car will be more impressed by the extra sun shields on the sun visors, the dual vanity mirrors, and the optional tailgate picnic table.

We have to admit that Ford knows its market. Still, we'd like to see more horsepower to bring the Taurus up to par with other cars of this type, a better-finished interior upholstered in more durable fabric, brakes that are capable of locking a wheel in a panic stop if necessary, and handling that doesn't get all mushy when you push the car hard.

Audi 5000S

Audi invented the Wonder Wagon market when it introduced the 5000S three years ago. Remarkably, the Audi doesn't look dated in the least.

Audi's 5000S interior is meant to be equally advanced, but we think it's overdone. "Bizarre, too baroque for my taste" was a typical comment. Despite the 6-way power seats, it's hard to get comfortable, and testers of all sizes found it difficult to get properly positioned behind the wheel.

Other ergonomic complaints were pedals that are too close together and off-center, and small windows and high belt-line creating a closed-in, claustrophobic feeling. Rear vision is particularly poor due to the maze of spoiler, wiper and pillars. A mild redesign could solve all our complaints without losing any of the Audi's unique style.

The 5000S costs more than the other cars in this test, yet it was a mid-pack performer. You can order it turbo-charged, of course, but that ups the price. None of our road testers ranked the Audi higher than fourth, not even the lone enthusiast who said: "This is the best Audi I've ever driven." The rest of us preferred VW's Quantum Synchro, which after all, is an Audi with a VW emblem.

Nissan Maxima GXE

We liked the Maxima sedan we tested a year ago, considering it a bargain at \$13,500. The yen/dollar relationship has changed all that. This Maxima wagon costs a heady \$17,000, which brings it into competition with an upscale group of serious sports machines.

The Nissan finished last in our track testing, and mid-pack in the hearts of our road testers. As one driver put it: "The Maxima is confused. It's been Americanized, which leaves it without a clear image. It's not very sporty, but not luxurious enough, either."

There's nothing wrong with the basic Maxima package. The conservative styling is fine. Fit and finish is excellent. But our testers weren't as happy with the offbeat "designer" interior.

By far the best part of the Maxima is its smooth 3-liter V6 engine, shared with the Hardbody pickup and 300 ZX. The car goes, stops and handles well, but the limits are not very high.

The Maxima's good performance, smoothness and obvious quality captured supporters; its busy interior and "synthesized nag" vocal warning system turned off others. There is nothing wrong with the Maxima that a couple of good design engineers couldn't fix in a

week. At that point, this would turn into a true Wonder Wagon. The basics are already there.

Chevrolet Celebrity Eurosport

What a disappointment. The last Eurosport we tested was a sedan that we called one of the best bargains on the road. At that time, our test Celebrity Eurosport was equipped with the stiff suspension, more powerful H.O. V6, top-grade Eagle GT tires and a variety of heavy-duty parts. Although Chevy says that its standard 1987 multipoint fuel injection V6 now has the same 130 hp as the H.O. V6 of the original Eurosport, it sure doesn't feel that way on the road.

Compared to that fondly remembered Eurosport sedan, this wagon seemed to be down on everything—handling, power, ambience. It's a Celebrity wagon with blackout door handles. Instead of being an inexpensive road-burner, the Eurosport is now a \$16,000 family station wagon, distinctly out of date compared to archrival Taurus. In our track testing, the Eurosport finished sixth. It's perfectly competent, just not the Q-ship that we remember.

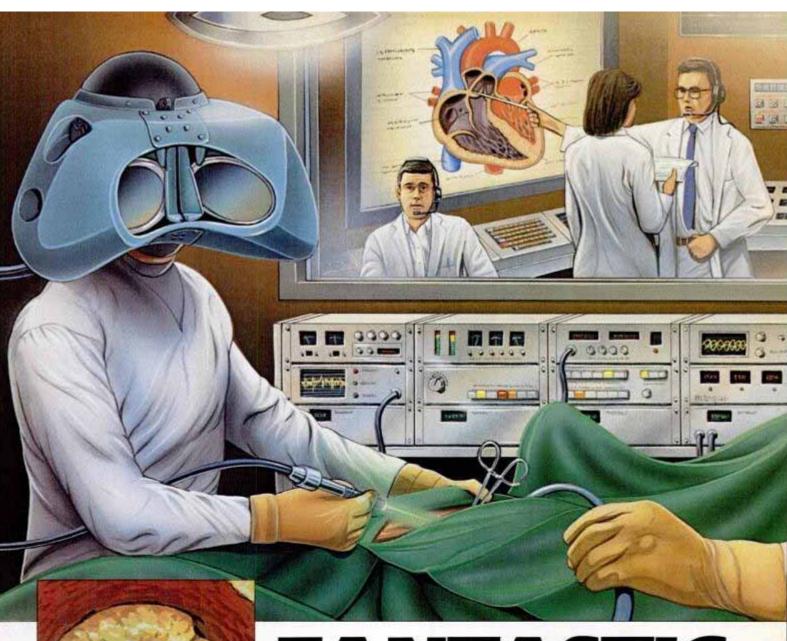
Our testers voted it resoundingly last. "This thing drives like a Mommy/ Daddy station wagon with painted trim instead of chrome. It's neither Euro nor Sport," said one tester.

Our track test driver felt quite strongly about the Eurosport. "This basic wagon is excellent, and the quality is surprisingly good. The handling is stable and predictable, but there's lots of bump steer and chatter through the steering wheel at high speeds. The 4speed automatic hunts and pecks annoyingly, and the 2.8 V6 just doesn't feel like it has 130 hp. The brakes are very poor-lots of fade. On paper, the Eurosport may not have changed much since '84, but the new generation of Wonder Wagons runs rings around it on the road." We think its time for Chevrolet to update the Eurosport to keep it competitive.

Conclusion

This was one of the closest tests we've run in years. Even the last place finishers are good, solid wagons, they just lack that certain something that distinguishes the winners. Call it performance, call it style, call it élan, the Volvo and Peugeot have most of it.

The Eurosport, Maxima and Camry could be world class with just a bit of massaging, while the Audi 5000 and Taurus have been so successful, their manufacturers need no advice from us. The wagon that we think has the most potential is VW's high-tech Quantum Synchro. Spiff up the interior and this would be a Wonder Wagon, indeed.



FANTASTIC VOYAGE

Leading-edge, fighter-plane technology is about to take doctors almost literally inside patients' hearts.

BY THOMAS A. FURNESS III

Heart surgeon of the future will physically feel as if he has entered a blood vessel and is traveling through it toward the heart. A catheter probe transmits the sights and sounds to the surgeon's special helmet where the world inside the patient's body is recreated. Like a shrinking man of science fiction, the surgeon is able to discover unhealthy situations like fatty tissue blocking the aorta (inset) and make repairs.

hush settles over the operating room. A catheter is inserted into a vein in the patient's arm. At the end of the catheter is a micromechanical device containing a scanning TV and pressure sensor. The chief surgeon places a special helmet on his head. The power to the catheter and helmet display is turned on. A green glow reflects into

Thomas A. Furness III is chief of the Visual Display Systems branch of the Armstrong Aerospace Medical Research Lab at Wright-Patterson AFB, Ohio. the surgeon's eyes. Instantly, he is transported visually into the body of his patient as his helmet gives him the sights and sounds received from the probe located at the end of the catheter.

As he makes his incredible journey inside this human being, he sees a whole new world from inside the blood vessel. He "pilots" the catheter probe, navigating toward the heart, while hearing the gurgle of the blood around a defective heart valve. As he approaches the heart valve, he reaches out with his hand to remotely control a minia-

FANTASTIC VOYAGE

ture suturing machine which corrects the valve malfunction. On the other side of the heart, the surgeon continues his journey into the aorta. He fires his laser ray gun to destroy another enemy—fatty tissue blocking the aorta.

Sound incredible? It's just another application of a revolutionary set of new technologies being developed by the U.S. Air Force to aid pilots in high-performance aircraft. The aim of these new technologies is to create artificial but realistic computer-generated worlds of sight, sound and touch which the pilot can use to find the enemy and control the fighter aircraft more effectively.

Both Air Force pilots and design engineers are concerned that modern fighter cockpits have become too complex. Some of these cockpits can have up to 300 switches and more than 70 instruments or displays of information. In real combat, the pilot must deal with all of the information available and operate his aircraft and its weapons simultaneously. Instead of showing the pilot a true perspective picture of the world, there are several electronic symbol displays in the cockpit which the pilot has to search in order to put together, in his mind, an overall picture of the combat situation. He must quickly answer the questions: Where am I? Where is the enemy? What is the health of my aircraft? Where are my friends? A new way is needed to convey this information rapidly to pilots if the battle is to be won. And it may be as simple as putting on a helmet.

Instead of being forced to remain on the outside of the action looking in-as current computer-aided designs appear on conventional TV monitors-it is now possible for a computer programmer-or a pilot, or surgeon-to journey inside the design, becoming part of the world or object which is being designed by the computer. The programmer is able to reach out and touch objects which do not really exist, but are actually illusions fabricated by the computer. While operating in this virtual design space, the programmer speaks to the computer and commands objects to move or change as he reaches out to touch them. Consider such a virtual design terminal applied in the automotive industry. It would be possible to go inside a hypothetical automobile, design the instrument panel, and drive the car before it actually exists. Once the design would be completed and optimized in the computer, other computers would take over to produce the drawings and to manufacture the parts.

Another commercial application of the virtual world technology will be in the retail merchandising business. Instead of a paper catalog, the consumer will have a "virtual catalog" to look through with his magic helmet. The procedure could be used to select and fit a suit using stored physical information. Virtual suits could be tried on for sizing and color matching before the order would be placed



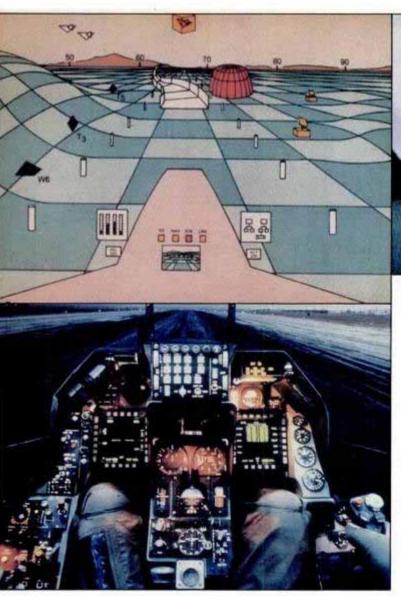
Experimenter at Wright-Patterson AFB, Ohio, sits inside a virtual cockpit simulator wearing helmet containing the visual displays he needs to fly. The helmet is connected to a large, parallel processing computer system that generates images on small screens, sounds in three dimensions inside the helmet, and a sense of touch inside a special glove.

to a computer-aided clothing manufacturing operation.

In the future, the television viewer will wear his TV set, being able to go inside the televised scene to participate in the action and have a 3-D panoramic representation of the transmission (instead of a small-screen TV picture).

Air Force laboratories at Wright-Patterson AFB, Ohio, have been pioneering a new set of cockpit technologies termed the Super Cockpit. The approach is to link the human more effectively to computer-generated information by building "virtual" worlds for the pilot. Three virtual worlds will be created in the Super Cockpit: a 3-D visual world, a 3-D sound world and a 3-D touch world. A familiar virtual world is the image you would see of yourself in a mirror. The image in the mirror appears to be standing behind the mirror, but is not really there.

These virtual worlds are created using special devices incorporated into the pilot's helmet and gloves. The pilot literally wears the Super Cockpit. An airborne computer called a virtual world generator receives information from the rest of the aircraft electronics (radios, navigation equipment, and so on), radar and infrared sensors and creates the signals for producing the visual, aural and tactile presentations to the pilot. The on-board computer uses parallel processors composed of very-high-speed inte-



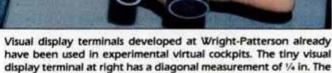
All the displays shown in a current cockpit (above) are translated into a 3-dimensional picture (top) inside the helmet of the virtual cockpit. As the pilot turns his head, or as the craft changes heading, the display scrolls, moving like the real world outside.

grated circuits (VHSIC) and draws information from a laser-disc memory.

The visual information is shown on two dime-sized TV picture tubes (one for each eye), which create the images generated in the aircraft's computers. These pictures are magnified and projected into the pilot's eyes using mirrors on the helmet so that he sees a "cinemascope" picture which appears in 3-D. A tiny magnetic sensor, also in the pilot's helmet, tells the virtual world generator the direction in which the pilot is aiming his head so that the images on the TV tubes can be repositioned to appear to be stabilized.

In order to control the functions within this virtual cockpit, the pilot speaks commands and directs his hands and eyes toward the switches to be controlled. Weapons are also aimed in the direction of the pilot's eyes. Infrared sensors outside the aircraft are positioned by the orientation of the head and displayed to the eyes via the helmet projectors. In this way, the pilot is given a remarkable X-ray vision to see through the plane—and at night!

As the pilot peers at the horizon in the dead of night, an external infrared sensor shadows his head movement one-for-one while the computer scrolls the stored terrain database from optical memory. The computer-generated scene, attack information and infrared picture of the world are



combined electronically and projected to the pilot on his visor overlaying the darkness. Night is turned into day.

smaller VDT is 1/2 in. in diagonal measurement.

Along with the visual world, a 3-D sound world is generated and played to the pilot using special earphones in the helmet. When the pilot talks to his wingman, he hears the wingman's voice coming from the direction of the other aircraft. When an enemy aircraft sends a radar signal to track his aircraft, the pilot hears those incoming signals from the threatening enemy's direction.

Also, as the pilot moves his head, the sound is correspondingly moved so that it always seems to come from the proper direction. A quiet but compelling voice also whispers in his ear when there are items of information that he shouldn't ignore, such as: "There is a fire in your left engine!" The audio system also recognizes the pilot's speech as he gives verbal orders to the aircraft.

The tactile or "touch" world is created for the pilot using special gloves containing both a magnetic tracker and tactile simulators. The magnetic tracker precisely measures the position of his hands in the cockpit and, at the same time, provides touch stimulation to his fingers as he touches virtual objects (such as cockpit switches) which have been drawn by the computer and appear in the visual virtual world. For instance, if the pilot wants to program coordinates into his navigation computer or desires to select and ready a missile for launch, he reaches in the cockpit toward an invisible switching panel. The magnetic tracker keeps tabs on his hand location. As his hand enters a predetermined volume within the cockpit, the pilot feels a sharp edge cross his palm. This is caused by piezoelectric vibrotactile devices in his glove that stimulate his hand by vibrating at high frequency. Simultaneously, an image of the switch panel is projected into the cockpit space. The pilot points his finger at the correct switches.

Although the Air Force is anxious to continue the development of virtual world technologies for advanced aircraft, there are also other exciting applications which are being pursued. Imagine a suitcase training simulator allowing the pilot to sit at his desk anywhere, open his briefcase, put on a special headgear containing the same components as the Super Cockpit and practice flying missions. Any room could be converted into a simulator.

While Super Cockpits will be helping maintain our nation's defense, ultimately these technologies will better couple humans to computing machines and will achieve another great leap in the information age.



Sand Photocology

Amuse and educate your children with these six easy-to-make toys.

BY CLARK AND PEGGY CASWELL

esigned exclusively for POPULAR MECHANICS, these six toys use alphabet blocks and puzzle parts to challenge, enlighten and teach children about spelling and arithmetic, U.S. geography, angles within a protractor, telling time, inch dimensions, and volume and fractions and their relationship to the whole.

Most of the toys are made of ¼-in. birch-veneer plywood. The magnetic blackboard is a sheet-metal panel framed in solid maple. The clear Plexiglas volume cube houses several maple blocks. The paint used on the toys is safe, nontoxic Accent paints manufactured by Illinois Bronze of Lake Zurich, Illinois. The child-safe paints contain no lead, heavy metals or hazardous substances. All unpainted toy parts are protected with polyurethane varnish, which is also nontoxic when dry. Caution: A few of the toys have small parts that could be swallowed accidentally. These toys are not recommended for use by infants

Color photo: Bill Ashe Black-and-white photos: Peggy Caswell Toy designs: Clark Caswell, Steven Willson Technical art: Dyck Fledderus

and very young children.



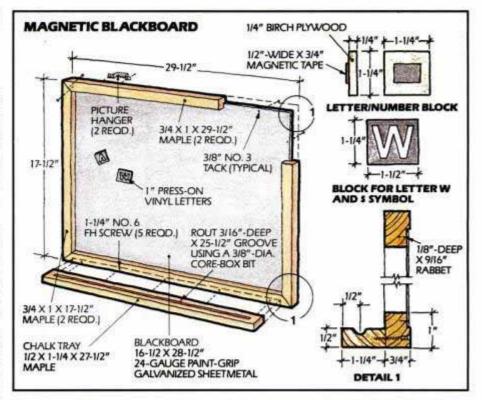


Alphabet Blackboard

elp to develop your child's reading, writing and arithmetic skills with this magnetic blackboard. Use 24-gauge paint-grip galvanized sheetmetal for the blackboard surface. Paint-grip metal is specially treated to accept paint and is available at sheetmetal shops. Spray-paint the sheetmetal and letter and number blocks with a nontoxic, semiflat black paint.

