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AUTOMOBILES

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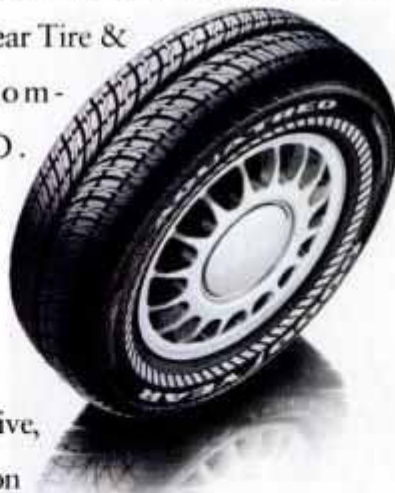
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GOODYEAR

THE BEST TIRES IN THE WORLD HAVE GOODYEAR WRITTEN ALL OVER THEM.

Editor-In-Chief Joe Oldham

EDITOR'S NOTES

● One of the interesting sidelights to Desert Storm last year was the renewed interest in the Army's utility vehicle, the HMMWV. The letters stand for High Mobility Multipurpose Wheeled Vehicle, but the troops all call it the Humvee or Hummer. When the Hummer replaced the venerable old M151, truck, ¼-ton, one each, it made news. The Hummer was our cover story in April, 1983. Then for a long time, the Hummer wasn't news—until the Gulf War. Suddenly, everyone was asking what that thing was whizzing across the sands of Kuwait, and could they buy one. The maker, AM General, knows a good thing when it sees it, and now you can buy one—the Civilian Hummer. Check this month's cover story beginning on page 27. . . . Still wondering what to do with that old, cracked concrete patio?

Don't rip it out, cover it up with a great looking wood deck. When we decided to show you how, we again called on the talents of Ron Riker, master carpenter from Hazlet, New Jersey, to design and build the example you see on page 64 while we observed and took notes. Riker has worked for us several times in the past, and he's the guy we like on the job when we can't do it ourselves. And thanks to the California Redwood Association for its help with this project. . . . Enormous doings at the Henry Ford Museum in Dearborn, Michigan, recently as the "Possible Dreams" exhibit opened to rave reviews. We celebrated with not one but two black-tie dinners, invited all our friends in Detroit and had a great time. Even Tim Allen (a native Detroit), star of ABC's hit comedy, "Home Improvement," was there. Do get to the museum to see "Possible Dreams" if at all possible. If not, you can tour the exhibit every month in our pages, thanks to the special support of Ford Motor Co. . . . Pontiac used the occasion of the Daytona 500 in Daytona Beach, Florida, to introduce its new limited-production Richard Petty Grand Prix. Watching Davey Allison win the 500 was fun, but driving the Richard Petty Grand Prix on the beach at Daytona was even more fun. More about the Richard Petty Grand Prix in this month's New Cars report. Till next time.



Master carpenter Ron Riker and his creation.



Tim Allen with PM's Deb Frank, Barb Novak, Robin LaSalle.

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Petty Grand Prix mingles with surf and sand.

Joe Oldham

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Speed vs. fuel efficiency.

An interview with Michael Andretti



Within a few years of his 1983 Indy Car debut, Michael Andretti had become runner-up in the CART/PPG Championship no fewer than three times. Then in 1991 he drove his Kmart/Havoline car to a record 8 official victories in a single season, and the championship was his. One factor contributing to Michael's success was mastery of the age-old question of whether to sacrifice fuel efficiency or speed:



"Indy Car rules require you to maintain at least 1.8 miles per gallon of fuel during a race," Michael says. "Like it or not, each team is allocated the same set amount of fuel, and if you run out, that's your problem."

"So how do you go fast enough to win—efficiently enough to finish?" Michael continued. "You do it through a combination of teamwork, driving technique, and technology—which is becoming increasingly important. And as more manufacturers use motorsports to extend their research and development, you can expect more racing technology to find its way into cars we drive on the street."

Fuel management.

"The heart of an Indy Car's fuel management system is the ECU—the Electronic Control Unit—like the 'black box' you find in many modern street cars. It's basically a computer that adjusts fuel mixture to varying ambient conditions. We program it—which we call 'mapping'—prior to each race according to our strategy. Data from the ECU and other functions is sent back to the pits via telemetry. That helps me drive to a pattern of fuel consumption that my team manager, Ed Nathman, and I have decided will carry us either to



the next pit stop or to the end of the race. It's a little scary, because in an Indy Car you don't get an exact measurement of fuel remaining in your fuel cell—just the amount of fuel flow. It's all based on calculation, and in past years we've been known to pay a penalty or two for miscalculation."

From the cockpit, the modern Indy Car driver can control fuel mixture (from 90% to 100% rich), turbo boost, front and rear brake bias, and front and rear anti-roll bar (swaybar) stiffness. His dashboard typically has a digital tachometer, and at the flick of a switch can tell him oil and coolant temperatures, lap times, and fuel flow, among other things. At his right hand lies a gearshift lever that gives him 6 forward speeds, plus reverse on road tracks. So how much of all this does Michael Andretti use in traffic that on superspeedways can exceed 240 mph?

"All the above," he answers. "In varying degrees, of course. I usually don't play a lot with turbo boost and unless the dash flashes a warning, I don't pay great attention to temperatures. But I often make brake and suspension changes to chase down weather, fuel load, and/or tire wear. And I adjust mixture or driving style to chase down fuel consumption. Each element, of course, has a symbiotic relationship with the other. Suspension adjustments help increase

cornering speeds, which can give you momentum to go faster on less fuel. And I try to be as smooth on the throttle as possible—which is also useful on the street."

Racing performance and everyday performance.

At Texaco, we race not just to prove, but to improve the quality of products we make for your car. Michael Andretti understands that very well. He had this to say about it:

"It's another example of racing technology becoming everyone's technology.

For instance, my Newman-Haas team has shared our experiences on the track with Texaco people. An experience we're sharing right now is the use of Havoline Formula¹ Motor Oil—an oil everyone can buy off the shelf, that we use regularly right out of the bottle in our Indy Cars. On the road, Havoline Formula¹ is very effective against heat stress, starting friction, and engine dirt. And on the track, we haven't had a single oil-related failure with it. As for Texaco System³ Gasolines, I use them in my everyday driving. System³ constantly cleans a car's engine, which can help an older car run younger and a new one stay in its prime—and System³ comes in every octane grade. Cleaning is important because residues from fuel and combustion can restrict flow and reduce energy. And energy means performance—on the track, or on the road."



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LETTERS



"Born To Ride" was a great article on one of America's true legends—the Harley-Davidson motorcycle. It was good to see a quality American product get some well-deserved recognition in a non-biker magazine.

C.J. SECOGES JR.
READING, PA

As an avid biker for almost 40 years, I'd like to point out that when Harley "pioneered" hydraulic forks in 1949, European bikes had been using them for years. When Harley went to rear shocks in '59 or '60, European and Japanese bikes had years of experience with rear swing arms. When Harley pioneered unit construction on the K model in the '50s, Moto Guzzi had been using unit construction since 1927. Thank goodness Harley doesn't make cars. We're far enough behind.

ROBERT PENTO
RIVERSIDE, CA

Harley-Davidson pioneered the use of the hydraulic front fork . . . in the U.S. The company was at least 10 years behind the British and Germans. In 1943, the British Army was using machines with hydraulic forks. And the first cycle I ever rode was a Wermacht BMW. It had hydraulic forks and hydraulic brakes.

LAMAR WRAY
KILMICHAEL, MS

Letters are subject to editing for length, style and format.

I enjoyed the Harley article, especially the photo of the restored 1927 model. But I don't completely agree with your information about the V-twin 45-cu.-in. engine. You say it was introduced in the mid '20s, enlarged to 61 cu. in. in 1936 and then 74 cu. in. in 1941.

As a former owner of a 1925 OHV 61-cu.-in. V-twin, I remember it differently. During the '20s, the most common Harley was the 74-cu.-in. Flathead twin, also the 61-cu.-in. OHV and possibly a 31-cu.-in. single. The 45-cu.-in. twin came out about 1929 to replace the single.

MYRON R. SONNETT
SLIPPERY ROCK, PA

During the '30s, I owned a 1927 Harley and always thought it was 74 cu. in. At the time, the Indian Scout, a much smaller machine, had a 45-cu.-in. engine and we considered it underpowered. The Connecticut state police had 4-cylinder Hendersens and the big Harley left them far behind, easily exceeding 100 miles per hour.

HENRY J. McCARTHY
GRANTHAM, NH

Your article boasts of Harley-Davidson's new innovations like electrostatic coating of parts and O-ring drive chain. I really hate to burst your bubble, but my trusty and reliable '79 Honda 16-valve 750 had an O-ring drive chain from the factory. Congratulations H-D. If you are really trying to improve reliability, try a driveshaft that eliminates chain adjusting which is sometimes still required on the O-ring chain.

RENÉ RICE
GRAND ISLE, LA

Lost And Found

The "Lost Squadron Found" article boggles my mind. I find all of the money and time spent on such a useless project absolutely outrageous. There isn't a shred of useful information to be gleaned from this dumb project. Davis-Monthan AFB in Tucson, Arizona, has thousands and thousands of old aircraft and probably dozens of this airplane. To figure out how to bore a hole in the ice? To have Georgia Tech spend time and money? To have Textron Aerostructures reconstruct the junk? For heaven's sake, send all those millions of dollars of cost to cancer research or to feed the poor. If nothing more, send it to the U.S. government to help lower the deficit.

CHARLES S. VACTOR
MAYFIELD HEIGHTS, OH

Fire Safety

The article "Build Your Dream Shop" was typical of the fine work that you put out each month, with one glaring exception. You thoughtfully suggested a first-aid kit and fire extinguisher in any shop. But the extinguisher's placement in the photograph is a major error. The picture showed it mounted on the lumber rack near the center of the room. Please alert your readers: 1. Extinguishers should not be mounted on, or in the vicinity of, a likely fire hazard, and 2. Extinguishers

should be mounted near the exit/entrance door. Thus, getting out of the room and getting the extinguisher are in the same direction.

BRUCE A. CRANE
EVANSTON, IL

Vic's Lux

In response to a letter about the "Fast And Fancy" article, you said the Ford Crown Vic was not considered a luxury-class sedan. I have a 1989 Ford Crown Vic. It has auto headlights, auto climate, door-lock lights, power windows, power bucket front seats, power locks, lights in both mirrors, three cigarette lighters, two front armrests, power antenna, 6-speaker stereo cassette radio, tilt steering wheel, computer for general gas info and a clock for time and date. This car was bought off the lot. For \$15,000 more, yes, you can buy a Cadillac with leather seats. But how much more could you add?

ED TURNER
KENMORE, NY

We didn't say the Crown Victoria wasn't luxurious. We said it wasn't considered part of the luxury segment. For statistical and marketing purposes, all cars are divided by the industry into segments—sub-compact, compact, intermediate, full-size, luxury, specialty, etc. The Ford Crown Victoria is part of the full-size segment.

—Ed.



Luxurious, but not a luxury car.



On September 14, 1990, a modified GMC Truck set a new F.I.A. authenticated record of 204.145 miles per hour, two-way average, in the flying mile. Yes, you read that right. A GMC Truck. The street-legal truck inspired by these explorations was a

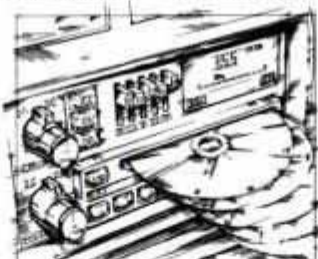
IF YOU HAVE SETTLED IDEAS OF LUXURY, SAFETY AND PERFORMANCE, A TYPHOON WILL BLOW THEM AWAY.

compact pickup called Syclone. Performance cognoscenti still speak of how *Car and Driver* pitted Syclone against a \$122,000 Ferrari 348ts. "In a blink, the Ferrari is looking at tailgate," they wrote.

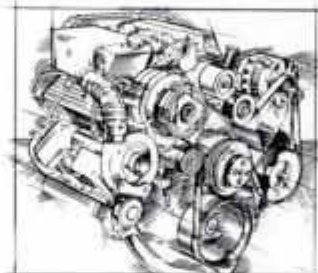
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Typhoon's luxury appointments will be comforts to you, too. Body styling that's easy on the eyes. A leather-trimmed seating area with front bucket seats. Adjustable lumbar supports and side bolsters in the buckets. A Delco AM/FM stereo system with available compact disc player.



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4.3L V6, TURBOCHARGED. A PRACTICAL APPROACH TO SHEER EXUBERANCE.


Did we mention 67.3 cubic feet of luggage space (with the rear seat folded down)? Typhoon is still, after all, a utility vehicle.

Only from a company with over 80 years of truck experience could a vehicle so wholly unexpected seem so wholly fitting. Call 1-800-879-4621 to find out how to put yourself in the eye of the storm: Typhoon, from GMC Truck.



THE STRENGTH OF EXPERIENCE

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TIME MACHINE

90 YEARS AGO: JUNE 1902

POPULAR MECHANICS

Busiest Harbor in the Country



Boats Waiting for the Bridge to Open

THE BUSIEST HARBOR IN THE COUNTRY
CHICAGO
The harbor, for example, ranked second only to London in tonnage handled, even with a long winter off-season when ice froze out shipping. Civic pride had turned the port from an eyesore to an attraction. Clean again were Lake Michigan, once a source of pestilence, and the Chicago River, where burning oil-refinery refuse had often floated.

Harbor View

Hometown Chicago, transport hub of the Midwest, always provided plenty of early editorial material. The harbor, for example, ranked second only to London in tonnage handled, even with a long winter off-season when ice froze out shipping. Civic pride had turned the port from an eyesore to an attraction. Clean again were Lake Michigan, once a source of pestilence, and the Chicago River, where burning oil-refinery refuse had often floated.



Tractor Feed

Farm mechanization was speeding agriculture for a booming population. Steam plows blazed the trail for gasoline-powered equipment.

Back then, lug-studded steel tires provided the traction. Before WWI, tractors proliferated quickly in the U.S., but not so on the labor-intensive farms of Europe.

60 YEARS AGO: JUNE 1932

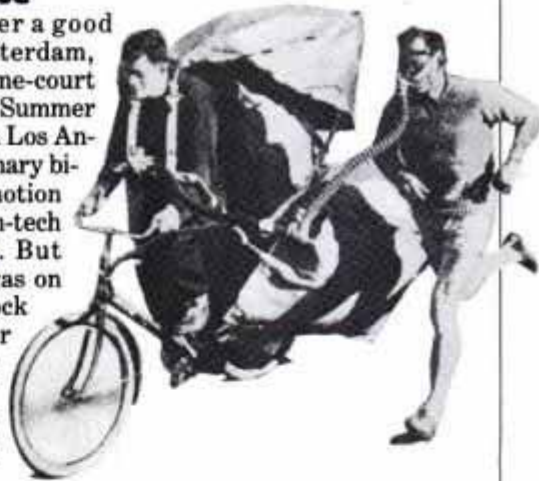


Fly By Might

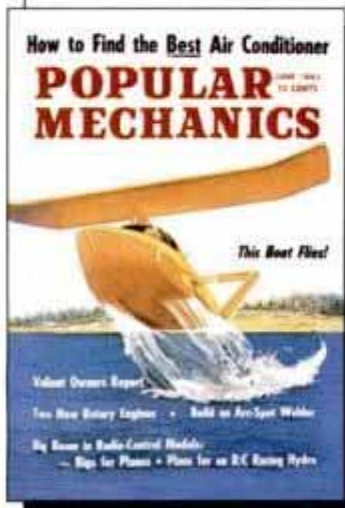
Inventors continued to flirt with flight long after man-powered aviation had proved its worth. The Germans, in particular, insisted on pedaling winged bicycles off the roofs of buildings. In one machine, the pedals were geared to a front-mounted propeller on a lightweight wing-and-tail frame. Once that contraption took flight, a second inventor one-upped him by strapping a primitive rocket engine to his bike's rear fender and blasting off at more than 100 mph.

Running Hose

Four years after a good showing at Amsterdam, the U.S. had home-court advantage at the Summer Olympics, held in Los Angeles. The stationary bicycle and slow-motion film were as high-tech as training got. But sports science was on the move. To clock metabolism, for example, cycling physiologists collected breath samples from runners.



30 YEARS AGO: JUNE 1962



Flying Fish

A Connecticut inventor spent 30 years perfecting the WingDingy, a beamy little speedboat with a unique variable-pitch wing overhead. Blown along by a pusher prop, the watercraft could scud across the waves at 129 mph on a stepped hull. To get airborne, the pilot set the wing to a high angle of attack, then flicked a lever to flatten it out for cruise flight. The wing also pivoted side-to-side so that the craft stayed level even during sharp banks.

Atom Jockey

General Electric built an 85-ton robot to work on future nuclear-powered rockets. Developed for the Air Force and the Atomic Energy Commission under Project Rover, the "Beetle" housed a squatting man who operated the robot's 16-ft. arms. It was designed to allow last-minute adjustments to propulsion reactors without scorching launchpad personnel with radiation. **PM**



WHAT WILL YOUR UNDERWEAR BE DOING A YEAR FROM NOW?



CHANCES ARE, IF THEY'RE
BVD® UNDERWEAR,
YOU COULD STILL WEAR THEM.

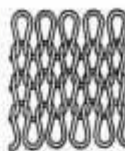
Because our comforts are made to last.

Unlike most of our competitors,
we're picky about cotton

VERY PICKY.



That's why we **COMB OUR COTTON** so



only the longer fiber remains.

The rest we reject. Then we knit

more of this incredibly soft,

incredibly strong fiber into every square inch
of our briefs, so they'll hold up longer.

And even after loads of washing, our

CLOTH STAYS THICK while

those others waste away.



These are just three of the

many reasons you'll still be sitting in the lap
of our luxury long after other
underwear have started
second careers
cleaning up paint.



TO FULLY APPRECIATE NORELCO'S INCREDIBLY CLOSE, COMFORTABLE SHAVE, YOU HAVE TO LOOK BENEATH THE SURFACE.

It's amazing, but true.

Norelco® can actually shave *below* skin level. And equally amazing, Norelco can shave you without the blades even touching your skin.



This feat is accomplished with a patented technology unique in all of shaving. The "Lift and Cut"™ system.

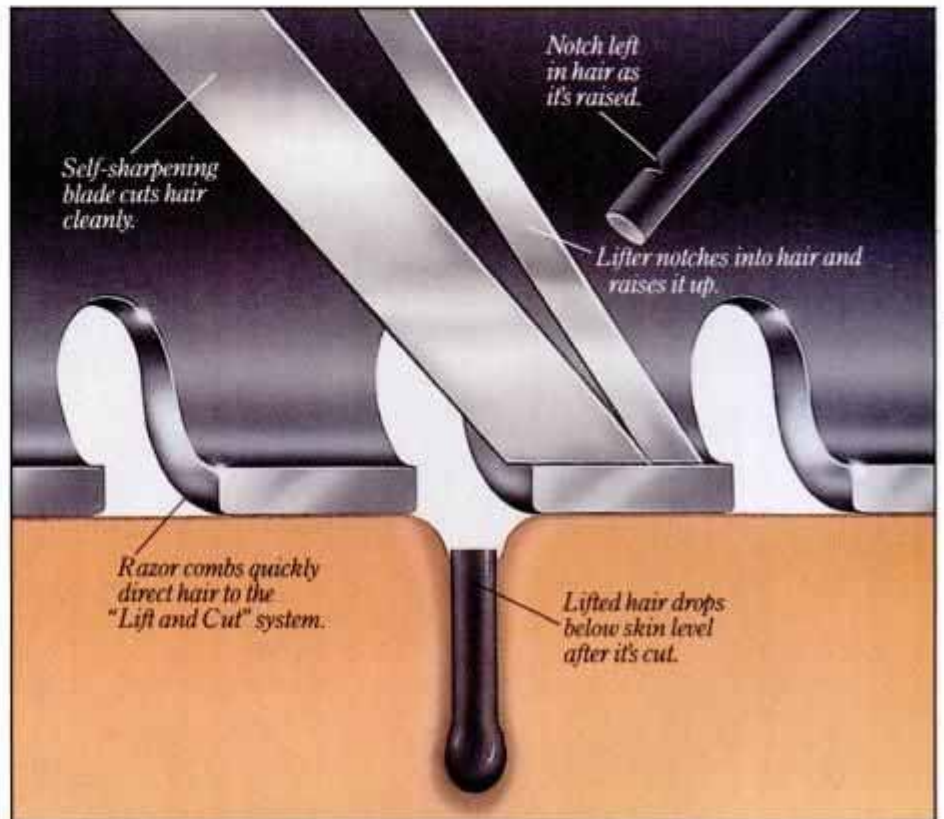
Here, a precision



Hair enters the chamber.

Lifter raises the hair.

Blade cuts hair which then drops below skin level.



Self-sharpening blade cuts hair cleanly.

Notch left in hair as it's raised.

Lifter notches into hair and raises it up.

Razor combs quickly direct hair to the "Lift and Cut" system.

Lifted hair drops below skin level after it's cut.

mechanism has been engineered by positioning a lifter in front of the blade. When the lifter notches into a hair, it lifts it up. As the blade cuts it, the hair shaft can actually drop back *below* the skin.

The result is an incredibly close shave. And because you can shave without the blades even touching your face, it's incredibly comfortable.

Try the Norelco. And experience the deep satisfaction of a perfect shave.



Norelco®

We make close comfortable.

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TECH UPDATE

News Of Tomorrow's Technology Today



PM ILLUSTRATION BY JEFF MANGIAT

Ground-Effect Goliath To Thunder Across Tundra

TAGANROG, RUSSIA—A vast featureless plain sweeps from Murmansk to the Bering Strait, cutting off Russia's Arctic seaboard from the rest of the nation. This ocean of land could be the proving ground for a mammoth wing-in-ground-effect (WIG) transporter that skims equally well over flat lands or water.

WIG researchers in Russia and the United States are calling such a vehicle a triplane, since it would gain lift from three airfoils. Two would span the twin lower hulls, while the upper deck would function as a third foil.

A pure ekranoplane (see "Wingships," page 35, May '92), the machine couldn't fly out of ground effect. Instead, it would barrel along at 40 ft. above the surface.

Twelve turbojets would

deliver the power to move the 4000-ton vehicle, which would stretch 408 ft. long and 166 ft. across. Cruise speed: 300 mph.

In Russia, the machine wouldn't hurtle at will over the frozen plains, but would stick to surveyed tracks laid out with navigational beacons. Elsewhere, the triplane could negotiate the Negev desert, the salt flats of Nevada, Canada's tundra and other similar environments—and skim across the water as well.

A. N. Panchenkov, a follower of the late Italian-born Soviet designer Roberto di Bartini, conceived the craft to resupply Arctic military bases and merchant-marine ports. But it could also ferry

Editor: Abe Danc
Assistant Editor: Greg Pope
Contributors: Philip Chen, Mike Fillon

imported freight from Russia's Pacific ports to Eastern Europe, supplementing the Trans-Siberian Railroad. Added impetus for its development may come from the new Russian government's desire to tap the natural

resources of the tundra.

Small-scale prototypes, roughly 70 ft. long, have already flitted across Russia's Lake Baikal.

Highlights This Month

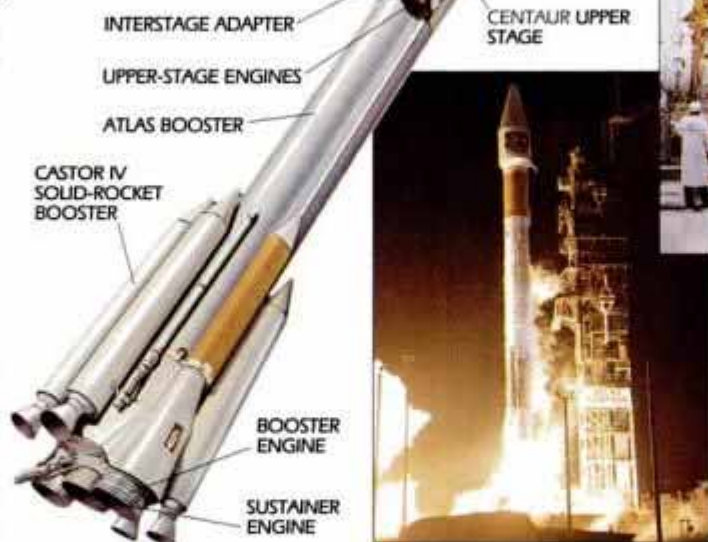
- **That's Mr. Atlas To You**—The veteran rocket's new muscle.
- **Reversal Of Fortune**—Smart trailer backs around corners.
- **King Of Rulers**—Machine will measure atomic distances.
- **The Wrath Of ARES**—Rutan's fighter shows off firepower.
- **Cooking With Gas**—Drag car's alternative fuel.
- **Wasteland Warrior**—Huge robot arm fights our toxic Cold War legacy.

Atlas The Weightlifter

CAPE CANAVERAL, FL—In 1958, Atlas became America's first intercontinental ballistic missile. Today, it remains in production, giving General Dynamics' fledgling commercial-launch business a boost.

The latest incarnation is Atlas II, which hoisted its first payload—a European TV satellite—in time for Olympic Games coverage last December.

Souped-up booster and upper-stage engines give Atlas II the ability to plant 6000 pounds in geosynchronous orbit, outlifting Atlas I by 900 pounds. Other improvements include a ring-laser gyro navigation unit and a hydrazine roll-control sys-



tem to replace the vernier thrusters that have steered the rocket since the 1950s. An even stronger version,



Atlas IIA, will blast off later this year. And next year will mark the debut of the true Charles Atlas of the family



Atlas IIA's maiden mission (left) lofted Eutelsat II-F3 (above). Future Atlas IIAS (far left) will go up in 1993.

—the IIAS, featuring four strap-on solid-rocket boosters. The vehicle will deposit 8000 pounds in a geosynchronous orbit.

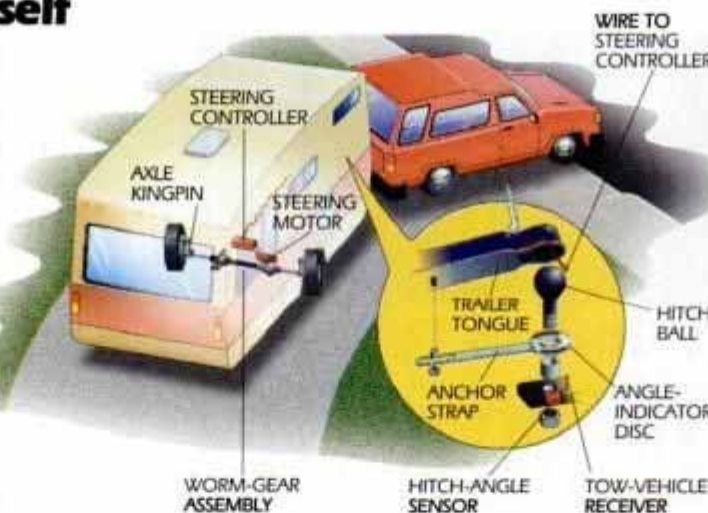
Meanwhile, Atlas I is still rolling off the assembly line, recently lofting a Hughes TV satellite. That was flight 502 for the veteran booster.

Trailer Steers Itself

SALT LAKE CITY, UT—Technology in the works at the University of Utah may straighten out the problems that trailers sometimes cause during tight turns and back-up maneuvers.

The hardware, in its simplest form, features a hitch-angle sensor and a motor that steers the trailer's wheels. Other sensors located on the trailer and tow vehicle would deliver information on speed and yaw rate to the steering controller.

Whipping through a feedback-control algorithm 2000



Trailer measures angle at hitch point to steer its own wheels. System promises to prevent fishtailing and jackknifing.

times per second, the controller adjusts the trailer wheel angle via the steering motor.

Tests on a retrofitted commercial trailer have proven out the concept, say the developers, who include former General Motors Research engineers. The system virtually eliminates jackknifing and high-speed fishtailing. Its wheels follow those of the tow vehicle during turns, and the trailer can be backed up around corners as fast as 30 miles per hour.

Future efforts will focus on reducing the number of sensors and refining the control algorithm accordingly.



Radar Topography

PASADENA, CA—NASA's Jet Propulsion Laboratory has been flying a prototype radar system for mapping the surface contours of Earth. Known as TOPSAR (for Topographic Synthetic

Aperture Radar), the hardware promises three times the precision of current topographical maps.

Mounted on the fuselage of JPL's DC-8 are two Italian-made radar antennas sepa-

rated by nearly 8 ft. The dishes capture radar pulses bounced off the landscape from a third antenna. The system triangulates to get the height of a ground point.

Once error due to aircraft motion is eliminated, TOPSAR should achieve an ac-

curacy of 6 ft. in altitude measurements and a spatial resolution of about 30 ft.

NASA hopes to loft a satellite carrying TOPSAR to map the globe.

TOPSAR created this image of Walnut Gulch, Arizona. Each color marks a 20-ft. contour.



Free Fishing Days

Grab your rod and reel, because this year, the following states have set aside special times when you can fish without a license.*

- JUNE 1-7 DC
- JUNE 5-7 AR, IA
- JUNE 5-8 IL

*Check with your state fish and wildlife agency for regulations that apply.



On sale from May 31-June 13, 1992, at all USA Kmart stores.

Friends make fishing more enjoyable. So do the low prices at Kmart.

Eagle Claw
Fishing Line.
Premium
mono line.
6 lb.-40 lb.
Your choice.
99¢



Zebco Learn To Fish Combo. Features 5'6" rod with reel, spooled with 80 yds. of 8 lb. line. Tackle pack and Learn To Fish book included. **17.97**



Zebco Mickey Mouse/Duck Tales Combo. Child-size reel with rod; fun designs; spooled with 50 yds. of 8 lb. line. **9.97**



MINN KOTA.

Minn Kota Trailing Motor 40T. 4 speeds, turbo magnetic power and efficiency. Weedless power prop. 24 lbs. of thrust. **124.97**





Watch "Fishin' with Orlando Wilson," Saturdays at 5:35 p.m. (ET) on TBS, sponsored by Kmart.



Zebco 1014K Spin Combo. Features 101 reel, direct-drive and durable gears. 30-inch fiberglass rod. **7.97**

Zebco 2200 Bullet Combo. 22-bullet reel, spooled with 80 yds. of 6 lb. line; 5' light-action composite rod. **26.99**



Zebco 202 Spincast Combo. Features the 202 reel, 5' medium-action rod, spooled with 75 yds. of 10 lb. line. **11.97**

Zebco Pro-Staff 50 Combo. Available in salt water area stores only (not shown). **34.97**

Zebco Pro-Staff Spin Combo. PS20 reel, ball-bearing drive, right/left retrieve. 6' composite rod. **24.97**
Pro-Staff Spin Reels-PS20, PS2. **14.97**
PS40. **16.97**

Zebco 33 Anniversary Spincast Combo. Features 33 reel, 2-pc., 5'6" rod. Limited edition design. **26.97**
Zebco hat offer. Hat included in package.



Free Fishing Days

Grab your rod and reel, because this year, the following states have set aside special times when you can fish without a license.*

JUNE 6 AL, AZ
CA, CT, NH, NM, OR
TN, TX, UT, VT, WI

*Check with your state fish and wildlife agency for regulations that apply.



Abu Garcia Colt 3 Spin and Spincast Combos. Features size 3 graphite reel with 6' fiberglass rod. New! Assorted colors. Your choice. **14.97**

Abu Garcia



Tangle-Free
Johnson Reels



Johnson TF 10 Spincast Combo. Tangle-free action. Reel spooled with 10 lb. line, matched 5½' graphite composite rod.

17.97

TF 10 Reel (not shown) **12.97**

TF 8 Reel (not shown) **11.97**

Available in most stores.

SHIMANO



Shimano Spin Combo AX200-6' Aeroglass Rod. Spin reel with QuickFire II® anti-reverse switch, No-Fall Ball® spring, one stainless-steel ball bearing, and 4.2:1 gear ratio. AXULS Combo with 5' Aeroglass Rod (shown). Your choice. **34.97**

AX100, AX200 and AXULS Spin Reels
21.99 ea.



The quality you need,
the price you want.

On sale from May 31-June 13,
1992, at all USA Kmart stores.

Free Fishing Days

Grab your rod and reel, because this year, the following states have set aside special times when you can fish without a license:

JUNE 6-7 CO, FL, GA
KY, LA, MD, MI, MN
MO, NJ, ND, OK, PA
RI, SC, VA, WA, WV

*Check with your state fish and wildlife agency for regulations that apply.



fishing
licenses

Sold in most Kmart Sports Departments



Eagle Claw

Mach III-6' Rod and Mach ULS-4'6" Rod Combos. 2-piece, graphite rod, graphite composite reel, rear drag, right/left retrieve, auto trip bail. Your choice.

32.97
Mach VI (not shown).
39.97

Eagle Claw Gold Rod. Pro-style EVA grips with blank through handle design. Aluminum oxide guides. Fly Rod (not shown). Your choice.

14.99
Assorted lengths and actions.



Daiwa Baitcast Combo MA1000X. Low-profile design, magnetic anti-backlash control, with 6' graphite construction rod.
44.97

Daiwa Apollo Spinning AG1300X and AG80X Spincast Combos. Stainless steel ball-bearing drive, long cast spool, with 6' graphite rod. Your choice.
26.97

Daiwa Apollo Longcast Spin Reels AG705X, 1305X, 1605X, 500X, 2000X*
Your choice. **16.97**
*Available in most stores.



Magic Catfish Bait.
Assorted prepared dough
flavors to choose from.
Your choice. **1.99**



Culprit Plastic Worms.
7 1/2" worm with flavor
enhancer and unique
action. Many colors.
Your choice. **2.99**
Not available in AZ, CA, CO,
ID, MT, NM, NV, OR, UT,
WA or WY.



**Blue Fox Super Vibrax
& Super Vibrax Grizzly
Spinner Bait.** New!
Assorted sizes and colors.
Your choice. **1.99**



**BLUE
FOX**
Tackle

Pradco Famous Brands 4-Lure Kit.
Heddon's famous tiny torpedo,
Cordell's neon spot, Bomber's famous
mini-bushwhacker spinner bait, and
Rebel's weedless arrowhead spoon.
New! **8.99**



**Siberian Super
Bait.** Salmon eggs.
Natural ingredients to
attract and catch even the wariest
fish. 1.45 oz.; only available in
AZ, CA, CO, ID, MT, NM, NV,
OR, UT, WA and WY. **1.59**



Siberian
SALMON EGGS CO.

Norman Deep Baby 1/4,
Deep Little 3/8, Little
Scooper, Quarterback 1/4.
Assorted sizes and colors.
Your choice. **1.69**



**BILL
NORMAN**
LURES

**Mister
Twister**

Electric Fisherman
by Mister
Twister

Mister Twister Electric
Fillet Knife. Features 7"
blade with safety release
button, bright yellow
and green with easy grip.
19.99

mart
K

The quality you need,
the price you want.

On sale from May 31-June 13,
1992, at all USA Kmart stores.



Gusdorf Fishing Tackle Cabinet. Organizes fishing and sporting gear. Sponge grippers hold up to 10 rods on each side. Four internal adjustable shelves. Galley top allows additional storage. Ready to assemble. **Everyday Low Price 99.97**
Available in most stores.



Plano Tackle Box* Two-Tray 4200. Up to 26 compartments in two worm-proof trays; sturdy handle and rugged latch with solid brass hasp. **8.47**

Plano 707 Tackle Box* Two drawers, 14 worm-proof compartments. 3 1/2"-deep well for bulky gear, super-strength plastic construction. **14.97**

Plano Tackle Box* 8605. Hip-roof box with six trays and 36 worm-proof compartments. **18.97**



Plano Magnum Sidekick* #3215. Adjustable dividers allow up to 27 compartments. worm-resistant body, see-through amber lids. **8.47**



Plano 1232 Tackle Racker* Includes five Plano stowaway boxes, built-in hand grip, available in light gray, with dark gray lid; worm-proof plastic construction. **18.97**



*Tackle shown in boxes not included.



Free Fishing Days

Grab your rod and reel, because this year, the following states have set aside special times when you can fish without a license.*

JUNE 13 ID, NV
JUNE 20-21 MA
JUNE 21 ME

*Check with your state fish and wildlife agency for regulations that apply.

Action
 PRODUCTS CO., INC.

Action Deluxe Boat Seat. Choice of color, padded, molded bottom without swivel. **29.97**



Lowrance Eagle Ultra ID. Liquid crystal, ultravision super-twist display, advanced fish ID system, split screen, instant screen update, completely waterproof. **264.97***



HUMMINBIRD



Techsonic Humminbird LCR 400ID Fish Finder. High-resolution LCD screen, zoom and bottom alarm, completely waterproof. **124.97***

Techsonic LCR 400 Portable Fish Finder (not shown). **164.97***



MotorGuide Trolling Motor Stealth ST350. 35-lb. thrust on 12-volt, 5-speed, ninja prop, and power prop in box. Model HT 34. Your choice. **199.97***
Everyday Low Price

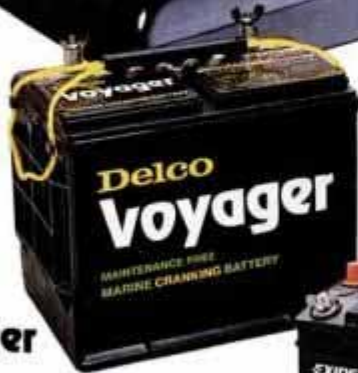
MotorGuide®

*Electronics available in most stores.

Delco Voyager

Delco Voyager Marine Battery. Features 620 Marine cranking amps and 90-minute reserve capacity. **Everyday Low Price 49.93** with exchange

M24, 620 MCA 125 R/C. With exchange **64.93**
 M27, 720 MCA 160 R/C. With exchange **69.93**



EXIDE

Exide Nautilus Marine Battery is maintenance free, with dual terminals for easy application. **Everyday Low Price 129.93**

with exchange.
 NG-27, 620 MCA 180 R/C. With exchange. **82.93**
 XHD-M-24, 465 MCA 47 R/C. With exchange. **39.93**



The quality you need, the price you want.

On sale from May 31-June 13, 1992, at all USA Kmart stores.



Free Fishing Days

Grab your rod and reel, because this year, the following states have set aside special times when you can fish without a license.*

JUNE 27-28 NY
SEPT. 26 CA, GA, NM

*Check with your state fish and wildlife agency for regulations that apply.