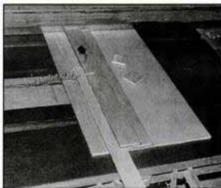
Start by cutting the frame parts to size from maple stock. Cut 45° miters on both ends of each part. Next, saw a ½-in.-deep × ½-in. rabbet in each part to accept the sheetmetal. Assemble the frame using glue and 4d finishing nails. Then, cut the ½-in.-thick maple chalk tray. Using a ¾-in.-dia. core-box bit, rout a ¾-in.-deep × 25½-in.-long groove in the tray. Now glue and screw the tray to the frame with 1¼-in. No. 6 flathead screws. Sand the wood and apply two coats of polyurethane varnish. Drill holes in the sheetmetal and attach it to the frame with ¾-in. tacks.

Next, cut the letter and number blocks from ¼-in. birch-veneer plywood. First, rip the plywood into 1¼-in.-wide strips then use a shopmade jig, as shown, to safely crosscut the strips into 1¼ × 1¼-in. blocks. Cut a couple of blocks 1½ in. long to accommodate the letter "W" and the dollar (\$) sign. Spray-paint the blocks and apply 1-in. Gothic vinyl, press-on letters and numbers. Vinyl letters are at artist supply stores. Apply a ½-in.-wide × ¾-in. piece of adhesive-backed magnetic strip to the back of each block.





Clamp the frame parts together and bore pilot holes for 4d finishing nails. Locate the holes so the nails don't hit each other.



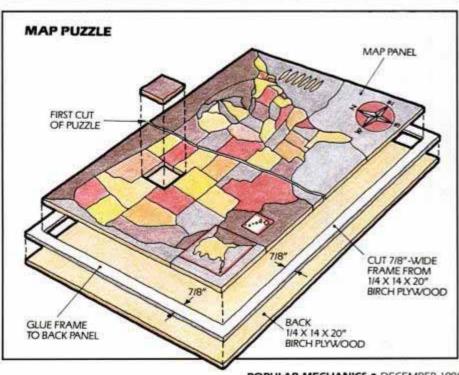
Cut blocks quickly, safely with this jig. Nail (arrow) driven through jig acts as a stop. Butt strip against the nail and cut block.

USA Map Puzzie

state, with this colorful jigsaw puzzle. It's a fun way for children to learn state names, shapes and geographic locations. Make the puzzle from two ½ × 14 × 20-in. pieces of birch plywood. Cut the states from one piece and use the second as a backboard. Use a United States map and carbon paper to trace the state outlines to the plywood. We used a map that measures 15½ in. from California to Delaware.

After tracing the map onto the plywood panel, use a scroll saw to cut a %-in.-wide border from the perimeter of the panel. Then, glue and clamp the %-in.-wide frame to the second plywood panel, as shown. Spray-paint the backboard with nontoxic flat-white paint.

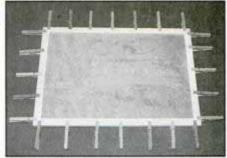
Next, paint each state using Accent acrylic paints. Use the three primary



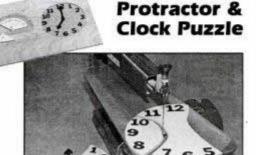
paint colors—red, blue, yellow—as is, and mixed to produce about eight different colors. Then, apply the state names with dry-transfer lettering. Now start cutting the map into puzzle pieces on a scroll saw. Make the first cut through the Gulf of Mexico, along western Louisiana and north through Canada. Cut along state borders. Continue cutting out each state. Part of New England and the Maryland region combine more than one state. Sand lightly and seal the edges of each piece with polyurethane varnish.



Bore a small-diameter hole in the corner of the map, insert the scroll saw blade and cut a 1/4-in.-wide border from the map.



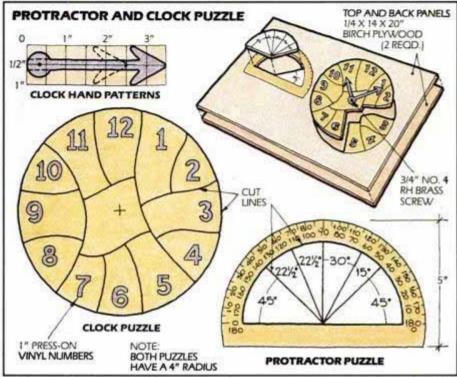
Here's an effective way to glue the map's border to the plywood backboard: Use several spring-type clothespins as clamps.



First, cut the clock face into three large parts, as shown. Then, cut each part into the smaller pieces that form the Jigsaw puzzle.

This toy is actually two games on one board. The full-scale protractor and its six parts help teach angles from 0 to 180°. The jigsaw-puzzle clock with movable hands makes telling time fun and easy.

First, cut two ½ × 14 × 20-in. pieces of birch-veneer plywood. In one piece, make two circular cutouts using a scroll saw or saber saw. Cut an 8-in.-dia. hole for the clock and a 5-in. portion of an 8-in.-dia. hole (see the drawing detail) for the protractor. Save the pieces cut from the holes to make the protractor and clock face. Use a scroll saw to cut the D-shaped protractor. Then, saw the protractor's center-cutout into six angles,



as shown. Sand the edges of all parts with 120-grit sandpaper. Also, sand off any sharp points.

Paint the clock face, apply 1-in. vinyl press-on numbers and make two hands from 1/4-in. birch plywood. Now, use a band, scroll or saber saw to cut the clock face into at least 13 pieces. Be

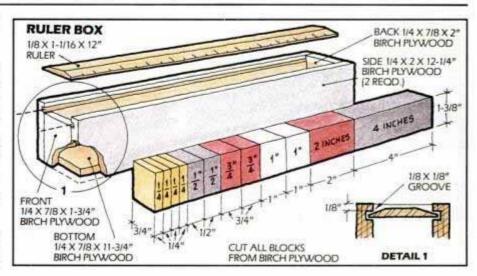
sure that each number is on a separate piece. Attach the hands to the center piece with a ¾-in. No. 4 brass roundhead screw.

Finally, glue the plywood panel with the cutouts to the second backboard panel. Apply two coats of polyurethane varnish to the panel assembly.

Ruler Box

simplify the understanding of inch and metric dimensions with this clever ruler box. The ¼-in. birch-veneer plywood box houses 12 wood blocks of varying sizes. A standard 12-in. wood ruler is used as the box top. The ruler slides in ½ × ½-in. grooves cut in the box sides. The box dimensions shown in the drawing accommodate a ½-in.-thick × 1½-i6 × 12-in. ruler. Alter the size of the box to accept other size rulers.

Cut and assemble the box with glue only. Hold the glued-up box together with masking tape. After the glue



dries, sand the box smooth with 120grit sandpaper and apply a coat of nontoxic paint. Next, make the dimension blocks from 1/4, 1/2 and 3/4-in. birchveneer plywood. We cut 12 blocks from ¼ to 4 in. long, but you can vary the number of blocks by changing their dimension. You can make metric dimension blocks, too.

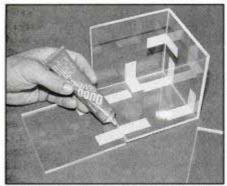
Paint each set of wood blocks a differ-

ent color. For example, paint the ¼-in. blocks bright yellow, the ½-in. blocks green, and so on. Then, identify the block sizes with rub-on dry-transfer lettering.

Volume Cube

This toy makes comprehending volume child's play. The clear Plexiglas cube represents the whole. Painted blocks represent different amounts of volume that together make up the whole. The blocks show clearly that the same amount of volume, say ½, can be represented by two different size blocks.

Cut the ¼-in. Plexiglas parts on a table saw with a smooth-cutting blade. Sand the edges of the Plexiglas with



Dry-assemble the cube using masking tape. Then, fold down the sides, apply plastic cement and reassemble the cube with tape.

VOLUME CUBE CUBE PARTS: 1/4 1/4" PLEXIGLAS 3/4" PRESS-ON VINYL NUMBERS 2-3/16 2-3/16 * 2-3/16" 如日本 4-1/2 16 ¥1-1/16" 1-1/16"* **CUT ALL BLOCKS** 2-3/16 FROM MAPLE *9/16" LAMINATE WHEN NECESSARY

100-grit sandpaper. Next, dry-assemble the parts using tape to hold the cube together. Then, peel back the tape and fold down the four sides. Leave the sides taped to the cube bottom. Now apply plastic cement, or any glue rec-

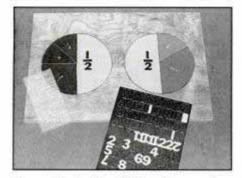
ommended for plastics, to the sides and reassemble the cube. Leave the tape in place until the glue dries. Next, cut the maple blocks to the dimensions given in the drawing. Paint the cubes and apply press-on vinyl numbers.

Fraction Puzzle

a child understand fractions. The puzzle shows the relationship of different fractional parts to each other and to the whole.

Start by cutting two ¼ × 14 × 20-in. birch plywood pieces. Cut two 8-in.-dia. holes in one piece on a scroll saw. Now glue the two plywood pieces together to form the puzzle board.

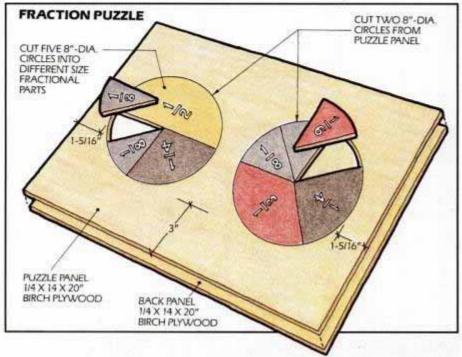
Next, cut five \(\frac{1}{4} \times 8\frac{1}{2} \times 8\frac{1}{2} \times in. \) birch plywood squares. Mark each square

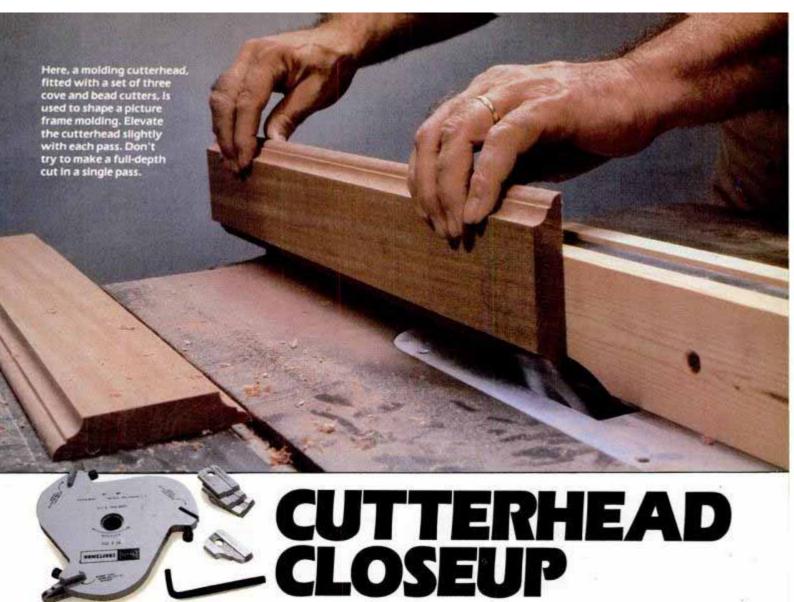


The smaller fractional designations are drytransfer numbers. Larger, one-half fractions are peel-and-stick black vinyl numbers.

with different fractional parts—1/8, 1/6, 1/4, 1/3 and 1/2. Then, use a scroll, band or saber saw to cut the squares into 8-in.-dia. circles. Now carefully cut along the lines to divide the circles into fractional

parts. Sand off the sharp points and paint with nontoxic paints. Apply dry-transfer numbers to all the parts except the one-half pieces, which require large press-on vinyl numbers.





Molding cutterhead holds three identical knives. Knife sets are available in numerous styles for cutting thousands of shapes.

Here's how to mill your own moldings—and much more—using a molding cutterhead.





The completed mahogany picture frame (top) is made up of eight pieces of stock. Cross-section profiles (above) reveal how frame molding is made. Shape each part separately before gluing them together.

TEXT AND PHOTOS BY ROSARIO CAPOTOSTO, Contributing Editor

ost woodworking shops are built around a table saw and radial-arm saw because of their versatility. And, of the many accessories available for use on these two essential shop tools, none is more versatile than a molding cutterhead.

A cutterhead, which fits on the saw's arbor in place of a saw blade, holds three identical blades, or knives. The knives are sold in sets of three and are available in more than 30 different shapes. A few of the many timesaving jobs you can perform using a molding cutterhead include milling custom and standard moldings, shaping decorative edges, cutting an ornate picture frame and surface-planing lumber.

Many cuts are made using only a portion of the knives' profiles. Therefore, a single knife set can produce several different-shaped cuts. Also, knife sets are commonly used in combination to achieve a desired shape. Simply change the knives after each cut. Certain knife sets, though, such as the tongue-and-groove, glue joint and cabinet door lip, must be used full profile in order to obtain correct results.

Note that we show molding cutterhead techniques being performed on both the table saw and the radial-arm saw. The fact is, all molding cutterhead operations can be executed on either tool. Regardless of the tool used, always make the cuts in stages. Increase the depth of cut slightly with each pass until the desired shape is formed. This is especially important when working with hardwoods that splinter easily. Also, feed the work slowly over the cutterhead to reduce the chance of splintering, chattering and kickback.

Table saw techniques

To use a cutterhead on the table saw, first remove the blade guard and the saw blade table insert. Replace the

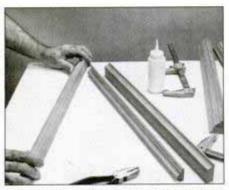
PICTURE FRAME MOLDING



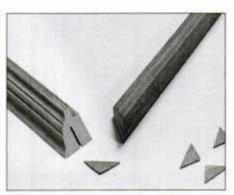
Cut a cove shape in both edges of two 4-in.wide boards. Then, rip the boards down the center to produce the rear frame members.



Install a set of planer and jointer knives to cut rabbets in the narrow frame parts. Pushstick and featherboard ensure safe cuts.



Giue frame parts together to form molding. Use double-pointed brad pins to prevent parts from slipping when clamped.



Cut grooves in the mitered molding ends to receive triangular-shaped splines. Glue the splines in place and clamp the frame square.

standard insert with a molding cutterhead table insert that has a wider, but shorter, opening. Then, attach an auxiliary wood fence to both sides of the saw's rip fence. Be sure to cut a semicircular notch in the bottom edge of each wood fence to allow clearance for the knives. The wood fences allow you to work on both sides of the cutterhead.

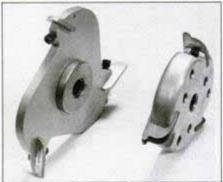
There are two ways to feed work into a cutterhead: flat on the saw's table or on edge with the work's broad surface against the fence. To shape only a portion of an edge, feed the work flat on the table with the edge to be cut guided against the fence. This is known as an inboard cut. When shaping the entire edge of a board, pass the work between the fence and the cutterhead. Guide the uncut edge against the fence. This is called an outboard cut.

Here are two safe ways to make small-dimension strip molding. For the first method, simply cut the desired shape on a board that's at least 3 in. wide, then rip the strip molding from the board. The second method requires the use of a simple strip molding jig (see page 110). The jig is comprised of a length of 2x4, rabbeted to accept the molding stock, and a 1/4-in. plywood base. Cut out a window in the base to allow cutter clearance. Note that the jig conceals the cutterhead completely. To shape the molding, simply feed the stock into the jig and pull it through from the outfeed side.

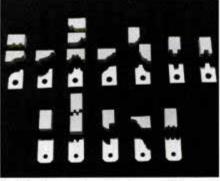
Use the miter gauge to cross-grain shape the end of a board just as you would for crosscutting. As the knives exit the workpiece, though, splintering will surely occur. To prevent this, simply insert a ¼-in.-thick wood backup strip behind the workpiece. As the cut is made, the backup strip will splinter, but the workpiece will be cut cleanly.

Most cuts are made on the table saw with the cutterhead in the vertical position. But, the cutterhhead can be tilted to any desired angle to produce a wide variety of shapes and profiles. Angle the cutterhead to make attractive crown (cornice) moldings (page 110). However, since a tilted cutterhead cuts a wider path than a vertical one, you must make a new table insert. Cut out a new insert from ½-in. plywood.