Kransco Kahala Wave Board. Fun, quick and maneuverable, angled rails, multi-colored, includes sturdy leash. New! **16.97***

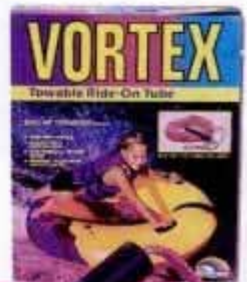


Nash Water Skis Neonics. Adult water ski pair, with slalom ski; black with neon design. **39.97***
All skis on sale.



Ero Mickey Mouse Vest. Kiddie-safe with ensolite; fits infants, 0-30 lbs., child, 30-50 lbs., and youth, 50-90 lbs. **18.97***
Fusion Vest (shown) **24.97***

O'Brien Pro Hydro Slide. Two retractable fins, rail grooves, polished bottom, foam core, quick-release strap. **84.97***



Ero Vortex Towable Ride-On Tube. Two heavy-duty, sure-grip handles; rugged, reinforced-nylon towing harness; resistant to salt water and chlorine, 48". **19.97***



STEARNS

Stearns Life Vests. Adjustable waist belt and leg strap, for proper fit and maximum safety; Coast Guard approved; flotation collar with grab strap; meets all new standards; infant and child sizes. **18.97***

Stearns Classic Ski Vest. Strong nylon shell and lining with four, 1" safety belts. Coast Guard approved. Assorted colors. S/M or L/XL. **24.97***



NATIONAL FISHING WEEK
JUNE 1-7, 1992

*Available in most stores.

Kmart ADVERTISED MERCHANDISE POLICY

Our firm intention is to have every advertised item in stock on our shelves. If an advertised price is not available for purchase due to any unforeseen reason, Kmart will issue a rain check on request for the merchandise (one item or reasonable family quantity) to be purchased at the sale price wherever available or will sell you a comparable quality item at a comparable reduction in price.



The quality you need,
the price you want.

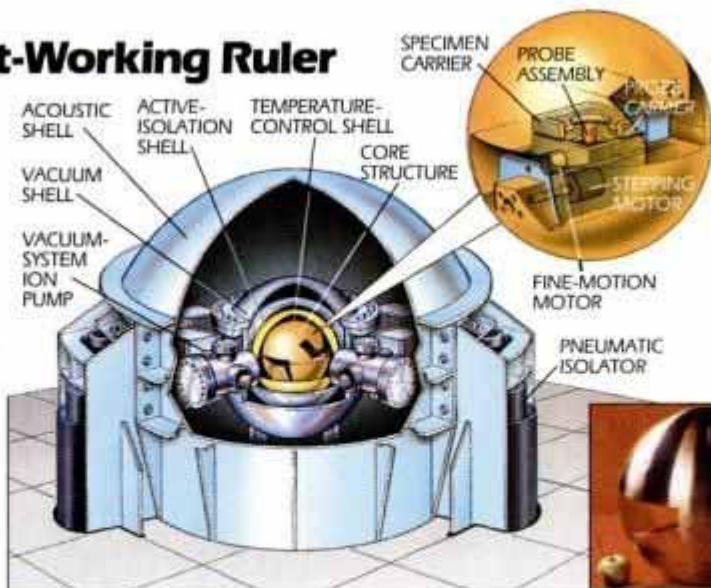
On sale from May 31-June 13,
1992, at all USA Kmart stores.

World's Hardest-Working Ruler

GAITHERSBURG, MD—How do you gauge the length of a molecule, or map the distance between two atoms in a supercompact silicon chip? Industry wants to know, so the National Bureau of Standards and Technology is building the most accurate ruler of all time.

The Molecular Measuring Machine, or M-Cubed, will use an atomic-scale probe, such as a scanning tunneling microscope, to pinpoint the location of a single atom. Then, an ultraprecise carriage will reposition the probe, gliding on sapphire-coated pads. Laser-interferometry apparatus positioned around the probe will provide the measurement.

The probe and specimen



M-Cubed will work inside vacuum system (below right) wrapped in extensive environmental isolation hardware.

carriages will move in grooves machined to a basketball-size sphere of copper. That core structure, in turn,

will rest in a vacuum chamber deep inside a nest of shells that isolate the ma-

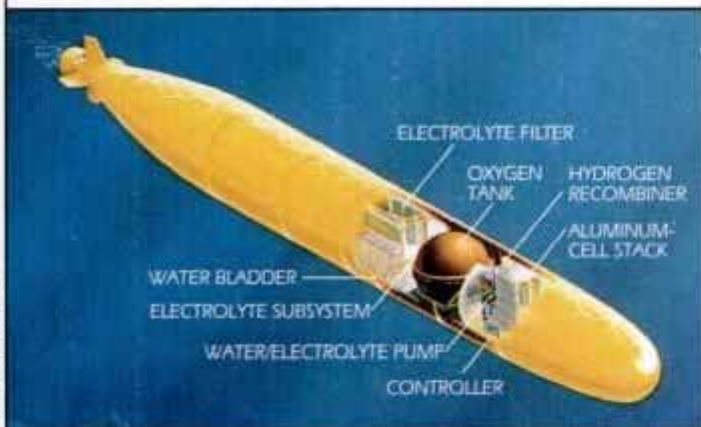
chine from noise, vibration and temperature swings. A clean room walled with solid concrete blocks will surround the whole thing.

NIST doesn't pretend that the M-Cubed's mechanics will guarantee the accuracy goal—within 5 to 10 atoms' widths. But once engineers have nailed down the error caused by the carriage motion, they can factor it in and close in on the desired precision.

The machine is currently undergoing final assembly.



PM ILLUSTRATION BY HANK IKEN, NIST PHOTOS



DARPA's surveillance UUV will soon get an aluminum-oxygen fuel-cell powerplant to give it a 3-week mission capability.

Marathon Robot Swimmer

AKRON, OH—To boost the endurance of unmanned underwater vehicles (UUVs), Loral Corp. is developing long-lasting aluminum-oxygen fuel cells. The Defense Advanced Research Projects Agency (DARPA) is funding the effort.

The fuel cell would generate more than 1300 kilowatt-hours spread over a 3-week period. That offers three times the performance of silver-zinc batteries, which

currently power DARPA's UUV testbed (see Tech Update, page 18, Oct. '90).

The system also sidesteps the dangers inherent in storing hydrogen fuel.

Loral will first demonstrate the technology in the lab, then put it in the 44-in.-dia. DARPA vehicle. Once that works out, engineers will fine-tune the system for high energy density and plug it into a submarine-launchable 21-in.-dia. vehicle.

Blinking Telescope

ATLANTA, GA—A technique that wipes atmospheric blurring from photographs of Mars may help researchers track dust storms that rage across the surface of the red planet.

Developed by Georgia Tech Research Institute and NASA's Jet Propulsion Laboratory, the method is called speckle imaging. The key is a high-speed imaging chip that snaps off a series of exposures of $1/50$ th of a second—very short by astronomical stand-

ards. The shots freeze the blurring caused by Earth's

turbulent atmosphere.

By comparing the images, a computer can pick out distorted areas from areas that

remain stable from frame to frame. The processor then molds the pictures into a single high-resolution image.

Speckle imaging would permit year-round tracking and prediction of Martian weather. And in fact, JPL has proposed a Mars-monitoring program based on the technology. The system proved itself last year on the University of Hawaii's 80-in. telescope.

Speckle-imaging system involves extensive computer hardware and two alternative detectors and displays.



PM ILLUSTRATION BY ADOLPH E. BROTHMAN

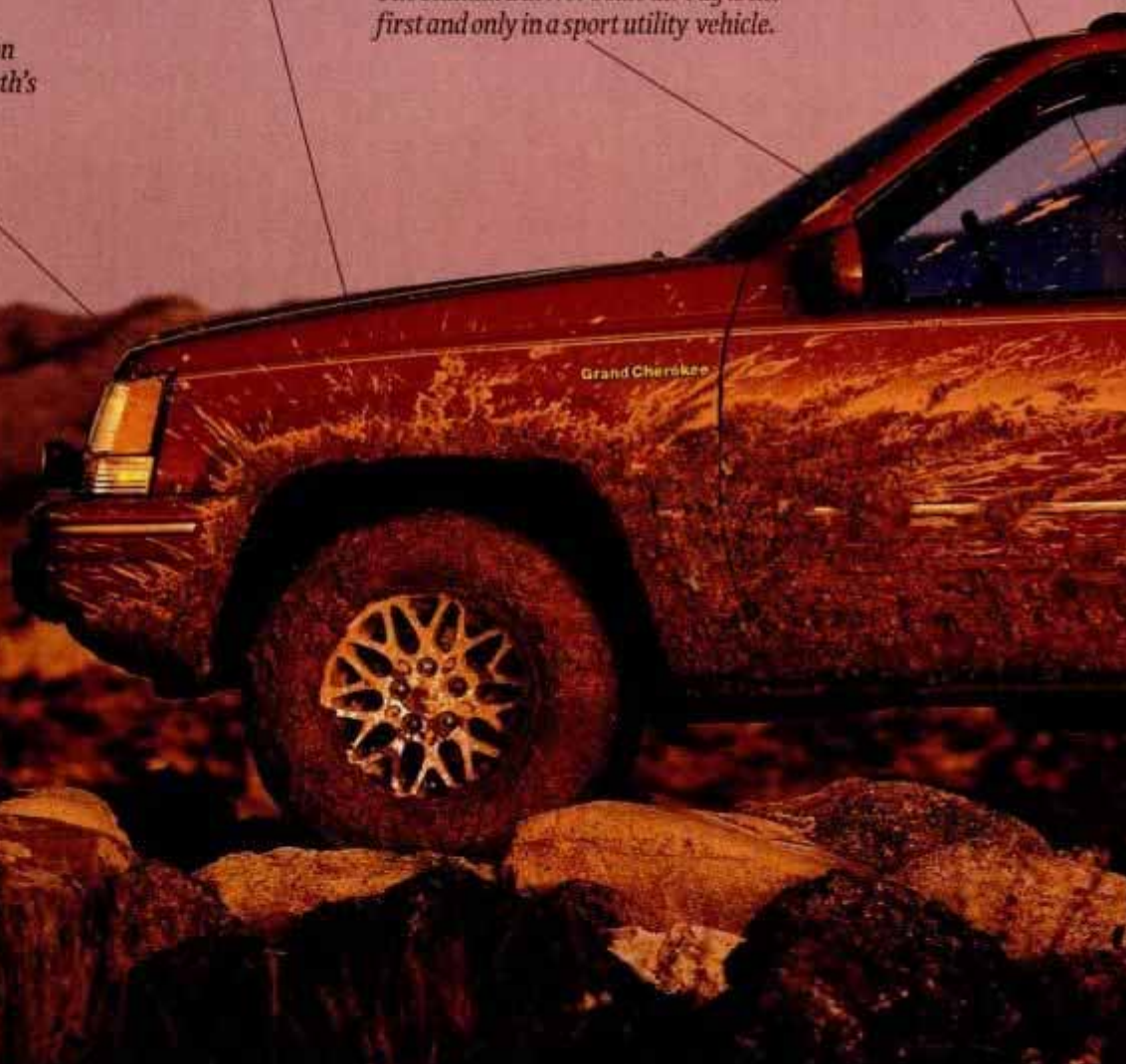
This Is What Happens When A Team Of Jeep® Engineers

The I-6 engine delivers 190 horsepower and 225 foot-pounds of torque to conquer tough terrain.

The automatic temperature control system, another exclusive standard feature, constantly monitors and adjusts the interior climate to your specifications.

The new Quadra-Coil[®] suspension system helps smooth out the Earth's roughest spots.

The standard driver's side air bag is the first and only in a sport utility vehicle.



Introducing The New Jeep® Grand Cherokee.

Forget everything you ever knew about sport utility vehicles.

This is the new Jeep Grand Cherokee Limited. And it's the result of some of the freshest, most advanced

thinking ever put into a 4x4.

For example, instead of settling for a conventional four-wheel drive transfer case, Jeep engineers created the new Quadra-Trac — a

revolutionary all-the-time four-wheel drive system that actually thinks its way over, around, and through all kinds of road conditions.

Instead of installing an ordinary

ens When You Give ineers A Clean Slate.

The revolutionary new Quadra-Trac[®] all-the-time four-wheel drive system automatically adjusts to different road surfaces for optimum traction.

140 cubic feet of interior space make this one of the roomiest 4x4s in its class.

The sophisticated four-wheel anti-lock brake system is another one of Jeep Grand Cherokee's unexpected standard features.



OFFICIAL SPONSOR OF THE 1992 U.S.A. U.S. OLYMPIC TEAM 36 USC 380


air conditioner, they designed an automatic temperature control system that not only keeps the passengers comfortable, but also keeps the ozone safe because it uses an environmentally friendly refrigerant.



In other words, instead of building a conventional 4x4, Jeep engineers built the new Grand Cherokee Limited. And, in the process, totally redefined what a sport utility vehicle should be.

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ARES Fires Its Gun

MOJAVE, CA—Can a light-weight composite airframe stand up to the ferocious recoil of a 25mm gatling gun? Burt Rutan's ARES (short for Agile Responsive Effective Support) close-air-support fighter recently answered that question with a solid yes.

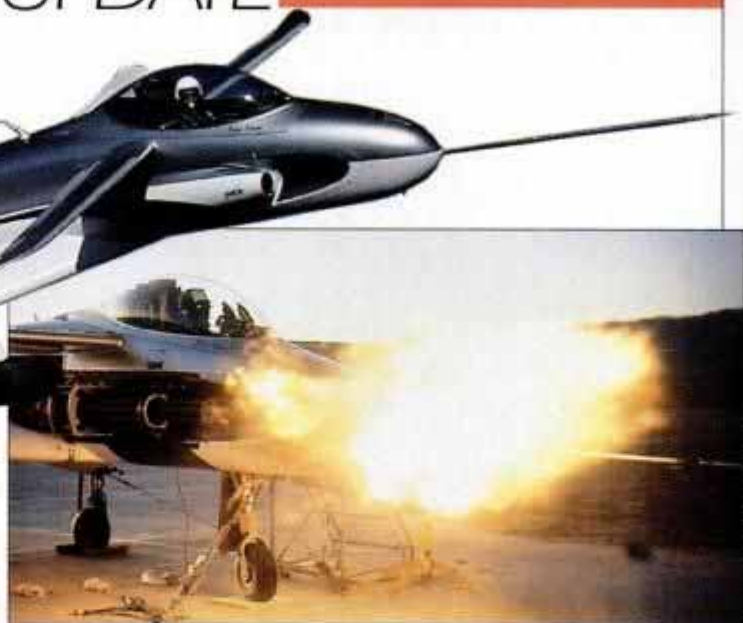
The demonstrator plane, built by Rutan's Scaled Composites, Inc., is a hodgepodge of urethane foam, fiberglass, Kevlar and epoxy, weighing only 6700 pounds.

It packs a General Electric GAU-12 cannon that spits out 5 rounds per second and hammers the airframe to the tune of 3.5 g's. The barrel is offset to starboard to keep

engine-choking muzzle gases away from the port-mounted jet intake.

Fired both on the ground and while airborne, the gun didn't damage the structure or engine of the plane, even during 40-round bursts. That a few electrical components did come loose was dismissed as due to poor mounting.

But during inflight target practice, a test pilot report-



Rutan's lightweight ARES didn't shoot itself in the foot during gun-firing tests. Aircraft may become weapons testbed.

ed, the gun generated shock waves that disrupted with aerodynamic forces on the plane, yawing it right and

pushing the nose down.

Scaled Composites now wants to test-fire some 2.75-in.-dia. rockets from ARES.

Self-Propelled Shock Buoy

NORWICH, ENGLAND—A powered buoy may help the oil industry carry out seismic surveys at sea without exposing ships to damaging shock waves. The guns used in such operations, which map sub-seafloor oil pockets, are more powerful than ever these days.

Developed by Specialized Offshore Lifting (SOL) Ltd., the disc-shaped vehicle can chug to a safe distance off the side of an offshore supply vessel. Then four seismic air



guns fire from a submerged platform beneath the disc.

The buoy runs on a ducted propeller driven by a 55-hp

hydraulic motor, an unusually muscular powerplant for a small unmanned vehicle.

Two tethers link the de-

powered buoy delivers seismic survey blasts at a safe distance from offshore support vessel.

vice to the support ship. One feeds hydraulic fluid to the motor, while the second, running from the ship's bow, gives the motor something to pull against, providing tension to hold the buoy in place. The idea is to make the system as undemanding as possible, so the ship's captain can focus on holding station during the survey.

SOL hopes to obtain oil industry funding to manufacture and test a full-scale prototype named Gunboat.

Hot Rod Cooks With Gas

CLEVELAND, OH—It may have no history as a racing fuel, but natural gas has a lot going for it, says Joe Mezquita. His Natural Gasser—a "super gas" drag car—can roar to 155 mph in a quarter-mile from a standing start,

thanks in large part to the fuel's 130 octane rating.

The car, a fiberglass reproduction of a 1987 Buick Somerset, houses a cylinder that stores the gas at 2400 psi. The engine's induction system has been tailored for natural gas, with carbure-

tion that takes the fuel down to the same pressure as a gas stove. The powerplant, a V8 Chevy racing block, has also been modified for a 14:1 compression ratio.

Not only does natural gas provide smooth combustion, but it doesn't spark until it hits 1400° F, a much higher temperature than gasoline's ignition point. The fuel has the added safety feature of being lighter than air.

The Natural Gasser drag car will perform in the National Hot Rod Association's Spring International in Columbus, Ohio.



Joe Mezquita's 700-hp "super gas" racer is the only drag car on the circuit fueled by natural gas.



(More Tech Update on page 24)

Материал подготовлен авторским проектом

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Robots Of The Wasteland

RICHLAND, WA—The Department of Energy is mustering its brainpower to clean up the nuclear waste left from 40 years of Cold War weapons production.

Obviously, robots would be better suited for the job than humans. So engineers from five national labs have collaborated to demonstrate a gigantic prototype at the Hanford Site, where officials have declared 177 deteriorating waste-storage tanks a national priority.

The double-handed arm, built from commercially available hardware, is the

forerunner to smaller versions that will tackle the tanks. After pumps siphon out the liquid, laser and ultrasound scanners will map out the toxic crust on the inner face of a tank. Manipulators will then scour the crust away. Sandia National Labs has developed a videogame-like telecontrol system for the machines (see Tech Update, page 20, Feb. '91). For the next five years, the big arm, nicknamed Red Zone, will serve as a testbed.

Giant arm will help Energy Department design nuke-waste remediation robots.



WESTINGHOUSE PHOTO

Body Machine

HOUSTON, TX—Doctors dream of the day when organs for transplantation can grow in culture. Engineers at Johnson Space Center have taken the first step, with a bioreactor that permits cell cultures to develop into real tissue.

Inside, cells grow between two slowly rotating cylinders, which simulate zero gravity, conducive to tissue culture. The machine should work even better aboard the Space Station.



Rotating bioreactor frees cells from gravity, allowing complex tissue growth.

NASA PHOTO

Plastic Piston Rings

AUBURN HILLS, MI—Plastic continues to supplant metal in even the toughest automotive applications. Now Hoechst Celanese is setting engine components in a new high-grade version of polybenzimidazole, called T-Series Celazole.

Significantly, conventional extrusion and injection-molding machinery can work this thermoplastic to form parts such as piston rings, valve guides

and high-temperature bushings. Other plastic engine parts have required further sintering or machining.



Automotive parts can be molded directly from tough new Celanese thermoplastic.

HOECHST CELANESE PHOTO

Mechanical Caterpillar

GREENBELT, MD—A unique crawling robot invented at NASA's Goddard Space Flight Center can slink into all kinds of out-of-the-way places.

Like a caterpillar, the machine moves by choreographing a ripple of steps along a segmented body.

Each individual body module consists of two U-frames facing each other and joined by cables. Four actuators enclosed by each pair of U-frames expand and contract in a computer-controlled rhythm. To pull the machine along, gripper feet alternately seize and release whatever surface the robot is crawling over.

Other robotic climbers suffer from high centers of grav-

ity and have difficulty climbing straight up. But this machine can scuttle up towers at a rate of 80 in. per minute. Modules can also negotiate turns by contracting two actuators while ex-

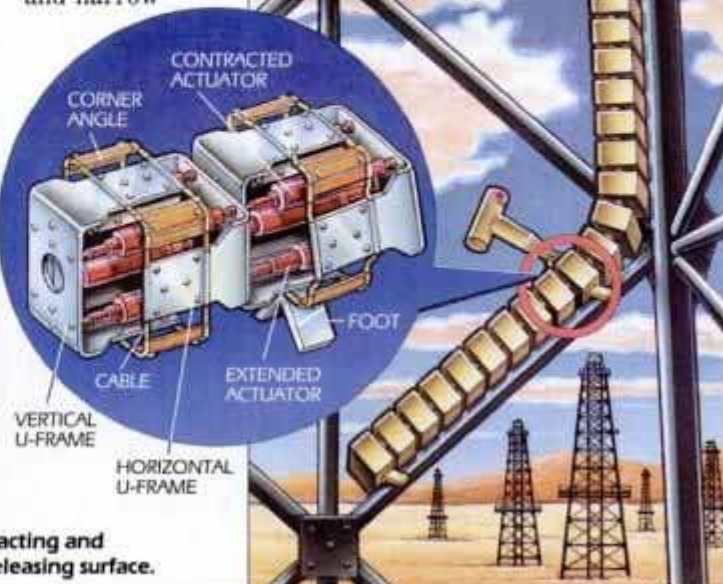


Caterpillar robot moves by contracting and expanding while gripping and releasing surface.

panding the other two.

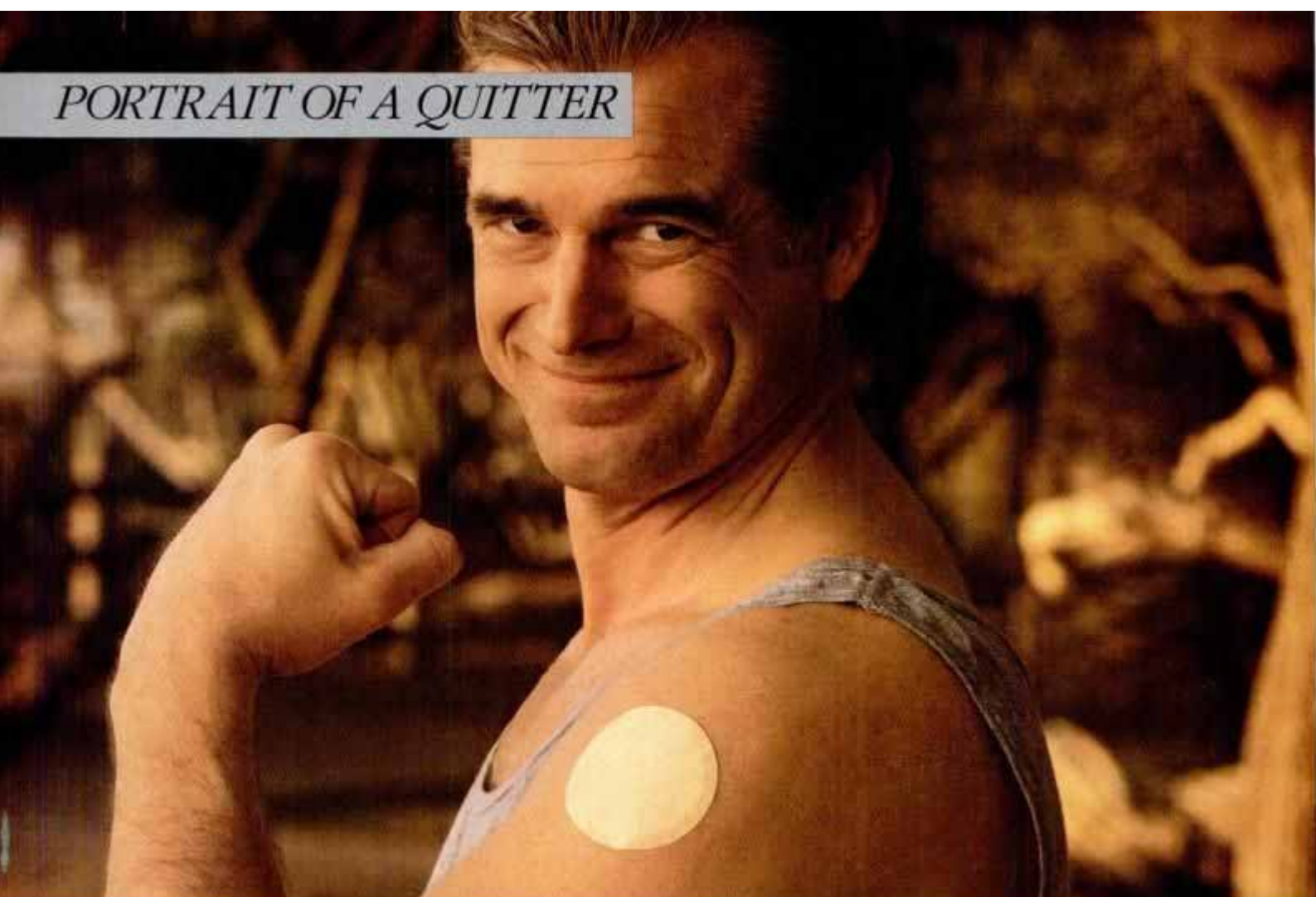
Outfitted with the right tools, the robot could repair high-tension wires, inspect oil rigs and narrow

pipes, or do remote-control vacuuming, painting or sandblasting. **Tu**



PM ILLUSTRATION BY PAT RUGGERO, NASA PHOTO

PORTRAIT OF A QUITTER



See brief summary of Prescribing Information on next page.

About six years ago, I decided to stop smoking. So I tried cold turkey. It seemed to work for a while. But within three months, my wife caught me sneaking cigarettes out the bathroom window.

QUITE FRANKLY, I NEVER THOUGHT I COULD REALLY GIVE UP SMOKING.



Habitrol® is a skin patch. When used as part of a comprehensive behavioral smoking cessation program, it has been clinically proven to significantly increase the chances of quitting by relieving the craving for nicotine.

As part of my smoking cessation program, I was given a free support kit. The kit includes tips on getting through the rough times and an audio tape for relaxation and motivation. My doctor is a big support as well. He even gave me a list of support groups I could attend.

Habitrol contains nicotine. If you're pregnant or nursing, or have heart disease, be sure to first find out from your doctor all the ways you can stop smoking. If you're taking a prescription medicine or are under a doctor's care, talk with your doctor about the potential risks of Habitrol. Habitrol shouldn't be used for more than three months.

If you're really determined to quit, ask your doctor about Habitrol therapy. Or call 1-800-YES-U-CAN, for more information, today.

If you're tired of quitting and failing, this could be your chance.

IF YOU'VE GOT THE WILL, NOW YOU CAN HAVE THE POWER.

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(nicotine
transdermal
system)

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Habitrol® (nicotine transdermal system)

Systemic delivery of 21, 14, or 7 mg/day over 24 hours

BRIEF SUMMARY. FOR FULL PRESCRIBING INFORMATION SEE PACKAGE INSERT.

INDICATIONS AND USAGE

Habitrol treatment is indicated as an aid to smoking cessation for the relief of nicotine withdrawal symptoms. Habitrol treatment should be used as a part of a comprehensive behavioral smoking cessation program.

The use of Habitrol systems for longer than 3 months has not been studied.

CONTRAINDICATIONS

Use of Habitrol systems is contraindicated in patients with hypersensitivity or allergy to nicotine or to any of the components of the therapeutic system.

WARNINGS

Nicotine from any source can be toxic and addictive. Smoking causes lung cancer, heart disease, emphysema, and may adversely affect the fetus and the pregnant woman. For any smoker, with or without concomitant disease or pregnancy, the risk of nicotine replacement in a smoking cessation program should be weighed against the hazard of continued smoking while using Habitrol systems, and the likelihood of achieving cessation of smoking without nicotine replacement.

Pregnancy Warning

Tobacco smoke, which has been shown to be harmful to the fetus, contains nicotine, hydrogen cyanide, and carbon monoxide. Nicotine has been shown in animal studies to cause fetal harm. It is therefore presumed that Habitrol treatment can cause fetal harm when administered to a pregnant woman. The effect of nicotine delivery by Habitrol systems has not been examined in pregnancy (see PRECAUTIONS, Other Effects). Therefore, pregnant smokers should be encouraged to attempt cessation using educational and behavioral interventions before using pharmacological approaches. If Habitrol therapy is used during pregnancy, or if the patient becomes pregnant while using Habitrol treatment, the patient should be apprised of the potential hazard to the fetus.

Safety Note Concerning Children

The amounts of nicotine that are tolerated by adult smokers can produce symptoms of poisoning and could prove fatal if Habitrol systems are applied or ingested by children or pets. Used 21 mg/day systems contain about 60% (32 mg) of their initial drug content. Therefore, patients should be cautioned to keep both used and unused Habitrol systems out of the reach of children and pets.

PRECAUTIONS

General

The patient should be urged to stop smoking completely when initiating Habitrol therapy (see DOSAGE AND ADMINISTRATION). Patients should be informed that if they continue to smoke while using Habitrol systems, they may experience adverse effects due to peak nicotine levels higher than those experienced from smoking alone. If there is a clinically significant increase in cardiovascular or other effects attributable to nicotine, the Habitrol dose should be reduced or Habitrol treatment discontinued (see WARNINGS). Physicians should anticipate that concomitant medications may need dosage adjustment (see Drug Interactions).

The use of Habitrol systems beyond 3 months by patients who stop smoking should be discouraged because the chronic consumption of nicotine by any route can be harmful and addictive.

Allergic Reactions: In a 6-week, open-label dermal irritation and sensitization study of Habitrol systems, 22 of 220 patients exhibited definite erythema at 24 hours after application. Upon rechallenge, 3 patients exhibited mild-to-moderate contact allergy. Patients with contact sensitization should be cautioned that a serious reaction could occur from exposure to other nicotine-containing products or smoking. In the efficacy trials, erythema following system removal was typically seen in about 17% of patients, some edema in 4%, and dropouts due to skin reactions occurred in 6% of patients.

Patients should be instructed to promptly discontinue the Habitrol treatment and contact their physicians if they experience severe or persistent local skin reactions at the site of application (e.g., severe erythema, pruritus or edema) or a generalized skin reaction (e.g., urticaria, hives, or generalized rash).

Skin Disease: Habitrol systems are usually well tolerated by patients with normal skin, but may be irritating for patients with some skin disorders (atopic or eczematous dermatitis).

Cardiovascular or Peripheral Vascular Diseases: The risks of nicotine replacement in patients with certain cardiovascular and peripheral vascular diseases should be weighed against the benefits of including nicotine replacement in a smoking cessation program for them. Specifically, patients with coronary heart disease (history of myocardial infarction and/or angina pectoris), serious cardiac arrhythmias, or vasospastic diseases (Buerger's disease, Prinzmetal's variant angina) should be carefully screened and evaluated before nicotine replacement is prescribed.

Tachycardia occurring in association with the use of Habitrol treatment was reported occasionally. If serious cardiovascular symptoms occur with Habitrol treatment, it should be discontinued.

Habitrol treatment should generally not be used in patients during the immediate post-myocardial infarction period, patients with serious arrhythmias, and patients with severe or worsening angina pectoris.

Renal or Hepatic Insufficiency: The pharmacokinetics of nicotine have not been studied in the elderly or in patients with renal or hepatic impairment. However, given that nicotine is extensively metabolized and that its total system clearance is dependent on liver blood flow, some influence of hepatic impairment on drug kinetics (reduced clearance) should be anticipated. Only severe renal impairment would be expected to affect the clearance of nicotine or its metabolites from the circulation (See CLINICAL PHARMACOLOGY, Pharmacokinetics).

Endocrine Diseases: Habitrol treatment should be used with caution in patients with hyperthyroidism, pheochromocytoma or insulin-dependent diabetes since nicotine causes the release of catecholamines by the adrenal medulla.

Peptic Ulcer Disease: Nicotine delays healing in peptic ulcer disease; therefore, Habitrol treatment should be used with caution in patients with active peptic ulcers and only when the benefits of including nicotine replacement in a smoking cessation program outweigh the risks.

Accelerated Hypertension: Nicotine constitutes a risk factor for development of malignant hypertension in patients with accelerated hypertension; therefore, Habitrol treatment should be used with caution in these patients and only when the benefits of including nicotine replacement in a smoking cessation program outweigh the risks.

Information for Patients

A patient instruction sheet is included in the package of Habitrol systems dispensed to the patient. It contains important information and instructions on how to use and dispose of Habitrol systems properly. Patients should be encouraged to ask questions of the physician and pharmacist. Patients must be advised to keep both used and unused systems out of the reach of

children and pets.

Drug Interactions

Smoking cessation, with or without nicotine replacement, may alter the pharmacokinetics of certain concomitant medications.

May Require a Decrease in Dose at Cessation of Smoking

Acetaminophen, caffeine, imipramine, oxazepam, pentazocine, propranolol, theophylline

Possible Mechanism

Disinhibition of hepatic enzymes on smoking cessation

Insulin

Increase of subcutaneous insulin absorption with smoking cessation

Adrenergic antagonists (e.g., prazosin, labetalol)

Decrease in circulating catecholamines with smoking cessation

May Require an Increase in Dose at Cessation of Smoking

Adrenergic agonists (e.g., isoproterenol, phenylephrine)

Possible Mechanism

Decrease in circulating catecholamines with smoking cessation

Carcinogenesis, Mutagenesis, Impairment of Fertility

Nicotine itself does not appear to be a carcinogen in laboratory animals. However, nicotine and its metabolites increased the incidence of tumors in the cheek pouches of hamsters and forestomach of F344 rats, respectively, when given in combination with tumor-initiators. One study, which could not be replicated, suggested that cotinine, the primary metabolite of nicotine, may cause lymphoreticular sarcoma in the large intestine in rats.

Nicotine and cotinine were not mutagenic in the Ames Salmonella test. Nicotine induced repairable DNA damage in an *E. coli* test system. Nicotine was shown to be genotoxic in a test system using Chinese hamster ovary cells. In rats and rabbits, implantation can be delayed or inhibited by reduction in DNA synthesis that appears to be caused by nicotine. Studies have shown a decrease in litter size in rats treated with nicotine during gestation.

Pregnancy Category D (see WARNINGS)

The harmful effects of cigarette smoking on maternal and fetal health are clearly established. These include low birth weight, an increased risk of spontaneous abortion, and increased perinatal mortality. The specific effects of Habitrol treatment on fetal development are unknown. Therefore, pregnant smokers should be encouraged to attempt cessation using educational and behavioral interventions before using pharmacological approaches.

Spontaneous abortion during nicotine replacement therapy has been reported, as with smoking, nicotine as a contributing factor cannot be excluded.

Habitrol treatment should be used during pregnancy only if the likelihood of smoking cessation justifies the potential risk of use of nicotine replacement by the patient, who may continue to smoke.

Teratogenicity

Animal Studies: Nicotine was shown to produce skeletal abnormalities in the offspring of mice when given doses toxic to the dams (25 mg/kg/day IP or SC).

Human Studies: Nicotine teratogenicity has not been studied in humans except as a component of cigarette smoke (each cigarette smoked delivers about 1 mg of nicotine). It has not been possible to conclude whether cigarette smoking is teratogenic to humans.

Other Effects

Animal Studies: A nicotine bolus (up to 2 mg/kg) to pregnant rhesus monkeys caused acidosis, hypercarbia, and hypotension (fetal and maternal concentrations were about 20 times those achieved after smoking 1 cigarette in 5 minutes). Fetal breathing movements were reduced in the fetal lamb after intravenous injection of 0.25 mg/kg nicotine to the ewe (equivalent to smoking 1 cigarette every 20 seconds for 5 minutes). Uterine blood flow was reduced about 30% after infusion of 0.1 mg/kg/min nicotine for 20 minutes to pregnant rhesus monkeys (equivalent to smoking about 6 cigarettes every minute for 20 minutes).

Human Experience: Cigarette smoking during pregnancy is associated with an increased risk of spontaneous abortion, low-birth-weight infants and perinatal mortality. Nicotine and carbon monoxide are considered the most likely mediators of these outcomes. The effects of cigarette smoking on fetal cardiovascular parameters have been studied near term. Cigarettes increased fetal aortic blood flow and heart rate, and decreased uterine blood flow and fetal breathing movements. Habitrol treatment has not been studied in pregnant humans.

Labor and Delivery

Habitrol systems are not recommended to be left on during labor and delivery. The effects of nicotine on the mother or the fetus during labor are unknown.

Nursing Mothers

Caution should be exercised when Habitrol therapy is administered to nursing women. The safety of Habitrol treatment in nursing infants has not been examined. Nicotine passes freely into breast milk; the milk-to-plasma ratio averages 2.9. Nicotine is absorbed orally. An infant has the ability to clear nicotine by hepatic first-pass clearance; however, the efficiency of removal is probably lowest at birth. The nicotine concentrations in milk can be expected to be lower with Habitrol treatment when used as directed than with cigarette smoking, as maternal plasma nicotine concentrations are generally reduced with nicotine replacement. The risk of exposure of the infant to nicotine from Habitrol systems should be weighed against the risks associated with the infant's exposure to nicotine from continued smoking by the mother (passive smoke exposure and contamination of breast milk with other components of tobacco smoke) and from Habitrol systems alone or in combination with continued smoking.

Pediatric Use

Habitrol systems are not recommended for use in children because the safety and effectiveness of Habitrol treatment in children and adolescents who smoke have not been evaluated.

Geriatric Use

Forty-eight patients over the age of 60 participated in clinical trials of Habitrol therapy. Habitrol therapy appeared to be as effective in this age group as in younger smokers.

ADVERSE REACTIONS

Assessment of adverse events in the 792 patients who participated in controlled clinical trials is complicated by the occurrence of GI and CNS effects of nicotine withdrawal as well as nicotine excess. The actual incidences of both are confounded by concurrent smoking by many of the patients. In the trials, when reporting adverse events, the investigators did not attempt to identify the cause of the symptom.

Topical Adverse Events

The most common adverse event associated with topical nicotine is a short-lived erythema, pruritus, or burning at the application site, which was seen at least once

in 35% of patients on Habitrol treatment in the clinical trials. Local erythema after system removal was noted at least once in 17% of patients and local edema in 4%. Erythema generally resolved within 24 hours. Cutaneous hypersensitivity (contact sensitization) occurred in 2% of patients on Habitrol treatment (see PRECAUTIONS, Allergic Reactions).