TABLE SAW TECHNIQUES



Here are two popular styles of the molding cutterhead: the 7-In. Sears Craftsman model [left] and the 5%-in.-dia. Delta tool.



Basic knife assortment is shown with wood samples. There are more than 30 knife patterns available for creating most moldings.



Execute an inboard cut when shaping only a portion of an edge. Guide the workpiece slowly against the auxiliary wood fence.



To shape the entire edge of a board, perform an outboard cut. Pass the workpiece between the saw fence and the cutterhead.

Picture frame molding

The molding used for this mahogany frame is comprised of two pieces of stock, each shaped separately and then glued together to form the finished molding. Both pieces are shaped using the same cutterhead knife set: 5/16-in. cove and bead cutters. The wider, rear portions of the frame are shaped by the cove section of the knives only. The narrower, front frame members are edge-cut with the full cove and bead

(Please turn to page 109)

HOME ELECTRONIC ENTERTAINMENT

SPECIAL RE



■ Contest—Win A \$4000 Stereo System

PRODUCED BY THE PM ELECTRONICS DEPT: COVER PHOTO BY BRIAN KOSOFF

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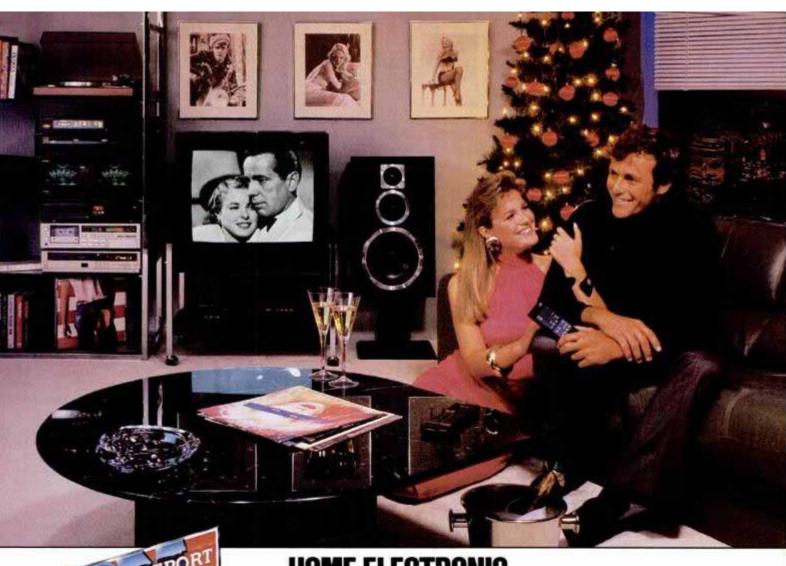
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HOME ELECTRONIC ENTERTAINMENT

CHANGING CHANNELS HOME ENTERTAINMENT IN THE ELECTRONIC AGE

The latest electronics components must handle an

ever-widening assortment of entertainment sources.

Here's how to make sure you're tuned into them all.

ook at the photograph above. Her clothes bear the stamp of our assertive age. The studied informality of his attire betrays yet another conceit of our times. But besides their wardrobes and the contemporary furniture, nothing you can see in this picture is fundamentally different from what you might have found in a

similar setting of 30 years ago. The TV set and stack of hi-fi components might have graced their parents' parlor in the guise of a radio-phonograph console and first-on-the-block color TV.

Yet this couple, indeed all of us, have something that wasn't available 30 or even 10 years ago. A clue resides in the images of popular entertainment personalities captured in frames on the wall. Compared to earlier generations, we today have access to more sources of electronic home entertainment in our homes than ever before. What's more, we have instant access to this entertainment whenever we want it.

That miracle of magnetics and electronics, the videocassette recorder, lets us watch a first-run movie, catch the latest news, or

PM PHOTO BY MARK KOZLOWSKI

HOME ELECTRONIC

ENTERTAINMENT

attend an out-of-town ballet without regard to movie timetables, TV schedules or theatrical calendars.

What electronics procures for us-at least in the area of entertainment-is freedom from the tyranny of time and space. It can introduce us to new experiences and help us understand what's just over the horizon-as much as a century ago the mechanical phonograph and player piano brought opera to the beggar and ragtime to the rich.

So much for the philosophical aspects of "consumer" electronics: There's a social aspect as well.

Electronics today exerts a democratizing influence on our society. As the cost of electronics merchandise continues to fall-both in retail price and against rising income-technological marvels such as the VCR or digital compact disc player become commodities within the reach of a broader spectrum of society. It takes money just to own the house that can accommodate a 10-ft. projection TV and a pair of tower loudspeakers. But an inexpensive headphone-radio hauls in the same FM program. And a VCR plays the same movies on a 19-in. tabletop TV.

Historically, consumer electronics products have bucked the trend of the official Consumer Price Index. For example, the stereo system you purchase today will cost you less than what you might have paid in 1969—and give you superior performance to what was available at the time.

This bargain-basement pricing owes not only to new technology, but also to the manufacturing efficiencies and marketing strategies which technology dictates.

In the not-too-recent past, consumer electronics products generally were the offshoots of professional products. Let's take open-reel tape recorders for an example. After a company designed a machine needed by professional sound studios, it might (presumably having recouped its research and development investment) decide to maximize its profits by producing an amateur or "consumer" version for the relative handful of enthusiasts who might buy one. This trickle-down product-and its professional forerunner -was probably made from many, many discrete electrical components. It's possible that some labor-intensive hand assembly was involved, too.

In today's consumer electronics, the jobs performed by yesterday's many discrete components are often accomplished by a single large- or very-largescale integrated circuit-often called a chip. And hand-assembly has given way to machines that build machines.

Complex chips are very expensive to develop. So, too, is production machinery. Consequently, consumer electronics companies do not produce a product unless they've determined there is a large, mass market for it. Once developed, chips fly off the block like newspapers off a press, and the cost of producing them drops dramatically. With volume, the production machinery soon pays for itself. The bottom line is this: It's unlikely that the studio digital recorder would ever have been produced unless manufacturers saw a huge consumer market for digital audio compact disc players.

That's not all there is to it. Beyond the



page are among the best available. From the top left: Dual CS5000 turntable (\$400) with Ortofon

X3 phonocartridge (\$140); Hitachi DA-003 compact disc player (\$800); Harman/Kardon TD392 cassette deck (\$550); Onkyo Grand Integra T4807 tuner, P308 preamplifier and 200-watt-per-channel M508 power amp (\$1500 total). Center is 26-in. monitor from Sharp System 96 component TV package (\$2700; rack and matching speakers not shown). From the top right: Dahlquist DQM-9 Compact loudspeakers (\$1600/pair with stands); controller for Sharp System 96; Harman/Kardon VCD2000 VCR (\$800). CD player a manufacturer looks for promise of additional potentially marketable products. In the audio section of this special report, you'll read how the compact disc is forcing improvements in the other hi-fi components required to reproduce music in the home-including the record turntable.

Similarly, in the video segment of the report, you'll learn how the VCR forced the TV set to improve its image-and why TV is now returning the favor. Change engenders further change in the world of entertainment electronics. In the flush of success, a new product raises the ante for its counterparts. Nothing, really, occurs in a vacuum.

In a sense, the dynamics of consumer electronics is very much like that of life itself-especially life in this particular decade of the 20th century. Change comes fast. Today's future becomes tomorrow's present. Technological innovation sometimes outpaces practical application.

It's difficult to make confident decisions based on the many and increasing variables that our age of information-overload serves up.

We, the editors, hope this special report will serve you as an overview to the current and ongoing changes in electronic home entertainment. By giving you a perspective on the billiardslike dynamics of the subject, we hope to eliminate at least some of the confusion caused by multiple choices and marketing hype-and thereby help you make an informed decision if you're shopping for those products.

One final word-on the threat posed by today's plethora of electronic entertainment possibilities.

Amidst the bells, whistles and flashing lights, we face the danger of mistaking the means for the end, or the medium for the message. It is, after all, possible to hear the pounding rhythm of Springsteen's "Born To Run" without listening to the desperate appeal for human companionship that its lyrics seek to convey. Similarly, one can laugh at the comic antics of a young Jack Lemmon in "The Apartment" yet overlook the black-and-white tragedy of his misplaced priorities.

In its ability to provide diversion, electronic entertainment can make us passive participants in life-indifferent to the events and circumstances that affect us. In doing so, electronic entertainment becomes the enemy of its own promise. That promise is to communicate, across time and distance, our hopes and anxieties, our joys and fears. Only through such communication can we hope to understand that it is the differences among us that unite us as individuals.-Stephen A. Booth



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HOME ELECTRONIC ENTERTAINMENT

HOME HI-FI THE DIGITAL CHALLENGE

Digital audio compact discs demand even higher fidelity

from the rest of the hi-fi chain. Here's how the latest

amps, speakers and other components measure up.

Components for the digital age are shown opposite. Topmost is Bang & Olufsen's Beocord 5500 cassette deck (\$900). Across the center, Sansui's 110-watt-per-channel AU-G77X-II integrated amplifier (\$600) links up with Denon's massive DP-59L turntable (\$600) and Akai's SW-M40 flat-panel diaphragm loudspeaker (\$240/pair). Harman/Kardon's HD300 compact disc player (\$550) rounds out the quintet.

hange is always fast in the world of electronics, but the last few years have seen changes in audio component design on an unprecedented scale. Indeed, today's hi-fi components hardly even resemble those of a mere three years ago, both in outward appearance and in capabilities. This breakneck pace can be attributed to two key developments—the appearance of the digital compact disc and the interest in merging audio and video components to create an integrated home entertainment system.

Of course, not every recent technical advance in audio was spawned by these developments. Engineers are constantly at work trying to advance the state of the art. It can be argued that many of these improvements would have occurred anyway. Yet, it's also likely that they hit sooner than they might otherwise have, hastened along by the demands of the new digital disc. Here is a look at the most recent innovations.

Loudspeakers

A great deal of attention in speaker design lately has focused on three areas: higher power handling, faster response to sudden peaks and better imaging.

The first two have always been high priorities on the speaker engineer's list of goals, but they have assumed greater importance with the advent of the CD. That's because the CD, with its greater dynamic range (the difference between a program's softest and loudest passages), will often draw more amplifier power during momentary peaks than an LP would. This taxes a speaker's ability to reproduce music without distorting it.

For this reason, you'll find many speaker manufacturers touting liquid-cooled tweeters to keep tweeter voice coils from overheating during peak passages. The speaker "drivers"—either traditional cones or the more recent flat, square panels—are made increasingly from new materials designed to handle high power and react faster to program peaks. To reproduce the CD's deep bass, speaker manufacturers are building their woofers with stronger magnets and deeper-thrusting voice coils.

Stereo imaging—the ability to accurately pinpoint the placement of the various instruments—is also receiving a lot of attention from speaker designers lately. Effort is being focused particularly on maintaining a stable, realistic image anywhere in the room rather than requiring you to sit squarely between the two speakers. Several models are now available that claim to create a more realistic soundstage through some ingenious designs. The MGC-1 and MGC-2 from Acoustic Research, the three Soundfield models from dbx, and others combine multidirectional driver arrays with some signal processing. Flat-panel or enclosureless speakers, such



Also in the digital arsenal are Altec-Lansing's Model 501 4-way tower loudspeakers (\$1500/pair).

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HOME ELECTRONIC

as The Amazing Loudspeaker from Carver, are also becoming more common as their proponents argue that they can deliver a better image than conventional box speakers.

Amplifiers

High-powered, low-distortion amplifiers are not new. But with the coming of the compact disc and the demands it places on an amplifier, more of us can benefit from an amp that can deliver a lot of power cleanly.

As with loudspeakers, it is the very high momentary peak levels that a CD can deliver that makes it desirable to have an amplifier with enough reserve power to handle those peaks. It's a lot like a turbocharger in a car: When you're cruising, the turbo unit just coasts, but when you need to accelerate quickly, the turbo kicks in to provide the extra power.

In fact, that's exactly how many newer amplifiers operate. Though many carry moderate power ratings, their circuitry is such that the amps can deliver high momentary bursts of power whenever the material demands it.

Of course, all that power has to be delivered cleanly, so that no residual amplifier noise is added to the CD signal. Consequently, work continues on low-distortion circuitry. Many companies emphasize "signal purity" by using separate power transformers for the amp's different sections, compared to more mundane designs that let a single transformer do the job for the entire unit.

Receivers

The same design innovations you'll find in separate amplifiers have been incorporated into the amplifier sections of many receivers, and for the same reasons. But beyond that, receivers have changed perhaps the most radically of all audio components in the past few years.

The prime reason is the availability of high-quality sound from video sources, such as Hi-Fi VCRs and television sets capable of decoding stereo broadcasts. These developments have ignited an interest in merging audio and video components to create an integrated home entertainment system.

Yesterday's stereo receiver is today's audio-video control center, with facilities for switching not only among audio components, but video components as well. The newest receivers will select and control not only your turntable, CD player, tuner and cassette deck, but also your VCR (in most cases a pair of VCRs). Other capabilities include dubbing between two VCRs, video enhancement circuits, and built-in sur-

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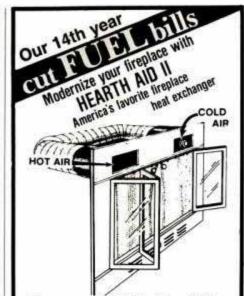


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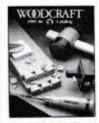
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round-sound circuitry for adding more depth to movie soundtracks. Some receivers even have a second built-in ancillary amplifier to power the extra speaker channels needed for theaterlike surround sound.

Tuners

Progress in tuners isn't nearly as dramatic as in other component categories. Quite frankly, with the nearly universal use of quartz synthesis technology, today's tuners are rather good, with most limitations in FM sound-quality inherent in the FM broadcasting system itself. A few companies have done a better job of combating multipath—the muddy sound caused when more than one signal from the same station arrives at your tuner after bouncing off large buildings and other structures.

Cassette decks

The compact disc hasn't sparked any new developments in cassette deck technology, but it has given added importance to those sound-enhancing technologies already available in tape

Noise reduction, for example, is more important than ever when recording the CD with its complete absence of background noise. Dolby C-type noise reduction, which offers twice the noise reduction capacity of the original Dolby system (Dolby B), is nearly universally available, except in the lowest priced decks. The dbx system, a more powerful noise reduction system than Dolby NR, was once available on only a handful of decks, but is now relatively easy to find. It still, however, is not as universal as Dolby C NR.

Dolby HX Pro, a circuit that makes it possible to record high frequencies at higher record levels and thus produce better tapes, is rapidly gaining new adherents several years after it was developed jointly with Denmark's Bang & Olufsen, Improved head technology, such as the oxygen-free copper wiring used in Akai's GX-6 deck (shown on page 73), also makes for clearer recording.

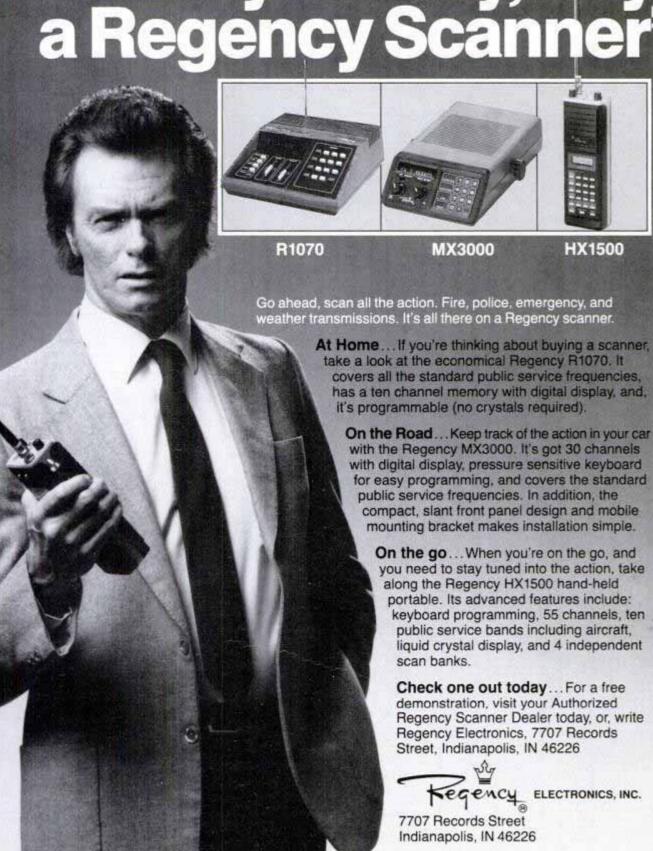
With the advent of auto-reverse dualtransport decks, the cassette deck is also better able to rival yet another advantage of the CD player-long playing time. With the ability to play both: sides of a C-90 cassette in both directions, these decks can play for three hours without repeating a selection. Programmed to repeat, some can play for 24 hours.