Probably Causally Related

The following adverse events were reported more frequently in Habitrol-treated patients than in placebo-treated patients or exhibited a dose response in clinical trials:

Digestive system - Diarrhea, dyspepsia
Mouth/Tooth disorders - Dry mouth
Musculoskeletal system - Arthralgia, myalgia
Nervous system - Abnormal dreamst, somnolence

Frequencies for 21 mg/day system

*Reported in 3% to 9% of patients
†Reported in 1% to 3% of patients.
‡Unmarked if reported in < 1% of patients.

Causal Relationship Unknown

Adverse events reported in Habitrol- and placebo-treated patients at about the same frequency in clinical trials are listed below. The clinical significance of the association between Habitrol treatment and these events is unknown, but they are reported as alerting information for the clinician.

Body as a whole - Allergy†, back pain†
Cardiovascular system - Hypertension†
Digestive system - Abdominal pain†, constipation†, nausea†, vomiting†
Nervous system - Dizziness†, concentration impaired†, headache (17%), insomnia†
Respiratory system - Cough increased†, pharyngitis, sinusitis†
Urogenital system - Dysmenorrhea†

Frequencies for 21 mg/day system

*Reported in 3% to 9% of patients
†Reported in 1% to 3% of patients
‡Unmarked if reported in < 1% of patients.

DRUG ABUSE AND DEPENDENCE

Habitrol systems are likely to have a low abuse potential based on differences between it and cigarettes in four characteristics commonly considered important in contributing to abuse: much slower absorption, much smaller fluctuations in blood levels, lower blood levels of nicotine, and less frequent use (i.e., once daily).

Dependence on nicotine polacrilex chewing gum replacement therapy has been reported. Such dependence might also occur from transference to Habitrol systems of tobacco-based nicotine dependence. The use of the system beyond 3 months has not been evaluated and should be discouraged.

To minimize the risk of dependence, patients should be encouraged to withdraw gradually from Habitrol treatment after 4 to 8 weeks of usage. Recommended dose reduction is to progressively decrease the dose every 2 to 4 weeks (see DOSAGE AND ADMINISTRATION).

OVERDOSAGE

The effects of applying several Habitrol systems simultaneously or of swallowing Habitrol systems are unknown (see WARNINGS, Safety Note Concerning Children).

The oral LD₅₀ for nicotine in rodents varies with species but is in excess of 24 mg/kg; death is due to respiratory paralysis. The oral minimum lethal dose of nicotine in dogs is greater than 5 mg/kg. The oral minimum acute lethal dose for nicotine in human adults is reported to be 40 to 60 mg (<1 mg/kg).

Two or three Habitrol 30 cm² systems in capsules led to dogs weighing 8-17 kg were emetic, but did not produce any other significant clinical signs. The administration of these patches corresponds to about 6-17 mg/kg of nicotine.

Signs and symptoms of an overdose of Habitrol systems would be expected to be the same as those of acute nicotine poisoning including: pallor, cold sweat, nausea, salivation, vomiting, abdominal pain, diarrhea, headache, dizziness, disturbed hearing and vision, tremor, mental confusion, and weakness. Prostration, hypotension, and respiratory failure may ensue with large overdoses. Lethal doses produce convulsions quickly and death follows as a result of peripheral or central respiratory paralysis or, less frequently, cardiac failure.

Overdose From Topical Exposure

The Habitrol system should be removed immediately if the patient shows signs of overdosage and the patient should seek immediate medical care. The skin surface may be flushed with water and dried. No soap should be used since it may increase nicotine absorption. Nicotine will continue to be delivered into the bloodstream for several hours (see CLINICAL PHARMACOLOGY, Pharmacokinetics) after removal of the system because of a depot of nicotine in the skin.

Overdose From Ingestion

Persons ingesting Habitrol systems should be referred to a health care facility for management. Due to the possibility of nicotine-induced seizures, activated charcoal should be administered. In unconscious patients with a secure airway, instill activated charcoal via nasogastric tube. A saline cathartic or sorbitol added to the first dose of activated charcoal may speed gastrointestinal passage of the system. Repeated doses of activated charcoal should be administered as long as the system remains in the gastrointestinal tract since it will continue to release nicotine for many hours.

Management of Nicotine Poisoning

Other supportive measures include diazepam or barbiturates for seizures, atropine for excessive bronchial secretions or diarrhea, respiratory support for respiratory failure, and vigorous fluid support for hypotension and cardiovascular collapse.

Safety and Handling

Habitrol systems can be a dermal irritant and can cause contact sensitization. Although exposure of health care workers to nicotine from Habitrol systems should be minimal, care should be taken to avoid unnecessary contact with active systems. If you do handle active systems, wash with water alone, since soap may increase nicotine absorption. Do not touch your eyes.

Disposal

When the used system is removed from the skin, it should be folded over and placed in the protective pouch which contained the new system. The used system should be immediately disposed of in such a way to prevent its access by children or pets. See patient information for further directions for handling and disposal.

How to Store

Do not store above 86°F (30°C) because Habitrol systems are sensitive to heat. A slight discoloration of the system is not significant.

Do not store unopened. Once removed from the protective pouch, Habitrol systems should be applied promptly since nicotine is volatile and the system may lose strength.

CAUTION: Federal law prohibits dispensing without prescription.

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EARTH MOVER

The Civilian Hummer—for those who would boldly go where no 4x4 has gone before.

BY TONY SWAN, Automotive Editor



● So you've acquired this mountain getaway, but the access road looks like it's better suited to something equipped with hooves rather than tires. And there are all these random tree trunks scattered around the place. Besides that, you just can't seem to come up with a vehicle that's capable of towing your howitzer.

If these or other limiting factors

have been troubling you in your search for a 4x4 that really will go anywhere, AM General in South Bend, Indiana, (800) 348-6833, has an intriguing answer.

Our friends in uniform call it the HMMWV, for High Mobility Multi-purpose Wheeled Vehicle, better known as the Humvee. But you can call it the Hummer. AM General

would like that, since that's the registered trademark for the vehicle. And you no longer need a uniform to put this big horse through its impressive paces. All you need is about \$40,000 and some terrain you wouldn't dare tackle in any other sport/utility vehicle available today.

Although the Hummer has been around for a while, it took the Persian



PHOTOS BY ROY AT/AT/AVAY



A General Motors 6.2-liter diesel Turbo 400 automatic transmission and Torsen differentials pull the Civilian Hummer into (and out of) some pretty heavy sledding.



Gulf War to make it visible to most Americans. And with visibility came a shock: America learned that this hulking, no-nonsense newcomer had replaced the beloved Jeep. This is like finding out that your old high school burned down—a little of you goes up in smoke, too.

But for anyone with an emotional stake in the old military Jeep, there's some consolation in the Hummer's or-

igns. AM General is descended from the Willys-Overland Co., which was more or less responsible for the design of the original Jeep and produced some 350,000 of them during World War II.

Like the Jeep, the Hummer design evolved from a set of military specifications aimed at generating a High Mobility Multipurpose Wheeled Vehicle (HMMWV)—one with a much broader range of capabilities than its famous predecessor (see "The Jeep Is Dead, Long Live The HMMWV!", page 89, Apr. '83).

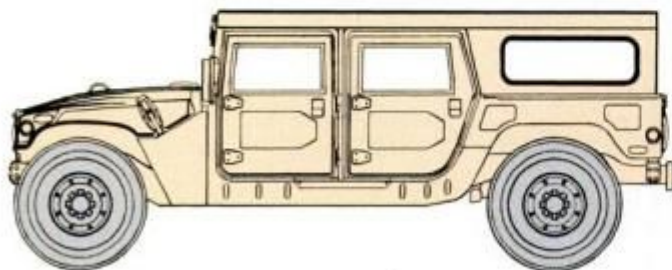
The performance targets, outlined by the military in 1979, included the ability to operate in climatic conditions ranging from desert to arctic, with or without armor, and with adaptability for a broad range of applications—such as troop transport, TOW missile platform, ambulance work, artillery towing, ammunitions hauling and other functions.

Eye of the Storm

The Hummer was already solidly established with the U.S. Army, Marine Corps, Navy and Air Force by the time Desert Storm broke last year. But like so many other elements of American military technology, the crucible of combat put this vehicle's exceptional capabilities into sharp focus. While the 20,000 Hummers involved in Desert Storm didn't command the kind of media attention given to Patriot Missiles and smart bombs, they performed their multiple workhorse chores in the gear-grinding grit of Saudi Arabia, Kuwait and Iraq with a level of reliability that exceeded expectations.

And somewhere in the middle of the Gulf War, AM General's phones started carrying a lot of nonmilitary traffic. The basic message was, "I want a Hummer. Do you have a civilian version? How can I get one?"

Well, here it is.



AM General's preliminary sketches of Civilian Hummer variants include from left: ambulance/troop carrier clone, 4-door short-box pickup.

The vehicle

One glance tells you this is no toy. Although its overall length is actually shorter than the new Chevrolet/GMC Suburban 2500, it's 8 in. wider and a couple hundred pounds heavier.

But the statistic that really sets this vehicle apart from any other 4x4 you can buy is ground clearance. There's 16 in. between the Hummer's undercarriage and the earth—a good 6 in. more than anything else in the sport/utility field.

Even more important is the nature of the clearance. When you use up the ground clearance on an ordinary 4x4, the first thing that starts scraping over rocks is likely to be something essential to transmitting power to the wheels. When the Hummer scrapes bottom, the first contact will be with the chassis itself. The tender drive-line elements are tucked up between the frame rails.

When we toured the Hummer factory in Mishawaka, Indiana, it took one look at those massive steel rails to convince us that this chassis can take a pounding that would leave other 4x4s crying for mercy or dead on the trail. The massive rails are united ladder-style by five equally robust cross-members, and the resulting assembly measures well up on the stiffness scale usually reserved for bridges and railroad trestles.

Suspension consists of beefy double A-arms and coil springs at all four corners. Brakes are 10.5-in. discs all around. The rotors are mounted in-board, and the master cylinder has dual reservoirs.

Propulsion is supplied by a GM 6.2-liter diesel, mated to a 3-speed automatic transmission, also from GM. Horsepower is rated at 150, torque at 250 ft.-lb. Given the mass of the vehicle, this output seems modest, but the torque curve is flat and the Hummer's gearing makes the most of it. Though it's quick only by locomotive standards—as one observer put it, "0 to 60 is June"—the Hummer can be coaxed up to freeway speeds. And in mountain-goat terrain, where just keeping going replaces going quickly, the Hummer plods through and over stuff that almost defies credibility.



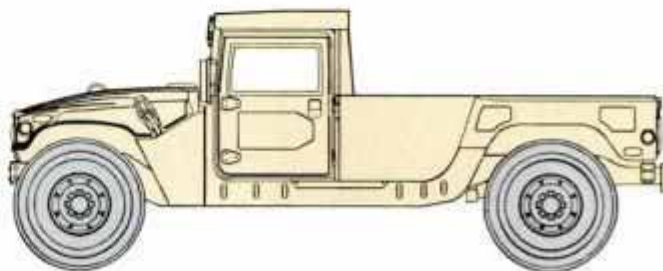
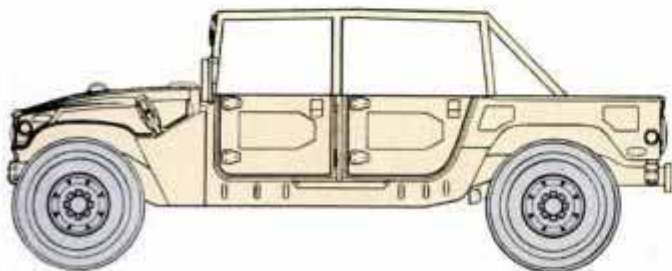
PHOTOS BY ROY ATTAWAY

Hummer's capabilities include traversing 40% slopes and fording 30-in.-deep streams. Its chassis can take a pounding that leaves other 4x4s dead on the trail.

The test

Almost all of our evaluation was conducted at AM General's rambling test

facilities near South Bend—the former Studebaker proving grounds. Included in this acreage is a rich mixture



a Jeep-style softtop and a 2-door long-box pickup version. Conversion to civilian use includes 12-volt electrical systems and federal lighting.

EARTH MOVER

of deeply rutted woodland trails, cliff-like downhills, soggy-bottomed ponds, steep-sided ditches that looked very much like anti-tank traps and square-edged concrete steps 18 in. high.

Thanks to its combination of limited overhang, steep approach and departure angles and high ground clearance, the Hummer can climb over tree trunks and rock shelves that would stop anything this side of a tank. High chassis rigidity keeps it going even when one or two wheels are off the ground, and its wide track (72 in.) keeps it going on 40% side slopes.

The Hummer can trundle itself up slopes of up to 60%, and it can ford waterholes as deep as 30 in.

We spent an entire day sampling these capabilities, and when we left, we were believers. For dirty work, this warlike roughneck has no peer.

On the street, it's a different story. The Civilian Hummer is downright posh compared to military versions, with real upholstery (as distinct from canvas), padded dash, steel doors (for improved side impact protection) and padded door panels. Other variations from the GI Hummer include a 12-volt electrical system—military Hummers use 24 volts—and civilian side marker lights and turn signals.

But none of these modifications do much to disguise the elemental brute within. It's like putting a gorilla into a Brooks Brothers suit. He may look stylish, but he's still a gorilla, and he's not gonna let you forget it.

The street-going Hummer is sluggish and clumsy in traffic, not to mention noisy. And massive. Of the three body styles offered—2-door pickup, 4-door pickup and 4-door softtop—we think the 4-door pickup is the most practical, as well as the most comfortable. Like an old-fashioned pickup, the 2-door is limited in terms of legroom, and the fixed seatback is too close to vertical. The 4-doors offer more legroom, but none of these vehicles can be called comfortable by con-



The Hummer will take you places some civilian 4x4s won't go at all, but its size and slow acceleration keep it from being much fun to drive on the highway.

Specifications

Base price	\$40,500
Engine	6.2-liter V8 diesel
Horsepower	150 @ 3600 rpm
Torque	250 ft.-lb. @ 2000 rpm
EPA fuel economy, city	13.2 mpg
EPA fuel economy, hwy.	13.8 mpg
Transmission	3-speed automatic, 4wd
Wheelbase	130.0 in.
Length	180.0 in.
Height	72.0 in.
Width	85.0 in.
Track, f/r	72.0 in./72.0 in.
Curb weight	5424 lb.
Suspension	Double A-arms, coil springs, hydraulic dampers
Brakes, f/r	10.5-in. disc/10.5-in. disc
Tires	36x12.5R16.5

Test Results

Acceleration 0-60 mph	20.8 sec.
Braking 60-0 mph	186 ft.

temporary sport/utility standards.

However, the Civilian Hummer doesn't pretend to be a Ford Explorer. Since most sport/utility vehicles almost never leave the pavement, their off-road capabilities are compromised in favor of ride comfort and all-around driveability.

The Hummer's superb off-road capabilities aren't compromised even slightly. It's a real outback brute, and we predict that novelty buyers will quickly tire of it. We wonder, for example, how often Arnold Schwarzenegger, who bought one of the first civilian models, takes his Hummer through its paces in Hollywood.

But if there's serious off-road work to be done, the Hummer is in a class by itself.

PM



Side-by-side comparison illustrates differences in ground clearance, width and overall bulk between Hummer and Range Rover.

ELECTRONICS

MEMORY DISCS

Put your snapshots on television using the new Photo CD player.

BY GEORGE SCHAUB

● Starting this summer, you'll be able to see family, friends and all those old vacation spots on television. All these images will be stored on a compact disc which will be played on a new type of player called Photo CD.

Welcome to the world of electronic imaging, and say thanks to Kodak, the system's developer. Now, anyone with a 35mm camera and a Photo CD player can put their snapshots on television for easy viewing and even cropping. Photo CD may just change the way we look at photographs.

The road to a mass-market electronic still-imaging system has been long, and not without its potholes. In the early 1980s, Sony sprung the idea of electronic still photography on the world. Known



Put 100 of your favorite snapshots onto a compact disc for easy viewing on your television.

PHOTO BY SPENCER JONES.
SCREEN PHOTO FROM STOCK MARKET

MEMORY DISCS



In side-by-side comparisons, the CD-based prints score well. A conventional print (left) has a slightly "burnt-out" face and dark background, but is certainly crisp and sharp. Print from CD made on laser color copier (middle) has better colors on face, but shows some fuzzy edges where bright light falls. CD digital print (right) has excellent colors and more open background than other versions.

as Mavica, it was composed of a CCD camera (similar to the pickups in camcorders) that records images on a "video floppy disk." The still pictures from the Mavica, and a host of prototype still video cameras that followed, were more of a curiosity than a rival to pictures produced by even the most humble conventional camera.

But the Kodak approach is different. It eliminates the need for a separate still video camera and, at first glance, delivers the quality that we've come to expect from film. Plus, you can order prints right from the CD.

Want to give Photo CD a try? All you need is a regular 35mm camera (anything from a point-and-shoot to an SLR will do), a roll of colorprint film and the Photo CD player. Kodak intends to have a 3-model line, with the least expensive model selling for about \$400.



By using the Photo CD remote control, you can enlarge a portion of the picture or crop out certain elements entirely.

The bonus is that if you don't yet have an audio CD player, you can play back prerecorded music discs on the Kodak CD player as well.

You can also play back your Photo CD on a CD-I player or a computer with a CD-ROM XA drive. However, you can't play CD-I discs on a Photo CD player because, as a Kodak spokesperson says, "Photo CD is a subset of CD-I." In addition, Kodak cautions that not all CD-ROM XA drives can handle the Photo CD system—at least not yet.

How it works

Here's how the Photo CD system works: After you shoot a roll of film, bring it to where you regularly get pictures developed (be sure they offer Photo CD service) and ask for "the works." The works means you get your film developed, a set of prints and a jewel-case-enclosed compact disc that holds your electronically encoded pictures. As of this writing, the cost of a 24-exposure roll of film stored on a CD is about \$1 per shot.

At the lab, the photofinisher converts your color pictures to a digital file via a high-speed scanner—each 35mm frame is converted to 18 megabytes of information. The scanned image is then passed to a Sun SPARCstation computer where the image is compressed to a more manageable file size. In fact, the Photo CD holds many levels of image information, each one dedicated to a certain task.

To print the thumbnail-size picture diary that you get along with your Photo CD order, a lower-resolution image is required. For playback on a

TV, a so-called Base image (512 × 768 pixels) is used, and for impending high-resolution TV, the Photo CD has a 4Base image (1024 × 1536 pixels). If you want to make a print on a digital hard-copy device, you can draw upon the 16Base image, with its 2048 × 3072 pixels. The higher the resolution, the better the picture quality and the longer it takes for the system to bring up an image. However, this system also ensures that Photo CD won't be obsolete, at least in terms of resolution, before its time.

Up to 100 pictures can be recorded on the disc, though this will vary according to what other information is included in the files. Kodak recently announced that graphics, sound bites and other information can be stored along with individual pictures. One picture of a grandparent and child, for example, may warrant two sound bites, one from the grandparent and one from the child. How much additional information you include on the disc affects the overall storage capacity for pictures. Photos can be added at will until the disc is full.

Viewing the pictures

For playback, you load the CD just as you would in an audio player. You can set an interval timer and sit back and enjoy every frame, or you can randomly access pictures with the remote control using the supplied picture diary as a guide. You can even set up picture scripts using the playback memory, and show a branching series of, say, No. 5, then No. 7, then No. 44 and so forth. As you play back pictures, you can select portions of the frame for closer examination.

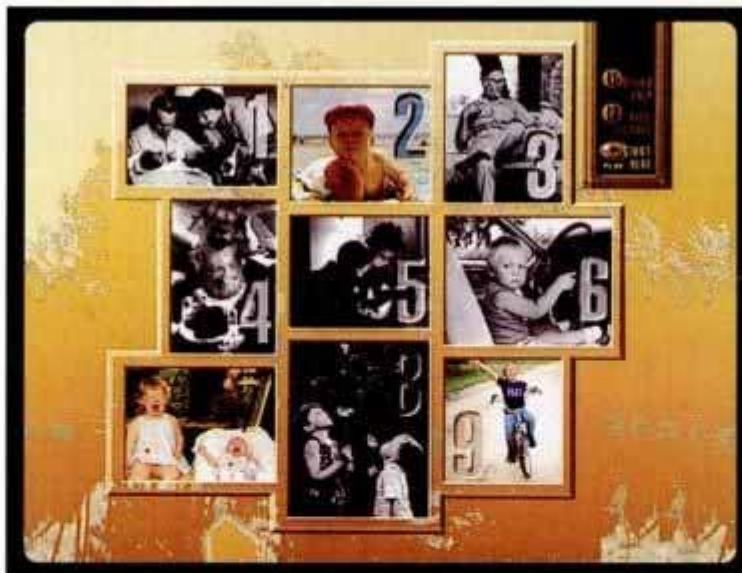
For those who like to delve into im-

age manipulation, you can plug the image into a computer with a CD-ROM XA drive and play with software such as PhotoShop. If you really want to go whole hog, you can buy a dedicated printer and make hard copies of your creative work. This may well replace the amber-lit darkroom work of the past. Our initial experience with Photo CD left us very impressed. First we took pictures with a good point-and-shoot camera—the Olympus Stylus—on a roll of Kodak Gold 200 colorprint film. After we sent in the film, we got back prints, negatives and the Photo CD disc.

The TV format is horizontal and doesn't match up to the aspect ratio of the conventional 35mm frame, so some picture edges were cropped. Not to worry—you can hit a button to get the whole picture, albeit with a smaller image, on the screen. In fact, few people monitor the edges of frames when they shoot, so you might only notice the edge loss when looking at pictures of groups. Vertical shots can be easily rotated to stand straight up. Overall, the picture quality on the TV screen was very sharp and colorful, with no noticeable aliasing or jitter, a real problem with still video images of the past.

After viewing, we had a set of prints made directly from the disc, and here again the quality was a welcome surprise. We had two types of prints made—one set from a color laser copier and the other from Kodak's digital hard-copy printer. The color copier prints appear to have lower resolution, with some burnt-out areas where the picture may have been overexposed and some soft, fuzzy edges in contrast borders. But some of the problems here stem from the paper stock and the way color is laid down on the page.

The digital hard-copy prints were excellent. In fact, compared to the conventional prints, they had more open shadow areas and an excellent color balance. We're told that the software in the system automatically corrects some of the common photographic problems. For example, if you shoot a closeup flash shot, you may get a burnt-out face and a dark background in your prints. However, the "information" on the face and in the background is actually in the film—it's just that the conventional prints can't reproduce it all. Photo CD



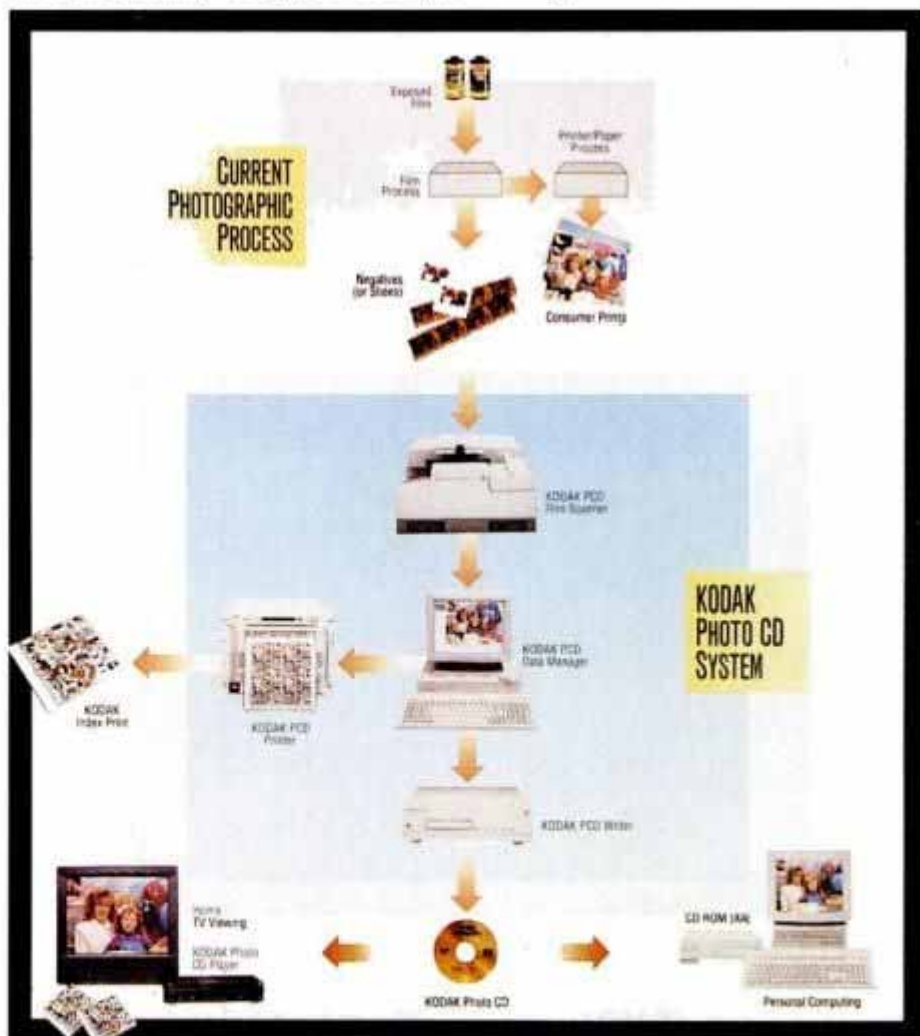
The Photo CD indexing system can show everything on a disc or be used to create a specific branching playback program.

overcomes such problems by using computer algorithms that first recognize, then correct the problem when the image is written. Perfect prints? No, but pretty close.

The clarity of these digital prints is also affected by the paper stock, a

dead ringer for photographic paper with a fine sheen surface. But there is something different about such prints, and you need a magnifier to discover what it is. Conventional photographic images are composed of clumps of grain, or in color paper, the echo of the silver grains that remains in the color dyes that replace them. The grain here is what I call the "pixel box," and the image is composed of very fine squares rather than random clumping. You may notice this in the fine edges of big prints if you look real close, but they aren't obvious to the naked eye.

Will Photo CD be a hit? Technically, we think it's a home run. But it's how the labs handle the task, and how photographers take to seeing their pictures on TV and storing them on CDs, that will determine whether it even gets to first base. **FM**



How Photo CD works: Negatives or slides are scanned into a computer for processing. The image is converted into digital form and inscribed on a compact disc. Meanwhile, a printer creates an index that doubles as album cover art. Images can't be erased.



Marlboro

Marlboro

Marlboro

5

BOSCH

HOLSER

Mobil 1

Mobil 1



WHAT'S NEW AT THE INDY 500

● The Indy 500, "The Greatest Spectacle In Racing," is the world's oldest race, as well as the world's richest and fastest. At one time, it was also the bastion of the backyard dreamer, the gearhead inventor, American ingenuity and homegrown genius.

Over the years, Indy has seen 4-wheel drive, front-wheel drive, 6-wheeled cars, twin-engined cars, all-independently sprung cars, cars with solid axles on both ends, diesels, 2-strokes, turbines, side-valve stock blocks, Fours, Sixes, Eights, Twelves, Sixteens, nitromethane, gasoline, intercoolers, superchargers, turbos.

This year, most of the starters will come from the same factory (Lola) in England, and will be powered by one of four basic engines. When the lights go green and the flag drops, 33 monocoque, midengined cars—all burning methanol, all powered by turbocharged Vee engines—will race for Turn One.

So much for gearhead innovation. You can thank ever-tightening rules and escalating costs for the virtual elimination of radical experiments.

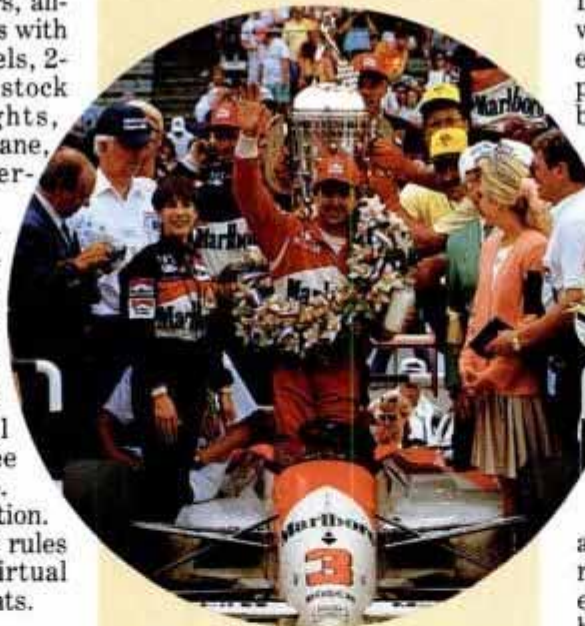
Power struggle

While it would be a mistake to rule out Buick-powered cars this year, the 1992 running of the Memorial Day classic figures to be a classic battle between Ford and Chevrolet. Both will bring new 4-cam 32-valve aluminum V8 engines to Indy.

Not long ago, the Cosworth V8 was the engine you had to have if you really wanted to win the 500. Cosworths were developed for Indy from the Cosworth-Ford DFV 3.0-liter normally aspirated F1 engine that dominated Grand Prix racing from 1967

It's the classic Ford vs. Chevy battle this year—with Buick thrown in for added interest.

PM Illustration
by Jeff Mangiat



Emerson Fittipaldi (opposite) and Rick Mears (above) form the toughest 1-2 punch in the IndyCar field.

until the onset of the Honda epoch.

It was Cosworth, Cosworth, Cosworth—until the Chevy-Illmor in 1986. By 1988, it was all Chevrolet.

Code XB

But 1992 may be a different story. Cosworth responded to Chevy's IndyCar dominance with the new XB, officially the Ford-Cosworth XB. The XB is 15% lower and 19% narrower than the older DFS (latest version of

the DFX). Ford claims a weight of 260 pounds dry, down from about 330—an impressive improvement. The rpm limit is extended to 12,700, but all other performance figures are confidential. The official comment from Cosworth: "No comment."

According to Carl Haas, who runs the Newman-Haas team, as well as Lola Cars USA, the new Ford-Cosworth XB is smaller than any other engine in IndyCar racing. The XB appears to have a slightly more than 90° bank angle. Ford hints at the same kind of sump-main-bearing-girdle arrangement employed by the Chevy engine (as well as many earlier engines).

The small size of the engine allows a lower rear deck height, lower center of gravity, reduced drag and greater downforce—as much as 200 pounds, according to Haas—through improved contouring of the under-car tunnel. The downforce payoff is higher cornering speeds.

The XB's water and oil passages are integral whenever possible to help reliability. According to Ford insiders, the new engine also has lower vibration levels than other Indy powerplants. The flat-plane cranks used for exhaust-tuning purposes on other Indy engines are shakers—early DFVs were particularly bad. The Chevy Indy engine was designed with rear-mounted timing gears to reduce balance problems.

Since boost is fixed—and carefully monitored—by the rules at Indy, horsepower gains come primarily from higher rotational speeds, and the new XB is expected to have higher rotational speeds than any other engine running at The Brickyard this year, as well as an "exceptionally

INDY 500



Michael Andretti testing at Laguna Seca in the Newman-Haas Cosworth XB-engined '91 Lola.

aging advantage over the old Cosworth. The Ilmor features a lighter weight, shallow, low, structural sump that incorporates the main-bearing caps, cam gears at the fly-wheel end, narrow valve angle (24°), high exhaust manifolds (better aero) and carefully packaged pumps and ancillaries.

Originally a Team Penske-only weapon, IndyCar

rules demand open availability after three years. So distribution is now more widespread and Chevy is working to lower the cost of ownership, leasing and operation of this engine, now known as the Chevy A.

Chevy B

While the standard Chevy Indy V8 will certainly be a force at this year's 500, rumors of the new Ford engine design quickly got the attention of Roger Penske. This in turn spurred Ilmor and Chevrolet into action, resulting in a brand-new B version of the Chevy Indy V8 for the new

wide" powerband. This generally means shorter strokes, bigger bores, longer connecting rods and lower reciprocating mass. Engine management electronics are by Cosworth for the time being, while Ford develops a more sophisticated unit.

Drivers will be the Andrettis, father Mario and son Michael, for Newman-Haas Racing with the new Lola T9200 chassis, and Eddie Cheever, racing for Chip Ganassi.

Chevy-Ilmor V8

Think of the Chevy-Ilmor V8 as the logical development of the Cosworth

DFX. Mario Illien and Paul Morgan left Cosworth to found Ilmor Engineering in England. Roger Penske instigated the defection, and eventually involved Chevrolet. Chevy supplied the engine-management system, worked on cam development and provided that most essential of all racing commodities—cash.

Ilmor designed a very compact combustion chamber that, combined with slightly smaller exterior dimensions and other hidden (read secret) wonders, gave the new engine both a power (partially from a higher rpm limit—they admit to 11,400) and pack-

• Few cars have what it takes to perform Indy 500 pace-car duty in box stock trim. The real Indy 500 pace car has to be able to accelerate from the pace mode of 80-90 mph to 120 mph as the cars enter Turn Four, then make a hasty exit onto the pit road, all the while making a hard left turn.

Most pace-car replicas sold by dealers have the graphics but not the guts of real pace cars.

There have been only a few exceptions to this in recent years. This year's car, the 1993 Cadillac Allanté, is one of them. Armed with an all-new 32-valve Northstar V8 engine, new 4T80-E transmission, new speed-sensitive electronically controlled suspension, new-generation traction system and numerous refinements, Cadillac's luxu-sport flagship moves from showroom to Brickyard with nothing more than the required added safety equipment of rollbar, strobe lighting and on-board fire safety equipment. In essence, every '93 Allanté is a full-blooded pace car.

Engineering starts with a 4.6-liter double-overhead-cam aluminum V8 producing 290 horsepower at 5600 rpm and 290 ft.-lb. of torque at 4400 rpm. That's enough muscle to launch the 3766-pound roadster to 60 mph in the high 6-second bracket and top it out at over 150 mph. Borrowing technology used in ultrasports and racing engines, the Northstar block uses 2-piece construction and 4-bolt main-bearing journals. The main bearings, developed by Federal-Mogul, are the strongest units used in a passenger car today. Durability is also enhanced with forged-aluminum pistons swinging on

Pacer With Panache



forged-steel rods, and they put a 10.3:1 squeeze on the intake charge. The hydraulic, direct-acting valvetrain, using roller chains and eight sprockets, promises maintenance-free operation.

Northstar's modular electronic sequential port fuel-injection induction system is tuned to a flow efficiency equivalent of a straight pipe that has been perfectly polished. The system is thermally isolated for a cooler intake charge and better hot-start.

Sparks are generated by GM's Direct Ignition System—four separate coils with no moving parts. Dual-tipped platinum spark plugs have a service life of 100,000 miles.

Complementing Northstar is a 4T80-E transmission. The 4-speed automatic has a unique dual lubrication system that uses a large pump to provide fluid pressure and lubrication under hard acceleration. In highway cruising, this pump shuts down and a smaller pump takes over to increase fuel efficiency. Final drive ratio is a stiff 3.73:1.

Cadillac suspension engineers wanted to maintain the high level of control required for high speeds and spirited cornering, but

without giving up luxu-smoothness and comfort. The answer is Cadillac's new computer-controlled suspension system that's called Road Sensing Suspension (RSS). The system uses four specifically valved dampers equipped with a 2-position solenoid valve that modulates between soft and very firm. Four accelerometers mounted on the body measure vertical motions, and four position sensors mounted between the suspension and the body

determine wheel position relative to the body. A computer controller uses this information to read road conditions at a rate of 1 in. of road travel for each wheel at 60 mph. The controller tells each damper independently to change the firmness of the setting. Response time at the damper is 10 to 15 milliseconds.

Complementing the RSS system is a speed-sensitive power rack-and-pinion steering that increases feel and effort with speed. A new design rear suspension, a unique Short/Long Arm (SLA) multilink arrangement, locates each rear wheel with a short upper control arm, a longer lower control arm and an additional lateral link for optimal alignment under all conditions.

After blasting around on the twisty mountain roads above Palm Springs, California, for a day in a '93 Allanté, we can personally attest to the fact that this package works. We had along for comparison purposes a Mercedes-Benz 300SL and 500SL and a Jaguar XJ-S. Frankly, the Allanté was the superior overall car. And a fitting vehicle to pace the greatest spectacle in racing.



CART requires the Penske-only Chevy-Ilmor A engines be available to other teams after three years—but this season, Penske has the potent B engine exclusively.

Marlboro/Penske racers of Rick Mears and Emerson Fittipaldi.

Like Ford-Cosworth, the B is all “no comment,” and fabricated from unobtainium. Unlike the all-new XB, it is a modification of the existing Chevy Indy V8, with new heads, new electronics (Gen III from Delco), new external accessories and new intake manifold. Like the Ford XB, the Chevy Indy B is substantially narrower and lower, and allows better aerodynamics. Chevy is also claiming lighter weight and more power.

Stock-block Buicks

For '92, the 2-valve Buick V6 users have been allowed to raise boost pressure from 45 in. to 50 in. (at Indy's near sea level, about 11 psi) for all IndyCar races (every race in the PPG series except the Indianapolis 500). With the increased boost, horsepower goes from last year's 690 to 720. Indy, however, is sanctioned by USAC, and for the 500, the Buicks will be allowed 55 in., boosting horsepower to 785.

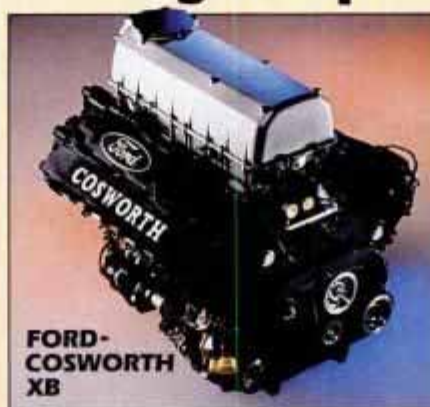
Brayton Engineering (owned by Lee Brayton, father of Indy driver Scott) works with Buick to machine, assemble and develop the 209-cu.-in.