Turntables

Despite the popularity of CD players, record turntables will be around for

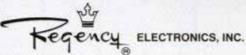
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many years to come. And though the platter-spinner can't match the CD in reproducing wide dynamic-range music, some refinements in the turntable can narrow the gap.

One way to increase the turntable's dynamic range is to make it quieter. Many new models in the \$200-and-above range reduce noise (that might be transmitted to the pickup cartridge) by damping internal motor vibrations, and by incorporating pliant suspensions that isolate external disturbances. The latter is sometimes achieved with nonresonant chassis and tonearm materials.

Another sonic improvement in turntables is the cartridge tonearm itself. Records do warp, leading to sound distortion. To prevent this, many recent turntables have tight-tracking tonearms that can ride the warp and reproduce the music accurately, much the way a surfer keeps his balance in the curl.

To imitate the convenience of CDs, quite a few LP turntables now can be programmed to play selections in the order you'd like. Some models, in fact, boast two tonearms and cartridges to play selections alternately from either side of the record.

Compact disc players

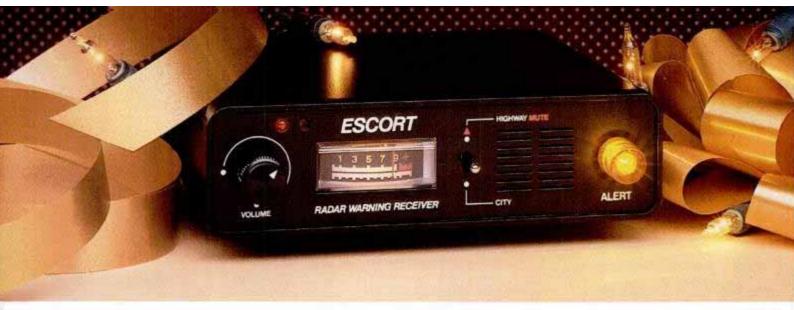
Though originally claimed to offer sonic perfection, the CD player has gone through some improvements over its 4-vear lifespan.

A look at the current crop of digital disc players finds that an increasing number opt for the more complex circuitry first offered by Philips, the CD format's co-inventor. This combination of oversampling and digital filtering is said to offer more accurate frequency response. But one of the most interesting developments is Onkvo's use of fiber optics, in place of conventional wire, to transmit digital data within the player. Onkyo contends that noise generated by a player's internal digital processing can degrade the analog sound output we hear. Accordingly, the company developed a system for transmitting the digital data over light beams, which don't generate or transmit electrical noise.

Onkyo offers this feature in two players, the DX-320 and DX-220. Other companies have recognized the same problem, and improved their designs earlier by isolating and shielding the CD player's digital and analog circuitry.

This evolving understanding of the CD, and the promise of refinements in lasers and signal-handling microprocessors, indicates we'll continue to see change and improvement in hi-fi products—and hear them, too.

-Terry Shea



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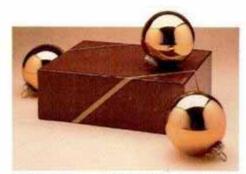
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HOME VIDEO THE BIG PICTURE

TV screens are getting bigger. And the latest

easy-to-program VCRs fill them with the sharpest

pictures yet. But there's more improvement on the way.

Five top contenders for the VCR championship grace the page opposite. From the top: RCA's VMT-400 digital VCR sends two programs to your TV screen. Canon's VR-HF720 has HQ picture enhancement, hi-fi sound, stereo reception, combo remote control/programmer (not shown). Unique timer-card in Sharp VC-T64U slips into slot on right to program deck. Pan-asonic Model 1564 produces clear special effects in all recording modes. Harman/Kardon VCD2000 boasts audiophile sound. Behind the VCRs is the new Magnavox 27-in. Star monitor receiver. Prices range from \$700 to about \$1000.

ometime in the future, historians will characterize our age as the one when TV became video. And the fact is, describing what emerges from today's screens as "television" reveals only part of the story—much like calling a Ferrari Testarossa "transportation."

The technology of television entered a period of somnolent complacency after its last innovative leaps—color and transistorization—established themselves in the 1960s. What woke it from its slumber was the raucous arrival of video cassette recorders in American households during this decade.

The old boob-tube, once perfectly adequate for receiving TV broadcasts, today must deliver alternative sources of entertainment. Besides video cassette, these include video disc, electronic games, computer graphics, satellite- and cable-borne programming, teletext and videotext.

As a result, TV technology has entered a renaissance, with innovation and improvement proceeding at an unprecedented rate. Progress is evident on four fronts: image size, image quality, expanded capabilities and, last but not least, high-fidelity sound.

The most obvious changes you'll see in TV are the wider variety of screen sizes and the increasing size of screens. In addition to the familiar 13-, 15-, 19- and 25-in. color screens, you'll now find models with displays measuring 14, 18, 20, 22, 26 in. and larger. At this writing, the largest television tube available measures 35 in. diagonally. Projection TVs come even larger.

Why would anyone want so large a display? You can credit the availability of theatrical programming on video disc and cassette. Once it became possible to convert the living room to a movie theater at will, it became

desirable to simulate the wide-screen experience of the movie house—and the sonic ambience as well.

Today's larger cathode-ray tubes are the result of advances in glassmaking and electron-gun technology. Better glassmaking techniques enable manufacturers to build tubes with flatter screens than yesteryear's more convex displays. This flatness yields two advantages. One is more viewing area: A 25-in. display can be stretched to 27 in. The other is a more viewable display: The flatness reduces optical distortion formerly caused by a curved screen, and lets you see more of the display when you're viewing it from an off-center position.

Though today's TV display is larger, the tube isn't any deeper than older designs. That's because newer electron guns can sweep across a wider area than those of just a few years ago.

This increase in display size is accompanied by an increase in display resolution—that is, greater picture detail. In video jargon, this is measured in lines of horizontal resolution—meaning the number of picture elements arrayed left to right across the screen. The more, the better: A simple light-and-play TV set might have 250 lines of horizontal resolution, while a better monitor/receiver boasts as many as 450.

"Monitor/receiver" is the name TV adopted once the VCR and its cousins joined broadcast programming as sources of visual entertainment. Like the TV of old, a monitor/receiver's tuner section receives over-the-air programming. But video cassette and other nonbroadcast sources travel straight to the

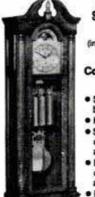


Sony SL-HF1000 has "jogging dial" for professional editing capabilities.

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tions, completely bypassing the tuner.

This sidestepping makes for better picture quality. For a VCR's signal to reach the screen through the TV tuner, the video signal first must be converted to a radio signal. In effect, the VCR is broadcasting to the TV's tuner. Because any signal conversion generates some deterioration in picture and sound quality, a direct connection to the video monitor and audio section is preferable.

That's why you'll find a multitude of input and output jacks on the back panels of today's versatile monitor/receivers. They provide a direct route for images from your VCR, video disc and perhaps computers, games and teletext decoders, too. Meanwhile, the sound from these sources travels separately to the monitor/receiver's audio



Akai's VS-565U, a VHS format VCR with hi-fi sound, has a built-in 10-watt amplifier.

amplifiers and loudspeakers. These pack more wallop than those in a conventional TV—and do it in stereo. Consequently, you'll be able to enjoy the growing number of TV programs broadcast in stereo, as well as the sophisticated soundtracks that accompany many of today's movies.

To reproduce the special effects on those soundtracks more realistically, the monitor/receivers of the not-too-distant future will incorporate built-in surround-sound circuits.

Once that happens, you'll relive at home the same sonic experience as when you first saw Star Wars and other flicks in the theater. You can expect further enhancement in the monitor/receiver's picture, too. This will come from digital technology.

Right now, digital circuitry is used in a handful of TVs for special features, such as projecting a second program in a corner of the screen. But soon, "digital" sets will boost image resolution, maintain color purity, and eliminate multipath ghosts and other forms of distortion—such as the video noise or snow that sometimes afflicts dark areas.

That snow, more often than not, is generated by dropouts on a videotape. You might not notice it on an older TV set, but today's higher-resolution displays make it painfully evident. Ironically, displays have become so good they're prompting improvements in VCRs—the very source component that sparked the video revolution.

Since their introduction in 1975, home VCRs have become easier to

program and use, and have developed longer recording times and more sophisticated special effects. By 1984, home VCRs had even gotten hi-fi stereo worthy of the soundtracks they play and record—and nearly as good as the digital audio on compact discs. But until recently, little has been done to improve the VCR's picture quality.

The best VCRs today—whether Beta, VHS or the new 8mm format—top out at about 300 lines of horizontal resolution. That's less than many monitor/receivers can reproduce. In fact, the only picture sources that can match a monitor's 450-line resolution are the laser video disc and a live telecast.

To clean up their act, just about every VCR today has some sort of picture-enhancing circuitry. It's called Super-Beta in Beta decks, and HQ (for High Quality) in VHS machines. Both yield about a 20-percent improvement in picture quality. If you compare their results against pictures from older VCRs, you'll see the improvement mostly in more sharply defined image outlines, and in greater picture-detail in contrasty image areas, such as shadows.

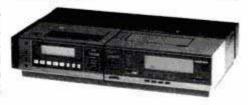
For the record, the still-new 8mm format holds promise of improvement when the highly touted "metal evaporated" tapes arrive. Today's 8mm decks use "metal powder" tape.

It's technically possible to improve the VCR's image even further—but only at the risk of losing compatibility with older machines and the tapes recorded on them. Accordingly, VCR makers are counting on the same digital enhancement promised for TV to work similar magic on videotapes.

The first digital-effects VCRs are just now arriving from Hitachi, RCA, NEC and Toshiba. Like digital TV, the "digital" VCR's bag of tricks currently is limited to special effects.

But when you see what digital enhancement does for a freeze-frame picture, you'll easily imagine how it might upgrade the moving kind.

Because moving video is memoryhungry, this technological leap won't occur until the cost of digital memory chips comes down. This makes the estimated time of arrival more dependent on the computer industry than on Hollywood. Accordingly, we'll see digital VCRs in time for the next remake of Beau Geste.



The recorder section detaches for field use in Kodak's modular 8mm VCR.

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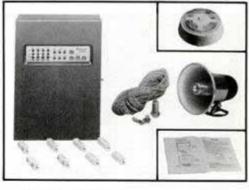
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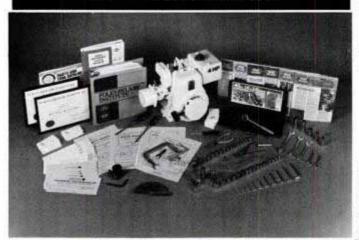


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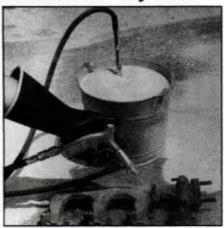
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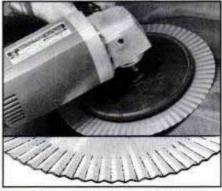
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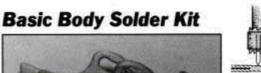
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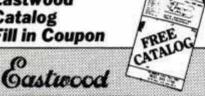
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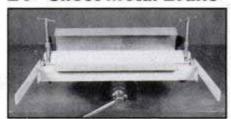


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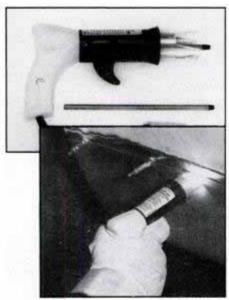
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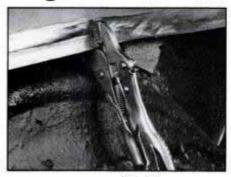
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- 2. Drawings or schematics are not necessary to win, but might help you clarify your thinking and express it more effectively.
- 3. While there is no limit to the length of your suggestion, please be to the point and as brief as possible.
- 4. All 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 Electronics Dept. editors of POPULAR MECHANICS. From the initial selections, the final winner will be selected by 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 Sansui Super-Compo hi-fi system with a suggested retail value of \$4000. All taxes and other fees are the responsibility of the winner. POPULAR MECHANICS will ship the system to the winner, prepaid, by common carrier.
- 9. No cash payment will be made in place of the
- 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: Sansui Super-Compo Contest, Popular Mechanics, P.O. Box 1409, New York, NY 10101.
- 12. Entries must be postmarked before midnight Feb. 15, 1987, and received by Feb. 22, 1987.
- 13. The winner will be notified by April 1, 1987, and may be asked to execute a qualifying affidavit.
- 14. After the winner is notified, POPULAR ME-CHANCS will provide the winner's name to anyone who wishes it and who sends us a stamped, selfaddressed envelope with the request.
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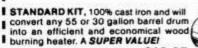
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Electronics components, like cars, need regular
maintenance to run at their best. The right accessories
can keep your equipment out of the repair shop.

Maintenance accessories (above, clockwise from left) include Nagaoka's record-cleaning roller, Discwasher's compact disc cleaning fluid and VCR headcleaner, Ortofon's static-eliminator pistol and disc-spindle coupler. At near left are gold-plated connecting cables by Memorex.

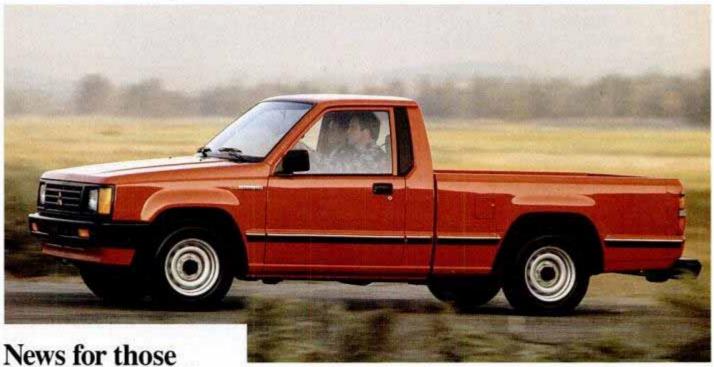
PM PHOTOS BY LAYMANINEWMAN

ven in this age of disposable commodities, chances are you'd never put your car in jeopardy by letting the radiator, transmission and crankcase fluids run dry. You probably keep a watchful eye on the battery, connecting hoses and wires as well.

Electronics components need routine maintenance, too, in order to prolong your enjoyment and protect your possibly considerable investment. Trouble is, we sometimes neglect their care and feeding because we don't perceive them the way we do an automobile or an outboard motor.

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HOME ELECTRONIC ENTERTAINMENT

Compared to these cantankerous assemblies of moving parts, electronics components appear static and selfsufficient. And the truth is, the electronic and electrical elements in a hi-fi or video component are pretty durable. Unless you fry them with current or douse them with liquid, they'll probably soldier-on until old age takes the spring out of their step.

It's easy then, to overlook the mechanical elements in these components that reproduce sight and sound. Yes—despite all the digital circuits and microprocessor chips, the critical link between a waveform and a bass note is often mechanical. To perform optimally (or sometimes at all) these mechanical elements require routine maintenance, much as your car's engine does.

Keeping clean

Cleanliness is the best form of preventive medicine you can administer to your components. Foreign contaminants that cause friction or clogging are as harmful to electronics equipment as they are to an automobile's pistons, gears and carburetor valves.

With electronics, these invaders most often arrive airborne. Dust infiltrates nooks and crannies, and adheres to critical surfaces with the help of oily films generated by cooking or tobacco smoke. Sometimes, the infiltrators are guided to their landing zone by static electricity—most prevalent in places where the air is dry.

From the foregoing, it should be evident that your electronics gear habitates a hostile environment. Your first line of defense should be protective storage. There is a wide assortment of furniture-quality racks and cabinets available today for storing components, records and tapes. But because electronics do need ventilation, some contaminants will inevitably slip through the chinks. Consequently, cleaning accessories are necessities.

Stroll through any electronics or music store and you'll see dozens of products designed to accomplish this task. Most numerous are the brushes and solutions for cleaning vinyl records and the stylus (needle) that plays them. Cleaning tapes for audio and video cassette decks abound, too, and lately, cleaning systems for digital compact discs have emerged.

Nearby these cleaning accessories you'll also find a bewildering assortment of cables and connectors, plus devices designed to suppress external vibrations. These products subscribe to the theory that a chain is only as strong as its weakest link.