(Please turn to page 113)



PHOTO BY ART FLORES

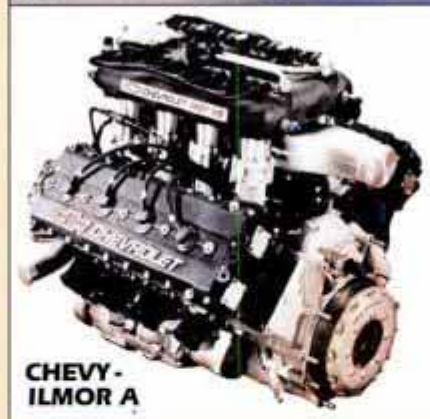
Engine Spotters Guide



FORD-COSWORTH XB



BUICK INDY V6



CHEVY-ILMOR A



CHEVY-ILMOR B

• With most observers giving the Judd and older Cosworth engines little or no chance for victory this Memorial Day weekend, it comes down to the Ford and Chevy V8s and the Buick V6 to do battle for the winner's circle. Right now, the favorite has to be the good old Chevy, now known as the Chevy A engine. It has won the past umpteen IndyCar races and completely dominates the sport.

It's proven. It's just about bulletproof. It makes the horsepower.

And there will be more of them in the race than any other engine.

The new Ford XB and Chevy B V8s are unknown quantities, although Penske's Marlboro Team with Fittipaldi and Mears driving finished 1-2 with the Chevy B in the first CART race of the season in Australia. The best XB finish was a fifth. Let's see how they do at The Brickyard.

For fans from Flint, Michigan, new boost rules give Buick's V6 more muscle—and hope—than in previous years. If the engineers can boost reliability, Buick can't be counted out.

—Joe Oldham



Goodyear will be supplying its new-construction Superspeedway Eagle radials to all 33 cars in 1992.

LeSabre Ladies and gentlemen,

	'92 Buick LeSabre Limited	'92 Toyota Cressida Sedan
Engine	3.8-litre V6	3.0-litre V6
Drivetrain	Front Drive	Rear Drive
Passenger Room	109.2 cu ft	89.0 cu ft
Trunk Room	17.0 cu ft	12.5 cu ft
Driver Air Bag	Standard	Not Available
Anti-Lock Brakes	Standard	Optional
M.S.R.P.*	\$21,100	\$24,618

All new, all Buick

When you compare the 1992 LeSabre Limited to its import competition, one thing stands out — the value built into this new Buick.

In key areas — from engine capacity to trunk capacity, from passenger room to a



Toyota Cressida



*Manufacturer's suggested retail price including dealer prep. Destination charge, tax, license and options additional. Levels of equipment vary.

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Buckle up, America!



for 1992. start your comparisons.

driver air bag — the Buick LeSabre gives you more.

Yet LeSabre asks less of you in return. Thousands of dollars less.

So go ahead and start your comparisons. We're confident you'll end up

behind the wheel of a new Buick LeSabre.

For more information on LeSabre quality and value, call 1-800-531-1115, or visit your Buick dealer today and take a thorough test drive.



BUICK
The New Symbol For Quality
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Buick LeSabre

THE MECHANICS OF THE PERFECT GOLF SWING



Editor's note—Lee Trevino's record of major wins includes the U.S. Open, the British Open, the Canadian Open and the PGA championship. He was inducted into the World Golf Hall of Fame in 1981, and currently plays the PGA Senior Tour, sponsored by Cadillac.

● Many people think that golf is a very easy game. But it's not. To hit the ball long and straight, all you have to do is swing the club head at 100 mph, position the club face exactly perpendicular to the target and make contact with the ball at an impact point about the size of a pin. If the club face is 2° off exact center, your 250-yard drive—which has an initial velocity of about 150 mph and a spin rate of more than 5000 rpm—will be off target by as much as 25 yards. And it will only be that close if the club head doesn't twist on impact, you center hit the ball in the

BY LEE TREVINO



club's sweet spot and you do everything else exactly right.

Golfers themselves often compound the difficulty by buying a set of clubs and a pair of shoes with spikes on them, and then heading right out to the course. Oh, sure, they'll go to the driving range, pick up a driver, tee up some balls and hit drive after drive. But hitting a driver isn't all there is to golf. A driver is an important club, but it's not as important as the wedge and the short game.

People often spend hours trying to increase their distance with the driver, but there's really no secret to it. The bigger the swing arc, the more club-head speed you generate and the farther you drive the ball. That's all there is to it. John Daly, the biggest hitter in golf today, has a

Booming drives and short chips are a matter of technique and high-tech.



swing arc that's very long. He gets his hands way up high over his head at the top of his swing. Most people's hands only go up as high as their ear. Greg Norman is another big hitter with a very long arc. Davis Love hits the same way.

But one thing big hitters have to give up with their long arc is accuracy. There's no question about it. However, they always have the option to pull back. Davis Love, for example, has shortened his arc recently. And I wonder if John Daly will eventually do the same thing.

To me, a perfect golf swing, if there is such a thing, is something like the 6-iron shot I had in the 1987 Skins Game. It was on national TV and there was \$175,000 riding on the hole. It was 167 yards long and the pin was on the right side of the green. I hit the 6-iron short and the ball took two hops. It went right into the cup, but we couldn't see exactly what happened because the sun

was right in our eyes. Then the gallery started jumping up and down and going crazy, and we knew I holed it. I also birdied the 10th hole, the 13th and the 18th, so I won all the skins (prize money) on the back nine.

That day, my swing was in a groove, and the reason for it isn't hard to understand. Hard work and sound fundamentals are the keys to the perfect swing, and there's no substitute for these two.

Ain't got a thing

When I first qualified for the U.S. Open in 1968, Sam Snead and Bob Goalby saw me hitting some balls. I was a raw Mexican kid coming out of Texas and they'd never seen me before. Goalby looked at my unorthodox swing and said to Snead, "He'll linger, but he won't last."

We still laugh about it, but you know, I think over the

THE PERFECT SWING

years people have finally accepted my swing. The conventional school of thought in golf says that you should set your stance in a slightly closed position, which means that your right foot and shoulder are drawn farther from the target line than the left. It also says that the path of your swing should come up inside (close to the body), down inside, and your wrists should roll over to get the club properly through the ball.

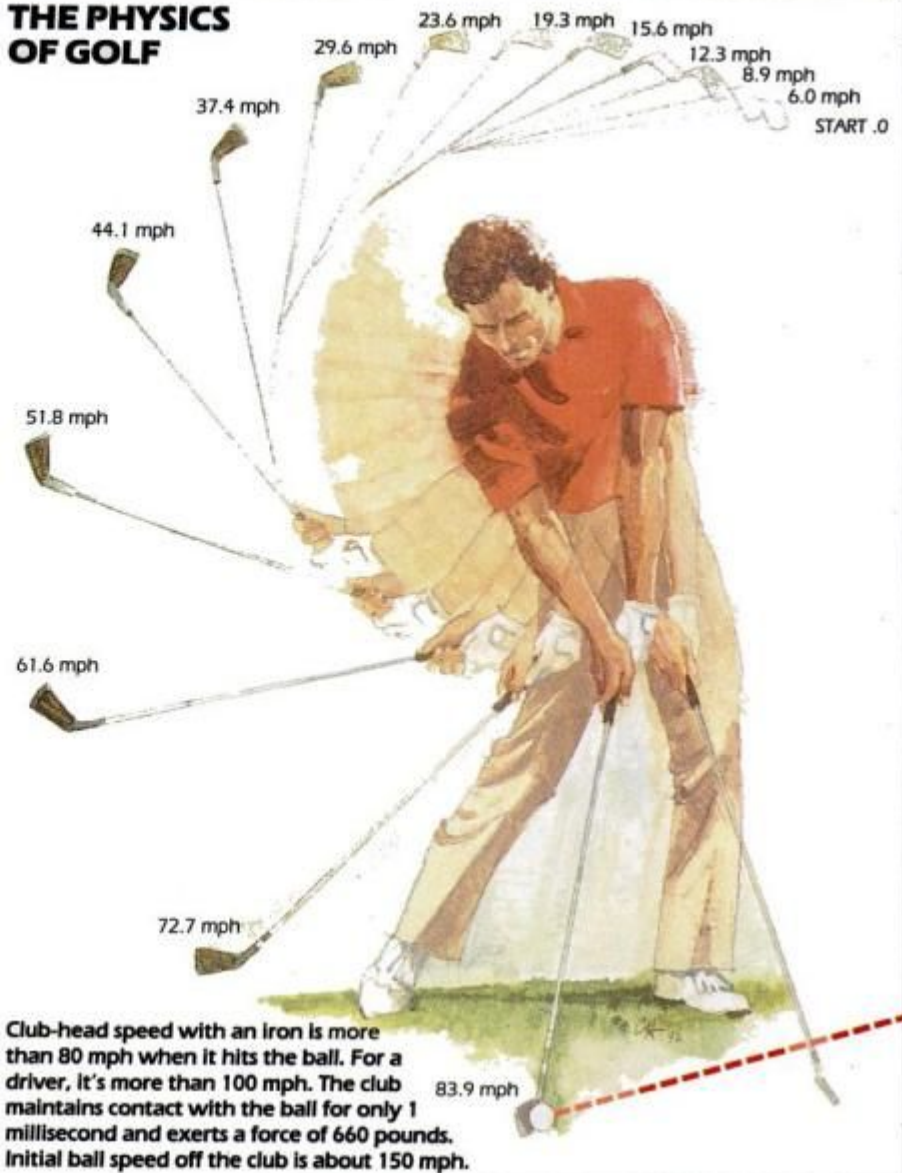
Well, I've never done that. First, my stance is slightly open, with my feet aligned a little left of the target. Then, on the take away, the club comes back along a path parallel to my stance. When I reach the top of my back swing, my arms draw inward so that on my down swing my right arm falls close to my right hip. This allows me to hit the ball from the inside.

In the air, my club head follows a figure-8 path that starts outside and comes back in. The swing of a poorly hit ball resembles a figure 8, too, but it traces the path backward from the inside out, and it usually results in a vicious slice.

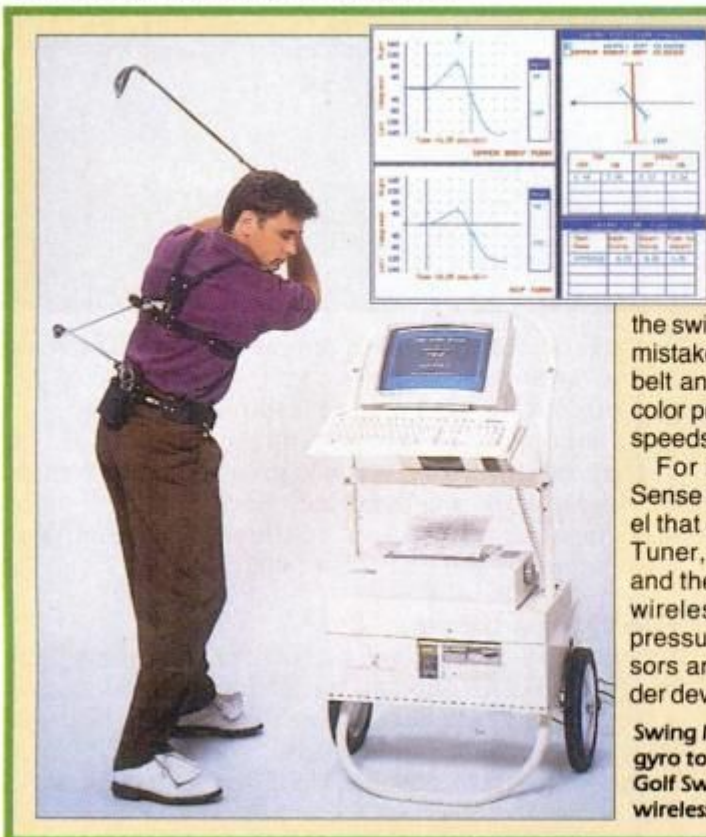
I've played all my life with this unorthodox swing, and I'll tell you who else uses it. Fred Couples, who is the hottest player in golf right now, sets his stance to the left and pushes the ball to the right. Mark Calcavecchia plays this way, as do Paul Azinger and Bernhard Langer.

There's less that can go wrong if you set up left and aim right. It's more consistent. It enables you to keep the

THE PHYSICS OF GOLF



PM ILLUSTRATION BY CHUCK HAMBRICK; SOURCE: KARSTEN MFG. CORP.



Computer-Aided Swing

● Taking the philosophy of learning through positive reinforcement into the realm of state-of-the-art electronics, SportSense, of Mountain View, California, has developed a series of golf training systems that uses high-tech motion sensors, software analysis and real-time audio feedback.

Called the Swing Motion Trainer, this new computer teaching and training system is designed for club-house instructors and retails for \$20,000. It analyzes the motions of the swing and then switches to an audio training mode for correcting mistakes. The system obtains data from a gyro worn on the golfer's belt and a multisensor tensionometer worn on the golfer's back. A color printout can be made for later study of various body angles and speeds throughout the swing.

For individual golfers, SportSense has developed a \$299 model that consists of the Golf Swing Tuner, a belt-worn control unit, and the Power Shift Module, a wireless weight sensor. Grip pressure and turn/swing sensors are options currently under development. —Joe Skorupa

Swing Motion Trainer (left) uses a gyro to analyze your swing. The Golf Swing Tuner (right) uses a wireless weight sensor.



left hand square to the target, and reduces the need to roll your hands over in the conventional way.

Today, very few pros go out and hook the ball, which was the goal of conventional instructors. And let me tell you something about big-name instructors, the so-called golf gurus who often disagree with my swing philosophy: Not one of them that I know of has taken a raw kid at the age of 15 and made him a champion. All of the champions I know learned how to play on their own and then moved up through the ranks. After they made a name for themselves, their game might have gone astray and they might have gone to an instructor at some point. But all an instructor can really do for a player with skill is cure bad habits.

The truth about the perfect golf swing is that it's only perfect if it's perfect for you. There's no definitive way of playing. A good instructor will ground you in the fundamentals of the swing: the stance, the weight balance, the grip, the knee flex, the back swing, the down swing, the weight shift, manipulation of the hands, the

Swinging On The TV Chalkboard

● Everybody's seen John Madden's TV chalkboard for analyzing action in football. Now Skill Technologies, of Aurora, Colorado, has developed an interactive multimedia system that does the same thing for golf. Using two video cameras, a VCR, a monitor and a multimedia computer with live-motion capture, the new Golf Analysis System acts as a random-access digital VCR for frame-by-frame, sequential or split-screen analysis. Other functions include stick-figure analysis, chalkboard overlays and club-head speed/angle analysis.



Comparing Lee Trevino's swing (right) to a novice illuminates both.

Clever commentary is extra.

In addition to the chalkboard capability, one of the system's most unique features is the split-screen mode, which enables the novice golfer to view his swing alongside that of a top pro, such as Lee Trevino, and then analyze both.

Although the Golf Analysis System is currently in the prototype stage, it will be ready for instructors by the end of the year and retail for \$20,000 up to \$30,000. According to the system's creators, 3D golf technology is next and closer than you think. —J.S.

follow-through, and so forth. But making it all work is up to you.

Even though I see other pros re-routing their swings in a way that resembles mine, I'm not saying that my swing is the only way to go. All the

great champions you see, the Littlers, the Palmers, the Nicklaus's, all swing a little different. But in the area of contacting the ball, we're all the same, and that's what really counts.

Technology in the bag

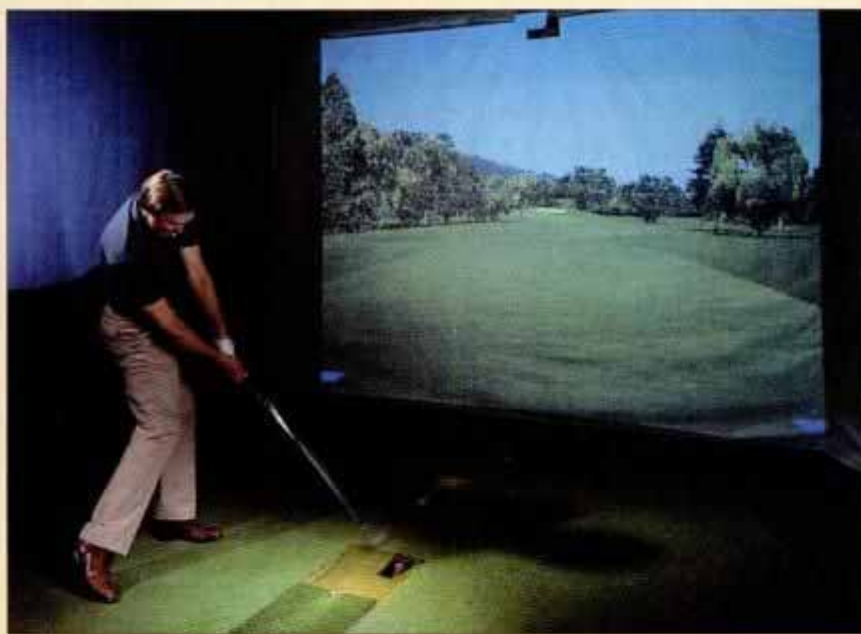
The first step to developing your swing is to get a set of golf clubs. The second step is to go to an instructor who knows the fundamentals. And the third step is to practice like hell.

Now when I talk about practice, I'm talking about going through the entire bag. The way to practice is to get out the wedge and hit it until you like it. Then get out the 9-iron until you're hitting it well. And if you're not hitting the nine right, then go back to the wedge and start over again. Go back and forth and back and forth until you're hitting all the clubs the way you want to.

But before you get to this point, you've got to have the right equipment. And with so much technology coming into the game, choosing the right clubs isn't as easy as it used to be. Today, you have to decide whether you should have a stiff shaft, a regular shaft or a limber shaft. Should your club's swing weight be light, heavy or in between? Should you be using a 43-in. driver, a 44-in. driver or a 42.5-in. driver? Should your clubs be upright or flat? How much loft should they have?

Then you've got to choose metal or wood drivers. In my opinion, the biggest improvement in clubs is the metal wood, which can be manufactured so that the center of gravity is high, low or in between. And if you break one, you can get another that's exactly the same. You can't necessarily fly

(Please turn to page 107)



Playing The Simulator Circuit

● Will you tee off at Pebble Beach? Or Pinehurst No. 2? Or Spyglass Hill? Why not Augusta? When you play the interactive simulator system developed by InGolf, of Sunnyvale, California, the world's top courses are yours for the asking.

Designed for golfers as opposed to video arcade fans, the InGolf system projects views from the world's top golf courses onto an active nylon screen. To do this, each course is shot from a thousand angles and the

data is programmed into a computer.

A floor-mounted spin sensor and a grid behind the screen provides the simulator with necessary information about your shot. A computer measures ball spin in two axes, calculates velocity and determines trajectory based on the location of the hit on the screen.

An hour of surprisingly realistic simulator golf or driving-range practice runs about \$14. Not bad for teeing up at Augusta. —J.S.



AMERICA'S LAST— AND BEST—SHUTTLE

The completion of *Endeavour* marks the end of Space Shuttle production—and the beginning of efforts to keep the fleet spaceworthy well into the 21st century.

● Eleven years ago at Kennedy Space Center, Launch Pad 39A vanished behind a cloud of flame as a brand-new spacecraft scorched into the sky. Up with *Columbia* rode the dream prescription for manned spaceflight: cheap, predictable access to orbit on a month's notice, in a wonderful reusable vehicle called a Space Shuttle. Five years later, on a raw January morning in 1986, that dream blew up in NASA's face.

BY GREGORY T. POPE

Now the maiden flight of *Challenger's* replacement—OV-105, better known as *Endeavour*—stands to launch a new decade of manned spaceflight. And with Cmdr. Daniel C. Brandenstein and his crew will ride, once again, a blueprint for the future of space transportation.

NASA's thinking now runs like this: As capricious and costly as the Shuttle may be, it embodies an investment that should be milked for all it's worth. New ban-



ners that hang at Johnson Space Center spell out a slogan grounded in pragmatism—"Our Vision In '92 Is 2020." Translation: "We want to do whatever we can to fly the current vehicles until 2020, if necessary," says Shuttle program director Leonard Nicholson. "It means NASA has one manned vehicle now, and no budget to build a new one," adds Dan Germany, manager of Johnson's Orbiter Projects Office.

What's more, in the new decade, Americans and their machines must spend not days but weeks in orbit. Space Station *Freedom* continues to hold center stage in NASA's scenario for the '90s, but the Shuttles will play key supporting roles. Not only are they tasked with hauling up the hardware, but they will be motels for the Station's first guests, offering a preview of prolonged spaceflight.

That's where *Endeavour* comes in. Shuttle builder Rockwell International has wired and plumbed the

spacecraft for gear that will turn *Endeavour* into an orbiting Winnebago. NASA calls it Extended-Duration Orbiter (EDO) capability.

Should the space agency decide to park *Endeavour* in orbit for longer than two weeks, the EDO modifications will snap into place at Kennedy Space Center. A pallet of cryogenic hydrogen and oxygen tanks will plug into the rear of the payload bay. A single pallet keeps the craft's fuel cells cranking out electricity and water for a 16-day mission, and a second unit could run them overtime, for 28 days. Other additions include a waste-compacting toilet, more lockers, added nitrogen tanks and a regenerative carbon-dioxide removal system for crew air.

Endeavour isn't carrying this extra baggage on its first flight, a 7-day affair. So far, only *Columbia* has already received 16-day EDO modifications, and will try them out in a 13-day flight slated for a month after *Endeavour* touches down.



AMERICA'S LAST—AND BEST—SHUTTLE

LOCKHEED/ERIC SCHULZINGER PHOTO



But six years from now, as *Freedom* takes shape 200 miles above the planet, the launch schedule is a lot looser. After eight or nine Shuttle flights, enough of the structure will be in orbit to allow what NASA terms man-tended capability. A Shuttle will berth at *Freedom*, and a crew will spend 13 to 16 days working aboard the Station, returning to the orbiter to eat and sleep.

The mod squad

Today, in an ongoing study at Johnson Space Center, a team of engineers is examining ways to extend a Shuttle's sojourn at *Freedom* to 30, 60 and even 90 days. Hardware modifications, "mods" in NASA lingo, are the focus. "The plan is to bite this thing off in

small chunks," says Germany. "What we're looking at right now are mods we have to make to stay for 30 days. We'd like to achieve that capability in January 1997."

As it turns out, the EDO mods for which *Endeavour* is rigged could suffice for a 30-day stopover. The critical components aren't pieces of hardware but consumables—food, crew atmosphere, clothing and power.

During a more protracted rendezvous, however, the Shuttle's fragile mechanical systems will become points of vulnerability. "As we push this thing to stay up longer," says Germany, "we'll get into the possibility of breakage. It's those fluids and gases that you have to worry about: hydraulics, helium to purge systems,

nitrogen to operate valves and so on."

But modernizing the 1970s-vintage anatomy of the Shuttle would require drastic surgery. Charged with keeping the fleet spaceworthy as cheaply as possible, NASA management has balked at forking out for expensive technological upgrades.

So far, the only major mod that has been approved for the Shuttle is the multifunction electronic display system, or MEDS—a glass cockpit that will soon replace the orbiter flight deck's electromechanical switches and dials.

"We're not actively pursuing any new technology unless it solves obsolescence," insists Nicholson. "That's the genesis of the MEDS cockpit. When we looked at failure rates of the display equipment, projecting into the late 1990s, we concluded that the old analog configuration could become a showstopper for us."

By opting away from other wholesale changes, Shuttle managers admit, they'll have to shell out more for vehicle repairs and life-support of an industrial base skilled in yesterday's technology. Still, says Nicholson, that's cheaper than gut-renovating the spacecraft.

The Next Generation

● When will NASA begin building a vehicle to replace the Shuttle? "My crystal ball's not clear enough to tell you," says Shuttle program director Leonard Nicholson. And spaceflight boss William Lenoir has made it clear that the question won't be considered for another five years. But that doesn't mean NASA hasn't laid the groundwork for a Shuttle follow-on.

At Langley Research Center's Vehicle Analysis Branch, engineers have been mulling options for an Advanced Manned Launch System (AMLS), ranging from 2-stage rocket vehicles to single-stage airbreathers.

Conclusions? They depend on whether designers play it safe with proven hardware or hold out for breakthrough technologies, such as those promised by the National Aero-Space Plane program. If near-term technology is assumed, then a winged 2-stage rocket system fits the bill. If advanced hardware proves itself, a single-stage vehicle would save money over the long haul.

High-performance rockets appear best suited for simple payload delivery to orbit, while airbreathers could handle more complex—possibly military—missions that might demand orbital intercept, loitering or vehicle recall. The



AMLS rocket-powered options include (left to right): advanced 2-stager with cargo held internally, near-term 2-stager with external payload bay and advanced single-stager.

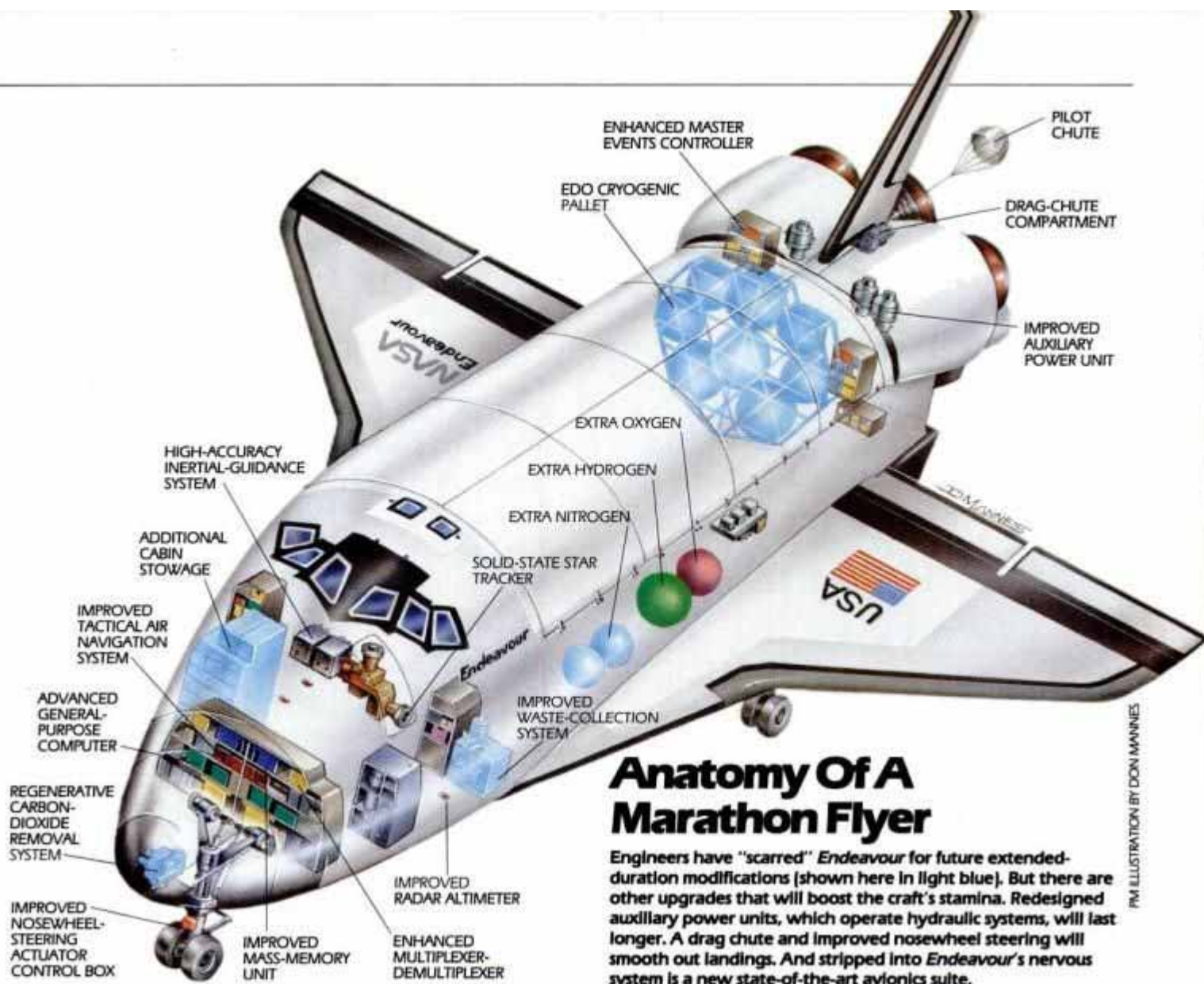
tradeoff for this flexibility is a more costly propulsion system and a heavier spacecraft.

For a simple Space Station rendezvous mission, which favors the rockets, AMLS designers factor in two new

safety features: a jettisonable crew module and single-engine-out capability on each stage. The airbreathers, geared for performance, may have neither.

—G.T.P.

PM ILLUSTRATION BY ED VALIGURSKY



Anatomy Of A Marathon Flyer

Engineers have "scarred" *Endeavour* for future extended-duration modifications (shown here in light blue). But there are other upgrades that will boost the craft's stamina. Redesigned auxiliary power units, which operate hydraulic systems, will last longer. A drag chute and improved nosewheel steering will smooth out landings. And stripped into *Endeavour's* nervous system is a new state-of-the-art avionics suite.

FM ILLUSTRATION BY DON MANNIES

The human factor

Beyond stacking the odds on hardware breakdown, marathon missions will take their toll on the Shuttle's human cargo. For *Endeavour's* first skipper, Cmdr. Brandenstein, prolonged space travel is nothing new. On his last trip into space, commanding *Columbia* in January 1990, the 49-year-old Navy pilot spent 11 days in orbit—then the longest Shuttle flight to date.

"We know you can adapt to zero-gravity very quickly and operate up there," says Brandenstein, who also happens to be chief of NASA's Astronaut Office. "But we have an uneasy feeling that there's a dropoff in your proficiency beyond 16 days."

The performance decay, officials fear, could erode the flight crew's ability to land the Shuttle safely. Not willing to gamble, William Lenoir, NASA's associate administrator for spaceflight, has ordered an automatic touchdown system called Autoland to bring in a Shuttle unassisted next year, possibly on *Endeavour*. The software has resided in every Shuttle cockpit since *Columbia's* first flight,

but it has never been tested out.

Astronauts bristle at the idea of relinquishing command of the Shuttle, especially during a maneuver that requires deft control and near-instinctive judgment calls. "It's a glider, remember, so you can't go around and try it again," Brandenstein argues. "We'd be more comfortable with a man in the loop from subsonic to touchdown."

Yet in the face of protracted missions, unmanned operations have drawn research attention. The concept appeals to engineers at NASA's Langley Research Center who have proposed the Personnel Launch System, a small winged spacecraft that would reach orbit on the nose of a heavy-lift rocket (see *Tech Update*, page 15, Jan. '91).

"It would be a lot cheaper to deliver the crew in a PLS," notes Langley's Ted Talay, "and by concentrating on unmanned delivery, you could boost payload capacity." According to a separate Rockwell study, by stuffing the crew compartment with cryogenic

tanks, avionics and fuel cells, the payload bay could stretch to swallow an extra 15,000 pounds.

But with NASA steering a conservative course for the Shuttle, the remote-control orbiter could remain a paper spacecraft. Instead, look for *Endeavour* and the rest of the fleet to continue shuttling men and women into space.

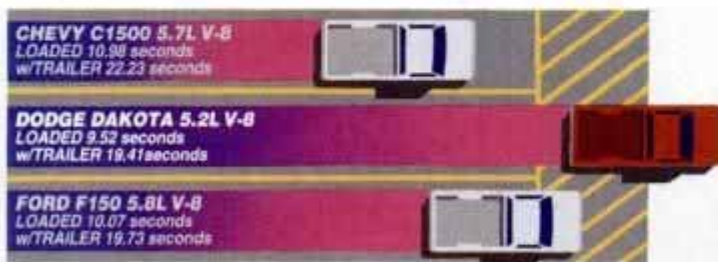
Dress rehearsals for space-station activities, in particular, will need the human touch. After kicking a stray Intelsat satellite into its proper orbit, *Endeavour's* first flight crew will practice space-station assembly techniques in the longest series of spacewalks ever attempted from a Shuttle.

As NASA gears up for a taste of *Freedom*, a performance machine like the Space Shuttle *Endeavour* will take on a heavy workload. And with no other man-rated spacecraft in sight, NASA's brand-new baby must lead its older siblings into the 21st century.



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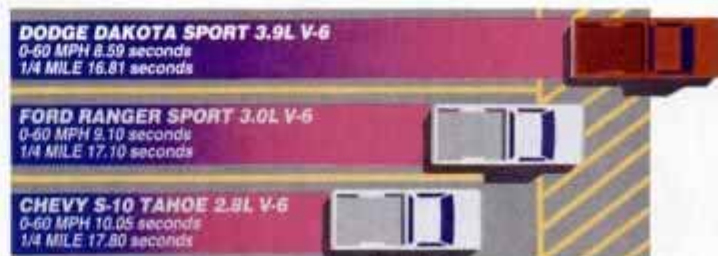
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THE RESCUE OF BOX TOP 22

The crash of a C-130 pits a massive rescue force against the deadly Arctic night.

ANCHORAGE

USAF C-5 GALAXY CARRYING
2 MH-60G PAVE HAWKS

C-130 HERCULES (3)

EDMONTON

BY DAVID HUGHES
PM Illustration by Paul Dimare

● Maj. Marvin Macauley turned his C-130 rescue aircraft back toward the darkened crash site and lined up for another pass, flying as low as he dared. In the cargo bay, his brother, Warrant Officer Arnie Macauley, and five other Search and Rescue Technicians (SARTECHs) were suiting up to dive into the high arctic blizzard raging below.

Safety margins were razor thin, but both Macauleys knew the situation on the ground was desperate. An unknown number of survivors lay in the wreckage of another C-130 below, whipped by 30- to 40-knot winds and temperatures that would freeze exposed flesh in 15 seconds.

They'd been down there for 30 hours. Their aircraft, part of a re-supply effort called Operation Box Top, had crashed 11 miles short of the lone gravel airstrip at Alert, a top-secret Canadian Forces base near the North Pole. Callsign Box Top 22 broke up on impact, and al-

though all 18 aboard survived the crash, flames from spilled diesel fuel engulfed their survival gear. Within hours, a howling blizzard closed in. Cloaked in the Arctic's near-constant darkness, they were almost unreachable by ground or by air.



Aurora maritime patrol aircraft photographed the wreckage with an 11-million-candlepower flash.

SOS by satellite

Word of the crash got out almost immediately. A U.S. SARSAT satellite passing overhead picked up the plane's emergency locator beacon and relayed the signal to a ground station. Within an hour, Canadian Forces bases in Greenwood, Nova Scotia, and Edmonton, Alberta, were alerted. Leaders began rounding up every SARTECH available, while C-130s were loaded up with extra survival equipment.

Edmonton's C-130 was the first to launch, carrying 12 SARTECHs and an extra flight crew for the 2100-mile trip north. The Macauleys' C-130 took off from Greenwood shortly afterward with a total of 14 SARTECHs. Two more C-130s followed from Edmonton—one with an air-droppable survival kit for 40 people and another with a partially dismantled Twin Huey helicopter. Gander and Trenton each sent heavy twin-rotor Labrador helicopters lumber-



Signals bounced off SARSAT sent aircraft scrambling from lower Canada, Alaska, Iceland and Newfoundland. Key players included three C-130s from Edmonton, carrying SARTECHs, supplies and a Twin Huey helo. The first SARTECHs to reach the scene came from Greenwood. Labrador helos couldn't make the long haul from Trenton and Gander, but a mammoth USAF C-5 transport brought two Alaska Air National Guard Pave Hawks within striking distance. Canadair Challenger medevaced the injured back to Ottawa.

ing northward, with 4-engine Aurora maritime surveillance planes guiding them from above.

As the air fleet worked its way north, Maj. Donald A. Hanson, who had directed Operation Box Top from Alert, organized an immediate rescue attempt. Volunteers were mustered to drive the base's four Go-Tracks—box-like, 13-ton, treaded utility vehicles—to the crash site.

They made slow progress, but 5 hours after the crash, the Go-Tracks

were within about 2 miles of the wreckage. They got close enough to see flares set off by the survivors, but were blocked by the Sheridan River. They had to turn back, and as they did so, the storm began closing in.

Meanwhile, the first C-130 from Edmonton was approaching the crash site. Warrant Officer Fred J. Ritchie had some of his SARTECHs suit up for a possible jump. They tossed a 3-ft. magnesium parachute flare out the back of the plane to see what was be-

low, but its 2-million-candlepower flame was quickly lost among the clouds. Unable to jump, they went on to Alert to change crews and refuel.

Grouping and regrouping

Ritchie went inside to talk to Hanson about the plan of attack. He proposed a second overland attempt using two of the Go-Tracks. He would split his SARTECH team and take six men with him while six others stayed with the C-130. Hanson agreed, and four

THE RESCUE OF BOX TOP 22

drivers volunteered to steer the vehicles out onto the tundra. This time, Ritchie decided, they would follow the coastline, then head inland after crossing the Sheridan River. They plodded through blowing snow that reduced visibility to a few feet, frequently sending a SARTECH to march ahead and warn of trouble.

Hoping for a break in the weather, the Edmonton C-130 took off again and began a round-the-clock vigil over the crash site, dropping flares frequently. Copilot Capt. Eric Volstad made radio contact with the survivors and found them to be fairly cheerful at first. He told them that the weather did not permit SARTECHs to parachute in but a ground party was coming. The batteries of the survivors' radio began to fade and the last thing they said was they could use a little heat. Then they began keying the mike to answer yes or no to questions.

After 7 hours, the ground team ran short of fuel and had to turn back once again, meeting up with a tractor-towed fuel container near Alert.

The Guard chips in

Back in Edmonton, Maj. Donald E. Blair, director of the overall Rescue Coordination Center there, was worrying about the helicopter situation. The Labradorers were making slow progress, hampered by their need for frequent fuel stops. As his mechanics struggled to dismantle the Twin Huey for the airlift to Alert, he decided to request helicopter support from the Alaska Air National Guard.

The Guard agreed to send two of its new, air-refuelable Sikorsky MH-60G Pave Hawk rescue helicopters from Anchorage to Thule AFB in Greenland, aboard a U.S. Air Force C-5 Galaxy transport. The helicopters would unload there and fly on to the crash site. The Americans also sent two HC-130s, one from Anchorage



SARTECH Master Cpl. Yves Carignan suits up aboard Edmonton C-130.

and one from Keflavik, Iceland.

Meanwhile, Ritchie was in the midst of his second overland attempt and things were getting downright scary. Ice fog obscured the surface, and the lead vehicle's driver suddenly realized that he had driven onto an overhang of snow built up by the wind. Ritchie yelled into the radio for the second vehicle to stay put. As the driver tried to back off the hazard, the snow bridge collapsed and the Go-Track toppled nose-first down a 30-ft. embankment.

One of the SARTECHs grabbed the toboggan in back to keep it from slamming into everyone. A coffeepot sprayed scalding liquid. But the vehicle's fall was cushioned by a snowbank, and no one was seriously hurt. Ritchie's crew drove along the bottom of the cliff as the other vehicle followed on above until the two could rejoin.

After a fuel stop at

Thule, Maj. Macauley and his C-130 were now back over the crash site, taking over for the Edmonton aircraft. With the help of a NAVSTAR Global Positioning System, they began dropping flares over known positions to point the way for the Go-Tracks. Occasionally, they would head over the crash site to see if conditions had improved.

A break in the weather

The Macauleys were nearing the end of their 10-hour mission before they began to get more than a glimpse of wreckage. The jumpmaster, sitting behind a Plexiglas shield at one of the troop doors, sighted wreckage on several passes. Maj. Macauley then began his run for the first airdrop.

It was a dicey maneuver. Maj. Macauley had to climb to 5500 ft., release a flare, then descend rapidly through the clouds while being careful not to hit the ground. The goal was to reach 1100 ft. above the site before the flare burned out so the SARTECHs could see it when they jumped.

His brother stood in the open troop door, bundled up in the standard SARTECH outfit—quilted “bunny pants,” mukluk boots, an arctic-weight parka, a wool balaclava and a helmet with its clear visor snapped down. On his back was his main chute which would open on a static line after 4 seconds. The reserve chute was on his belly, and below that a 55-pound first-response medical kit. He wore gloves instead of mittens so he could pull the reserve chute rip cord if necessary. Warrant Officer Macauley and his men decided to leave their 65-pound personal survival kits behind.

As the C-130 headed back to the crash site, the flare dropped through the cloud cover and lit up the scene below. The jumpmaster got a good fix on the target and the plane headed into the wind for 30 seconds, which would allow the jumpers to be blown back to the crash site. Macauley and five others plunged out the door.

Macauley's canopy blossomed, and he looked down to see that the crash site was still well illuminated. “I was quite happy. I realized we had made it,” he later told me. He began maneuvering his parachute into the wind to use its very limited forward speed of 7 knots to counter some of the 35-knot wind. At best, he would land traveling backward at about 28 knots.

Master Cpl. Bruce Best landed first. Seeing that the wind was dragging Best across the snow, Macauley opened the safety guard on his own chute's quick release. He hit the ground hard, and was dragged 50 ft.

(Please turn to page 116)



SARTECHs pose with the wreckage after 13 survivors have been airlifted to safety.



FORD ESCORT

A good deal becomes a better car.

BY MICHAEL LAMM, Contributing Editor; PM Photos by Rich Cox

● Ford used to bill the Escort as the world's most popular passenger car. This was based on collective sales totals of all cars bearing the Escort name and the domestic Escort's U.S. sales leadership in 1982, '87 and '88.

However, European Escorts were very different from their Dearborn cousins—different as in better. But the new Escort, introduced last year, eliminates this confusion.

The Escort now uses the same basic platform as the Mazda Protegé. Ford and Mazda engineers developed the new car jointly, and Mazda supplies the new Escort's performance powertrain. Styling came from Ford, and the interior design was developed in an international Ford studio located in Hiroshima.

The two liveliest members of the Escort family, the

GT coupe and new-for-'92 LX-E sedan, use the same 1.8-liter dohc 16-valve 127-hp Four that powers the Mazda Protegé. They're also equipped with 4-wheel disc brakes. All Escorts have a 5-speed transaxle, independent suspension and rack-and-pinion steering. The basic Escort and midrange LX model use Ford's 88-hp sohc 1.9-liter Four. They employ drum brakes at the rear, smaller discs at the front and 13-in. wheels. Both the GT and LX-E have more aggressive suspension components, alloy wheels and a lot of other extras.

But that's not to say that the lesser Escorts are strippers. The basic car comes with reclining front and folding rear seat backs, front and rear antiroll bars, 2-speed wipers, side-window defoggers, a hatch cargo cover, trip odometer and central console. The LX adds a digi-

FORD ESCORT



Instrument panel is clean and legible, but some owners wanted more gauges.



Seating comfort and all-around roominess drew high praise from most owners.



Mazda-built 1.8-liter dohc 16-valve Four is available only in GT and LX-E models.

tal clock, better fabrics, wheel covers, a 60/40 folding split rear seat back and AM/FM/cassette stereo system.

Basic and LX Escorts are available in 2- and 4-door hatchback body styles, as well as a 4-door wagon. And for 1992, Ford has added 4-door se-

dans in the LX and LX-E series.

Escorts have traditionally been favored by buyers who prioritize value. These down-to-earth cars have always meant economy for tight budgets, and the new Escort continues that tradition. So it came as no sur-

prise that price topped the purchase motives among our owners.

Buyers who had owned Escorts before—over 25% in our survey group—noted that the new generation is roomier, more comfortable and requires fewer repairs than previous

SUMMARY OF 1991 FORD ESCORT OWNERS REPORTS*

Total miles driven:	1,471,143	Good	38.6	Comfort/roominess	22.9	Yes	21.8
Average miles driven:	7583	Average	1.5	Engine power	20.2	What type of trouble?	
Purchase price:		Poor	0.5	Overall performance	17.6	No statistically significant complaints	
Average	\$10,130	Braking:		Specific dislikes:		Dealer repairs satisfactory?	
Range	\$7600-\$13,420	Excellent	40.6%	Automatic shoulder belts	14.3%	Yes	76.5%
Why did you choose the Escort?		Good	45.5	No complaints	12.5	No	23.5
Price/value	44.6%	Average	10.9	Brake squeal	11.9	Dealer service opinion:	
Styling	36.9	Poor	3.0	Insufficient power	7.1	Excellent	34.4%
Low operating cost	28.7	Overall performance:		Suggested changes:		Good	48.0
Past experience	25.6	Excellent	42.3%	Reduced brake noise	10.4%	Average	12.8
Reputation	10.3	Good	55.2	Improved instrumentation	8.0	Poor	4.8
Model choice:		Average	2.5	Friendlier automatic belts	7.2	Number of vehicles owned:	
Escort LX	68.5%	Poor	0.0	Make airbags available	6.4	This vehicle only	31.4%
Escort GT	19.0	Control layout:		Reposition ashtray	5.6	Two vehicles	46.1
Standard Escort	12.5	Excellent	41.9%	No changes	5.6	Three vehicles	15.2
Body style choice:		Good	54.0	Workmanship opinion:		Four or more	7.4
2-door hatchback	52.2%	Average	3.5	Excellent	48.9%	Principal driver:	
4-door hatchback	25.4	Poor	0.5	Good	48.4	Female	57.3%
4-door wagon	22.4	Instrumentation:		Average	2.1	Male	39.7
Avg. mpg, city/hwy.:		Excellent	42.2%	Poor	0.5	Equal	3.0
5-speed manual	30.4/36.4	Good	51.8	Comfort opinion, front seats:		Age distribution of owners:	
4-speed automatic	26.1/33.0	Average	4.5	Excellent	52.2%	Under 29	29.5%
Transmission percentages:		Poor	1.5	Good	44.3	30-49 years	40.5
Automatic	53.2%	Driver sightlines:		Average	4.4	50-plus	30.0
Manual	46.8	Excellent	44.7%	Poor	0.0	Based on your experience, would you buy an Escort if you had it to do over again?	
Engine power:		Good	45.2	Comfort opinion, rear seats:		Yes	68.3%
Excellent	42.5%	Average	9.0	Excellent	36.6%	Maybe	27.7
Good	49.0	Poor	0.5	Good	49.2	No	4.0
Average	8.0	Specific likes:		Average	13.1		
Poor	0.5	Low operating costs	51.1%	Poor	1.1		
Handling:		Styling	47.9	Mechanical trouble?			
Excellent	59.4%	Handling	34.0	No	78.2%		

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

models. In short, the new Escort is on a more equal footing with competitors like the Toyota Corolla and Honda Civic.

Among the new Escort's more compelling virtues is its economy of operation. Besides fuel efficiency, this means troublefree driving. So few owners reported mechanical problems that there wasn't enough data to tabulate.

Fuel economy numbers pretty much matched up with EPA projections, which is to say good. Since only 19% of our respondents owned Escorts with the 1.8-liter Mazda engine, we didn't tabulate the fuel performance of the two engines separately. Overall, about the only negative comment we heard in any volume on the new Escort concerned brake squeal. We get this complaint with lots of new cars. Ford is handling individual Escort brake squeal complaints at the dealer level.

A few Escort owners also complained about uncomfortable automatic shoulder belts. This too is a common complaint with many new cars. Some owners wished their cars were equipped with airbags, something Ford plans to make standard by the 1995 model year.

High marks for handling

Handling turned out to be one of the Escort's strong points, something that couldn't be said for the previous car. Nearly 60% of our owners rated handling as excellent, and most of the rest judged it as good. Engine performance satisfied most, especially drivers who had opted for the GT model.

Ergonomics also pleased most owners, although 8% did complain about the dashboard layout.

A few owners said the dashboard lighting rheostat was tricky to use, and others suggested swapping the radio and climate-control locations. A very few found the front seats either too soft, too hard or too confining. However, most respondents (95.5%) rated the front seats good or excellent, and 85.8% said the same for the rear seats. Driver sightlines and control locations also drew praise.

Sophistication quotient

Basically, what owners are telling us is that the Escort has gone from being a good deal to being a good car. No one ever argued with the Escort's price/value ratio. But with the sophistication and reliability that the Mazda connection has produced, the new Escort matches its Japanese competitors in terms of road manners, comfort and quality.



Closely resembling Mazda Protegé, formal sedan body style is new to Escort lineup for 1992. The family also includes 2- and 4-door hatchbacks, plus a 4-door wagon. While owners liked the new Escort styling, dollar value topped list of purchase priorities.

EDITORS REPORT

Positive Hybridization

● Like everyone else who had an opportunity to drive both the U.S. and European versions of the old Ford Escort, we were startled by the differences between the two.

But like the owners, we think the new Escort puts the issue of those differences to rest. This is a better car than any of its predecessors.

To update our new Escort experience, we spent a couple of weeks tooling around the Los Angeles area in an LX-E sedan, a new addition to the Escort lineup. With its 127-hp dohc 16-valve Mazda engine, 4-wheel disc brakes and sporty suspension tuning, it's virtually identical to the popular Mazda Protegé. Our tester included extras like power mirrors, power locks, cruise control and a power sun/moonroof that helped raise the price to a hefty \$14,008.

The new Escort has a number of strong suits and not many weak ones. Foremost on the list of much-improved traits are excellent front-seat legroom, good front and rear headroom, excellent seats, generous trunk volume and good ride quality.

LX-E handling is very much like the GT. There's a fair amount of body roll in hard cornering, but the LX-E's progressive understeer isn't as pronounced as many front-drive cars with sporting aspirations, and there are no quirks. The LX-E rolls on 185/60R14 tires (the GT model uses

185/60R15s). This is enough contact patch for ordinary driving, but we think both cars could use a little more for hurrying on twisty roads.

The LX-E's braking stacks up very well against cars of this class—quiet, as well as efficient. We'll bet that owners with brake squeal didn't bed their new brake pads in properly.

Good as this new Escort is, we think there are a couple of areas for improvement. Rear-seat legroom, for example, is tight. The Mazda/Ford consortium could take some lessons from Honda's new Civic on this score. We agree with owner complaints concerning skimpy instrumentation, although the Escort is far from unique in this shortfall. And even though driver sightlines are much improved, forward vision could be better.

Finally, we think Ford's home-grown sohc 1.9-liter might be disappointing to buyers who've been reading glowing Escort road tests. The Ford engine rates a couple of mpg higher on the EPA projections, but it's very ho-hum compared to Mazda's sparkling 1.8. Unfortunately, the 1.8 is only available in LX-E and GT trim levels, which start at \$11,871.

But even with the uninspired 1.9-liter engine, the new Escort is an impressive compact sedan. It's yet another proof that the Ford/Mazda cross-pollination is paying off for all concerned.

—Tony Swan



POSSIBLE DREAMS

Electricity brought power to the people as it lit up America's cities and farms.

BY MARY SEELHORST

Q. What contains 3 pounds of tungsten, is almost 3 ft. in diameter and can be seen in Henry Ford Museum's "Possible Dreams" exhibit?

A. *The largest incandescent light bulb in the world—in 1929.*

● A 1930 PM article reported that the lamp "is rated at 50,000 watts and develops 6 million candlepower." That's a lot of candles. Compared to the 10 to 16 given off by Edison's first practical incandescent lamps of 50 years earlier, it's a lot of wax under the bridge.

PM's article on the biggest, brightest bulb was only one of hundreds the magazine published from the 1910s into the 1930s, introducing readers to thousands of new electrical devices.

Mary Seelhorst is curator of the "Possible Dreams" exhibit at Henry Ford Museum & Greenfield Village in Dearborn, Michigan.

Decades of innovation and investment in powerplants and electrical distribution systems were finally fulfilling the dream of providing electrical candlepower, horsepower, convenience and efficiency to millions of Americans.

Short of a power failure, perhaps nothing can help us recapture the old enthusiasm for electricity better than Henry Ford Museum's "Possible Dreams" exhibit. Here, in a section called Electricity Wins, are displayed some of the once-radical machines and once-enthralling promises that marked the growing dominance of electricity as a power source in American cities, homes and farms between 1917 and 1935.

The public places in large cities provided many Americans their first experience with electrical applications. Some of the machines that made 1920s-style fast food possible are on

display here. The up-to-date beauty parlor no doubt contained the diabolical-looking device nearby—an electric permanent wave machine—that, according to PM, "changes the straight, unlovely tresses into the permanently waved coiffure."

Although it was many years before electronic music became truly popular, PM reported on "Electrical Music" in 1934. The mysterious-sounding, vacuum-tubed theremin was played without touching the instrument, prompting the prediction, "To be a musician in the future, you may need only learn how to wave your hands correctly." But if you visit the museum, you may find it's not as easy as it sounds when you try it yourself.

Electricity in the home, once a luxury available only to wealthy urbanites, began to touch the everyday lives of more and more Americans in the prosperous 1920s. The all-electric home, "replete with things that run themselves or that start operating at the pressure of a button," became a potent symbol of modernity and technical progress in America. We're still waiting, however, for the real-life advent of this optimistic PM headline, "This Electrified Home Runs Itself," featured in a 1934 issue.

Among the numerous domestic appliances described and illustrated in PM, we exhibit a 1920 "Locomotive" washing machine, pictured in a PM review of labor-saving devices. After clothes, soap and water were placed

(Please turn to page 127)

Quality Performance begins with quality parts. Motorcraft Quality Parts.



Motorcraft 

QUALITY PARTS FOR QUALITY CARSSM

TOOLS

HOES

Before you plant a garden, cultivate an interest in this family of tools.

BY THOMAS KLENCK,
Associate Home
Improvement Editor
PM Photos by Stan Silver



● If you like to make things grow, and you're fortunate enough to have a modest plot of earth nearby, you're likely to find yourself engaged in one of the most rewarding partnerships ever conceived—that between you, the ground you walk on, the air, some water and a small packet of seeds. Whether your motivations lead you to your own personal victory garden that supplements your table or a luscious flowerbed to delight the senses, the rules—and tools—are pretty much the same.

One of the foremost tasks in keeping your garden in tune is simple soil maintenance—that is, keeping the ground aerated, filled with the right

balance of nutrients and free from weeds so that the plants you're growing reach their full potential. Like every other aspect of modern living, we have an array of gas- and electric-powered tools to help make our cultivation chores a little easier and take less time from our busy schedules. However, amidst a plethora of multi-horsepower tillers and cultivators, you'll find ordinary hand tools—tools that were the only option not so long ago—still play an essential role in gardening. And when it comes to cultivation, the tool in question is the hoe.

Today's modern hoe features a steel blade and a hardwood handle that ranges from about 48 to 52 in. The

best models feature a one-piece forged-steel blade and shank that's welded to the handle socket. The handle fits in the socket and is secured with a pin. Hoes with independent sockets are next in line for durability and light-duty hoes often have a blade that's welded to the shank. In addition to head assembly variations, the better hoes usually have contoured ash handles. All hoes should have a sharpened cutting edge to penetrate the earth easily. Unlike shovels, hoes are not designed for picking up material. Their job is more to push it around. You'll use this capability to loosen packed soil, mix in fertilizer and to create mounds and raised beds.

As you might imagine, today's garden tool manufacturer isn't content to produce a single, basic hoe design. Competition for the gardener's dollar, as well as specialized needs in commercial applications, have produced an assortment of configurations all based on the same idea. You may never need to own one of each, but if you're interested, here are some of the more common variations.

1. Garden hoe—Here's the basic, general-purpose hoe to own and you'll find it in just about any store that carries gardening equipment.

The True Temper model G07 shown features a $4\frac{1}{2} \times 7$ -in. blade mounted on a 52-in. handle. It has a one-piece forged-steel head that's welded to the socket for extra strength, and is also available with a smaller $6\frac{1}{4}$ -in.-wide blade. The typical gooseneck shank design lowers the handle position to make the job easier. Slightly smaller versions are called floral hoes.

If you need a slightly larger hoe of the same basic design, choose a cotton hoe with a 5×7 -in. blade or a planter hoe with an extra heavy-duty $5\frac{3}{4} \times 8$ -in. blade. These larger hoes often have a simple bent shank rather than the gooseneck shank. The garden hoe shown costs about \$25. Contact True Temper, Box 3500, Shiremanstown, PA 17011.

2. Onion hoe—This shallow version of the common garden hoe has a $1\frac{3}{4}$ -in.-deep $\times 7$ -in.-wide blade. The blade and shank are forged from one piece of steel, and the head is connected to a 52-in. handle with a separate pinned socket. The model shown is also available with a 60-in.

handle. The shallow depth of the blade makes this tool suitable for root crop cultivation, and the narrow square ends of the blade can be used for deeper digging.

Slightly deeper designs are called either nursery or beet hoes. The model 18-411 onion hoe shown costs about \$23. For more information, contact Ames Lawn and Garden Tools, Box 1774, Parkersburg, WV 26102.

3. Scuffle hoe—Although this tool may seem more like some kind of specialized shovel, it's not designed for carrying material. Like other hoes, its function is to cultivate the soil—and in this case, that means loosening up the surface and weeding. The $4 \times 7\frac{1}{2}$ -in. blade is mounted at a slight angle to the handle so it ends up nearly parallel to the ground when in use. The blade is sharpened on both back and front edges so it can be drawn back and forth to remove weeds.

The slicing action of the scuffle hoe is also helpful in breaking up crusted soils. Scuffle hoes come in a variety of shapes—some have pointed corners for working in tight spaces. For more information on the model A25 shown (about \$25), write to True Temper, Box 3500, Shiremanstown, PA 17011.

4. Beet hoe—Also called a nursery hoe, this tool has

the same square corners as the onion hoe, but with a deeper and less rectangular shape. The blade measures about $3\frac{1}{2} \times 4$ in. The slightly deeper blade makes it more effective for deep digging and moving soil for mounds and beds. The narrow width gives it the edge for working between plants and narrow rows. The beet hoe shown is model 18-546, and it costs about \$23. Contact Ames Lawn and Garden Tools, Box 1774, Parkersburg, WV 26102.

5. Mortar hoe—If you think that all hoes serve agricultural purposes, here's one that's found its way into the construction industry. The mortar hoe is used for hand-mixing mortar and concrete. Its most notable feature, of course, is the pair of holes in the blade. These allow some of the mortar to remain stationary while the blade moves through it for a thorough mixing. To help even out the force applied to the handle when mixing heavy mortar or concrete, this tool also has a deep gooseneck shank.

The True Temper model PG7P shown is a light-duty homeowner's model with a $4\frac{1}{2} \times 7$ -in. blade. For heavy-duty mixing, choose one of the larger models that range up to 6×10 in. in blade size. This large size is also available without the holes.

The model pictured costs



about \$22. For more information, write to True Temper, Box 3500, Shiremanstown, PA 17011.

6. Winged Weeder—As with most simple tools, it's hard to improve performance without sacrificing the very simplicity that makes the tool effective. The Winged Weeder is one scuffle hoe variation that's taken the challenge.

All the edges on the 8 $\frac{3}{4}$ -in.-wide blade are sharpened so the tool operates on both the pull and push strokes. Its unique swept-wing design makes the blade easy to push into the soil, and the pointed corners are effective in confined spaces. To keep the tool light, it's built with a

tempered, spring-steel blade that's riveted onto a steel shank. The Winged Weeder (about \$20) is from Creative Enterprises, Box 3452, Idaho Falls, ID 83403.

7. Swan-neck hoe—Here's a hoe that combines some of the features of a scuffle hoe with those of a standard hoe. It fea-



tures a shallow blade with a straight, bottom cutting edge and curved top edge. Its pointed corners are great for working up close to plants. While it can be used like a standard garden hoe, its shallow blade and deep swan-neck shank enable it to slice through the top layers of the soil when the handle is held in a more vertical position.

The tool features a very solid one-piece socket, shank and blade forging that's mounted on a 60-in.-long ash handle. The model 4-257-9 (shown) has a 9-in.-wide blade—a 6-in. model is also available. The swan-neck hoe costs about \$29 from Gardener's Supply, 128 Intervale Rd., Burlington, VT 05401.

8. Action hoe—Although this tool

doesn't look like a typical hoe—there's no flat blade of any shape—it does, in fact, perform many of the functions of a scuffle hoe. In place of an ordinary blade, there's a ring-shaped cutter with a straight lower edge designed to slice through the surface of the soil.

The cutter mounts onto arms that allow it to pivot slightly—about ½ in. backward and forward. This causes the blade angle to shift with each change in direction to more effectively break up soil and remove weeds. The tool (model 18-663, about \$17) has a 6-in.-long blade that's sharpened on both edges. Write to Ames Lawn and Garden Tools, Box 1774, Parkersburg, WV 26102.

9. Garden mattock—While it isn't called a hoe, this garden mattock does perform related functions. Like a garden hoe, it's designed for chopping into the earth to loosen soil. However, with its long double-blade head, it's clearly not suited to careful weeding and cultivating. The blade head is designed for cutting power and depth, and is fixed to the handle pickaxe fashion.

Unlike typical pickaxes, however, the garden mattock has a long 54-in. handle for extra reach and leverage. For more information on the model 18-320 garden mattock (about \$25), contact Ames Lawn and Garden Tools, Box 1774, Parkersburg, WV 26102. **FM**



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TOOL TEST

TWO NEW SEARS TOOLS

TEXT AND PHOTOS
 BY THOMAS KLENCK,
 Associate Home
 Improvement Editor

● If you're like millions of other folks with a yen to get the job done themselves, you probably look to Sears when the tool bug bites. If that's true, then the odds are high that you'll be interested in these two recent additions to the Craftsman line: the model 27542, 7¼-in. Sawmill circular saw and the model 27141, ¾-in., variable-speed/reversible drill.

Why are these tools different from previous Sears offerings? First of all, they represent a new wave of Sears tools designed and manufactured by Sears' new partner in the power tool business—Ryobi Motor Products Corp. And, it looks like Ryobi's experience with professional-grade equipment is having a positive effect.

The model 27542 circular saw (about \$108) is only one in the line of Sawmill circular saws. It's the professional version that features a 13-amp motor. Three other less expensive models are rated at 12, 11 and 10 amps. These lighter-duty saws have a button that must be depressed to actuate the trigger, and all models have a spindle lock for easy blade changing.

This saw is designed for better balance than previous Sears offerings. Although its features are typical—as far as circular saws go, standard pivot-foot depth-of-cut adjustment, 45° bevel capacity and a stamped-steel base—we found that it performs powerfully and smoothly. The knobs for securing the fence (supplied) and bevel quadrant are a little small, however. If you're looking for performance at a reasonable price, though, the 27542 Sawmill is a good choice.

The 27141 ¾-in. drill (about \$85) is also one of a new family of Sears tools. It has a hefty 4.5-amp motor that places it with the best in terms of power. No-load speed ranges from 0 to 1200 rpm and the trigger can be locked on at any point in the speed range. Power is transmitted through double-reduction gearing, and the drill has ball and roller bearings.



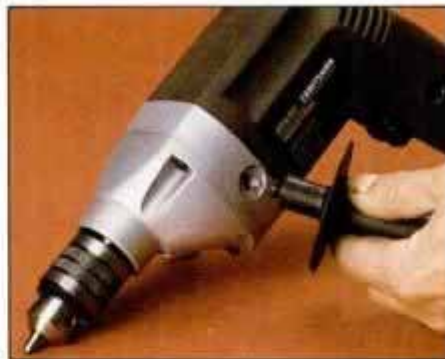
A new wave of Sears portable power tools is represented by the model 27542 Sawmill circular saw and the model 27141 ¾-in. variable-speed/reversible drill.

There were no surprises during our tests—variable-speed control is smooth, and the tool has ample power for most jobs you'll encounter. Although the drill is comfortable to hold, it does seem somewhat bulkier than

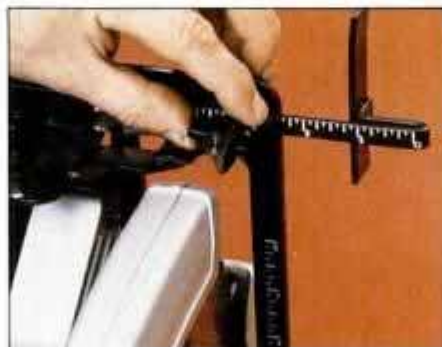
competitors' offerings. Other drills based on this design include a ½-in. model and a drywall screwdriver. For more information, write to Sears, Roebuck and Co., Sears Tower, Chicago, IL 60684. **PM**



Trigger on ¾-in. drill has a speed dial so any point in the speed range can be locked on. Reversing switch is above the trigger.



Tapped holes on both sides of housing accept auxiliary handle. Belt clip supplied with the tool fits in opposite hole.



All scale markings on bevel quadrant and rip fence are painted white for clarity. The rip fence is supplied with the tool.



A convenient spindle lock on the Sawmill makes blade changing fast and easy. Blade wrench stores in stamped-steel base.

HOME IMPROVEMENT

THE GREAT COVERUP

Stuck with a concrete patio? Don't remove it—cover it with a redwood deck.

BY THOMAS KLENCK, Associate Home Improvement Editor

● For the past 20 years or so, one of the most popular home improvement projects has been adding a backyard deck. Not only is a deck a great place to enjoy the outdoors—without really leaving your home—but it's simply an ideal project for anyone who can cut a board to length and drive a nail. You don't need a contractor, special experience or hard-to-find materials, and a trip to your local lumberyard is enough to get you started.

Before decks, however, folks did try to tame their backyard recreation spaces. And one of the most common strategies was to cover a portion of the landscape with a concrete patio. While it did make the natural terrain a little more habitable, the emergence of the wooden deck left many homeowners wondering whether they'd made an irrevocable decision.

If you're in this position, and your backyard patio has lost the appeal it

once had now that your neighbor's homes are sporting natural-wood decks, there is a solution—and you don't have to rent a jackhammer to get underway. The trick is to build your new deck right over the concrete slab.

For our project, we chose a typical concrete patio slab that protruded about 4 in. above the ground line. In addition to the slab, our site included a flagstone walkway in front of the sliding patio doors. Our deck design, therefore, had to not only unite both the concrete patio and flagstone walkway areas, but also fit under the lower edge of the patio door.

The solution involves constructing a 3-piece deck with a lowered section in front of the patio doors. While our

Photos: J.R. Rost
Technical art: Eugene Thompson
Photo stylist: Gabe Herrick



Where gray concrete once dominated the view, a new redwood deck now adds warmth and beauty to the backyard scene. The recessed deck section fits under the sliding door, and all of the supporting framework is made of pressure-treated lumber.

example may not suit your specific situation, its variations should be enough to help you devise a design that meets the constraints of your backyard. Of course, the variations in deck design are endless. To make our deck just a little more interesting, we





chose to lay the deck boards diagonally on the main deck. And to break up the broad expanse of diagonal lines, we added intersecting belt boards along both centerlines of the main deck. Along with the trim around the deck edges, the effect is of four distinct framed areas of diagonal decking.

While many decks are built entirely of pressure-treated wood, we chose a combination of construction-grade redwood and pressure-treated lumber. We used redwood for all decking

and trim—the components that will be visible in the finished deck—because of its great appearance and natural decay resistance. We treated the redwood on all sides with a stain/preservative before each piece was installed. For this project, we used Olympic Redwood stain. Underneath, the supporting framework is made of moisture- and insect-resistant pressure-treated lumber.

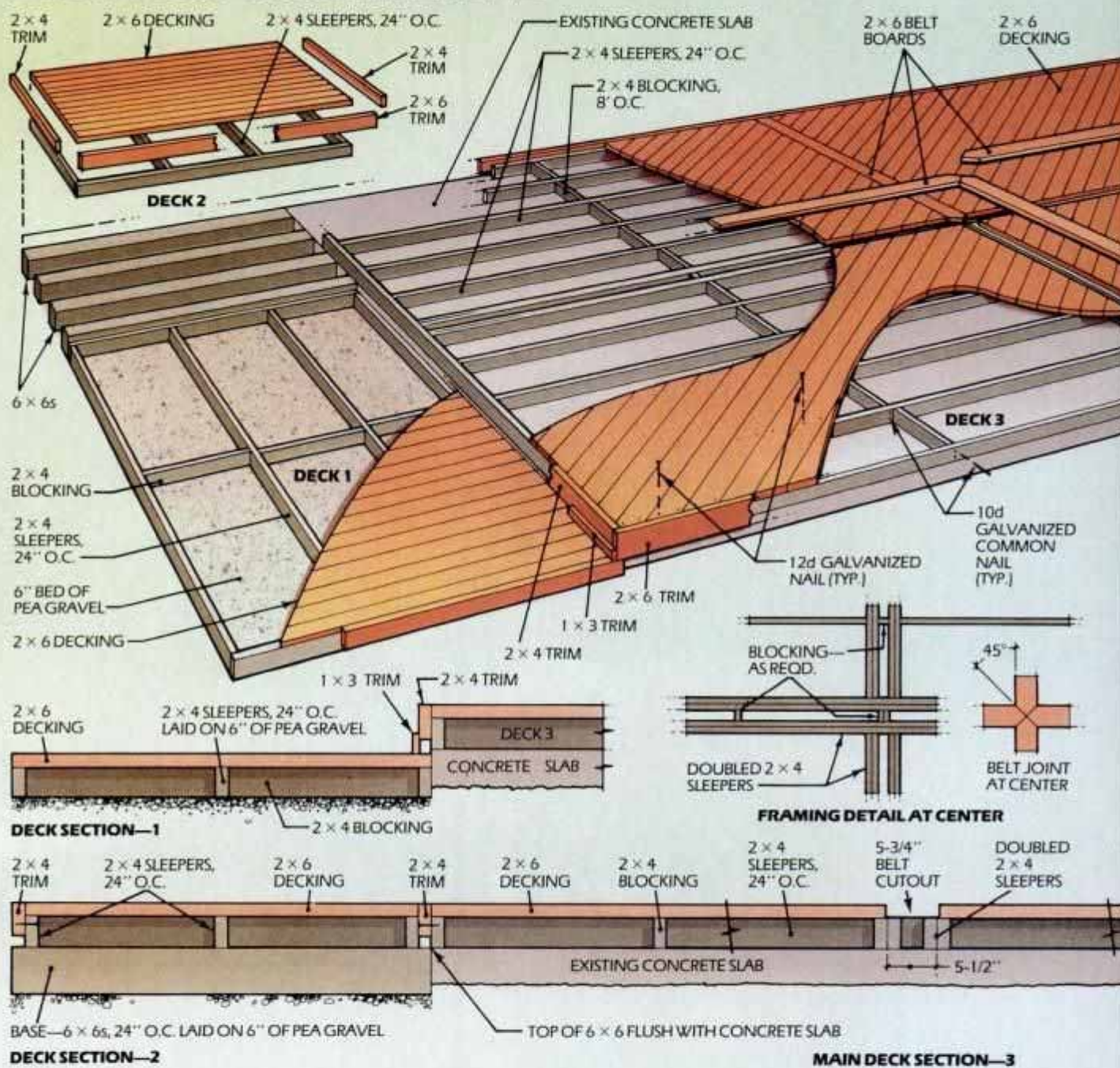
Before starting, bear in mind that the entire deck structure should not

be connected to the house, but simply rest on the concrete or ground. Because the slab can move up or down as the ground freezes or thaws—and the house doesn't—securing the deck to the house may cause it to shift out of level far more dramatically than if it's left independent.

Framing over the slab

We began construction with the main deck that rests on the concrete patio. Before you start, lay out a plan to suit

DECK OVER CONCRETE SLAB



the size of your slab which indicates sleeper placement and spacing. When using 1½-in.-thick 2 × 6 deck boards, plan the sleepers to be spaced on 24-in. centers. To support the intersecting belt boards and the ends of the diagonal 2 × 6 deck boards that are adjacent to the belt boards, use doubled 2 × 4 sleepers.

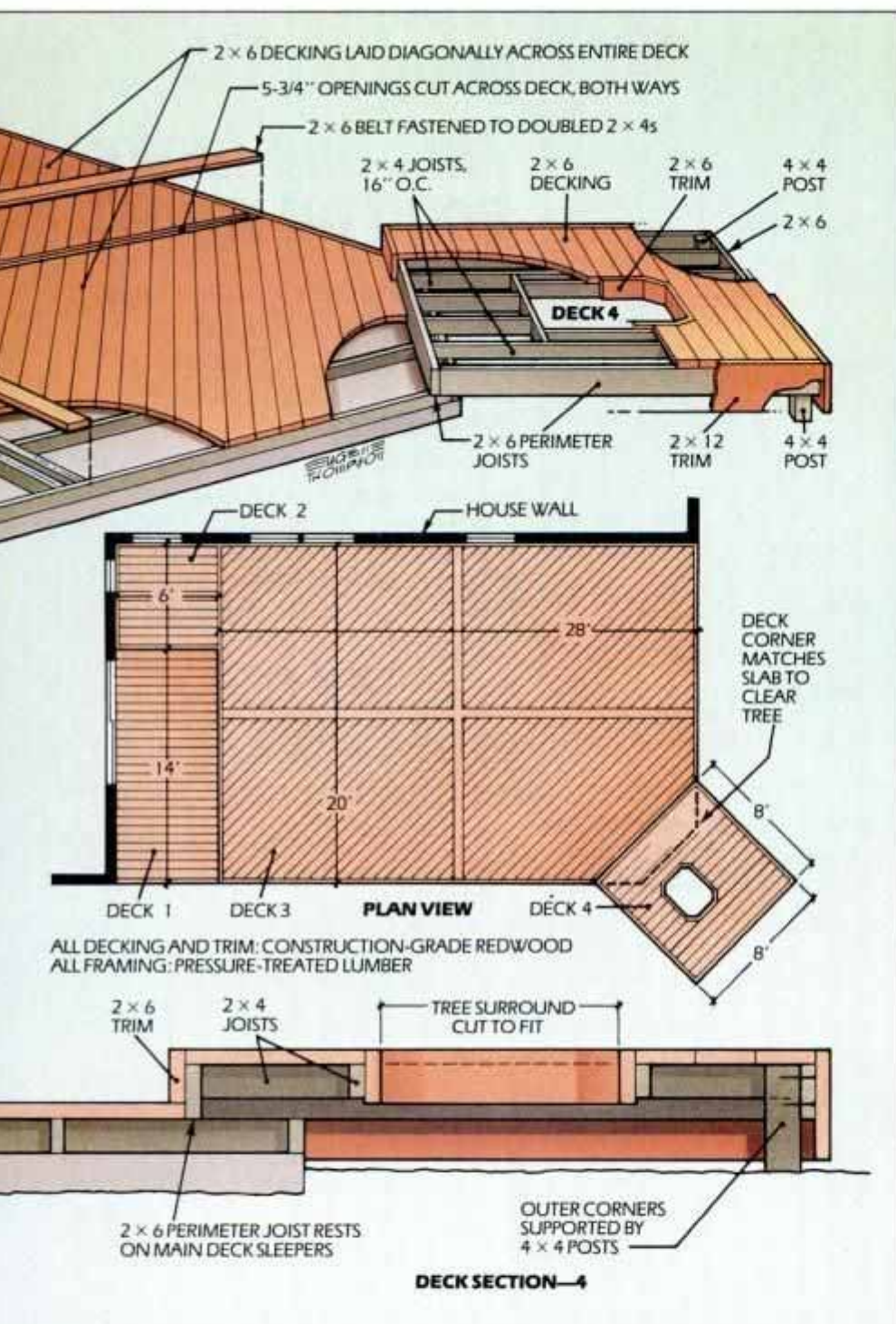
Begin construction by cutting pressure-treated 2 × 4 stock to length for the perimeter of the sleeper framework. Note that the 2 × 4 adjacent to the house wall has a 2 × 4 redwood trimpiece attached to it to act as a bor-

der for the decking. Nail this trim to the back pressure-treated sleeper before building the frame. However, don't attach it with the top edges flush, but space the edges 1½ in. apart so that the decking will be flush with the top edge of the trimpiece. Note that, in our case, the back 2 × 4 trim extends into the house corner and forms a rear border for our small corner deck unit (Deck 2 on the drawing).

Then, nail together the perimeter components with 10d galvanized common nails. If the length of your patio slab is longer than available stock,

join shorter lengths with a 2 × 4 nailed to the inside surface of the perimeter sleepers. Locate these joints where they won't interfere with other sleepers, blocking or belt board framing.

After the perimeter is framed, cut pressure-treated 2 × 4 stock to length for the doubled center sleepers that support the belt boards on the long axis of the deck. Mark the exact centerline positions on the perimeter frame, and then place marks 2¾ in. to either side of the center marks. These marks indicate the 2 × 6 belt board locations. Nail together the long dou-



bled sleepers, and attach these to the perimeter frame. Align the seams between each doubled sleeper with the belt board marks so they're centered 5½ in. apart, and add 2 × 4 blocking between the sleepers as shown in the drawing above.