Until a better system comes along, the signals bearing music and images

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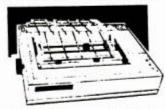
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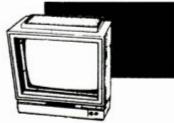
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HOME ELECTRONIC ENTERTAINMENT

travel from component to component via cables-usually made of copper wire. These cables terminate in connectors of one form or another, which plug into suitably matched receptacles on the components.

If time and household environment cause these connectors to corrode even slightly, the signals they pass will deteriorate. Gold doesn't corrode, so you'll find a wide assortment of cables with gold-plated connectors.

Only the most expensive hi-fi and video components come with goldplated receptacles, but you can match a gold plug to a receptacle of lessnoble lineage, since most connectors cover and protect the receptacle.

As for the cables themselves, the thicker the better. The wider the path, the more freely the signal-bearing electrons will flow. This is most important with loudspeaker connections, and especially so if you're forced to have a long run of wire between your amplifier and speakers. If the cable (for any component) is shielded, all the better. This will prevent it from acting as an antenna for all the electrical junk mailspurious radio frequencies-that travels around any house equipped with a lot of electronic gear and electrical appliances.

In this connection, so-called "surge suppressors" or electrical-line filters can prove a worthwhile investment. They go between your component's power plug and the electrical outlet. For one thing, they'll filter out any signaldistorting AC line noise. They'll also protect any microprocessors in your gear should lightning or power-supply irregularities send a sudden flood of juice down the pipe.

Vibrations

Electricity isn't the only form of energy that can impair the performance of your electronics components. Mechanical energy in the form of vibrations and sound waves can muddy the sound of your stereo, too. Record turntables are the most vulnerable. Wooden floorboards are great conductors for footsteps and bass vibes. You'll find a wide variety of acoustic isolators (usually in the form of add-on "feet") designed to absorb these disturbances before they reach the turntable and its seismograph-sensitive stylus. You install them under the record player. If your loudspeakers sit on the same surface (Never!) as your turntable, or even nearby, you should install isolators under the loudspeakers, too.

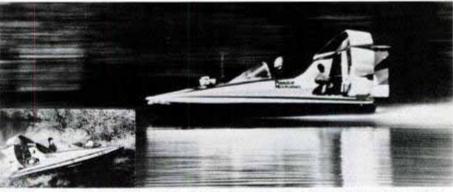
Human fitness and hygiene require a regimen, and so does the proper care and feeding of electronics components. Here's some advice on what you

POPULAR MECHANICS . DECEMBER 1986

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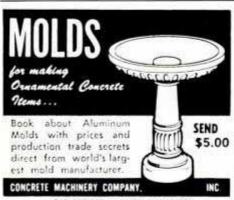
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HOME ELECTRONIC ENTERTAINMENT

should do and how often. But as your doctor might tell you, common sense is the overriding rule.

 Vinyl records require cleaning each time you take them out of their dust jackets to play them. That's because paper jackets generate more dust than they keep out (synthetic "rice paper" jackets are better, and widely available). But even sliding the platter out of its sleeve generates static electricity. Static not only attracts dust, but can create noise on its own. A liquid-impregnated record brush removes and breaks the static charge. Where static is severe, you might need a deionizing "anti-static" gun. As for phonocartridge needles, the many devices available to clean them should be used whenever you see an accumulation of debris. Sometimes, though, the dirt isn't obvious to the naked eye. For safety's sake, clean the needle when you start out to use the turntable.

 Audio and videocassette players don't need cleaning as often as records do. Over time, though, the heads that read the tape, and the capstans and roller that transport it, do accumulate residues left behind by the tape itself. To remove this junk, you'll find cleaning cassettes that slip right into the player and do the job effortlessly. These cassettes employ one of two techniques: either dry-cleaning or wet-wash. There are opposing points of view on which is best-but the point on which experts agree is moderation in use. Don't fix it 'til it's broke-meaning, don't use a cleaner until you hear distortion or see it (in the form of a snowy picture). The best preventive medicine is to use highquality tapes-which rarely shed magnetic particles on the delicate tape heads. Also, store your tapes carefully. As for demagnetizing those heads, it depends on the equipment you own. The heads used in older audio decks needed occasional "degaussing." Today's audio cassette decks have heads that are more resistant to magnetization. There are simple pop-in cassettes for degaussing, but again, use moderation. Don't demagnetize an audio deck until the music begins to sound dull. As for VCRs, they might need degaussing if you're running an illegal high-volume duplication shop-but never under normal home use.

 Digital compact discs seldom need cleaning-only when something (peanut butter, or a grimy fingerprint) prevents the laser from reading the transparent surface. In fact, incorrect cleaning can damage the disc. For those rare Saturdays when your CDs need a bath, you'll find a selection of cleaning systems that do the scrubbing thoroughly and painlessly.

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GREAT AMERICAN CHASE

(Continued from page 57)

the pit area of Indianapolis Motor Speedway about 15 minutes in front of a dark rain cloud. As cars circle the track for a ceremonial lap, the rain hits with ferocious intensity. Everyone is disappointed, but there is still a thrill traveling in a 50-year-old car around Indiana's classic Brickyard.

Day 8—Indianapolis to Columbus

Well off the main road, with tall corn stretching in all directions, it's hard to pinpoint position. The countryside takes on the look of a Bonnie and Clyde film as '20s and '30s cars race through this timeless American backdrop. We take 27th overall for the day.

Day 9—Columbus to Alexandria

Today we hit the East Coast, just south of Washington, D.C. It's July 3, the day of the relighting of the Statue of Liberty torch in New York harbor. From my hotel window in Alexandria, the Washington Monument and Rotunda of the U.S. Capitol stand clearly against the horizon. The hotel parking lot looks like

the pits at a NASCAR race. The top three finishers for the day are all firsttime winners. The amateurs are getting better, which adds to everyone's optimism of getting a shot at the \$100,000 final-day prize.

Day 10—Alexandria to Wilkes-Barre

Our first stop out of Alexandria is the Ellipse in front of the White House, where the cars stand on display on the Fourth of July, just a few feet from a monument commemorating the first transcontinental motor trip on the Lincoln Highway.

From the shadow of the White House, we parade north through the famed Civil War area of Gettysburg, along Highway 83.

More than 10 miles out of Wilkes-Barre, hundreds of people jam overpasses, TV news crews drop in behind us and a helicopter circles overhead, beaming live coverage of our entry into town as our car comes "home."

Soon thousands line the roadside. At the finish line, police estimate that some 60,000 people crowd the downtown area to get a look at the car. Local press coverage has stimulated the best spectator turnout of the race.

Day 11—Wilkes-Barre to New York City

It's only a couple of hundred miles, but the promoters have mapped out a confusing route for three hours worth of automotive torture. The beauty of the Northeast's back roads fades as it becomes obvious that the GAR folks didn't want anyone walking away with the 100 grand without fighting for it.

The end of the race at the World Trade Center is anticlimactic compared to the excitement of the greeting the day before in Wilkes-Barre. Owing to the events surrounding the Statue of Liberty, a parade of 100 classic cars goes almost unnoticed in this city, but it meant a lot to us. We had finally arrived, and finished 27th out of 83 starters that day.

Ron Hayslett and Dave Teeter of White Sands, New Mexico, won the \$100,000 in a 1936 Packard. The PM team finished 32nd overall, and although we never placed in the money, the joy of finding thousands of old friends of the magazine and making plenty of new ones as we crossed this vast nation was reward enough.

The 1987 GAR will run from Disneyland to Disney World on June 30 to July 10, with stops at San Diego, Phoenix, Albuquerque, Lubbock, Dallas, Houston, New Orleans, Birmingham, Atlanta, Jacksonville and Orlando.

We hope to see you somewhere along the way.



profile. To make the 16 x 20-in. frame shown, first cut two pieces of 4/4 stock (actual thickness: 13/16 in.) 4 in. wide x 20 in. long and two other pieces 4 in. wide x 24 in. long. Next, cut a cove on both edges of one 20-in.-long piece and of one 24-in.-long piece. Then, readjust the cutterhead and fence and shape the full cove and bead on both edges of the two remaining pieces of stock. Replace the cutterhead with a standard saw blade and rip the eight shaped edges from the 4-in.-wide boards. Now install 1-in. planer and jointer knives to cut a rabbet in the four narrower front frame members. Cut the rabbets deep enough to accept the glass pane, picture, backing material and brads. Glue the front frame members to the wider rear pieces

to form the completed molding.

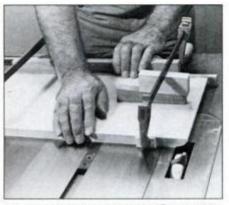
Miter both ends of each molding length to 45°. Then, using a tenoning jig to hold each piece on end, cut a 1/8-in.wide spline groove in each mitered end. Cut triangular-shaped splines to fit snugly in the grooves. Finally, glue the splines into the grooves and clamp the frame square. After the glue dries, sand the frame smooth and apply two coats of polyurethane varnish. Now you're ready to install the picture.

Radial-arm saw methods

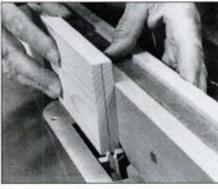
A molding cutterhead can be used with the saw's arbor in the horizontal and vertical position. For top surface molding cuts, position the arbor hori-(Please turn to page 110)



When a deep cut is made, workpiece can split easily. Avoid this dangerous situation by tack-nailing a backup board to the work.



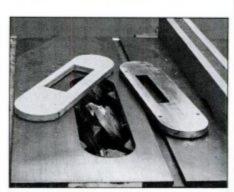
A cup-warped board must be flattened to obtain a uniform cut. Use a short bar clamp and wedge, as shown, to flatten the board.



sure the center of the workpiece aligns with the exact center of the molding knives.



Properly cut glue-joint fits together precisely. Sample blocks, on top of boards, show the effects of a misaligned cutterhead.



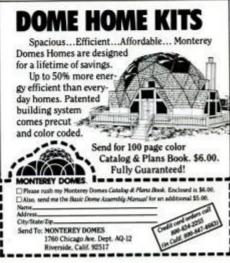
After cutting one edge, rotate the board so

the opposite board surface is against the

fence. Don't readjust the cutterhead or fence.

Angled cuts require a wider opening than a'standard cutterhead insert. Make a new insert (left) from 1/2-in. plywood.







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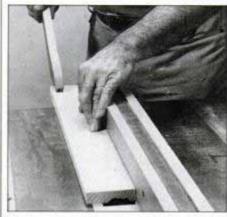
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CUTTERHEAD CLOSEUP

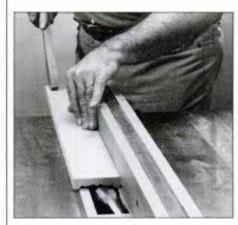
(Continued from page 109)

zontally so that the cutterhead rotates on a vertical plane. To perform edge-shaping, position the arbor vertically with the cutterhead on a horizontal plane. Always use the standard blade guard when the cutterhead and arbor are in the horizontal position. When the arbor is positioned vertically, use an accessory cutterhead guard. Note that for photo clarity the guard has been removed. Caution: Never operate a molding cutterhead without a guard.

(Please turn to page 112)



Make crown molding easily with a molding cutterhead. Install a set of cove and bead knives and tilt the cutterhead 45°.



After completing the first cut, rotate the workpiece end for end and make second pass. The result is a symmetrical profile.



Replace cutterhead with a standard saw blade. Angle saw blade 45° and make rip cuts to produce finished crown molding.

cuts to produce finished crown molding.

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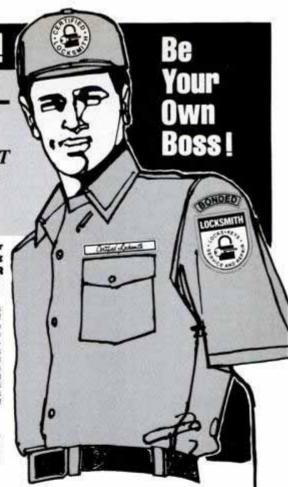
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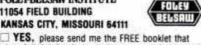
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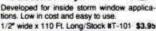
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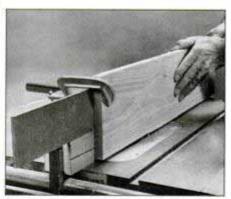
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Replace the standard 1-piece saw fence with a 2-piece fence that can be separated at the center to provide cutterhead clearance. When removing stock from the entire edge of a workpiece, such as during edge-jointing, the infeed fence and outfeed fence must be offset slightly. The offset is necessary to provide full support of the workpiece throughout the cut on both sides of the cutterhead. To form the offset, install one shim in front of the infeed fence and another shim of equal thickness behind the outfeed fence. Cut the shims' thickness equal to the amount of stock that will be removed. Be sure that the shim on the infeed side doesn't protrude above the worktable's top surface.

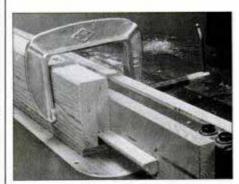
CUTTERHEAD CLOSEUP

(Continued from page 110)

(Please turn to page 114)



Use this setup for full-edge jointing. Clamp a board to the work to establish the depth of cut. Board rides atop the fence edge.



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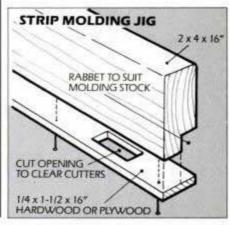
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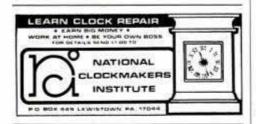




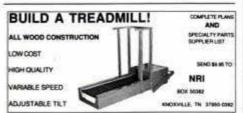
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CUTTERHEAD CLOSEUP (Continued from page 112)

To cross-grain shape the end of a board, position the arbor horizontally as you would for standard crosscutting. Hold the board against the fence and pull the saw carriage across the work. Make several shallow cuts, moving the work into the knives slightly after each pass until the desired shape is made.

Caution: It's very important to always feed the work against the rotation of the cutterhead. Always stop and think before feeding a workpiece into a spinning cutterhead. If a board is mistakenly fed with the rotating cutterhead, the knives will grab the work and shoot it out the other side.

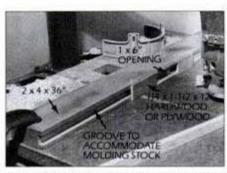
RADIAL-ARM SAW METHODS



Crosscut decorative patterns using radialarm saw. Align workpiece markings with lines on table to ensure evenly spaced cuts.



Molding cutterhead can also be used with radial-arm saw in the ripping position. Always feed work against knives' rotation.



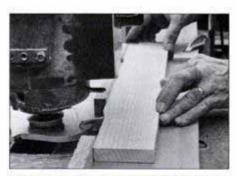
Shopmade strip molding jig allows you to mill small-dimension moldings on a radialarm saw. Position saw's arbor vertically.



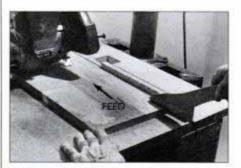
Lock the saw carriage in place and feed the stock against the knives' rotation. Note the use of an accessory cutterhead guard.



To full-edge-joint a board's edge, the fence must be offset to provide support for the workplece on both sides of the cutterhead.



Offset must equal the amount of stock removed. Note how work is supported against the fence before and after the cut is made.

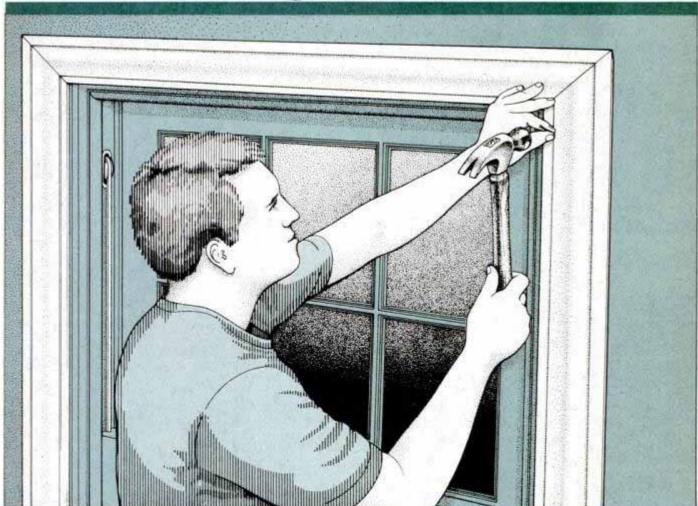


Surface-plane lumber with saw in rip mode. Install planer/jointer knives and make shallow cuts. Advance motor after each pass.



Use this 2-part jig to edge-shape circular workpieces. Triangular parts are nailed to strips that are clamped in fence channel.





How To Install TRINGRK

nstalling trimwork—which these days means basically installing casing, baseboard, shoe molding and ceiling molding—is not very difficult, though it can be time-consuming. In this respect, it's very much like taping drywall. The two jobs also share other similarities because, taken together, they represent the bulk of what is seen on the interior of a house. A poor job of either will never be out of view.

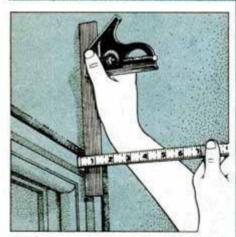
Of course, very little goes wrong with existing trim, especially if your house is new. But, if you plan to add on or convert a basement or attic to usable living space, knowing the ins and outs BY PAUL BARRETT Illustrations by George Retseck

of this finish trade will be invaluable. You can trim a room with a small selection of hand tools—basically a hammer, nailset, coping saw, block plane and a few sharp chisels. You also need a miterbox. Both the old-style, hand-powered boxes and the new electric tools are generally available at tool rental shops.

Depending on your local supplier, baseboards, casing and ceiling or crown moldings come in different sizes and shapes. But the ranch (clamshell type) and the colonial style are by far the most common. We used the colonial variety on this job. Both types are available in clear stock, if you plan to stain or cover with a clear finish, and in finger-jointed sections, if you paint.

There are no hard-and-fast rules about the order in which you trim a room, except at the point where the baseboard abuts a door casing. Obviously, the casing must be nailed in place first. (Note: Because trimming a window is more involved than a door, we chose the window as the basis of our illustrations. But the techniques for

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 Using a square, check to see if the jambs are flush with the wall surface. If not, measure the difference with a ruler.

casing the window are, in every way, identical to casing a door.)

Begin by checking the relationship between the outside edge of all window and door jambs with the wall surfaces next to them. Use a square and ruler as shown in drawing No. 1. If the jamb is within ½6 in. in either direction, it's fine; the trim will be able to lay flat against both surfaces. If it projects more, plane the jamb flush. If the jamb is recessed, rip a thin wood shim. Then, glue and nail it onto the jamb so it's flush with the wall. These shims are called extension jambs.

Doors and windows

Once the jamb is flush with the wall around it, mark the reveal; that is, the part of the jamb that will remain uncovered by the casing. Measure from the inside face of each jamb across the edge and make a mark at the 3 /₁₆-in. point. Do this at the bottom and top of both side jambs, and at both ends of the top or head jamb. These marks define the position of the inside edges of all casing boards. This reveal is basically cosmetic. But it does allow you to adjust your casing boards slightly if you cut a miter a little too long or too short.

The next step is to measure for the window stool. The stool is the piece which fits over the window sill, extending beyond the casing on either side of the window. Window stool is available at lumberyards, preshaped to fit over the traditional downward-sloping sill. It must, however, be notched to fit between the jambs or it won't slide into place. To fit the stool, first measure the distance between the window jambs. Then, add twice the reveal, plus twice the casing width, plus 2½ in. Your goal is to have the stool extend 1¼ in.



2 If jambs are recessed from the wall surface, glue and nall extension jambs in place. If jambs project, plane them flush.

beyond each side casing. Cut the stool to this length. Next, mark the edge of the stool at centerline of its length. Also, mark a centerline on the sill between the jambs. Hold the stool against the sill, with these marks aligned, and then mark the location of the inside edge of both jambs.

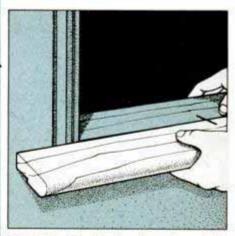
Make sure the lower sash of the window is closed, then measure the distance from the stool to the sash. This determines how deep the notch should be on both ends. Cut the notches by hand, keeping the saw blade to the waste side of the line. Next, trace the profile on the front edge of the stool, to both ends. Cut the ends to this shape with a coping saw. Sand smooth, and toenail the stool into sill and jambs.

Casing

Using a miterbox set to 45°, cut one end of the head casing so that the long point of the angle is at the thickest part of the material. Hold the piece against the

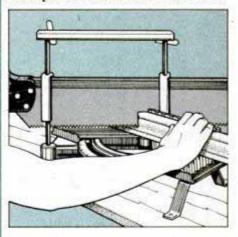


9 Nall the finished apron under the sill. Note that ends of apron should align with outside edge of both side casing boards.

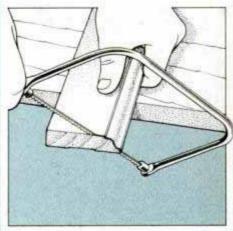


3 Cut the stool to length and mark its centerline. Then, mark center of window sill. Hold stool against sill and align marks.

head jamb with the short point of the mitered cut on your reveal mark. Then, mark the other end of the head piece at its reveal mark. This establishes the short point of the second miter. Care-

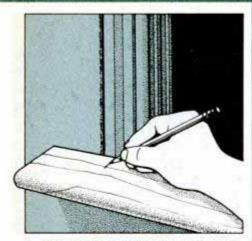


7 Using a miterbox, cut a closed miter on both ends of the sill apron. Hold the board firmly while making the cut.



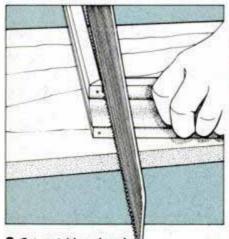
10 Inside corners on baseboards must be coped. First, cut open miter on end, then back-cut profile slightly with coping saw.

HE BETTER

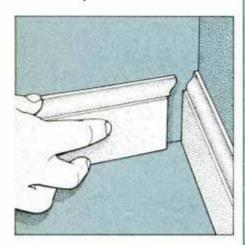


4 Mark stool—at both ends—where inside edge of jamb falls. Remove stool and cut the notches with a backsaw.

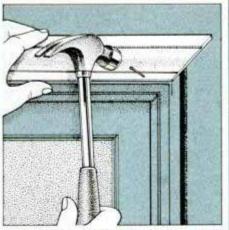
fully make the cut, keeping the saw blade to the waste side. Align the head piece between the reveal marks, then nail it to the jamb using 4d finish nails. The short points of the miters should be



8 Cut matching closed with miters on small sections of casing. Glue and nail to apron ends. Cut ends flush.



11 Nail square-cut baseboard in place first. Then, test-fit coped cut. If necessary, refine profile cut with sandpaper and rasp.

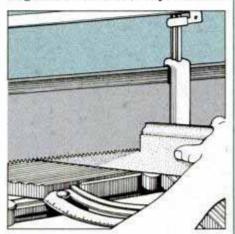


5 Carefully miter both ends of the head casing. Then, nail the lower edge to the head Jamb using 4d finishing nails.

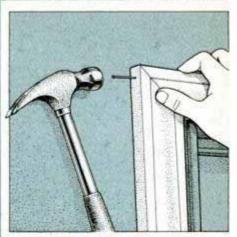
³/₁₆ in. above the inside edge of the head jamb, so that the reveal is uniform on the sides and top.

Next, measure from the stool to the top of the head casing at both ends. Cut and miter the respective side casings. Apply glue to both members of each miter joint, then nail the sides to the jambs with 4d finishing nails. Also, drive a nail through each miter as shown in drawing No. 6, then nail the casing boards to the wall surface with 6d finishing nails. These should be positioned about ½ in. in from the outside edge of the boards so you'll be sure to hit the jack studs within the wall.

Now measure for the apron, which is the trim piece that runs underneath the stool. Generally, its length matches the measurement between the outside edges of both side casings. Cut a piece of casing to this length, with a closed miter on both ends. (A closed miter means that the angle is cut so the face is longer than the back. An open miter is



12 Outside corners require closed miter on both baseboards, if wall corner is square cut at 45°. If not, bisect angle.



Cut side casing and apply glue to miter. First, nail casing to jamb, then nail miter together with a 4d finishing nail.

cut so the back is longer than the face.) Next, cut a closed miter on two small scraps of casing. Glue and nail one on each end of the apron. When the glue is dry, carefully cut the ends flush with the back of the apron, as shown in drawing No. 8. Nail the apron into wall studs using 6d finishing nails.

Baseboards

Once you've finished the windows and doors, turn your attention to the baseboard. Locate the wall studs and lightly marking their positions on the floor or wall. If the drywall is up off the floor more than an inch, fill in the gaps with strips nailed to the floor plate. (These don't have to fit perfectly; you just need some solid backing for the baseboard.) There are four basic cuts involved in applying baseboard. The first is a square cut. This is used on ends that abut a door casing or other trim board that extends to the floor. The second is a closed miter that is cut on ends of both boards that meet at an outside corner. (See drawings No. 12 and 13.)

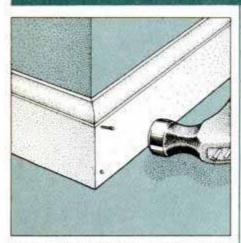
The third is an open miter. It's used along with a closed miter when you need to splice two boards together in the middle of a wall. And the fourth is a coped open miter that fits over a mating baseboard on one side of an inside corner (See drawing No. 11)

corner. (See drawing No. 11.)

The straight cuts should be made with your miterbox set at 90°. Any board that has a straight cut on both ends can be nailed to the wall immediately. Use 6d finishing nails driven into the studs along the top of the baseboard and into the plate along the bottom.

The open and closed miter cuts, that form a splice, are cut with the miterbox set at 45°. Always cut the open miter on the first board you nail to the wall.

HE BETTER



13 Glue miters together and nail with 4d finishing nails. Blunt tips of nails before driving to prevent splitting wood.

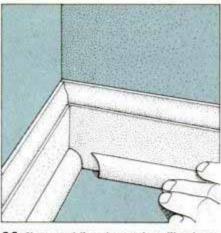
Then, cut the closed miter, apply glue to the splice joint and nail the board onto the wall. When the glue dries, you can sand the joint smooth.

When making the matching closed miters for an outside corner, keep in mind that very few house walls meet at a precise 90° angle. For this reason, it's wise to check each corner with a sliding T-bevel square and protractor. Just place the square around the corner, lock it in place, then read the angle against a protractor. Bisect this angle, that is, divide it by two. The resulting number is the angle that should be cut on both boards. Nail the boards to the wall, being sure to glue the joint.

The coped miter is used on one board of an inside corner. It requires two cuts: First, make a 45° open miter. Then, cope the end, following the profile of the mitered cut where it meets the face of the board. You should under cut, or back cut, the cope slightly so the front edge of the board is longer than



16 Outside corner on ceiling molding requires closed miters. Keep in mind that top of molding is held away from saw fence.



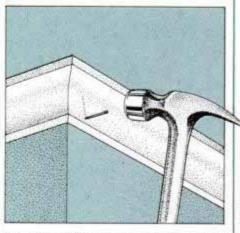
14 Shoe molding is cut just like baseboards. However, it is usually nailed in place after the floor covering is installed.

the back. This allows a small amount of stock that can be easily filed or sanded to make the joint fit tightly. Test your cut against the baseboard that is already in place, then nail to the wall.

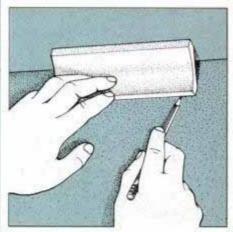
If you plan to add a shoe molding over the baseboard, cut and fit it now, even though you may not install it yet. All the cuts and installation techniques for shoe molding are the same as for baseboards. Whenever possible, plan your installation sequence so you have only one mitered or coped cut on each board. By doing so, you can adjust the cut so that it fits perfectly before you cut the entire board to length.

Ceiling molding

Ceiling molding went out of fashion somewhat in the past 30 or 40 years. But it's not much harder to install than baseboard, and it can add something special to any room. It does have one complication: Instead of laying flat against the wall surface, ceiling mold-



17 Join outside corners with glue and 4d finishing nails. Nail as close to corner as possible, but avoid nailing through miter.



15 To establish a straight line for ceiling molding, scribe bottom edge of scrap molding at wall ends. Snap chalkline.

ing bridges the corner between the wall and ceiling at a 45° angle. Begin by cutting a scrap of ceiling molding approximately 5 in. in length. Hold the scrap against the ceiling in one corner of the room and lightly mark the wall below it. Do the same thing at the other end of the wall. Then, chalk a very light blue line between these points. Check to make sure the scrap block will fit between the line at every point on the wall. If it is too tight in some places, snap a new line lower than the first. The molding is difficult to nail in place without it moving up or down. The line provides accurate reference.

Keep the bottom edge of your molding on the line, then nail it into the studs. As with the baseboard and the shoe molding, miter the outside corners and cope the inside corners. But, keep in mind, when you cut the ceiling molding, you must hold the lower edge firmly against the fence because the top edge does not bear on the fence. The installation techniques are the same as the baseboard and shoe moldings.

The material used to fill nail holes and small gaps in joints depends on the finish you use. For instance, work that is to be stained is much less forgiving than paint grade work. Any glue on the surface will show up as light blotches after the wood is stained. The same is true for many wood fillers, unless the filler comes colored to match various stains. Paint grade work is much more forgiving since any fillers will be completely covered. Painting also allows you to caulk areas where the trim is not flush to the wall or ceiling. No matter which way you finish the trim, set all nailheads, apply some kind of filler, and lightly sand any blemishes with 220grit sandpaper.

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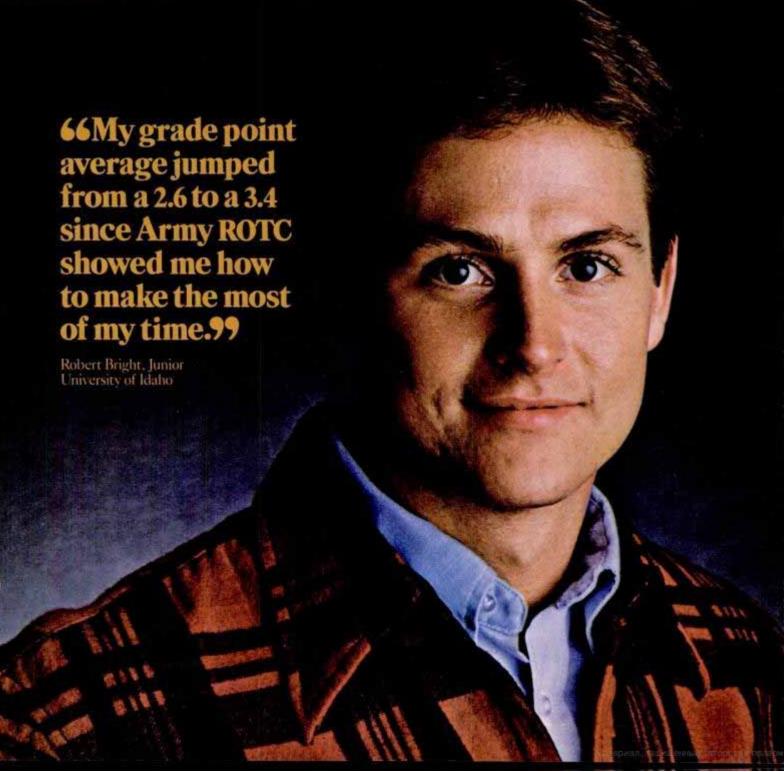
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-PM LONG-TERM CAR TESTS-



OLDSMOBILE DELTA 88

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FORD TAURUS LX

Friendly alien.

MAZDA B2000

Attractive helpmate.

SUBARU 3-DOOR

Improving with age.

JEEP COMANCHE

Reaching retirement.

his month we add two new American cars to our fleet, the hotselling Ford Taurus station wagon and the good-looking Oldsmobile Delta 88 version of GM's front-drive H-body, which is identical to the Buick LeSabre and is, in fact, powered by a Buick 3.8-liter V6. Our Mazda B2000 pickup and Subaru 3-Door have survived another few thousand miles, and our Jeep Comanche is being retired.

Olds Delta 88

We really wanted to like the Oldsmobile Delta 88. In fact, we *do* like the Olds Delta 88. Now. But for a while, it was touch and go.

This Oldsmobile Delta 88 has a tough act to follow. It's Oldsmobile's version of the H-car, the car designed to replace the old B-cars at General Motors. Only one B-car—the Chevrolet Caprice—is still being built. Meanwhile, Buick has replaced its old B-car LeSabre with a new H-car version and Pontiac's new

'87 Bonneville is their version of the new H-car. And of course, the subject of this report is the H-car replacement for the old B-car Delta 88 Royale. The thing is, the B-cars are one of the best families of cars General Motors has ever built. It has proven to be one of the most popular and troublefree designs ever out of GM. And we liked the B-cars a lot here at PM, even picking the Chevy Caprice as one of our 10 best cars last year.

So we decided right away that we wanted to try an H-car to see if it could live up to the fine reputation of the car it was replacing.