Next, mark the opposing belt board position on the long doubled sleepers. Construct the short doubled sleepers, and nail them to the perimeter frame and long doubled sleepers as shown. If necessary, use shims between the 2 × 4s and the slab so that the top edges of the sleepers are flush.

With the doubled sleepers in place, cut stock to length for the remaining sleepers and nail these in place on 24-in. centers. Then, install 2 × 4 blocking in between the sleepers to complete the framing for the main deck.

Main deck boards

Before laying the deck, double check that the sleeper frame is flat and level. Lay a long, straight 2 × 4 or 2 × 6 on edge across the sleepers at different locations to check for flatness. If necessary, add shims cut from pressure-treated lumber to correct low

spots or level the frame. Also, mark the belt board positions on the outside of the perimeter frame, so they'll be visible after the deck is installed.

Install the 2 × 6 redwood decking across the entire deck (the cutaway for the belt boards is made after the decking is finished). Start decking by cutting a 45° angle on the end of the longest diagonal board and positioning this end against the redwood trim that's already attached to the perimeter frame near the house wall. Let the opposite end extend over the perimeter framing to be trimmed later. If your stock isn't long enough, butt pieces together over the belt board locations so the joints will disappear after the belt boards are installed.

Continue cutting and installing deck boards along the house wall. Rough cut each piece to length, and save the cutoffs for use as the required lengths get shorter at the corners. After installing all the boards that butt against the house-side trim piece, continue decking the remaining corner, letting both ends of each board extend over the frame. With the decking in place, snap chalklines along the deck to match the perimeter frame, and use a circular saw to trim the deck edges. Nail the deck boards with 12d galvanized nails. We used spiral-shank nails for greater holding power—you can also use screws designed for deck construction. When nailing into the doubled sleepers, be sure to nail only into the outer 2 × 4 of each pair.

To make the cutouts for the belt boards, strike chalklines across the deck at the belt board marks. Then, set the depth of cut on your circular saw to slightly more than the thickness of the deck boards and cut along the chalklines. Make the actual width of the cutout slightly more than 5½ in., so the belt boards will slip into place easily. Cut the ends of each belt board in a double miter as shown in the center framing detail in the drawing, and then install.

Complete the main deck by installing redwood trim around the edges. We used 2 × 6 trim to cover the deck board ends, perimeter sleepers and slab, and 2 × 4 trim where the main deck section joins the two smaller deck sections.

Decking over gravel

To extend the deck area beyond the concrete patio, first prepare the ground by digging away the earth and adding a bed of pea gravel. The gravel provides a firm bed for the supporting



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HOME & SHOP JOURNAL

framework and makes it easier to achieve a level structure. It also promotes good drainage which reduces moisture buildup. We built two deck extensions. The small corner exten-

sion (Deck 2) is level with the main deck, and the lowered section (Deck 1) accommodates the patio door.

First, level the gravel so its surface is 5½ in. below the surface of the slab.

In this way, the tops of the 6 × 6s that support the small corner deck are flush with the concrete slab. Lay the 6 × 6s in place on 24-in. centers, and check for level. If necessary, adjust the gravel bed for height and level.

Next, build the framework for the lower deck. Use 2 × 4 pressure-treated stock, and place the sleepers on 24-in. centers. Add 2 × 4 blocking between the sleepers as shown in the drawing, and assemble the components with 10d galvanized common nails. Check the framework to make sure it's square and level, and adjust accordingly. Also, double check that the structure is at the correct height in relation to the bottom edge of the patio door.

Then, build the rectangular 2 × 4 sleeper framework over the 6 × 6s. If the area is small, you can build this frame separately and install it as a single unit. Otherwise, cut the components to length and assemble the unit on the 6 × 6s. As with the back trim piece on the main deck, any trim adjacent to the house wall must be pre-joined to the appropriate sleeper before the frame is assembled. Place the 2 × 4 sleepers on 24-in. centers, and toenail the frame to the 6 × 6s.



To accommodate a tree next to the main deck, we added a raised section that surrounds the trunk. The inner edge rests on the deck, and the outer edge is supported by posts.

When the framing for both decks is completed, nail the redwood decking in place at right angles to the sleepers. These deck boards must be cut to exact length before installation. Finally, install the 2 × 4 trimpieces as shown, and add the 1 × 3 trim strip that covers the gap between the main deck 2 × 4 edge trim and the deck boards of the recessed deck.

Tree surround

At the corner of the main deck, we added a small deck to frame a tree. The outer edge of the deck is supported on two 4 × 4 posts, and the inner edge rests on the main deck sleepers. To maintain consistency with the floating nature of the entire deck, don't place the posts in a hole. It's better to either rest them on flagstones or dig an approximately 6-in. hole and fill it level with gravel to act as a base.

First, construct perimeter framing with 2 × 6 pressure-treated lumber. Position this on the main deck, and block up the outer edge so the frame is level. After nailing the frame to the main deck, cut the 4 × 4 posts to exact length and nail them to the inside corners of the outer frame edge. Add 2 ×



Tasteful design elements include belt boards that intersect at the middle of the main deck. The decking is laid diagonally, and the perimeter is trimmed with redwood.

4 joists on 16-in. centers with cross-blocking that frames the tree trunk.

Nail the deck boards in place, perpendicular to the 2 × 4 joists. Then, strike chalklines in line with the perimeter joists and cut to the lines with a circular saw. Complete the outside

of the tree surround by adding the redwood trim. Use 2 × 6 stock on the edge that's on the main deck and 2 × 12 stock on the other three edges. Cut the hole in the decking with a sabre saw, and use 2 × 6 redwood to frame the hole as shown. **PM**



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**HOME
 MAINTENANCE**

**MAGNETIC
 WATER
 TREATMENT**

BY MERLE HENKENIUS
 PM Illustrations by
 George Retseck

● Can specially designed magnets attached to plumbing pipes really keep scale from building up in water heaters and boilers? Some experts say yes, others say no. Both sides are emphatic. In fact, few physical concepts have been so fiercely debated and yet so miserably resolved. Our own investigation produced a blizzard of confusing data that also points in all directions.

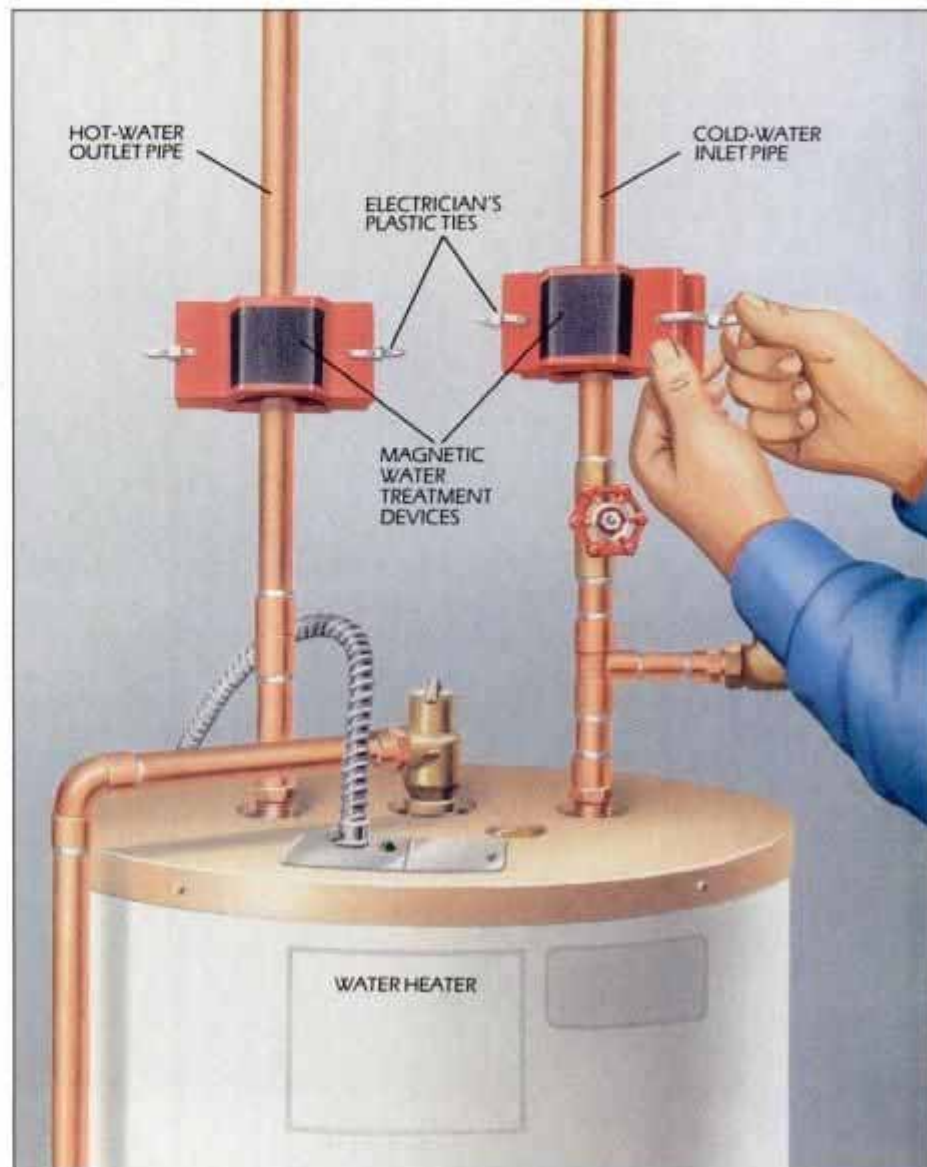
Meanwhile, the consumer is caught in the crossfire. The aggressive marketing strategies of the manufacturers are matched by equally vigorous attempts to discredit the products. While we can't tell you whether magnetic water treatment is effective, we can offer an overview of the debate. At the very least, the information may help you make an educated guess as to the usefulness of magnetic water treatment in your home.

The pros and cons

Magnetic treatment devices sold at the retail level suffer a fairly shabby history—especially in the United States. Shortly after the concept was introduced by a Belgian scientist in 1947, the market was flooded with toy magnets that were useless. Even today, the strength and configuration of the magnets vary widely. Many have been tested independently, and have been found to be ineffective.

Based on these findings, many chemists and engineers see the sale of such products as fraudulent. State governments apparently share this view, as several have sued the manufacturers to halt the use of unsupported advertising claims. Only some of these suits have been successful.

The major problem, from the scientific point of view, is that almost all the so-called proof offered by the manufacturers is in the form of testimonials. And in terms of science, these won't do. Even the most reasonable person is subject to some wishful thinking—especially after investing



Domestic magnetic water treatment devices are claimed to reduce scale buildup in water heaters. This design has magnets for both the inlet and outlet pipes.

a substantial amount of money in a product. Moreover, testimonials fail to take into account all of the variables that can affect product performance in different situations.

What really rankles the scientific community, however, is that most of these devices are presented under the guise of hard science, often in pseudo-scientific jargon that implies impeccable independent research.

And, finally, the entire notion is vigorously attacked by a well-financed water-softening industry—which, by the way, funds a good many water-quality studies. Traditional water-softening companies offer a proven technology that works in the lab, as well as the field. However, the industry's official indignation may not be as altruistic as it appears. Effective water treatment with maintenance-free magnets could take a big

bite out of a profitable market.

If magnetic water treatment is unproven, and the independent sources we contacted agree that it is, then why look further? Perhaps because unlike many gadget fads, this one doesn't go away. The testimonials continue to accumulate and grow more impressive. Today's satisfied customers include cost-conscious and maintenance-plagued building managers. And, the technology is used at locations such as the medical school building at the University of California at San Diego and San Antonio's Victoria Towers, a 15-story office complex.

Then, there is the fact that industrial-grade magnetic water treatment devices have been used successfully for 30 years or more in Europe. However, some suggest that the European scientific community has been

slightly less critical on this issue.

Seemingly, official support from our own side of the Atlantic has also been forthcoming as this quote from a 1986 U.S. Dept. of Energy study suggests: "Magnetic water conditioners . . . are operating extensively throughout the world today with tremendous economic effect. Marked reduction in scale formation in steam boilers has been verified in practice and confirmed in laboratories."

Dr. Kenneth Busch, a chemist at Baylor University, offers additional food for thought. He set up a number of stills, some with magnets and some without. His study revealed significantly less scale accumulation on the heating elements of the magnetized units.

Denver Collins, chief design engineer with State Industries, one of the nation's largest water heater manufacturers, offers another calm voice amid the rantings. State was finding that in certain problem-water situations, extreme scale accumulations caused its commercial water heaters to fail—and well within the warranty periods. With commercial heaters priced in the \$2000 range, this was a costly problem for State Industries.

Collins sought a solution in a magnetic device of his own design.

He found that by arranging inexpensive speaker magnets around a copper cylinder and then mounting the device on the water inlet, he could extend the heater's life beyond the warranty. Some State water heaters are still sold with this option, even though other scale-fighting improvements have been incorporated.

Collins would not reveal how much this option adds to the price of State's commercial heaters, but says simply: "It's minimal."

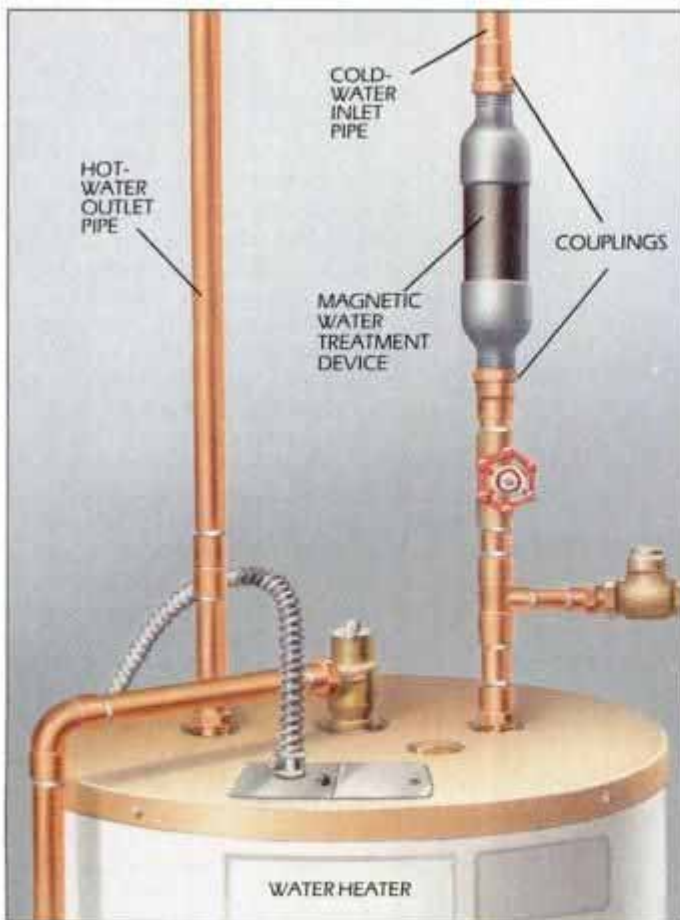
Mor-Flo America, another heater manufacturer, sells an inexpensive magnetic device (about \$30) under the Lime Fighter trademark. Mor-Flo has also incorporated magnets into some of its heaters.

How do the magnets work?

As a matter of fact, no one knows how magnets do what they're said to do. Proponents claim that the magnets keep scale-producing mineral particles suspended in water, thus preventing their electrochemical precipitation into scale.

Water passing through a powerful magnetic field does receive an electrical charge that affects the inherent charges of the mineral ions in the water. This aspect of the technology is fairly well documented, though the strength of the magnetic field and the volume, turbulence and oxygen saturation levels of the water appear to affect the degree of impact.

According to an article in *New Scientist* magazine, field testing by City University of London, in England, found that both descaling and scale prevention occurred when industry water was magnetized. After testing scale accumulations with X-ray diffraction and electron microscopy, researchers found that magnetic treatment in-



This inline magnetic device is attached to the cold-water inlet pipe. There's no agreement as to whether both pipes require devices.

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creased the size of the precipitated crystals.

The *New Scientist* report also indicates a compositional change. X-ray diffraction and electron micrographs of the hard-water scale from evaporated untreated water reveal calcite and aragonite (two forms of scale) in a ratio of 4 to 1. When magnetically treated water was evaporated, its crystals revealed a calcite/aragonite ratio of 1 to 4.

They concluded that when the surface charge of scale-producing crystals is altered, scale accumulation is reduced. This conclusion was borne out at a Bedford automotive plant, where industrial-grade magnets reduced maintenance costs by £22,000 in one year.

On the home front

By now, you've noticed that the most promising research has been done at the commercial and industrial levels. Most experts point to this fact as an important distinction—commercial units process water differently, and certainly in greater quantities, than residential models.

Two compelling questions remain: Do these devices work at the residential level? And if they do, do they make financial sense? You don't have to look far to find homeowners who believe they work, but let's first look at the economics. These devices range in price from about \$25 on up to \$1500. The Magnetizer Group, one of the more prominent manufacturers, sells its residential water heater magnets for roughly \$235, and comparable makes are not far off. In contrast, a new gas-fired water heater can be found for as little as \$160 to \$180 in home centers, and these units are generally warranted for five years.

As for effectiveness, we still don't have a definitive answer. Jim Raber, chairman of a committee that investigates the nonchemical treatment of water for the National Association of Corrosion Engineers, said that, in his personal opinion, magnetic water softening is pure fiction.

In any case, the main difficulty for the consumer is that the industry lacks regulatory standards. And, standards are not likely until someone proves, conclusively, that magnets work—and even better, how and under what circumstances they work.

At this point, the best strategy may be to simply bide your time. If there's really something to this technology, it ought to be verifiable and repeatable by a variety of researchers. **PM**

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NEW TOOLS

HANDY HARDWARE

BY ROY BERENDSOHN, Assistant Home Improvement Editor

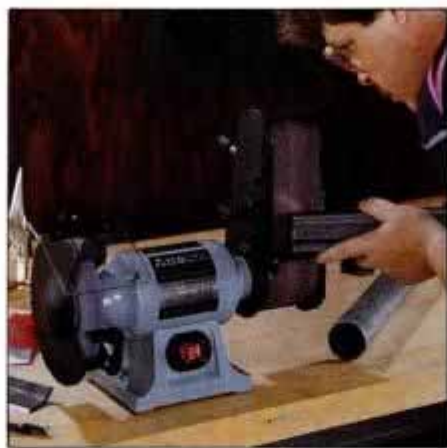
Well-Suited Shop Machines



● Delta has introduced a group of benchtop shop machines that are suitable for hobbyists or light commercial applications.

The 12-in. wood lathe (\$480) is powered by a 3/4-hp ball-bearing induction motor. Its speed is dial adjustable from 500 to 2000 rpm, and its headstock swings 90° for outboard turning. The one-piece cast-iron bed is long enough to accommodate turnings up to 36 in. in length. The tail stock is hollow for hole boring.

The router-shaper (\$360) is so named because it accepts 1/4-in. and 1/2-in. router bits, but you can switch up to shaper cutters by installing an



accessory spindle (\$7). The 2-piece fence is independently adjustable, but can be removed for freehand shaping. The 9-amp, 110-volt motor is an induction ball-bearing type. Its spindle speed is set at 12,500 rpm. It also has a die-cast 18-in.-wide x 30-in.-long aluminum table with a slot for a miter gauge, a clear plastic cutter guard and a thermal overload switch. A variety of accessories are available, ranging from a sheetmetal stand, to a table extension, template inserts and a miter gauge.

You can grind, sharpen and shape without having to change machines between operations with this com-



bination grinder/belt sander. The grinding wheel is 6 in. in diameter and turns at 3450 rpm. The abrasive belt is 3 in. wide x 24 in. long and turns at 3100 rpm. It's powered by a 1/5-hp ball-bearing induction motor. And it has a removable on/off switch to prevent children or others from misusing it.

Delta also introduces a pair of new scroll saws, a 20-in. model (above) and a 13-in. model.

The 20-in. saw (\$410) is powered by a 1/6-hp motor. It has variable-speed control from 400 to 1800 strokes per minute and a 2-in. cutting depth. Its 14-in.-dia. cast-iron table tilts 45° left, and it comes with slotted and solid table inserts. A 3-leg sheetmetal stand is available as an accessory for about \$70.

The 13-in. scroll saw (\$110) has a blade speed set at 1700 strokes per minute, a depth of cut of 1 1/4 in. and the table tilts to 45° left. Its frame is die-cast aluminum, and its base is cast



iron. The saw is powered by a 1-amp ball-bearing induction motor.

All the benchtop machines are sold at hardware stores, home centers and Delta machinery dealers. For more information, write Delta International Machinery Corp., 246 Alpha Dr., Pittsburgh, PA 15238.

Router Crafter Returns



After an 8-year absence, Sears reintroduces its popular Router Crafter (about \$130). Mount a router on the crank-driven device and you can produce turnings like table legs and railing balusters up to 36 in. long. It accepts most Sears routers (and other models) with a 6-in.-dia. base.

Sears' new 1/4-in. EZ router (\$60) is

powered by a 1 1/2-hp, 7-amp ball-bearing motor that produces 25,000 rpm. The motor is housed in an impact-resistant plastic housing. It cuts up to 1 1/2 in. deep, and its depth adjustment proceeds in 1/32-in. increments. The 4.6-pound router has built-in wrench storage and a 6-ft.-long cord.

Pair up the EZ router with this plunge attachment (about \$40) for easier routing of mortises, grooves and dados. It works up to 1 in. deep and permits cuts of 1/8 in. per pass.

Sears cut the weight and the cost of its two lightweight compressors by making them with universal motors. The 1-hp model weighs only 11 pounds, and the 1 1/2-hp model, 12 pounds. They cost \$100 and \$150, respectively. The 1-hp model delivers 3.8 scfm (static cu. ft. of air per minute) at 40 psi. The 1 1/2-hp model deliv-



ers 4.4 scfm at 40 psi. A pressure-adjusting valve is built into the air hose of each compressor. Just push it forward or back with your thumb.

Except for the Router Crafter, all the tools above are sold through larger Sears stores and through the Sears catalog. The Router Crafter, for now, is sold through Sears stores only. Write to Sears, Roebuck & Co., Dept. 903-PM, Sixth Floor, Sears Tower, Chicago, IL 60684.



Double Header

This cordless compressor does double duty. It provides 220 psi of pressure to inflate anything from a beach ball to a car tire. And, according to the manufacturer, its 12-volt battery serves as a portable power pack that can run tools or small appliances for up to 1 1/2 hours before it needs to be recharged (3-hour recharging time). It comes with two recharging cords, one works on 115 volts and the other hooks into a car's 12-volt cigarette lighter. It costs

about \$50 at hardware stores and home centers. For information, write Campbell-Hausfeld, 100 Production Dr., Harrison, OH 45030.

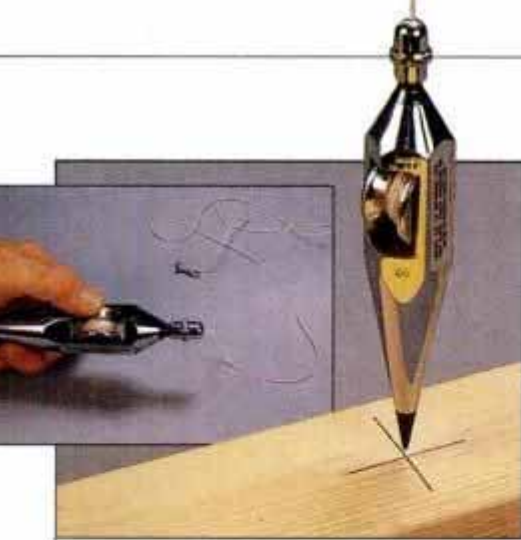


Made In America

Channellock introduces two new tools for electrical work. They are the 909 crimping pliers (right) and the 911 cutter for copper and aluminum cable. The 911 cutter is made of special-grade carbon steel for toughness, and its cutting edges are induction hardened to ensure durability. The 909 crimping pliers is made of forged car-



bon tool steel, and it cuts and crimps connectors from 10 to 22 ga. It has separate crimping dies for insulated and noninsulated solderless connectors. Both tools have vinyl grips. The 909 costs about \$21, and the 911 about \$23. Both are sold at hardware stores and home centers. For more information, write Channellock, P.O. Box 519, Meadville, PA 16335.



Speedy

The Speed Bob is a plumb bob with a free-spinning reel. To let out line, just loosen the end cap. (You tighten the end cap to fix the line length.) To retrieve the line, just flick the reel to set it spinning. The tool is made from chrome-plated zinc, and it has a case-hardened steel tip. It comes with 18 ft. of braided line and costs \$19.75 (includes shipping) from Glasco Concrete Accessories, 522 E. Airline Way, Gardena, CA 90248.

Electronic Level

The electronic SmartLevel indicates plumb and level within .1° of accuracy, and a digital readout also tells you any angle up to 360°. It can convert shallow angles to pitch readings (from 1/8 in. to 3/8 in. per ft. of run) for install-

ing plumbing pipes, gutters and other components that require a shallow pitch. Its body is made from anodized aluminum. A Series 200 (only sold in 2-ft. length) costs about \$50. A professional model (at top) is also available in which the level itself can be detached and swapped with a body of different length. A 2-ft.-long professional model costs about \$100. Both are sold at industrial suppliers, hardware stores and home centers. For more information, write Wedge Innovations, 2040 Fortune Dr., Suite 102, San Jose, CA 95131.



Take Charge

If you use cordless tools a lot, this recharger has several features worth considering. Its manufacturer says it recharges most battery packs, from 2 to 13 volts, in 3 minutes. To do this without overheating the battery, it's equipped with a micro-computer that monitors voltage level. A digital display tells the user whether the battery is charging, if the charging is complete or if the battery cannot be recharged. It costs about \$280 at hardware stores and home centers. Write DeWalt Industrial Tool Co., P.O. Box 158, 626 Hanover Pike, Hampstead, MD 21074.

Move In

Skil moves into the benchtop power tool market with six machines sold through hardware stores and home centers.

The 10-in. table saw (\$200) is powered by a 13-amp motor. Its 17 1/2-in.-wide x 26 3/8-in.-long table is made from die-cast aluminum while the base is made of lightweight ABS plastic (the saw weighs 40 pounds). It can rip stock to 12 in. wide, and has a 3 in. depth of cut at 90° and 2 1/2 in. at 45°.

The 4 x 36-in. belt on the combination sander pivots, so it can be positioned vertically or horizontally. The mechanism that adjusts the belt position is loosened with an Allen wrench that comes with the machine. (Allen wrench storage is built in.) The die-cast aluminum table by the 6-in.-dia. disc can be pivoted down from 90° to 45°. The sander is powered by a 1/8-hp induction motor and costs about \$170.

Skil's 16-in. scroll saw (\$170) uses both plain-end and pin-end 5-in.-long blades, and a blade storage compartment is built into the machine's base. The saw has a tilting die-cast aluminum table that tilts to 45° (the workpiece holddown also tilts) and a built-in blower that keeps the cutting area



at the table's center clear of sawdust. Choose from among five speeds (from 620 to 3100 rpm) while operating the 8-in. drill press. It accepts bits up to 1/2 in. dia., has a quill travel of 2 in. and costs \$170. It's powered by a 1/4-hp induction motor, has a traditional cast-iron base and a tilting table (0° to 45°).

The 6-in. and 5-in. grinders (\$60

and \$50) are powered by 1/4-hp and 1/5-hp motors, respectively. Each has a cast-iron base with a built-in quench tray. The larger model comes with 3/4-in.-wide wheels while the other has 5/8-in.-wide wheels. Both models operate at 3600 rpm.

For more information, contact Skil Corp., 4300 W. Peterson Ave., Chicago, IL 60646.

PM

APPLIANCE CLINIC

BY STEVE TOTH,
Contributing Editor

Washer Supply Line Burst

Recently, the hot-water supply line on my washing machine burst. Fortunately, I was home and was able to turn off the water quickly, but it made a big mess in the garage and doused my antique car. Is there a heavy-duty supply line I can use?

GARY HAGEN
SAN JOSE, CA

Aqua-Flow Corp. offers a flexible stainless-steel washing machine fill hose that, according to the manufacturer, can withstand water temperature up to 212° F and pressure up to 1600 psi—far higher temperature and pressure than will be experienced in an average washer.

For the name of your nearest distributor, contact Aqua-Flow Corp., 3815 Illinois Ave., St. Charles, IL 60174; (800) 332-7757.

Problems With 30-Year-Old Built-In

Our 30-year-old built-in electric Chambers oven has a problem with the rotary selector switch. It is open on the broil circuit in all positions. It is a Chambers OEKO SAI, serial No. 259175505. Where can I buy a replacement switch—or if one is not available, what appliance manufacturer makes an oven that fits my opening? The oven is only 24 in. deep.

RICHARD SEYFRIED
PARMA HEIGHTS, OH

For a replacement switch, try Macy's Texas Stove Works, 5515 Alameda Rd., Houston, TX 77004. This company buys, sells and repairs old ranges and parts for both gas and electric models. It may have a selector switch for your oven in its vast inventory.

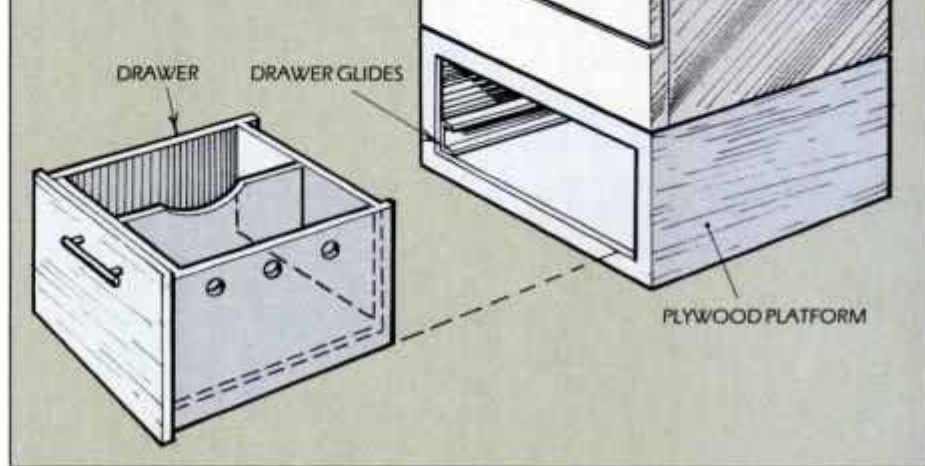
You would need to send your old switch to the company with a note including your address and phone number. Include the oven's brand and model number.

Be prepared to have the oven out of service. It may take from three to six weeks for the company to reply.

For a new appliance, call your local appliance retailer who sells either Maytag or General Electric products. Both make 24-in.-deep wall ovens.

DRYER PLATFORM

Bending over to load and unload clothes from the dryer can be tiresome. Maytag offers this solution: Elevate the dryer on a plywood platform. The company has a one-page set of plans giving basic information. Send a self-addressed, stamped envelope to Information Center, Dept. PM, Maytag Co., 1 Dependability Sq., Newton, IA 50208.



The retailer or the manufacturers can supply you with specifics about the appliances.

Contact GE at (800) 626-2000, and Maytag at (515) 792-7000.

Bowl-A-Day

I own a Kenmore refrigerator serial No. 0615043080, and model No. 253.8619161. During the defrost cycle, the drain spout stays frozen and water drips down inside the refrigerator instead of down the spout. It fills up a bowl a day. Do you have any suggestions?

TOM SMITH
WARNER ROBINS, GA

According to a 1985 Sears service bulletin, the company recommends that its service technicians do the following:

- 1. Check that the electrical defrost system is working properly.*
- 2. Check that the door gaskets are free of cracks and make a good seal between the doors and cabinet. A faulty seal allows excess moisture into the appliance.*
- 3. Check the refrigerator for level, both from side to side and front to back.*

If the items listed above are okay, install or have installed a frozen drain kit, Sears part No. 186618,

from Division 46. The \$6 kit should be available from your nearest Sears repair center. Installing the kit requires that the freezer compartment be disassembled, so if you have not done much refrigerator repair, you may want to have a Sears service technician install it.

Parts For Ronson

I have a Ronson Foodmatic, and I'm having no luck finding a distributor who can replace my blender. Can you help in locating a distributor?

ROBERT RANSFORD
GOLD BEACH, OR

A company by the name of Ronmatic Systems bought out the Ronson Foodmatic line about eight years ago. It produced the products in Fitchburg, Massachusetts, for two or three years. Later, the company transferred the product to a European company where it was redesigned and manufactured.

Contact B. F. Systems, 12 Baltic Ln., Fitchburg, MA 01420.

DO YOU HAVE AN APPLIANCE PROBLEM?
Just ask Steve about it. Send your question, along with the model and serial numbers, to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, NY 10019. While letters cannot be answered individually, problems of general interest will be discussed in the column.



Considering

everything your

air goes through,

don't you think it

should go

through

this?



While most furnace and air conditioner filters filter out larger dust particles, the new Filtrete™ Clean Air Filter from 3M goes the extra mile.

Its unique, electrostatically-charged Filtrete fibers work like tiny magnets that attract and trap allergy-causing particles that would blow right through an ordinary filter. Particles like smoke and animal dander.

In fact, the Filtrete Clean Air Filter removes 97% of the dust, pollen, and



molds circulating in your home right now. And it will provide three months of clean air performance under normal conditions.

Considering everything that goes into the air you breathe, you should consider the filter that takes more things out.

Look for the Filtrete Clean Air Filter from 3M wherever you purchase your furnace or air conditioner filters.

For a retailer near you call 1-800-388-FILTER (3458).

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HOME IMPROVEMENT

OLD HOUSE SPECIALISTS

BY LOUISE PARISI MCGOWAN



● Every old house tells a story, and each owner adds a chapter to the tale. This story, however, will be mute without careful restoration, and that's where old house experts, or specialists, can be valuable. They can help you sort through the maze of competing demands that make restoration such a tough job. In the end, this enables you to let your old house tell its story with the beauty and clarity that it deserves.

In restoring an old house, owners balance the need to have a structurally and mechanically sound house against the need to keep the house true to its historical period (and sometimes subsequent periods).

This balancing act is made more difficult because no one has unlimited time and money to spend on a renovation. Furthermore, an old house is no different than a new house in that anything you do to it has potential to affect its resale value.

Old house experts

Old house experts have different titles. Some are preservation architects. These professionals specialize in the renovation of old structures.



The 1870s New England farmhouse (above) was renovated and expanded (top) under the direction of preservation architect Allen Charles Hill, of Winchester, Massachusetts.

Architectural historians are a related group who may or may not be architects. Often they are historians who specialize in architecture and hold a degree from a program that is a subspecialty of art history.

Preservation contractors are artisans who can repair and sometimes duplicate old materials and methods. These artisans include plasterers, painters, paper hangers, masons, carpenters, joiners (artisans who make doors, windows, wainscoting and trim), blacksmiths, glass workers, stairbuilders and roofers who specialize in slate or sheetmetal work.

Plumbers and electricians sometimes fall in the category of preserva-

tion contractors, but they obviously don't duplicate old methods. It's always best to hire mechanical contractors who have previous old house experience.

Sometimes, architectural historians are hired by architects as consultants on restoration projects. This is usually the case on large-scale, museum-quality projects.

For the average homeowner, however, the full-time involvement of such a professional would be too expensive. Fortunately, archi-

tectural historians or preservation architects can be hired to evaluate and advise on restoration work. Preservation contractors may work directly with the homeowner or with the architect (or architectural historian).

Since these professionals are devoted to preserving the features that make an old house aesthetically and historically valuable, you will find their advice different from those who simply want to remodel your house.

The expert advantage

Old house specialists bring unique skills to a renovation, as they strive not just for beauty but for historical authenticity. Plumbers or electri-



Don't you think it's about time to get Dad organized?



Stanley 5-drawer tool chest helps organize both large and small tools. With steel construction, aluminum pulls, keyed lock. **Sale \$88.**
Stanley 3-drawer roller cabinet helps organize tools and supplies. Features double-wall steel construction, keyed lock, 4x1" locking casters and bulk storage compartment for large items. Reg. \$159, **Sale \$100.**

96-843 (roller cabinet) 96-815 (tool chest)

On sale May 31 through June 20, 1992 at all USA Kmart stores.

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STANLEY

cians are no less valuable. Their work ensures that an old house's mechanical systems safely meet the demands posed by modern living conditions.

By hiring an old house expert, you can avoid a variety of problems that an unknowledgeable person cannot foresee.

Suppose the brick chimney on your old house needs repair. Even a skilled mason may not know to avoid using modern bricks and portland cement mortar. Modern machine-made bricks are fired hotter and are considerably harder than the handmade irregular items from which the chimney was built. Portland cement mortars are much stronger than the mortars used before portland cement came into widespread use.

Instead of increasing the strength of an old brick chimney, modern materials will destroy it. They form a rock-hard inclusion surrounded by comparatively soft material. As the old brick and mortar expand and contract with changes in humidity and temperature, they are constrained by the modern rock-hard, more stable materials. Cracking results from this interaction, which in turn lets in water. When the water freezes and expands, the cracks widen and the destructive cycle accelerates as the chimney is pulverized. A mason who specializes in historic restoration will know the correct way to repair the chimney.

Come together

Often, it's a problem that brings together the owner and preservation

expert. Typically, an owner is confronted by something that defies easy solution, such as a perennially wet basement, sagging floors or paint that peels off walls despite repeated efforts to make it stick.

Old house owners, though resourceful, are usually constrained by their lack of experience. Old house experts, on the other hand, have seen it all before. In devising a solution, they can apply their hard-won expertise.

Other times, old house owners just want help getting to know their house. According to preservation architect Allen Charles Hill, of Winchester, Massachusetts, homeowners will often ask him to "lighten my darkness." He visits the old house with his clients. The homeowners may guide Hill through the structure, but Hill guides them on a path of discovery, explaining why the structure looks the way it does. As a result, owners emerge with a better understanding of their project and the features they should be careful with.

Depending on the building and the plan for its use, this consultation may not be enough. When something more is required, a preservation architect or architectural historian may prepare a Historic Structures Report.

Historic Structures Report

A Historic Structures Report describes the building and helps set the priorities for preservation and renovation. The report usually opens with brief biographies of the people who built the house, including the original

owners and the architect—if there was one.

A thorough description of the building in its present state and photographs of its "before" condition follows the biographical material. Any changes made to the building, and the reasons for them, are described. The report concludes with recommendations for restoration.