We selected the Olds 88 Coupe for the reason most buyers do—it's one of GM's best-looking front-drive cars with its semifastback styling instead of the formal roofline found on everything from Grand Ams to Eldorados, Oldsmobile selected the options and delivered a \$15,924 car that included \$1988 worth

(Please turn to page 122)



Aerodynamic styling and thoughtful features made the Ford Taurus wagon a big hit.



Attractive new cap improved both the appearance and usefulness of Mazda truck.

PHOTO ABOVE BY NORMAN MAYERSOHN; RIGHT BY HUMPHREY SUTTON; FAR RIGHT BY RICH TAYLOR

POPULAR MECHANICS . DECEMBER 1986

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Perim-A-Tron employs sophisticated micro processors, making it the most advanced system available for consumer use. Perim-A-Tron can call for help automatically if a break-in is attempted. It's on the job 24 hours a day, 365 days a year...and doesn't cost an arm and a leg.

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Some other features: While the house is occupied, a 2-beep signal alerts residents

Perim-A-Tron Protection

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- · Dials for help automatically
- Battery back-up in case of power failure
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- Inside and outside alarm sirens
- FCC and UL listed
- Protects any size home

to anyone entering or exiting. You can leave windows and doors slightly open for ventilation or pets while alarm is armed. Your personal 3-digit code disarms the system.

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At a break-in attempt, dual speakers blast an alarm. But that's not all. Perim-A-Tron is the first consumer-installed system to offer monitoring service. If you choose this round-the-clock protection, your Perim-A-Tron comes to you with a built-in digital dialer. If a break-in is attempted, it calls for help automatically on our toll-free number.

At the Central Monitoring Service, the skilled staff quickly calls your number to confirm the emergency. If there is no answer, or if you fail to respond with your private code, they immediately contact your local police. No matter where in the U.S. you live, help is on the way within seconds.

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LONG-TERM CAR TESTS

(Continued from page 120)

of options. Some of them were power windows, power door locks, Touring Car ride and handling package, a 3.8-liter V6 engine, and a midrange sound system. Most things are standard on this car—power steering, power disc brakes, automatic transmission, air conditioning and more.

Our test car was a Brougham model, which means a high-glitz interior. Some of our staff hate the velour cushions sewn on the bench seats and others think the seats are comfortable for a family sedan. A power seat could be adjusted for height and rake as well as forward and backward.

When we first received the Delta 88 from Oldsmobile, we put it in our test fleet and started driving it. The 3.8-liter V6 has multiport fuel injection and just about every other kind of electronic computerized device to help it make 150 hp at 4400 rpm. The engine was very responsive and the car felt strong out on the highway and around town, as we commuted to work in it. In addition, the special optional suspension gave the car a firm, stable feel that made driving it a real pleasure.

Unfortunately, the pleasure only lasted for three days. On the way home one night, the engine suddenly lost power. We didn't know it at the the time, but the engine computer had sensed a problem and gone into "limp in" mode. This is a limited power state where the engine is stressed as little as possible while still allowing you to limp home. That's what we did, making it to our driveway just before the engine died completely.

The next morning, the car had not healed itself so we called the local guy that Oldsmobile uses to wash their cars and jockey them around. He came out and hauled the car away. After an initial inspection, he declared that we had "totally abused" the car and caused the engine failure. Who, us? This was ridiculous, as we had only driven the car to and from work three times.

Subsequently, the engine was found to have scarred cylinder walls and seized bearings. The direct cause, however, is a little obscure, but there is some evidence that a number of early '86 cylinder blocks were not machined properly on the assembly line, according to GM service bulletins.

In any case, the dealer who replaced the engine apparently didn't do a very good job of tightening everything down because we experienced an electrical breakdown when we got the car back. The electrical problem was finally traced and fixed by Parkway Oldsmobile in Keyport, New Jersey (thanks, Victoria, the service manager). After all this early hassle, with three months down time, the car has been performing admirably, delivering 20 to 26 mpg on the highway and 15 to 16 mpg around town, which is excellent for a car this big—it's a full 6-passenger vehicle, so long as the center one up front is a kid.

This is a family sedan that isn't sloppy around a turn or floating down the road on the brink of control. The special suspension prevents that, and the big Goodyear Eagle GT tires on alloy wheels deliver a level of handling and stability that some sports cars only dream about.

We've driven the Olds Delta 88 several thousand miles now, and there's nothing more to report at this point. We'll keep you posted.—J.O.

Ford Taurus LX

Our Taurus wagon has been relatively troublefree, despite receiving much more abuse than the Oldsmobile. It came straight from a comparison test (see *Wonder Wagons*, page 58) to our long-term fleet. Track testing is really abusive, and in our 60 mph brake tests one of the Ford's discs warped to the point where it made the steering wheel shimmy under light braking.

The car also spun off the slalom track (thanks in part to its slippery General all-season tires) and tagged a guard rail. There was only slight cosmetic damage at the rear corner, but the suspension groaned and the hatch creaked after that. Neither of these problems was the car's fault, and we elected not to fix them immediately in order to keep the car on the road.

Compared to the old-fashioned, illhandling station wagons of just a few years ago, the Taurus is a revelation.

Its handling is steady and secure, even with the base suspension. Its digital dash is one of the best, easiest-to-read digital setups we've ever encountered. All of the knobs and controls are easy to find and use, making driving a natural act, not a series of distractions.

Performance from the 140-hp, 3-liter V6 engine and 4-speed automatic is strong for a family wagon, although the engine can occasionally be heard roaring away behind the sound insulation. Our major disappointment was the erratic performance of the cruise control. When you tap the RESUME button at low speeds, acceleration is snail-like until about 50 mph, then the transmission shifts down two gears, the computer floors the gas, and you take off like the afterburners have cut in. Smooth, consistent acceleration would be safer and more pleasant.

The power driver's seat looks and feels as comfortable as an easy chair. But one tester's wife complained that the manual passenger seat cut off circulation in her legs (a problem she'd found in the Merkur, too). When she drove, she was fine. A powered passenger seat, or at least a cushion angle adjustment, might avoid that problem.

The radical aerodynamic styling makes this wagon so quiet at highway speeds that you're often going faster than you thought and using more gas. We averaged 23 to 25 mpg in a combination of daily commuting and weekend trips, with a high of 29 mpg and a low of 18. The trip computer, though, was often more than 2 mpg off the amount we calculated at the pump.

Everyone, especially the kids, loved the flexibility of the cargo bin, with its hidden compartments, flip-up rear seat and picnic tray. The Taurus wagon starts at \$11,304, but the tag on our fully loaded LX model was \$16,246. Somewhere between these two extremes is the perfect family car.-W.H.

Mazda B2000

With more than 8000 miles on the odometer, our extended-cab Mazda hums right along. A majority of those miles have included a race car in tow. and while the 2-liter Four needs FIRST gear to tow 3500 pounds up a steep hill, it eventually gets there. Only a couple of times have I wished for more power.

Minus the trailer, the B2000 has more than enough punch for normal driving. Highway cruising at 75 to 80 mph is quiet and comfortable, and yields over 20 mpg. At the speed limit, fuel economy approaches 30 mpg. So far, not one thing has broken, rattled or fallen off, and this truck has needed no service of any kind. One quart of oil is all it's asked for.

As you can see from the photo on page 120, Slingerland's Honey of Westtown, New York, fitted a terrific cap that's a great improvement over the one we first borrowed. The new cap is of beautifully made fiberglass, colormatched to the Mazda, and was made by Jeraco of Milton, Pennsylvania. It also has screened sliding windows, interior lights and fully finished interior. Even at \$600, it's a great deal.

So far, there's only one complaint we have with the B2000. The rear step bumper supplied by Mazda is crafted of thin sheet steel, and we've damaged two of them in normal use. Otherwise, our long-term B2000 has been just about perfect.-R.T.

Subaru 3-Door Turbo

I was disappointed with the handling of our Subaru 3-Door as delivered. I replaced the stock Bridgestones with a set of Goodyear's new Eagle GT+4 allseason radials, size P185/70HR13. These have a high-performance tread pattern, but deep grooves that wrap (Please turn to page 124)

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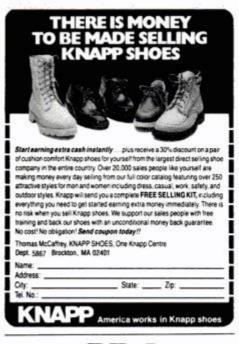
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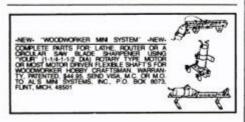
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LONG-TERM CAR TESTS

(Continued from page 123)

around into the sidewall for snow traction. The tread compound is formulated for wet-weather traction.

The Goodyears improve the Subaru's performance in every way. Cornering and straightline tracking are both more



A new set of Eagle GT+4 all-season tires made a big difference on the Subaru.

stable, torque-steer is reduced, wet adhesion is dramatically better-even the ride is softer and more comfortable.

In more than 5000 miles of driving, the Turbo has now averaged just under 26 mpg, used no oil and required not a penny's worth of attention. With the rear seat folded down, 8-ft. 2x4s will fit between the dash and the rear hatch. For everyday fetching and hauling, the Subaru is functional, reliable and economical. And sometimes, just knowing you have 4wd available is worth any tradeout in ride and handling .- R.T.

Jeep Comanche

When we returned our Jeep Comanche to AMC it had 11,500 miles on the clock and was beginning to show its age. The engine was starting to hesitate on acceleration, and it had developed a bizarre water leak that could deposit up to an inch of water in the driver's footwell when the truck was parked indoors! This was attributed to some sort of algae growth inside the air-conditioning evaporator that was blocking the drain hose, and also causing an overpowering musty smell.

AMC has already replaced the anemic GM V6 on our '86 truck with their own 170-hp straight Six, so the engine problem should not apply to '87 models. The a/c glitch was only one worrisome sign of poor quality control at the Toledo Jeep plant. Although we had ordered a tachometer and trailer-towing package, our Comanche was delivered without them. It did have the Selec-Trac 4wd option, although the chrome letters on the tailgate identified it as Command-Trac. We enjoyed our Comanche a lot, and Jeep is AMC's only profitable division. But if the folks there don't start paying attention to details, they may alienate even longtime Jeep fans, which would be a real

pity.-W.H.

TECHNOLOGY UPDATE 12/86



Future Rocket Will Make 'Local' Stops

Current space vehicles, including the Space Shuttle, are designed to take satellites to a specified orbit. But the Air Force has awarded to Hughes Aircraft Co. a contract to design and build an expendable launch vehicle that deposits satellites at different orbits on the same flight.

The Jarvis Medium Launch Vehicle (MLV) could carry six satellites to orbits ranging from low-earth to geostationary. The MLV is named for Hughes engineer Gregory B. Jarvis, who was killed in last January's *Challenger* explosion.

Working with Boeing Aerospace, Hughes plans to design the system around the Saturn booster, the same powerplant used by the Apollo moon launch project. Some elements of the rocketry used in the Space Shuttle may find their way into the Jarvis system.

As envisioned by Hughes, the rocket will stand more than 20 stories tall with a payload bay 6 ft. wider than a 747 Jumbo Jet passenger compartment. The nosecone section will have its own propulsion system and will open like flower petals, PM's conception of the Jarvis rocket shows powered nose cone releasing payloads at different orbits along flight path.

mechanically casting off satellites as it passes through different orbits. The Jarvis MLV should be ready for duty in the 1990s.

Editor: Dennis Eskow Contributors: Michael Fillon, Richard Schrader: Doug Dreys, Steve Eskow

TECHNOLOGY

UPDATE

SPECIAL REPORT

Star Trek IV a splash hit

"Star Trek IV" is expected to be the leading box office hit for December and early January. More than \$20 million was spent on the production, in which George Lucas assisted with special effects. But no effect can be more special than the scene in which a Klingon starship crashes into San Francisco Bay in the year 1986.

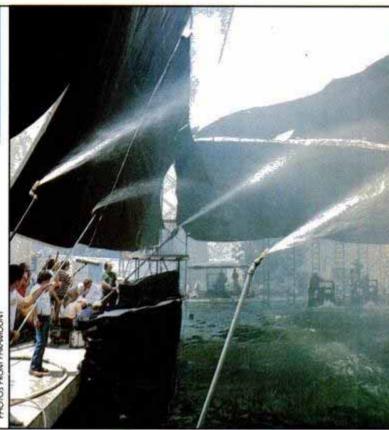
To film the scene, production designer Jack Collis (also of "Splash" and "Cocoon") used a large water tank within a water tank on the Paramount back lot. His crew constructed a full-scale Klingon ship of wood and metal plating with some resins used for the part of the vessel that was not sub-

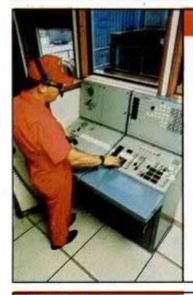


Enterprise crew departs downed Klingon starship.

merged. In the middle of the 12,000-sq.-ft. main water tank was an 8000-sq.-ft. secondary tank where underwater sequences were filmed.

The Klingon ship was set atop a huge, movable steel platform that allowed the crew to get different camera angles. Special lighting effects and a set of large hydraulic rams helped create the illusion of choppy waters. Crews continuously sprayed down the set to add to the excitement.





ENGINEERING

Fighting fires with simulator

The word fireplace is taking on new meaning with the advent of the Advanced Technical Systems (ATS) fire-simulator. Already in use in six states, the simulator creates several classes of fire emergency in prepared stations that are known as "fireplaces." A controller stationed in a remote area runs a high-speed computer that creates smoky fires,



chemical infernos and other specific firefighting assignments. Sensors and monitors at each station record how the trainees approach the fire, how they evaluate it,



and how quickly they put it out. Scenarios range from a smoke-filled building to a room behind a steel door. More than 20 fire departments may use ATS in 1987.

SPORTS

Runs, hits, chips and bits

The scoreboards in professional sports have become very high-tech, with such features as split-screen diamond vision video and computer animation on hand. A dozen inset video screens can be displayed at once.

At Yankee Stadium in New York, a crew of five technicians man the big board these days to show fans instant replays and provide updated game information. A 3M 64-bit character generator and a series of personal computers help coordinate dozens of cameras and the big screen at the Home of Champions in Bronx, New York.



PM



Tank within a tank (left) was used for the splashdown scene in Star Trek IV. Crew sprays the set (below) as cameras roll for the escape from the starship.



Special lighting was brought in by Paramount to dramatize splashdown.



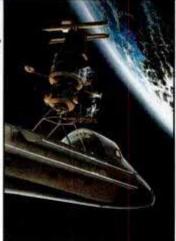


On the Klingon ship bridge, rear-projection provided computer images.

AEROSPACE

New repair bay for Shuttle

When the Space Shuttle returns to service in 1988, it will not be placing civilian satellites in orbit, but will launch military satellites and repair them. Thus, NASA and Lockheed have begun working on a new in-orbit report system called SAMS, for Space Assembly, Maintenance and Servicing. The program will be in two phases: the first to end in 1995 with the deployment of a new repair rig that captures and anchors satellites for repair (right). The sec-



ond phase ends in 2010, with the deployment of a repair rig for robotic servicing of orbiting devices, probably on an upgraded Shuttle.

X-29 gets an 'A' in tests

NASA officials have given the X-29 Forward Swept Wing (FSW) jet high marks for performance halfway through its 2-year testing program. Test pilots have become so confident in the plane that they flew four missions in one day, a record for experimental aircraft. The X-29's superlifting capabilities make it a vision of future jet fighters.



Props spin into a new era

It was a blustery afternoon in Woodford, England, but that didn't stop British Aerospace from running the maiden flight of the company's Advanced Turbo Prop (ATP). The remarkably quiet 60-passenger plane flew for 2 hours, 40 minutes, then landed perfectly in a 24-knot crosswind. It's powered by two Pratt & Whitney engines that use 6bladed props developed by Hamilton Standard. Because it is fuel-efficient, it will be good for commuter runs.



ENERGY

Oil from wood



With oil prices relatively But a research team headed by Don H. White at the University of Arizona is prepared for the next oil crisis with the only biomass-to-oil project currently supported by the Federal Energy De-



partment. A plastics extrudlow, the crisis mentality of er (above left) pumps a slurrecent years has subsided, ry of wood into a highly pressurized system, producing gases and solids that liquify. These rise through a 10-ft, vertical tower where they form oil compounds. It could be made commercially viable in five years.