These reports are expensive. Their price depends on the scope of the report and the work necessary to restore the structure. Fortunately, the expense can be reduced by omitting the biographies and narrowing the report to the portion of the house that needs the most extensive work.

Another way to look at it is that "The Historic Structures Report provides the 'Post-its' that you would put on a plan that says that this area should be retained," according to David Adams, president of Dodge, Adams & Roy Ltd., a preservation contracting firm in Portsmouth, New Hampshire.

Finding help

Start your search for help on the local level. Contact your State Historic Preservation Office or the local preservation group.

If you have exhausted your search locally, try the Association For Preservation Technology Intl., P.O. Box 8178, Fredericksburg, VA 22404.

Also, the Old-House Journal Catalog, 2 Main St., Gloucester, MA 01930, lists restoration consultants and services.

FM

REVIEW

PLANS FOR A ROSE ARBOR

● A rose arbor is a romantic and sentimental thing. Often seen in the vicinity of older homes, these structures have a way of reminding us that life can still be sweet.

Plan Sheet 32 from Western Wood Products Association is anything but sentimental, however. It's as compact a plan as we've seen for building a gracious, old-fashioned arbor—in 27 steps, no less.

The plan sheet unfolds into 16 sections. Twelve of the sections contain the 27 steps to build the arbor, the other four consist of illustrations and descriptive literature.

The pamphlet's drawings are clear, and its instructions concise. The materials list is broken down by section—such as posts, trellis and rails—

and includes a complete list of hardware needed to complete the job. Likewise, the few tools necessary for this project are listed—right down to the diameter of the drill bits. These plans look well detailed and very reliable, so much so that even if you have done little carpentry, you should be able to pull this off. Just be sure you understand the entire project before you break ground and start cutting lumber.

The plan sheet costs \$1.50 from Western Wood Products Assn., Yeon Building, 522 Fifth Ave. S.W., Portland, OR 97204-2122. The WWPA offers other plans, too. Among them are plans for building planters, benches, decks, a gazebo and even a doghouse.

—Roy Berendsohn



PHOTO BY ROSARIO CAPOTOSTO

**HOME
 IMPROVEMENT**
**WINDOW
 WASHING**

BY ROY BERENDSOHN,
 Assistant Home
 Improvement Editor
 PM Illustrations by
 George Retseck

● Windows are the toughest things to clean in your home because light entering through them makes the smallest streak distressingly obvious.

For this story, we cleaned a lot of windows a lot of different ways, and decided squeegees are best. Homeowners we spoke with, however, were dissatisfied with squeegees. They said squeegees are hard to use and leave streaks. We learned there are ways around these problems.

The right tools

First, buy a good-quality squeegee. We recommend squeegees from Ettore Co. (P.O. Box 2164, Oakland, CA 94621) and Mallory (P.O. Box 190, Blenheim, Ontario, Canada, NOP 1A0). Ettore squeegees are pro quality, and sold at hardware stores and janitorial supply houses. Mallory products are good-quality homeowner-grade tools sold at Kmart.

Stainless-steel Ettore squeegees tend to be more expensive than Mallory products, but we prefer them because of their extremely high quality. A 12-in.-wide stainless-steel Ettore squeegee costs about \$6.50. A comparable plastic Mallory squeegee costs about \$3.50. A 10-in. Ettore window scrubber costs about \$10, while an 8-in.-wide Mallory with a 12-in.-long



handle costs about \$3.50. If you're thrifty, use a bushy paintroller (minus the roller handle) for a scrubber.

Also, outfit yourself with old bath towels, some rags, a razor scraper, a step stool and a large plastic pail.

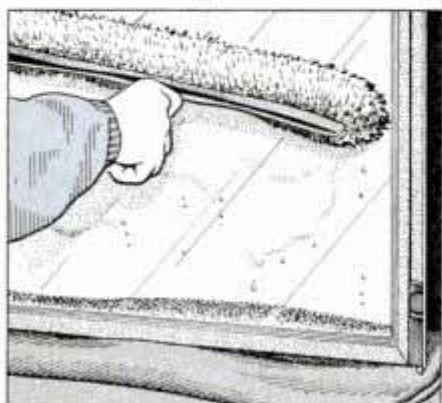
Window cleaning basics

This article assumes the outside of your double-hung windows need cleaning. But sometimes only the storm windows need to be cleaned, along with the inside glass of the double-hung windows. Other times, both sides of all the glass need cleaning.

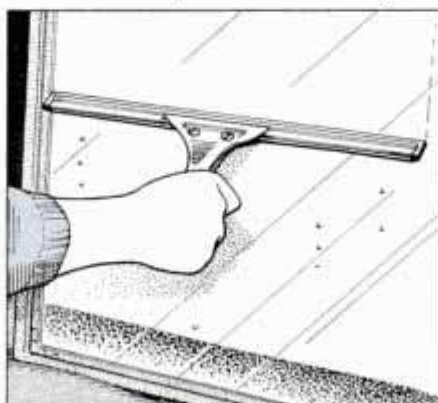
Clean the windows on the top floor first. Dirty water from washing a windowsill is liable to hit windows below.

Here's how a squeegee works: The soap-and-water solution loosens dirt and floats it off the window. The squeegee dries the window by shaving the dirty water off the surface. The more solution you put on the window, the more you have to take off. Therefore, use a damp window scrubber, not one that is sopping wet.

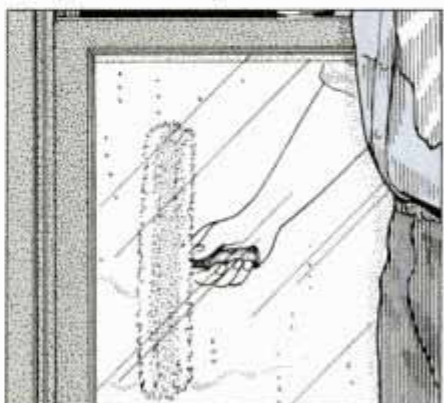
Always use light pressure with a squeegee. Wipe it dry with a rag or sponge after each pass.



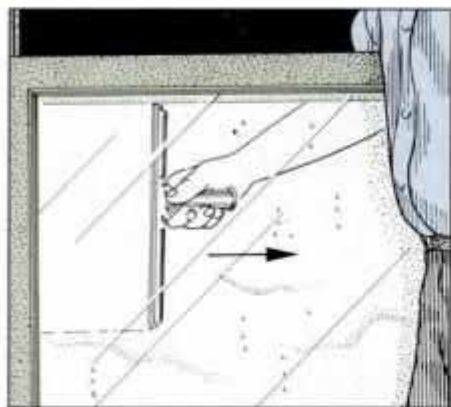
1 Place a storm window on a towel and mop over it with a window scrubber.



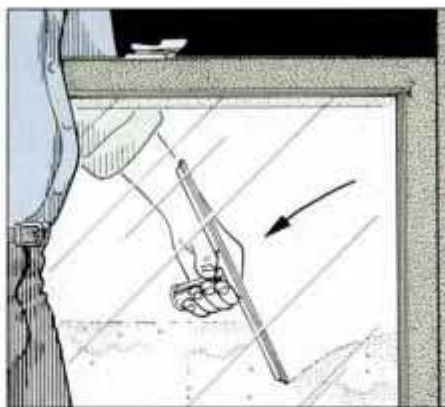
2 Using a wide squeegee, make several passes over the window.



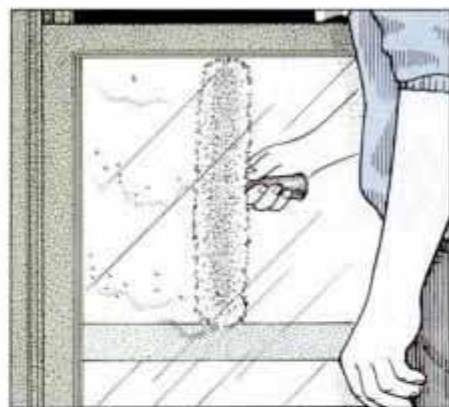
3 Stand on a stool, lower the outside window and mop its outside surface.



4 Take the first pass with a squeegee across the width of the window.



5 Facing the other direction, move the squeegee across and pivot it down.



6 Raise the inside window as high as you can. Mop the outside glass pane.

You'll find this technique is faster than cleaning with paper towels, and that windows stay cleaner longer. Here's why: Scrubbing a window with paper towels builds a static charge on a window that attracts dust. Also, the process is inefficient. Dirt is wiped around on the window and picked up a little at a time, as opposed to being shaved off in a few easy strokes.

Cleaning storm windows

Mix up a non-ammoniated window cleaning solution of your choice (am-

moniated cleaners are hard on your hands and the squeegee's blade).

Wipe clean a dusty windowsill, but if it's very dirty, clean it with a separate solution of cleaner.

Fold a bath towel into a narrow strip and place it near the wall. Remove the storm windows. Place one on the towel as shown. Scrape off spots with the razor scraper, and mop a damp window scrubber over both glass faces (Fig. 1).

Lightly draw a squeegee across the window. Then draw it down the win-

dow, stopping a few inches from the bottom (Fig. 2). In an overlapping stroke, make another pass down the glass, stopping as before. Next, draw the squeegee across the bottom.

If the storm window's frame pulls out as you handle it, water flows under the rubber gasket and between the frame and glass. Wipe down the window when you're done squeegeeing it to catch the water that leaks from the frame. If the gasket gets tucked under the frame, lift it out with the razor scraper.

STANLEY GIVES TO HOLD ALL



EDGE OF THE PROFESSIONAL © 1992 Stanley Tools, Division of The Stanley Works. White Mule is a registered trademark of Wells Lamont.
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7 Lower the window to a comfortable height and finish mopping its outside.

Double-hung windows

Push the top double-hung window down as far as it will go. Standing on the step stool, scrape off spots on the outside and mop the surface with the scrubber (Fig. 3).

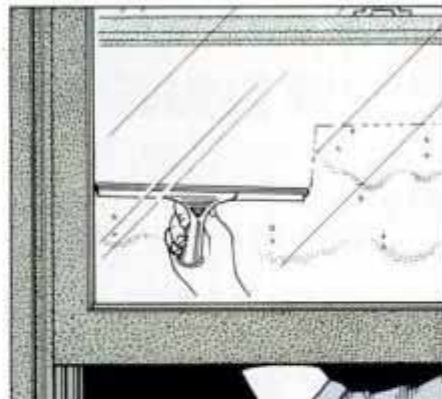
Position the ladder or stool so you are facing the left side of the window (if you are righthanded), and draw the squeegee across the window as far as you can. Reposition the ladder or stool, face the other side of the window and, using the other hand, draw the squeegee across to where you



8 Squeegee the top half of the window using the same technique as before.

stopped on the first pass. Pivot the squeegee down to complete the strip of clean glass (Figs. 4 and 5).

Raise both the inside window and outside window as far as each will go, and draw the squeegee down in overlapping passes to the bottom of the window. Next, lower the inside window enough so you can reach above it and push the outside window to its lowest point. Scrape and mop the top half of the inside window (Fig. 6). Raise the outside window, lower the inside window and repeat the cleaning



9 Lower the sash and squeegee down from the horizontal strip of clean glass.

process on the bottom half of the glass (Fig. 7).

Repeat the window movement, and use the squeegee technique as before to clean the inside window (Figs. 8 and 9).

Position both windows as normal, and clean the inside face of the top window first. Swerve the squeegee around the sash lock, then wipe off the glass around the lock.

Raise the bottom window to a comfortable working height and repeat the cleaning process on it. **PM**

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NEW PRODUCTS

PAINTING EQUIPMENT

BY ROY BERENDSOHN, Assistant Home Improvement Editor

Big Job

If you have a big painting job, step up to professional equipment. The HV 2000 pressure sprayer (about \$290) delivers 54 cu. ft. of air per minute at a low pressure (4 psi). High volume at low pressure greatly reduces overspray and delivers 86% of the coating to the surface, as opposed to about 40% using other methods, according to the manufacturer. It can spray anything from stain to oil-based enamel to latex paint. It's sold at hardware stores, farm stores and home centers. Write Campbell-Hausfeld, 100 Production Dr., Harrison, OH 45030.



Make It Stick

Paint sticks best to a clean surface, so if you're undertaking a painting job, this new power sprayer is worth a look. The 120-volt, 15-amp sprayer delivers from 145 to 1160 psi. Its manufacturer says it uses 80% less water than a garden hose to clean a given area. It comes with 26 ft. of spray hose and an adjustable nozzle. Accessories are available, including extension wands, wash brushes and a wet sand-blasting attachment. It's about \$570 at Stihl power equipment dealers. Write Stihl, Inc., 536 Viking Dr., Virginia Beach, VA 23452.



Breathe In

Lead, mercury, pollen and dirt are among the things you can breathe in when scraping paint—unless you wear a respirator. The Intego is a professional-quality respirator that consists of a flexible facepiece, adjustable elastic headband and an electrostatically charged filter. It costs about \$14 through industrial suppliers (a package of 25 spare filters costs about \$35). Write Racal Health & Safety, Inc., 7305 Executive Way, Frederick, MD 21701-8368.

In This Corner

This corner-shaped painting tool has a pivoting handle to make it comfortable and fast to use. You can use it as it is or screw it onto an extension pole. The paint pad has fine plastic bristles with a foam pad underlayment. To give it rigidity, yet make it easy to remove, the replaceable pad is backed with flexible plastic. The Smart Corner Painter costs about \$4 at paint and hardware stores and home centers. Write to Mr. Longarm, Inc., Greenwood, MO 64034.



Hang Around

These buckets are designed to make painting cleanup easier and brush storage more convenient. The Brush-saver (above right) is made from solvent-resistant nylon and has a detachable ring that brushes snap into. Pour some water or solvent into the bucket, clip the brushes in place and cover it. The covered paint bucket (above left) is made from polypropylene so paint doesn't stick to it. It stores two brushes and doubles as a paint pot. The covered paint bucket costs about \$10 and the Brush-saver about \$15 (in both cases, postpaid) from Paint & Go, 702 Advance St., P.O. Box 488, Brighton, MI 48116.



Cover Up

These coveralls (about \$7) are made of Dupont Tyvek, a durable plastic cloth. They come in extra large with a zippered front, a hood, and elastic wrist and ankle openings. Sold at hardware stores and home centers, or through Green Mountain Products, Inc., Muller Park, Norwalk, CT 06851.



HOMEOWNERS CLINIC

BY NORMAN BECKER, P.E., Contributing Editor

Serious Seepage

When it rains, I have a leak in my foundation wall along a cold joint that runs around the foundation's perimeter. The joint is the result of pouring the concrete on two different days. To fix this and make the wall more attractive, I thought of troweling a portland cement/sand mixture over the wall, but will it stop the seepage?

ROBERT TIETEL
SEARLES, MN

A cement stucco can improve the wall's looks, but won't stop the leak.

The surest (and most expensive) fix is to intercept the water before it gets to the wall with drainage, then undercut the crack with a masonry saw or chisel, and seal the seam inside and out. A less expensive fix is to patch only the seam's inside face.

There are at least three choices of patch material: hydraulic cement, epoxy patch and flexible joint sealant. You can buy hydraulic cement in hardware stores. However, you will probably have to order the epoxy patch. Joint sealant may be sold at home centers or it can be ordered. (See sources listed at the end.)

Hydraulic cement is simply troweled into the widened crack. Epoxy patch is troweled on both sides of the wall, though the seam is widened only on the wall's outside. If the leak is serious, you could patch the seam, as shown, and install copper-tubing stubs that form injection ports. Thin

epoxy is injected through the tubes, which are later pinched shut, cut off and covered.

Joint sealant is squeezed into the enlarged seam after the seam is wire-brushed. Apply butyl rubber, silicone or (preferably) polyurethane joint sealant using a caulk gun. If possible, on the inside, mask off along the seam and brush on a pourable (also known as self-leveling) joint sealant between the pieces of tape. You can temporarily repair the joint by just wire-brushing its inside face and brushing on joint sealant.

One source of epoxy patch is: Abatron, 33 Center Dr., Gilberts, IL 60136. One source of joint sealant is: Fox Industries, 3100 Falls Cliff Rd., Baltimore, MD 21211.

Gravel Driveway

Our gravel driveway has become difficult to drive on during the rainy season. I thought of fixing it myself, but I've been told the job involves more than spreading gravel over the surface. Also, if in the future I decide to pave it with asphalt, what can I do now to make the job easier and less costly?

WILLIAM MAHAR III
ALTAMOUNT, NY

A gravel driveway is really more than just a clearing with some gravel or crushed stone thrown over it.

Ruts develop if the gravel bed is too thin or the subbase (earth) is not graded and compacted properly.

Also, the gravel will be pushed onto the lawn unless curbing is installed.

A good gravel driveway begins with a well-graded and compacted subbase to prevent uneven settling. To form a suitable base for asphalt, excavate to a depth of about 4 in., then cover the area with a 4-in.-thick bed of 3/4-in.-dia. crushed stone.

Dripping Floor Joists

I live in a 3-bedroom ranch home built over a crawlspace. Two years ago, I put in air conditioning. Yesterday, I discovered there was so much moisture in the crawlspace that it was dripping from the floor joists. What can I do about it?

MARY COZZOLINO
STEVENSVILLE, MI

It is possible that the problem is unrelated to the installation of the air conditioning. Check the water distribution piping and drain lines in the crawlspace for leaks. Also, the vents around the perimeter should be clear. Quite often the vents' insect screens get clogged with dust and dirt.

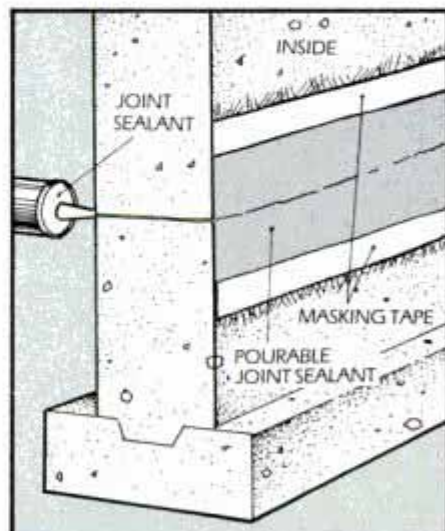
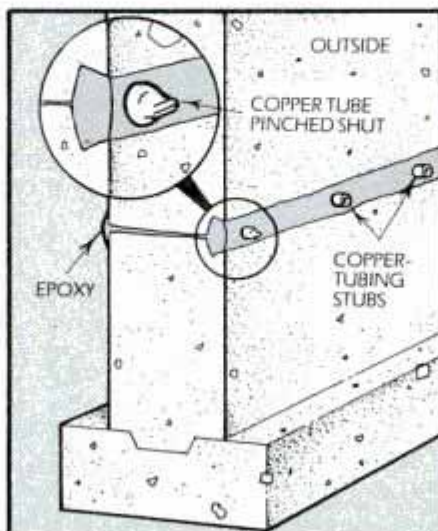
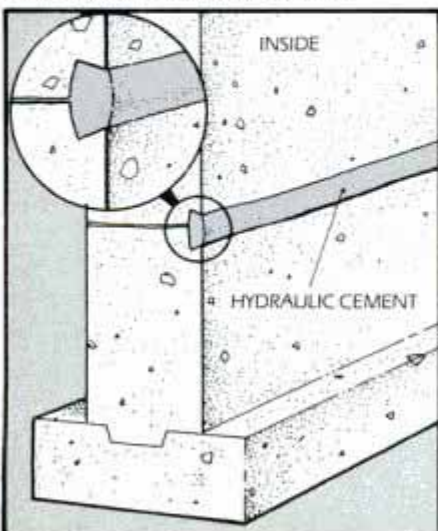
If you have a dirt floor in the crawlspace, cover it with a plastic sheet. Any air-conditioning ducts in the crawlspace should be insulated. And any open joints, through which cold air can escape and condense, should be sealed with duct tape.

PM

DO YOU HAVE A HOME-MAINTENANCE OR REPAIR PROBLEM?

Just ask Norman about it. Send your question to Homeowners Clinic, Popular Mechanics, 224 West 57th St., New York, NY 10019. While letters cannot be answered individually, problems of general interest will be discussed in the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$5.95 postpaid. Send your order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, NY 10101.

SEAM IN FOUNDATION



A cold seam in a foundation wall can be sealed using hydraulic cement (left), epoxy (middle) or standard joint sealant and pourable joint sealant (right). The best approach is sealing the cold seam on the outside of the wall. But it is possible to seal the inside wall face, too.



If You Don't Use Genuine Toyota Parts, You May Not Be Such A Popular Mechanic.

The wife says, "Let a professional fix it." You prefer to do it yourself. And if you don't use Genuine Toyota Parts, you may find yourself in a rather awkward situation.

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CAR CARE

MAINTENANCE BASICS

ANTENNAS

BY DON CHAIKIN

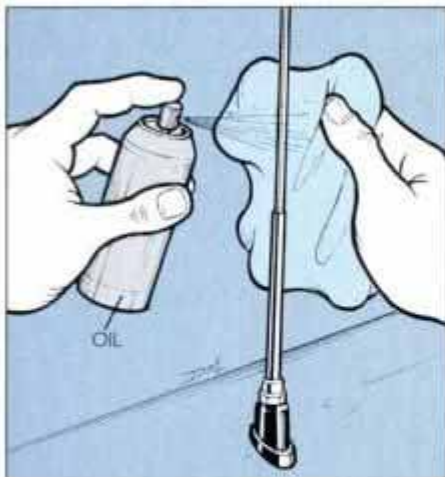
● Your car radio's sound quality depends on the antenna. Some cars have the antenna embedded in the windshield or even in the roof, but most have a mast-type antenna. And, while some masts are fixed, most are telescopic. Regardless of type, here's what you should do to ensure a clean signal.

● Thoroughly clean the extended mast of bugs and road grime. Then wipe it dry.

● Lightly lubricate all moving sections with a petroleum-based penetrating solvent. Wipe away excess lubricant.

● Do not use silicone-based lubricants, since silicone is not conductive.

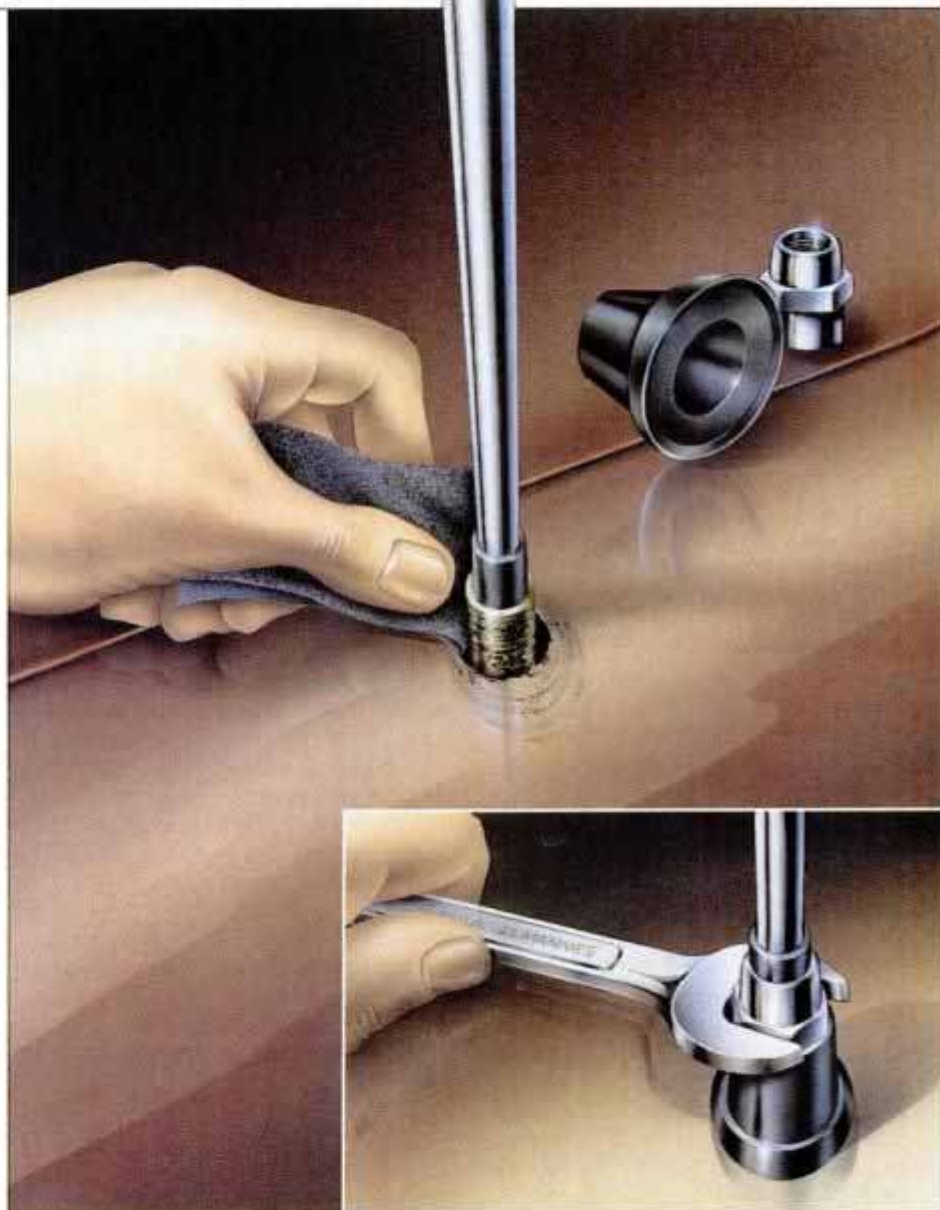
The antenna must be grounded to the car. Therefore, even light rust at the antenna's base can deteriorate ra-



Clean and lubricate a telescoping antenna using a petroleum-based lubricant.

dio performance. Undo the antenna's base mount to check.

● Remove any rust from the fender or roof mounting hole and the antenna's base clamp, using emery, sandpaper or a small wire brush. Check and then clean the swiveling bottom clamp on



antennas that are so equipped.

● Make certain the base gaskets—including sealing washers on mounting screws—are intact. Do not overtighten the mounting nut or screws, or you may distort the car's sheet-metal around the hole.

● Check that a fixed-mast antenna makes good contact with the base. Use a small open-end wrench on the hex-shaped bottom of the mast to unthread the mast from the base.

● Clean any rust or grime from the base connection's threads. Reattach the mast to the base, snugging but not

overtightening it to the base threads.

● Check the wire connectors at the connections of an integral windshield antenna. Clean corrosion from them. Re-crimp loose connectors.

The antenna cable runs from the antenna to the radio. Cars with a rear-mounted antenna may have an extension cable between the radio and the antenna—check any intermediate connections. Make sure the cable end is clean and tight in the radio jack. If necessary, spray the jack connector with contact cleaner and gently re-crimp the connector end.

PM

HOW IT WORKS

DISTRIBUTORLESS IGNITION

BY DON CHAIKIN

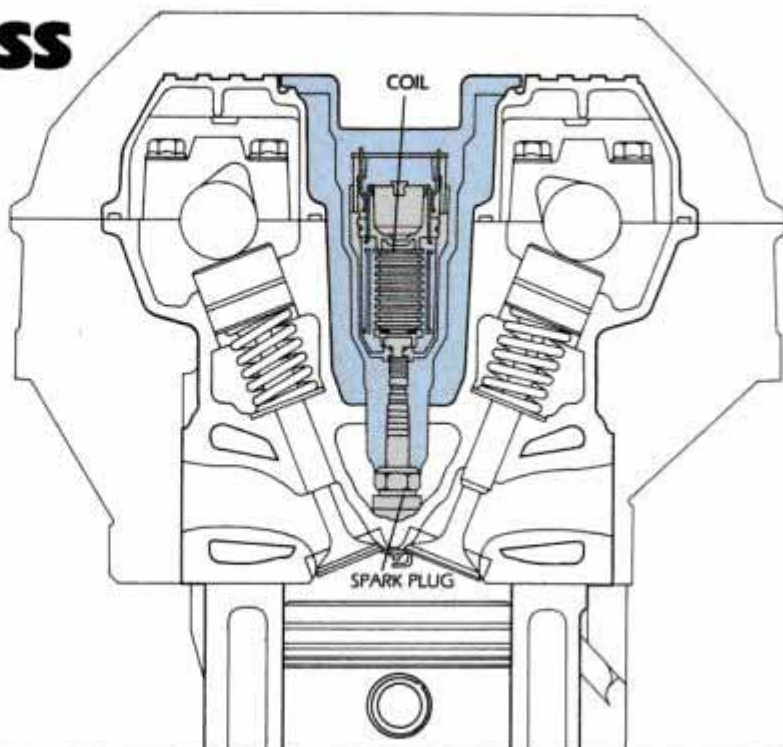
● Gasoline engines still need an electrical spark to ignite the compressed fuel/air mixture. And often the more powerful the spark, the greater the combustion efficiency.

The 40,000 or so volts currently being generated in most cars' ignition systems is produced by an ignition coil. The battery or alternator supplies 12 volts to loops of wire—the primary windings—that are wound around a metal core inside the coil, which becomes an electromagnet. High voltage is created when the 12 volts are momentarily directed to the ground, causing the magnetic field to collapse and generating electricity in a second series—the secondary—of thinner wire windings. In a traditional ignition system, the distributor is used to directly switch the 12-volt current on and off, and to direct the secondary voltage to the spark plugs.

As engine speed and load dictates, the position of the rotor—thanks to the distributor shaft to which it is attached—is constantly changed in relation to the engine's crankshaft. This changing relationship alters the moment in the combustion cycle when voltage is directed to each spark plug, changing the ignition timing.

With the distributor—a mechanical component—out of the loop, the electronic engine-management computer can more precisely control the timing of the individual sparks. In fact, a sophisticated ignition computer can alter timing between cylinders during a single engine revolution. But leaving the distributor off doesn't leave any way to switch the high-voltage side of the spark circuit between the cylinders. With enough coils, the ignition coils can send the high voltage directly to the spark plugs.

In the most sophisticated distributorless ignition systems—as used by Saab and GM in the Quad 4 engine family—there is one coil for each cylinder. Other, more common systems use one coil for each pair of mated cylinders. In a 4-cycle engine with an even number of cylinders, two pistons reach the top of their strokes at the same time: one during the compression stroke, the other during the exhaust stroke.



An ignition coil for each spark plug eliminates high-tension leads and the distributor.

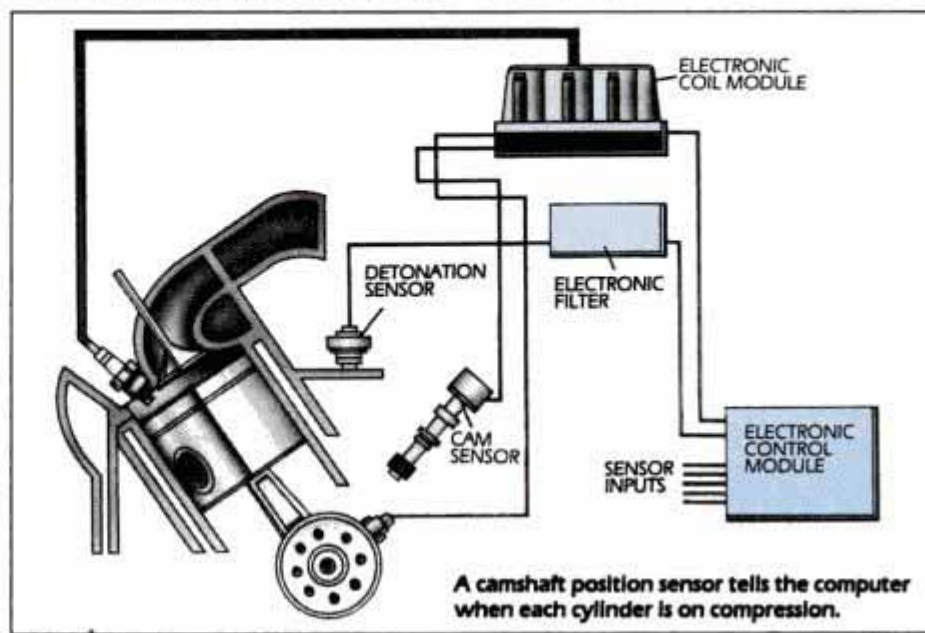
A crankshaft position sensor keeps the computer informed of the crank's position. Knowing that, the computer can determine the relative positions of all the pistons.

As a piston nears the point in its cycle that the computer determines optimum for a spark to occur, the computer signals that cylinder's coil to generate its ignition voltage. The voltage travels directly to the spark plugs that the coil serves. The cylinder that is on the compression stroke uses the spark to ignite the fuel/air

mixture. The cylinder that is on the exhaust stroke fires the spark harmlessly into the exhaust. In other words, in systems with one coil for two cylinders, each spark plug fires twice during each engine revolution—once uselessly.

Besides reducing spark plug wear and allowing a more precise control of ignition timing, systems with a coil for each spark plug eliminate the need for spark plug wires—a source of voltage leak that causes misfire and radio interference.

FM



A camshaft position sensor tells the computer when each cylinder is on compression.

FM ILLUSTRATION BY RON CARBONI



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SATURDAY MECHANIC

CURING BRAKE SQUEAL

BY PAUL WEISSLER

● You and your lady are turning off the boulevard into the valet parking area of that very trendy restaurant, spiffed out in a tuxedo for you and a little black dress and pearls for her. The attendant leaps from the curb, and the heads of a dozen chic patrons swivel toward you as you stop.

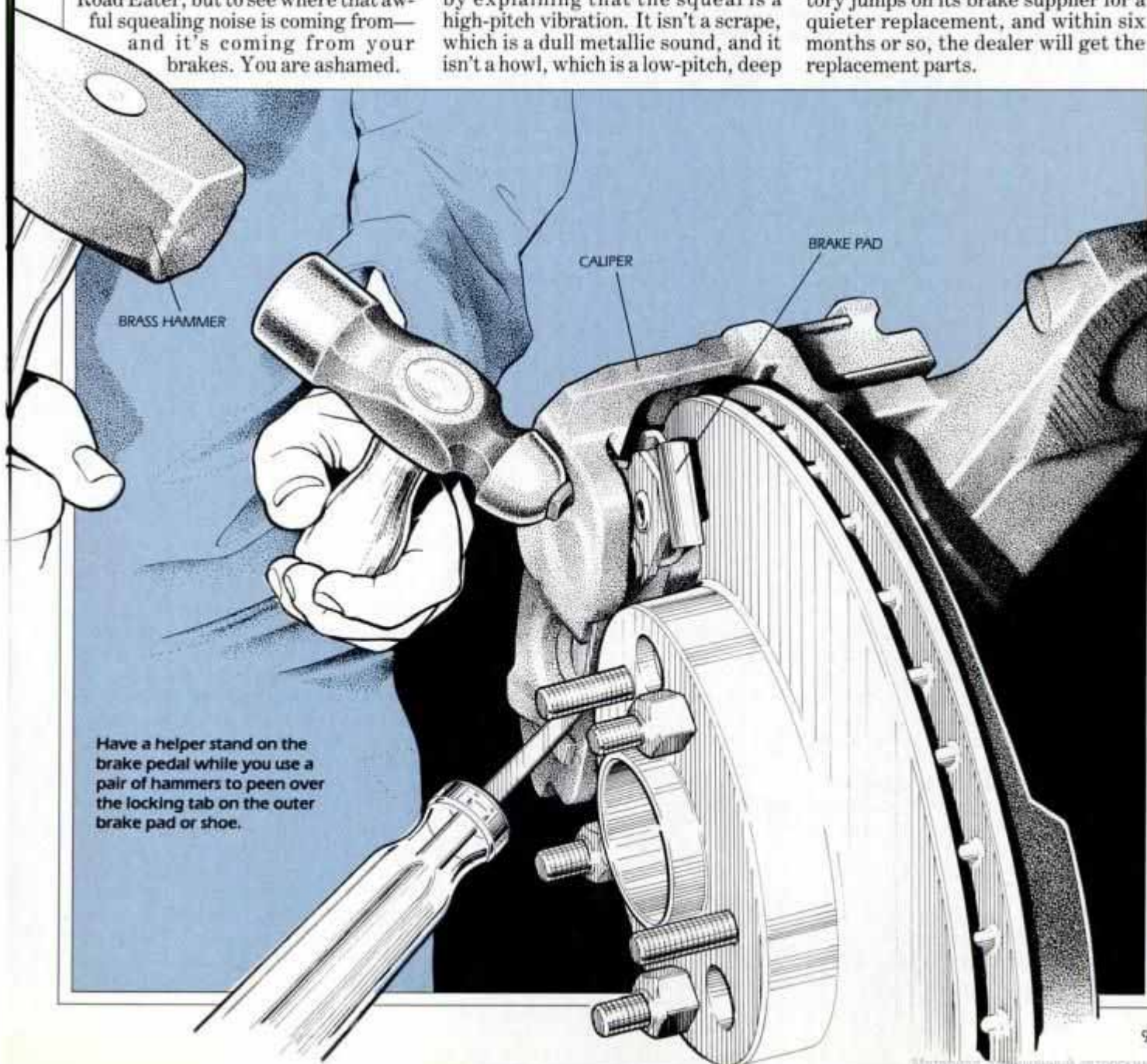
Unfortunately, they are swiveling not to admire your new Belchfire Road Eater, but to see where that awful squealing noise is coming from—and it's coming from your brakes. You are ashamed.

Defining the problem

Actually, despite the ear-piercing squeal, your brakes work just fine. The noise seems to come and go at random. Is it normal? Or does it mean trouble? Or could it be a sign of trouble to come?

The quick answer is "possibly all of the above." But you want a more precise answer than that, so let's begin by explaining that the squeal is a high-pitch vibration. It isn't a scrape, which is a dull metallic sound, and it isn't a howl, which is a low-pitch, deep

noise. When the brakes on a new car squeal, the cause is almost always in the brake lining or friction material that the car's manufacturer has chosen to use. It is also possible that the squeal means the brakes need a better shim or silencing pad for the disc brake shoes that the carmaker had hoped was not necessary. If a lot of people complain, however, the factory jumps on its brake supplier for a quieter replacement, and within six months or so, the dealer will get the replacement parts.



Have a helper stand on the brake pedal while you use a pair of hammers to peen over the locking tab on the outer brake pad or shoe.

Finding the source

If you have a new car or truck and the squeal is endemic to its breed, fine. Sooner or later its maker will have a fix. If not, it's your problem.