ELECTRONICS

Sound and 'site'

The cockpit of the future will be equipped with a helmet the aircraft. When the sensors pick up an approaching aircraft or missile, the pilot shown above.

will hear it coming from its true location. The military applications are obvious, but the civilian applications may include a special hookup for commercial pilots to help them "see" approaching airthat surrounds the pilot with craft as they start descendsensitive electronic speakers ing into a terminal area. hooked to sensors outside Georgia Tech researchers are developing the system in experiments like the one

MILITARY

TOW under power

The Army has developed a new mobile system to carry the Tube-launched, Optically Tracked, Wire-Guided (TOW) missile into combat. The missile components are mounted on a launcher platform attached to a modified M27 cupola atop an armored

personnel carrier. An elevating mechanism positions the launcher platform down into the tank to an automatic loading system. The vehicle carries 12 TOW rounds. Should it become disabled, the TOW components can be removed and used in a ground-mounted mode. An M60 machine gun can be mounted in tandem with the TOW. The vehicle weighs 26,000 pounds fully loaded.



Shake, rattle, rock and roll

The Navy's next underseabased guided missile, the Trident II, will have to travel 4000 nautical miles to a target. During the flight it will encounter pitch, roll, yaw and plenty of shaking. Before deploying the new missiles, the Navy has asked Lockheed to program every possible glitch in the missile's flight performance. Lockheed engineer Robert Bauer is shown at the controls of a new Inertial Measurement Unit (IMU) de-



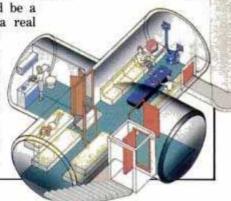
signed just for that purpose. The gimballed unit holds a simulated missile 4 ft. off the ground, twisting, turning and shaking the object as it would travel in actual flight. The tests already resulted in adjustments to the Trident II's guidance systems.

INNOVATION

Not just a hole in the ground

Most experts believe that ules. fallout shelters would be a waste of money in a real nuclear attack. But the Sunlock Co. of Japan has come up with a new fallout shelter design that could double as an underground living structure in areas where land is precious. The \$65,000 cross-shaped con-

crete structure with graphite lining provides comfortable living space for 11. Blastproof doors seal the tube ends, but can be removed to add on more mod-





WUNDERCARS!



You can see reminders of the Porsche 911 in the roofline of the flamboyant 959.

rive a Porsche 959 around Nurburgring's 2.8-mile road course for 30 minutes and you learn a few things. The 959 just might be the world's fastest, most powerful sports car. But at legal speeds, it's as docile as a kitten. Even at 145 mph, handling is as civilized as that of your family car on a winding Interstate.

Porsche claims 450 hp from the 2.8liter twin-turbocharged, 6-cylinder engine. It's the same basic engine that's in the 911 sports coupe, fitted with four cams, four valves per cylinder and twin intercooled turbos.

Performance is awesome. The Nurburgring is not the best layout for careful testing because of its short straight and its hilly, curved character. But still, I drove the car comfortably at just under 150 mph. And that was without using top gear—SIXTH. The Stuttgart factory claims a top speed of 190 mph and 0 to 60 in 3.9 seconds.

I found the handling better than any other Porsche. Take the rear-engined 959 into a curve at speed and tromp on the throttle. The result, thanks to a new 4-wheel-drive system, is no rear-end swing or other change in body attitude. The car pulls out of a curve

We test the state-ofthe-art 4-wheel-drive Porsche 959, and the new 32-valve 928S 4 on Germany's roads and top racetrack.

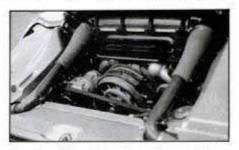
under power with the stability of a front-drive car.

Comfort features for the driver and front-seat passenger are similar to those of a regular street coupe. The engine is quiet and smooth-running. The clutch, unlike those of some musclecars, is soft, and provides an accurate feel of the driveline. The shifter is quick and takes no more effort to operate than the one on your family sedan.

Porsche plans to build only 250 959s and all of them are already sold. Only a handful will be shipped to the United States, and those will be used strictly for racing. Price is \$190,000.

Since our first look at the 959 (*Imports*, page 14, May '86), Porsche Chairman Peter Shutz says that the cost of adapting the 959 to U.S. safety and emission standards is too great to justify the effort. Shutz points out that technical innovations on the 959 will soon show up on the regular sports cars in the line. The list of new features is impressive, and includes:

- Automatic 4-wheel drive with a unique variable torque split to distribute power between the front and rear wheels as needed;
- Seventeen-inch tires with a low-airpressure warning system;
- Six-speed gearbox;
- Twin turbos;



Flat-6 engine with twin turbos and intercoolers pumps out 450 hp from 2.8 liters.

- Water-cooled cylinder heads;
- Hydropneumatic height control for the chassis;
- Speed-responsive shock absorbers;
- Antilock braking system (already on the 928S 4).

Four-wheel drive is different in the 959. Four different programs for torque distribution between front and rear wheels can be selected by the driver using switches on the dashboard: one for full traction, another for ice and snow, one for wet roads, and one for dry conditions. For example, at steady speed on a dry road, the rear axle gets 60 percent of the torque, the front axle 40 percent. But during acceleration, when the rear tires have more bite, the rear axle gets 80 percent, the front 20. In hard turns, when some tires may lose traction, torque is diverted to tires with the greater traction. The car exhibits uncanny grip at all times.

All-in-all, it's an incredibly expensive proof of concept, and still derived from the rear-engined, air-cooled 911 chassis layout.—Jim Dunne

Porsche 928S 4

Unlike the 959, production of the 928S 4 isn't restricted to a few hundred exotic (Please turn to page 132)

POPULAR MECHANICS • DECEMBER 1986

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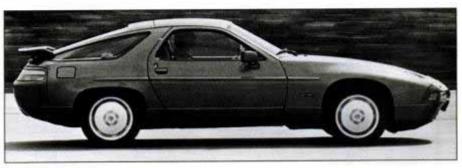
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examples, and even better, it's available in the U.S. Porsche is making the same smog-controlled, catalytic-convertered engine available in Europe and here. Aside from simplifying engine development, this also cuts off any gray-market operators at the knees. Why spend 10 or 15 grand to federalize a Euro-spec car when it's already available at the dealer?

The 928S 4 sports a 5-liter, sleeveless aluminum-alloy 4-valve engine rated at 316 hp, antilock braking, and revised aerodynamics that lower the Cd from last year's 0.39 to an impressive 0.34. How fast is it? Porsche claims 0 to 60 times of 5.7 seconds for the 5-speed and 6.3 for the automatic versions. (Corvette does it in 5.8.) I had no opportunistrongly from just above idle in any gear, and the Mercedes-built automatic transmission is calibrated not to downshift unless you're really serious about going faster. The midrange torque to achieve this comes from two sources: the 4-valve heads introduced last year, and a unique butterfly valve in the intake manifold.

The tremendous valve area, inherent in the 4-valve layout, permits good topend power without opening the valves fast or far enough to compromise torque. The intake manifold has two resonance points, one centered around 3000 rpm, the other around 4000, depending on whether the butterfly is open or shut. The fuel-injection computer signals the butterfly to open and



New aero devices for '87 928 include computer-controlled radiator louvers to reduce C_d.

ty for serious acceleration testing, but Porsche's performance figures are traditionally conservative.

The claimed top speed is 165 mph for the 5-speed and 162 for the automatic. I saw an honest 163 mph on the Autobahn near Stuttgart, and could have easily bettered it with a combination of less rain, less traffic, less jetlag and more bravery. Manfred Jahntke, Porsche's director of public relations, suggested that I try again, telling me that the car was capable of 170!

That kind of performance potential is unlikely to be utilized here in the U.S. But what's impressive about the car is its sophistication, smoothness and comfort. Part of the aerodynamic revision this year involves a set of louvers ahead of the radiator which are controlled by a microprocessor. They block any unnecessary cooling air from entering the engine compartment, and that means less drag.

The Bosch Antilock Braking System won't be used by most drivers on dry roads. The brakes are already excellent, and pedal pressures sufficiently high enough to call the ABS into play just aren't something you need very often. But on wet roads, aha! It sounds and feels as if one or more of the brake discs is disintegrating, but the car stops smoothly, and retains all of it's steerability until full stop. I suggest that you try out the ABS a few times before you need it, or it'll scare you silly.

The engine pulls smoothly and

close as the engine runs past these points.

The optional seats have a microprocessor controller that remembers three different seating positions, including resetting both exterior mirrors. That's one seat position for the driver, another for the spouse, and one for the 7-foot-tall parking lot attendant who always leaves the seat pressed against the rear stops.

I was driving along a back road in the Black Forest, not in any hurry, and looked uncomprehendingly at the Monopoly money numbers on the speedo. I figured I was doing 70 mph or so, just loafing along in FOURTH. Later, converting from kilometers, I calculated my speed at over 130 mph. That's impressive.—Mike Allen



Four-valve heads, two knock sensors, intake runners tuned to two different torque peaks give 10 percent gain to 316 hp.

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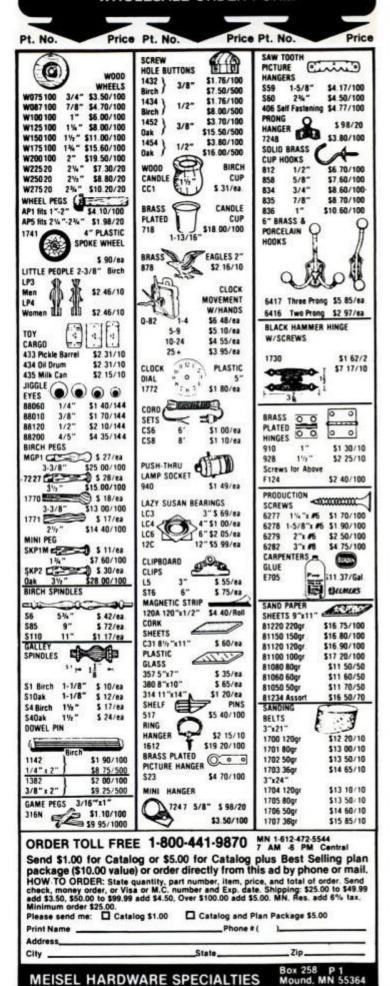
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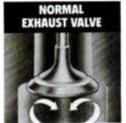
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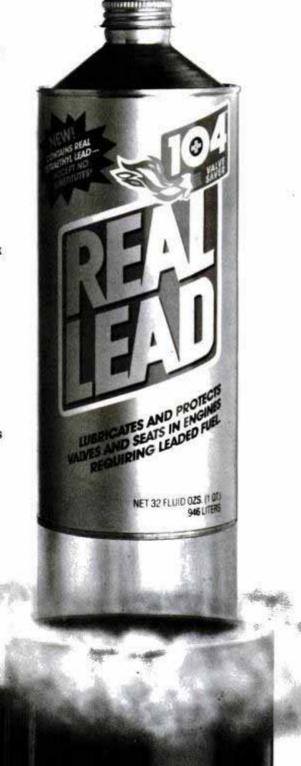
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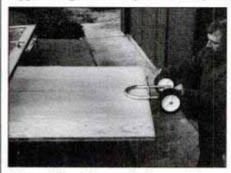
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Clamp-on dolly

A dolly consisting of a clamp-and-wheel assembly helps transport materials for shop use. However, you won't find this dolly at the hardware store or a home improvement center. It's a boat dolly that clamps to the boat's transom and enables the user to move a heavy cartopper single-handedly. The dolly is



A boat dolly makes moving large and heavy sheet stock easy. Just clamp it to the sheets, slide it out and wheel away.

sold at local marinas or in boater's catalogs.

The shop enthusiast or builder who works alone can use a boat dolly to move any number of heavy furnishings and lumber, even over rough ground, on its all-terrain wheels.

The boat dolly's greatest value is for transporting sheet stock. A single sheet of 11/s-in. plywood flooring weighs 120 pounds and is unwieldy to carry. The jaws of the boat dolly let you move two sheets of %-in.-thick plywood with ease-or up to eight sheets of 1/4-in. paneling.-Kenn Oberrecht

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A towel rack mounted 6 to 8 in. above the floor, a shelf or work surface in the kitchen or pantry will keep brown paper bags in order and within easy reach. Use a towel rack with an opening about 12 in. long. Just fold the paper bags and stuff them behind the rack.

-Walter E. Burton

Ungluing wood

You can unglue a small wood project by placing it in an oven and heating the glue. Heat the oven to about 350°F. After the glue is heated, you will be able to disassemble the parts, reposition them and clamp them correctly.

-Ted Anderson

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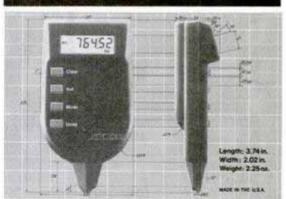
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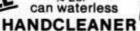
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HINTS FROM READERS

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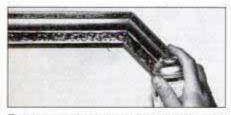
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1 Frame has damaged area of molding.



2 Mold (right) is shaped from undamaged area, then baked. Patch (left) is pressed into mold, removed, trimmed and baked.



3 After patch has been baked and glued in place, the frame is spray-painted.

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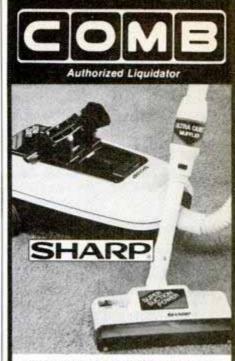


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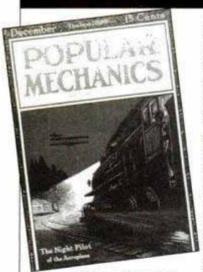
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DECEMBER 1986

TIME MACHINE

75 YEARS AGO: December 1911



Pilots on right track.

YOUR HOME ON WHEELS

DEC.

Fly by night

There were no electronic flight decks in 1911, so the first transcontinental airplane pilots had to rely on railroads as directional instruments. By day, railroad tracks guided planes, and by night, they used the lights of railroad cars to keep them on a true heading. "The value of following the railroad tracks to get the proper direction of flight was apparent at the start of the great coast-to-coast (flying) contest in September." A flier who followed the wrong track got lost and was out of the race.



Road to boating

The first boat trailer was a light truck with an extra set of nonsteering wheels projected by a metal rod under the watercraft. To give the trailer a test run, the 28-ft. boat was pulled by sedan 150 miles in a heavy rainstorm. The trip took 24 hours, slowgoing being attributed to safety concerns.

Curie's chamber

The University of Paris completed construction of a new building for radium experiments. Under the direction of Marie Curie, a new research center was lined throughout with lead plates. It was built on Rue Pierre Curie, where her late husband had started conducting radium experiments.

50 YEARS AGO: December 1936

Clipper era

"It sounds fantastic, but engineers think you will be buying tickets for a 1-day ride to Europe . . . within 20 years." We predicted clipper service, using large amphibious airplanes, back in 1936. The scale was never realized but amphibious airline service did eventually come into use. The 1936 story reviewed the work of flying boat designer Schuyler Kleinhaus, who wanted to build a 500-passenger clipper. The large size and necessary engine power proved to be the undoing of the project.



Roadwork robot

Roadwork was robotized in 1936 when a new rig was introduced that could dig, load, lift and haul automatically. It was "programmed" with a series of timing gears and hauled by tractor once its routine was completed.

Automatic autopilot

The autopilot was already in the airplanes of 1936, but PM reported on a new device to automatically test the autopilots. A vacuum-driven simulator with an autopilot installed on its back put the equipment through a 2-hour "flight." Gyroscopic mounting gave the input to the autopilot that simulated pitch, roll and yaw of a real aircraft. The testing device successfully demonstrated flaws in the standard autopilots of its day and a modified version of the simulator was used into World War II.

25 YEARS AGO: December 1961

POPULAR POPULAR First road test: Wankel retary engine four low-cost shelters you can build-quickly! Hold anything with 5 and your vacuum clemen!

Jumbo plane designed.

Tabletop talents

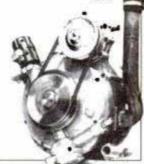
As Christmas 1961 was approaching, tabletop everything was the latest craze. PM offered plans for a pool table that converted into a ping pong table. Yet another tabletop sport for which we offered plans was slot car racing. We showed tabletop racing tracks built to accommodate from six to eight cars. The wired slots in the miniature tracks received an induction coupling that powered the little racers. Courses provided dead straightaways, loops and other breathtakers.

Wankel engine revs

We were impressed with our first test drive of a Wankel engine-powered car, a sport Prinz with a 400-cu.-in. powerplant. The engine was coupled to a Volkswagen transmission and had a 50-hp SAE rating at 6000 rpm. It started smartly, idled roughly at 1400 rpm, but gave silky performance when cruising. It ran at a smooth 90 mph in high gear and also yielded 47 mpg on test runs. We noted that the new engine called for an entirely new car design, taking advantage of its light weight.

Science kits

The hot science toys for 1961 included a basic \$85 computer you built yourself and a \$10 plastic "invisible-man" scale model of human internal organs.



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