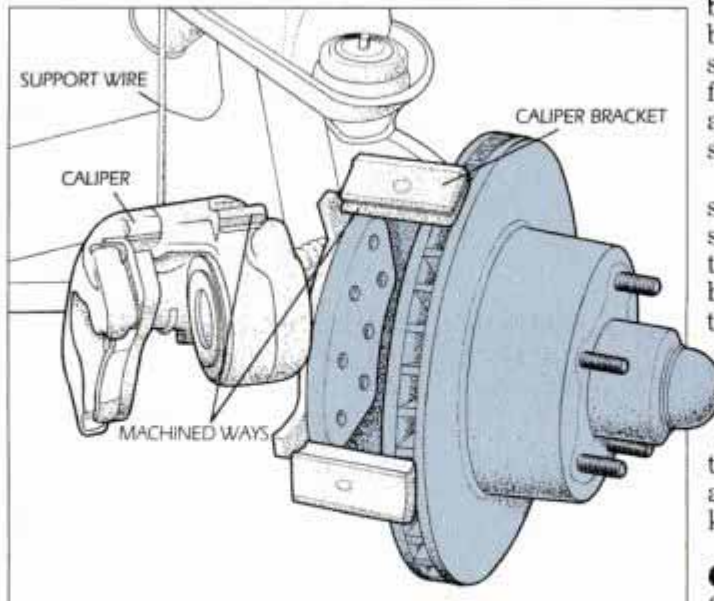
Begin by accurately determining the source of the squeal. Use a mechanic's stethoscope to check the brake pedal and the master cylinder. If either has loose mounting bolts, it can emit a squeal when you apply the brakes. Tighten or replace loose bolts or nuts. Be sure that the pushrod between the brake pedal and the master cylinder is not dislocated—reposition it, if it is.

Once you're satisfied the noise is emanating from one of the wheels, determine which one. Applying the parking brake—gently—as you drive is a quick way to isolate the front and rear brakes. Otherwise, listen carefully through open windows as you apply the brake pedal.

After you trace the squeal to its source, you must next determine what is causing the squeal. Then you can decide whether or not it's a problem or merely an annoyance. As noted above, a squeal is caused by a high-frequency vibration and, ideally, the brake shoes should not vibrate at all. However, almost any brake lining will vibrate when there are major changes in the weather, such as dry to wet or cold to hot, due to the change in its friction characteristics. To further complicate the issue, every brand of brake lining has its own recipe, so every one is different. None is completely squeal-free under all conditions. A once-in-awhile squeal is normal if the overall braking is not affected. Discs are more prone than drums, although both suffer.

Still another factor: The widely used semimetallic linings conform less easily than the formerly used asbestos linings to irregularities in discs and drums, so otherwise minor deviations in these parts can result in occasional noise.

What if the brakes squeal frequently? For years, imported cars suffered this malady because overseas owners accepted squeal, and so the linings were formulated with less regard to noise. It was an easy tradeoff for other desired characteristics. Most Americans don't accept frequent squeal as normal, so linings for cars sold here are designed not to have the

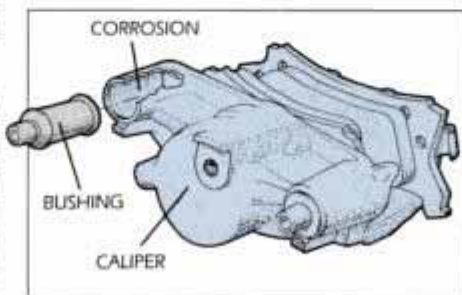


Wire-brush and lubricate the machined sliding ways on the caliper and bracket to allow the caliper to slide freely back and forth.

problem. If they do, it isn't normal.

Okay, but does it mean trouble? If the brake shoes are an economy replacement, a squeal on hard braking is probably telling you that the linings are fading, and you'd better not rely on them too much if you descend a mountain. Furthermore, that hard braking is causing some internal chemistry changes to the linings that not only will continue to reduce their performance, but will produce more squeal and less stopping power even in less-severe use. Replace the economy shoes with premium-lined shoes. Premium doesn't mean shoes sold in speed shops for cars that may go on the racetrack. Even if these are squeal-free, they're designed for high-speed braking, and you may have to really mash the pedal to get them to work in normal driving.

A sudden onset of frequent squeal with a quality lining may be telling you that the design that keeps them quiet is not working. It could be a minor matter—the silencing pad, shim or outboard shoe has come loose. However, you don't want to try any heavy-duty braking until you find out,



Clean and lubricate any sliding pins or bushings with antiseize compound.

because the squeal could also be caused by a shoe out of position—something that affects the way the shoes are applied or how well they can stop the car.

Begin by looking at the shoes (also called pads by some car and brake manufacturers when used on disc brakes) with a wheel off. If the linings are worn, that could also easily be the cause, particularly if the linings are riveted to the shoes and are worn down to the rivet heads. If the linings are more than 1/8 in. thick, keep looking and checking.

Calipers

Check the caliper for tightness, because a loose caliper equals loose shoes. You may have to pry on the caliper to see if there's any free play, although calipers that slide through rubber bushings or plastic sleeves will have some give if you pry hard enough. Use a torque wrench on the caliper bolts and the bolts that hold the anchor plate to the suspension.

Eyeball the fit of the shoes in the caliper, looking for something askew, such as linings that extend above or below the disc's contact surface into the unmachined rusty areas. Inspect the disc contact surface for circular "heat" spots, deep scores or even phonograph-record-like grooves (which result from the machine shop's failure to properly finish the disc's resurfacing). A shoe squeals as it tries to follow these grooves.

Uneven movement of the caliper affects contact between the linings and the discs, producing squeal. Remove the caliper and hang it on the suspension. If the caliper slides in machined guides, check these guides for rust or corrosion—and if necessary, wire-brush them clean and apply a thin coat of silicone dielectric grease. If the caliper slides along pins or bolts, similarly inspect them—and the rubber bushings or plastic guides through which they run. Replace damaged bushings or guides.

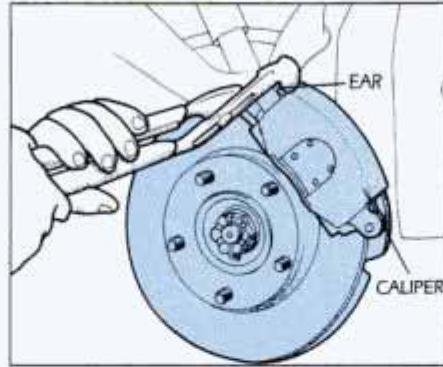
If bolts or pins on older cars are lightly corroded, they can be wire-brushed clean and lubricated. Most new-car bolts are coated against corrosion—so if there's corrosion, something's wrong and the best approach is to replace them. If the bushings are supposed to be a tight fit, make sure they aren't loose. If they're a push-in

CAR CARE

fit, sand away any corrosion, clean and lube the bores. Also lube the pins or bolts.

Even if the caliper moves smoothly, any extra movement of the shoes can produce squeal. Make certain that the brake shoes are properly installed. If the inboard shoe is supposed to have a clip holding it to the piston, make sure that the clip wasn't thrown away or bent during a previous brake job. Outboard shoes are almost always located positively in some way, and when that way isn't exactly to specs, squeal is the result.

In addition, there's often a steel shim or silencing pad attached to the back of the shoe. If the shim is out of position, put it back, perhaps using coats of moly grease or silicone paste on both sides (of the *shim*, not the brake friction material). The grease will hold it to the shoe and the caliper and add layers of silencing insulation. Or, install a silencing pad with self-stick adhesive on both sides. You can find these self-stick silencing pads at



Some calipers use shoes with ears that can be crimped over with a large pair of pliers.

the auto parts store. You may need to trim them with sheetmetal shears.

If there's nothing on the shoe back, apply a thick coat of silicone paste, allow it to cure for about 10 minutes, then install the shoe. This works much better—and longer—than the typical aerosol anti-squeal spray.

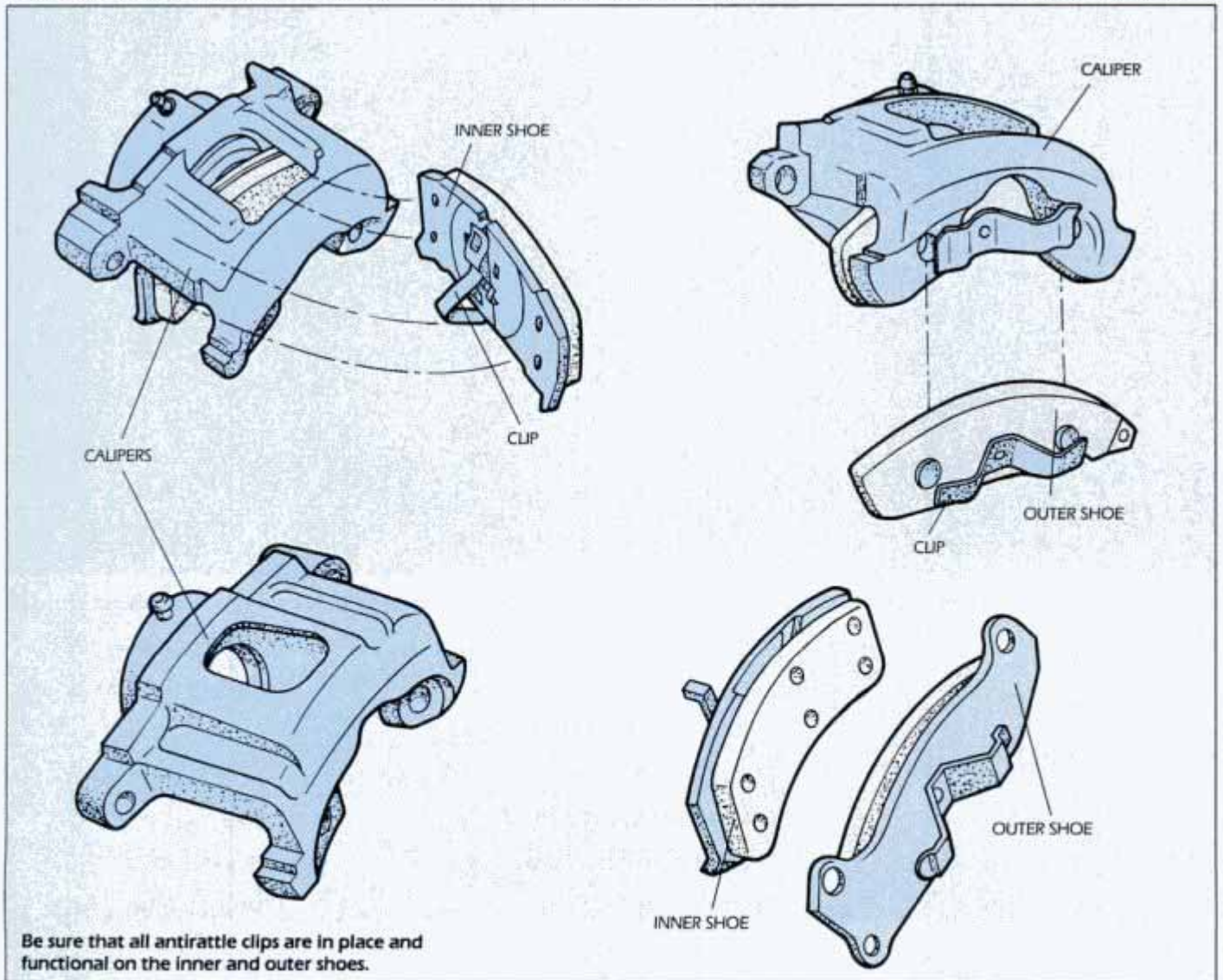
Many GM cars have outboard shoes with locating ears that should be bent down over the ends of the caliper.

Other GM cars may have tabs that go through slots in the caliper. Check these before you take off anything: Push on the back of the outboard brake shoe with your hand, and if there's any movement at all, the shoe has to be retightened in position.

Wedge a chisel or screwdriver shank between the hub of the rotor and the bottom of the outboard shoe, then have a helper firmly apply and hold the brakes. Hold a ball-peen hammer against the top of the tab, then hammer on the back of the ball-peen with a brass hammer to bend the tab down to a 45° angle. Pull out the chisel, have the brakes released and try to move the shoe again. If there's still movement, do it again.

On many Chrysler products, the outboard shoe has a thick ear that goes over the edge of the caliper to hold it. If that ear is even slightly loose, that's enough for the shoe to move and squeal. Want it right? Hammer down on the tab so the only way

(Please turn to page 98)





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the shoe will go on is by forcing it with a C-clamp, as illustrated. Use an old, worn-out set of shoes to prevent damaging the friction surface of the brake shoe with the clamp. That shoe should still get a silencing shim or coat of silicone paste.

Lining and disc problems

Even if the linings are near full thickness, inspect the surface for a glossy look, called glaze, which can be caused by uneven contact with the disc or by abusive braking, particularly with economy linings. Glaze accelerates a problem of uneven contact, which may have been started by a disc that is unevenly thick or "wobbling" slightly, or a drum that is out-of-round. In this case, the squeal is an early warning of a developing brake performance problem. You can measure wobble, also called lateral runout. Attach a dial indicator to the suspension and rest its plunger against the lining contact surface. With the disc held securely by tightened lugnuts, rotate the disc while you watch the indicator needle. The maximum needle movement should be no more than .005 in.

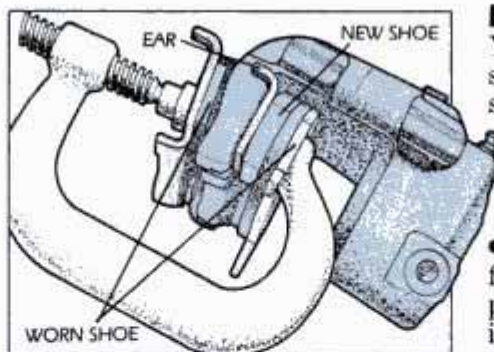
Excessive runout could be caused by worn bearings or a disc worn unevenly. Check the disc thickness with an outside micrometer at a half-dozen points around the contact surface (maximum thickness variation should be no more than .0007 in.). An unevenly worn disc should be machined or replaced. You may be able to sand off glaze, but it often indicates a chemistry problem with the linings, so it's better to change the shoes.

Also, inspect the linings for oil or grease. You may be able to sand off a light touch of grease, but even if you can, don't reassemble until you find out where the oil or grease came from—probably a defective seal—and stop the seepage.

Drum brakes

Although drum brakes are quieter than discs, they aren't immune to squeal. Check the outside of the drum first—there may be a sign that something is missing, such as a damper spring. Then pull the drum and look for an accumulation of brake dust. That alone can produce squeal, so just clean it out. But do so carefully.

Even though a large proportion of brake friction materials used today contain no asbestos, you should still take precautions. Always wear a disposable particle mask. Wear either a disposable smock, or change your clothing immediately after finishing

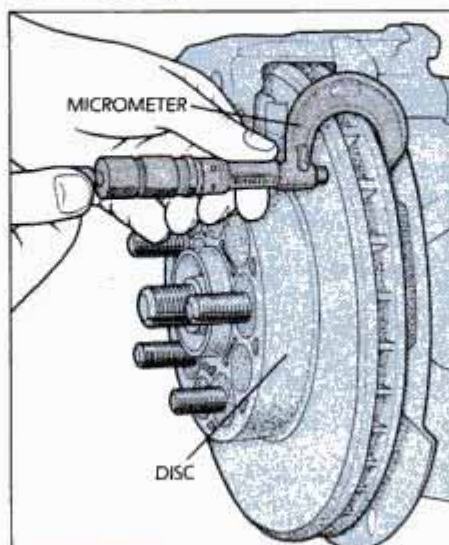


To press in new shoes, protect the friction material from the clamp with the old shoes.

your brake work. Use a commercial environmentally safe brake cleaner, not one of the older-style products based on chlorinated solvents. At the very least, soak the brake dust with water from a spritz bottle. Whatever you do, don't use compressed air to blow the dust all over. Sprinkle damp sawdust over the brake dust that does make it to the floor, and sweep it up before you track through it. Wash your hands.

Next, check for loose or broken shoe hold-downs and other shoe hardware. Inspect the linings for uneven wear, which could be a sign of an out-of-round drum. Have the drum measured at a machine shop.

Still looking? Pry away the shoes and inspect the platforms along which they slide. If you see rust, remove the shoes, sand the platforms clean and apply a film of silicone grease. Brakes are a balanced design system, and you should replace semimetals with new semimetals. Replace non-asbestos, nonmetallic linings with brand-name nonasbestos, nonmetallic linings that are recommended for use on your car.



Check the brake disc for any thickness variations with an inexpensive micrometer.

Last-ditch efforts

You've tried new shoes. You've got a shim or pad against the outboard shoe. The caliper or drum brake hardware is all new. But there's still squeal, so what do you do now besides give up? Make a last-ditch effort. Try some of our favorite demon tweaks:

- Make sure the noise isn't coming from the front or rear suspension, by prying on all the parts in rubber bushings. If you can't find anything, try spraying the rubber bushings with silicone lube or glycerin anyway, just to eliminate the possibility. And eyeball all the front spring coils for shiny spots, just to make sure they aren't coming in contact.

- Chamfer the edge of the linings on discs or drums. Just grind off about 1/4 in. at about a 45° angle. Remember, you're probably grinding asbestos—don't give yourself silicosis. If the squeal is originating from irregular edge contact, or if the problem is some shoe vibration you can't seem to trace, this just might work. One reason this often helps on disc brakes is that it also eliminates squeal resulting from slight relative movement between lining and caliper.

- Also try a coat of silicone paste over the backing of the inboard sides of the disc brake shoes.

- If the shoes you installed were relined, as is common with drums, try brand-new shoes. The relined shoes just might be off-shape enough to make uneven contact.

- Go back and recheck to see if the shoes you tightly installed have worked loose. There may be something worn in the hardware that could allow this.

- Some mechanics will tell you that all they have to do to eliminate squeal is change the shoes from bonded (glued-on) linings to riveted. It's true that riveted linings have a better history of low-squeal performance, although no one is sure why. However, there have also been cases where riveted shoes squeaked and the factory fix was replacement with bonded shoes.

- For reasons no one can explain, hacksawing a diagonal groove across the friction surface sometimes helps. This probably changes the resonant frequency of the system just enough.

Unless the car had a squeal problem when new, consider original equipment replacements from the car dealer (although be warned that the shoes will be expensive). However, if the linings once were squeal-free and now are not, there's a mechanical flaw you can find and correct.

FM

CAR CLINIC

BY MIKE ALLEN,
Associate Automotive Editor

In The Groove

I've replaced the front main seal on my Camaro twice now, and it still leaks. Is there some sort of wonder seal that I can use that will really keep the oil in? The harmonic balancer is kind of worn right where the seal rides. I'd replace the balancer—but I spent really big bucks getting the engine balanced, and I'm not really enthusiastic about the prospect of tearing it all apart to rebalance it.

TOM NICKS
BROOKLYN, NY

The problem is that dirt has worn a groove into the sealing surface of the balancer. The lip of the seal wears very rapidly when it rides on this groove, and you've got a leak.

The simple way out, as you are aware, is to replace the balancer—which wouldn't be a problem on a stock engine, but it's not exactly cheap, either. And if you've balanced the engine, just hanging an unbalanced part on the front of the crank is more than likely to upset it.

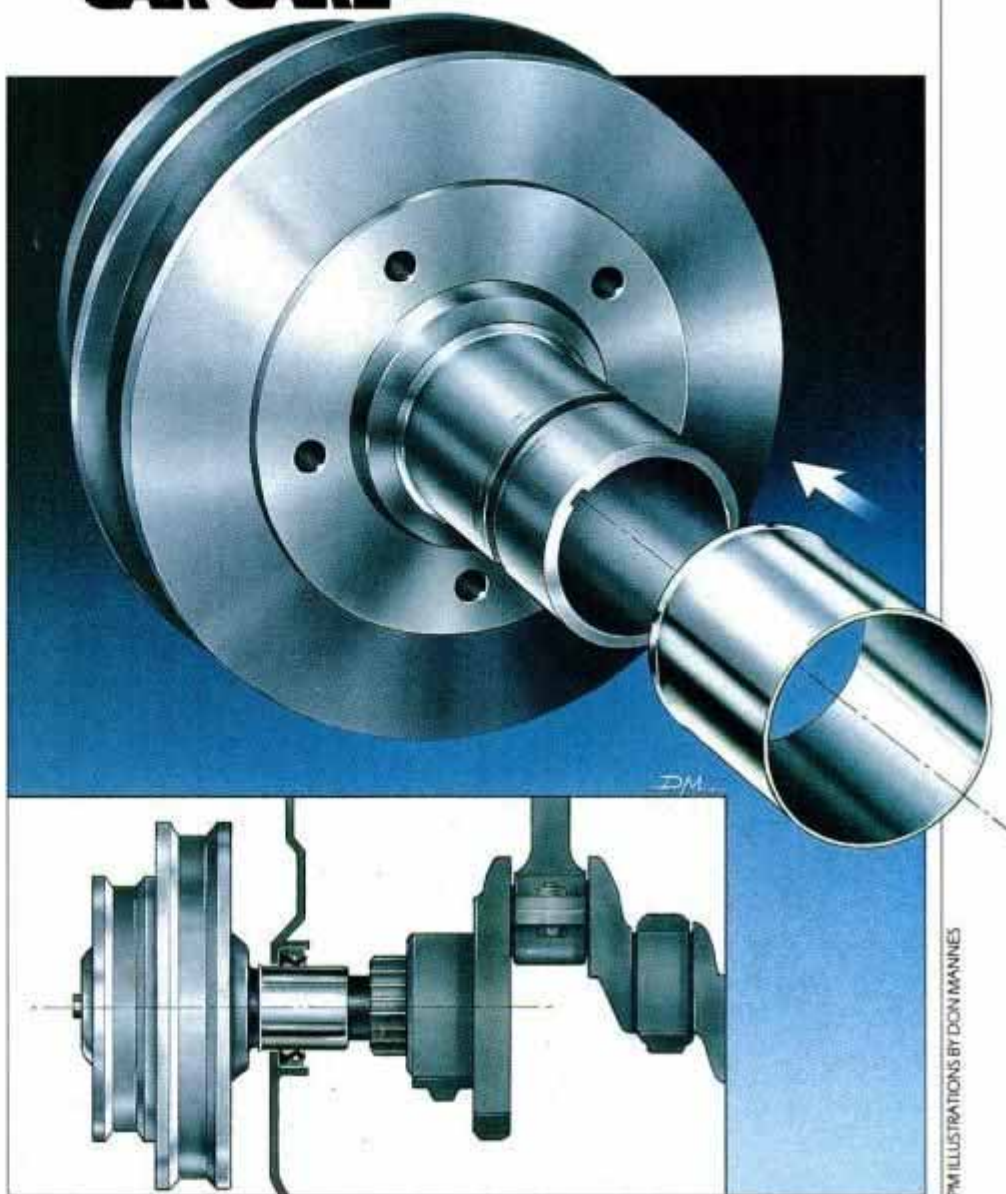
Trot down to the auto parts store and pick up one of the repair sleeves illustrated here. The sleeve is very thin steel shimstock—thin enough not to add significantly to the diameter of the balancer's snout. Remove the harmonic balancer and clean it thoroughly. Degrease it and the sleeve with brake cleaner, and be careful to avoid getting fingerprints on the contact surfaces. Use a couple of drops of Loctite to hold the sleeve on the balancer's snout, and let it cure for a couple of hours.

Bearing Down

I have a 1991 Plymouth Reliant. The problem is when starting out, the wheel wobbles, until I hit about 30 mph, and then evens out. There is a roaring noise that stops if I turn the wheel to the right. If I go around a turn to the right, it stops for a split second. No one I have talked to knows the answer.

MAYNARD DEAN
HOMOSSASSA, FL

Maynard, you've got a bad front wheel bearing. Get this car back to the dealer and see if he'll warranty it. I can't really tell you if it's the right or left front wheel. The bearings used on



most fwd cars are sealed, and they can't be inspected or repacked—just replaced. They're sealed at the factory, and generally will last for the life of the car—or about a week after hitting a curb or large pothole.

If you've hit anything with the front end of this car, the dealer might be unwilling to replace the bearing under warranty.

Bouncing Check

The CHECK ENGINE light on my 1983 Park Avenue comes on after about 2 minutes. The mechanic at the gas station hooked it up to a machine and got a CODE 24. He says he might have to rip out the dashboard to replace the sensor. He also says it's not important, and that I can drive the car. I should just put a piece of tape over the light if it bothers me.

LEONARD OLAF
MELVINDALE, MI

The CHECK ENGINE light is an indication that the engine's computer isn't

getting an important piece of information. In this case, it's something related to the vehicle's speed-sensor circuit. So the computer is just guessing as to how much ignition advance and fuel to use. The guess is predetermined by the manufacturer to be safe—it won't melt a hole in a piston. It also means you're getting reduced levels of performance, emissions and mileage.

The mechanic is wrong. You should try to get this fixed as soon as possible—preferably at a different garage.

Hot Flash

When I adjust the valves on the 2.6-liter engine in my Dodge Caravan, it says in the manual to adjust them when the engine is hot. But by the time I get the valve cover off, the engine has cooled. How much should I change the lash settings to compensate for this?

PERRY FROZZA
SPOKANE, WA

CAR CARE

Run the van for about 20 minutes on the road to ensure that it has warmed up thoroughly. Idling it in the driveway won't do the job here. Then, immediately remove the valve cover. This will go pretty quickly if it's not the first time you've ever done it. Then, adjust the valve lash to the hot settings. If you don't stop to answer the phone, you'll be able to get all eight valves adjusted before the engine cools too much.

Sometimes you can find a cold valve lash specification for an engine. I prefer to use this—mostly because I don't appreciate working on a hot engine, especially on a hot summer day. Don't try to strike an average of the hot and cold settings for a lukewarm engine, as the relationship between the engine's temp and the clearances is not necessarily linear.

Hot Pony

I have an overheating problem in my 1966 Mustang—289 V8, auto, air. I rodded out the radiator (twice), replaced the radiator cap, water pump, thermostat and sensor. I've chemically cleaned the system, replaced the

Ozone Depletion

● I was resurrecting a project car that's been moldering in my garage for a couple of years. (Putting PM together doesn't seem to leave as much time for projects as it used to.)

I had to pump up four flat tires to get the car to move far enough to remove the wheels to get four new skins mounted on the rims. When I finally got the car up on stands, I started to pull the brake rotors to turn the rust off of them. And I noticed the decrepit state of the rubber brake hoses.

This was a 1984-vintage car. And all the rubber brake lines had weather-checked badly. Serves me right for storing the car right next to the electric motor on my air compressor, which, like any electrical motor, makes a pretty good ozone generator. And ozone degrades rubber.

Replacing the brake lines was a task of only a few hours and about \$30 worth of parts. When was the last time you inspected your brake lines?

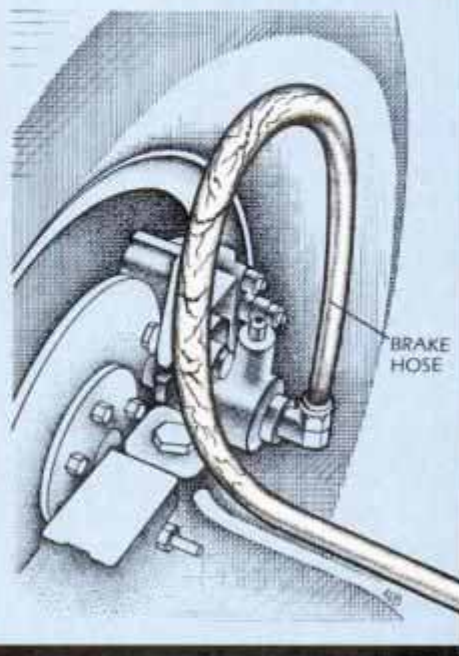


ILLUSTRATION BY ADOLPHE BROTMAN



**No matter where your car is from,
only one plug guarantees better performance.**

CAR CARE

viscous fan with a fixed one, checked for a head gasket leak with some sort of gadget that turns blue when there are combustion gases in the coolant and replaced the hoses.

I'm out of ideas.

DONALD BERTOSSA
SARATOGA, CA

Replace or recore the radiator. This is a common problem on cars of that vintage, particularly Fords. The inside of the radiator may be as clean as a whistle, but the solder connection between the fins and the tubes has corroded. It may look fine, but the thin line of corrosion is an excellent insulator, preventing heat from transferring from the hot, coolant-filled tubes to the fins.

Try pulling gently on the fins at one end. If there's serious corrosion, you'll be able to pull the thin, corrugated fin loose like a zipper.

Hot Wax

My daughter managed to crumble most of a bright red crayon into the gray cloth seats of our new car. I've managed to remove most of the wax,

but there is still some wax stuck in the fabric. What can I use to remove this?

EDUARDO 21

(FROM THE PM COMPUTER
BULLETIN BOARD)

Start by applying dry ice to the wax (use gloves or tongs—this stuff raises blisters in a second). Then use a dull knife to scrape away the hardened wax. This will prevent more wax from being pushed into the fibers.

Next, go under the seat and remove enough of the hog rings that hold the fabric cover to allow you to push some flannel or other highly absorbent fabric under the area of the stain. Back up the absorbent fabric with some cardboard or plywood. Use a dry iron to melt the wax, much of which will soak into the backing fabric. Keep changing the backing, and repeating the process. The remainder of the wax should succumb to a commercial spot remover.

PM

DO YOU HAVE A CAR PROBLEM?

Just ask Mike about it. Mail your question to Car Clinic, Popular Mechanics, 224 W. 57th St., New York, NY 10019. While letters, faxes or phone calls cannot be answered individually, problems of general interest will be discussed in the column.

SERVICE TIPS

- 1988 and '89 Chevrolet and GMC C/K trucks may experience dragging parking brakes because of an unusual accumulation of slush and ice on the cable. GMC TSB 89-5-124
- If your 1989 or '90 Buick Skylark or Century with 3300 (VIN code N) engine has a miss at idle or highway speed, one or more of the even-numbered spark plugs may be broken. If any plugs are broken, TSB 90-6E-16 recommends replacing them with R45LTS6 plugs. In fact, the R45LTS6 plug should be used as a normal service replacement.
- A clunk or rattle in the rear of a 1987 to 1990 Ford Tempo or Mercury Topaz with all-wheel drive may be caused by dry U-joints in the rear suspension. TSB 90-8-15 details the replacement of dry U-joints and the proper procedures for greasing these components.
- Excess oil consumption (more than 1 quart per 200 miles) on 1988 Jeeps with 2.5- or 4.0-liter engines may be caused by nothing more serious than an incorrectly installed crankcase vent in the cylinder head cover grommet. The bottom of the molded ring on the vent tube must sit on top of the rubber grommet. If the ring disappears into the grommet, follow the repair procedures given in TSB 09-56-88.



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NEW PRODUCTS

IMPROVE YOUR CAR

GORE-TEX Gaskets

The waterproof-material folks have an interesting new gasket material. GORE-TEX RT can be used for sealing fuels, oils and coolants, and withstand up to 600° F. The gasket is packaged as a strip on a roll, in one of four thicknesses and two lengths. All you do is peel off the adhesive backing paper and press the gasket strip down in place, overlap the ends and cut it. GORE-TEX RT is claimed to not harden or bake in place with age, so it should scrape off during disassembly. Prices range from \$9.95 to \$22.95 per roll. From W.L. Gore & Assoc., Inc., Sealant Technologies Group, 100 Airport Rd., P.O. Box 1010, Elkton, MD 21922; (410) 392-3200.



Dual-View Mirror

There is nothing new about a wide-angle rearview mirror. However, the Lanechanger II integrates a convex mirror with a standard mirror in one unit. The Lanechanger II bolts in place of your current mirror, and has a top convex section which reflects objects close to the driver—including children or pets in the rear seat—and a wide-angle view of traffic next to the rear of the car. The bottom section of the mirror shows traffic behind. The Lanechanger II has a day/night feature and costs \$29.95. From The Lanechanger, Inc., 601 Auguste Mondoux, Aylmer, Quebec, Canada J9H 5E1; (819) 595-3054.



Electronic Shift Kit

To improve the performance of a modern, electronically controlled automatic transmission, you need modern, electronic methods. Try this Gale Banks Engineering Transmission Command Module for Ford vehicles equipped with the E4OD electronic, 4-speed overdrive automatic. The Banks TCM works with the transmission's electronics to sense transmission load, and then reprograms the transmission to progressively in-

crease shift firmness as load increases. This added firmness is most appreciated when towing or when the vehicle's engine has been tweaked for more power. The Banks TCM is available with a switch to allow you to select either a heavy-duty shift mode—for when driving aggressively or towing—or a normal shift mode. The Banks Transmission Command Module costs \$299.50, from Gale Banks Engineering, 546 Duggan Ave., Azusa, CA 91702; (818) 969-9605.



Flexible Flash Holder

When you're out there by yourself in the dark trying to make a repair to get yourself home, the toughest part of the job is often getting your flashlight to stay pointed at what it is you're trying to fix. The Flashmate is one solution. The Flashmate has a magnetic, spring-clamp base so it can be attached to a wide variety of surfaces. Flexible straps hold the flashlight to a stand which can be rotated up to 90° vertically from the base and 360° horizontally. The Flashmate can hold a penlight or a full-size, 2-ft.-long flashlight. Cost is \$12.95, plus \$4 shipping. For more information, write Innovation, P.O. Box 117700, Burlingame, CA 94011; (415) 344-0863.

Hi-Po Truck Radial

For those who have fun-to-drive trucks, Firestone has introduced the Firehawk R4S LTP, a hybrid tire which combines the durability and traction of other truck tires with the comfortable, quiet ride and handling characteristics of a performance passenger-car tire. The tire comes in three sizes—LTP205/75R15, LTP215/75R15 and LTP235/75R15—and fits most pickups, sport/utilities and minivans. The Firehawk R4S LTP carries a suggested retail of between \$125 to \$150, depending on size. From Bridgestone/Firestone, Inc., P.O. Box 140992, 1 Bridgestone Pk., Nashville, TN 37214; (615) 391-0088. **PM**



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ADVENTURE ON THE ALASKA HIGHWAY

BY JOE SKORUPA, Boating/Outdoors Editor



● I fulfilled a lifelong dream last year by driving several hundred miles on the legendary Alaska Highway. It was marvelously twisty, densely forested and generously endowed with snowcapped mountains and abundant wildlife. It was everything, in fact, that I imagined it would be, except for one thing. It was paved. Oh, there were a few sections of gravel road here and there, but asphalt crews were hard at work covering them up with typical Canadian efficiency. No doubt their fate is sealed by now.

But it wasn't always that way. I remember a friend in high school who set off for the AlCan Highway, as it was called then. He drove an indirect route from New Jersey and arrived in Alaska a few weeks after graduation. He said there were paved roads from Seattle, Washington, to Dawson Creek, British Columbia—the Alaska Highway's southern terminus—but from there on it was all gravel.

What really impressed me about my friend's adventure was the toll it

took on his car. By the time he reached Fairbanks, Alaska, the windshield was cracked, the headlights were smashed, the grillwork was demolished, the hood and lower body panels were pockmarked by what appeared to be blasts from a shotgun, and the undercarriage looked like it should be renamed undercarnage. After staying in Alaska a couple of weeks, my friend sold his car for junk and hitchhiked home. When I eventually ran into him, he told me he'd do it over again in a minute despite the fact that he trashed his once-beloved car. That's what I call a great adventure.

The long and winding road

The date was Sept. 24, 1942. The place was Contact Creek, British Columbia. Two road crews working from different directions met here 50 years ago and completed construction on what has since been called one of the greatest and fastest engineering feats of the century: the building of the Alaska Highway.

Although agencies of the U.S. and Canadian governments had been studying the possibility of building the road since 1930, the Japanese bombing of Pearl Harbor, on Dec. 7, 1941, gave the planners real incentive. The sense of urgency increased when Japanese bombers and fighters attacked the Alaskan naval base at Dutch Harbor.

The first road crew arrived at Dawson Creek on March 9, 1942. A second crew began work at Delta Junction, a small town near Fairbanks, a short time later. At the peak of construction, 11,150 American troops and 7500 civilians were working on the project. They used 11,000 pieces of heavy equipment to conquer the incredibly harsh climate and rugged terrain. They built 233 bridges—the longest of which was 2130 ft. across the Peace River. They surveyed on the fly and set up dozens of temporary tent-city base camps.

Despite tremendous hardships, they triumphed over mud, muskeg

and voracious insects. When it was all over, the crews no doubt looked back at what they had done and shook their heads in amazement: 1520 miles of road carved out of hostile, rear-Arctic wilderness and completed in just six-and-a-half months.

First-year construction costs for the entire road were \$19.7 million. Today, more than \$20 million is spent annually on maintenance. The result of this scrupulous upkeep is a completely paved highway by the AICan's 50th anniversary. To off-roading fools like me, something has been lost in all the upgrading, but something has been gained, too. Now, unlike the conditions encountered by my high-school friend, anyone can expect to make the round-trip journey on the Alaska Highway and return with his vehicle in one piece.

If this sounds like a good idea to you, here are a few sources of information you might want to contact before you head out to the Great White North:

- Alaska Division of Tourism, P.O. Box 110801, Juneau, AK 99811; (907) 465-2010.
- Tourism Yukon, P.O. Box 2703, Whitehorse, YT, Canada Y1A 2C6; (403) 667-5340.
- Tourism British Columbia, Parliament Bldg., Victoria, BC, Canada V8V 1X4; (800) 663-6000.

For pre-trip planning or guidance along the way, I suggest either of these two books:

- *The Milepost* (\$16.95), GTE Discovery Publications, 22026 20th Ave. S.E., Bothell, WA 98021; (800) 331-3510.
- *The Alaska Highway—An Insider's Guide* (\$15.95), by Ron Dalby, Fulcrum Publishing, 350 Indiana St., Golden, CO 80401; (800) 992-2908.

Outdoors Tech

My office received a lot of interesting news about high-tech outdoors gear while I was away

The laceless Puma Disc System tightens up running, tennis and cross-training shoes with the twist of a button.



Rotating grip rings on the SupraBar allow freedom of wrist movement in workouts.

on my aforementioned Alaska Highway trip. Here are a few items I thought you should know about.

The high-tech sneaker wars continue to rage on the sports front, and Puma USA has fired the latest shot. Arriving in stores this month is a series of athletic shoes equipped with a laceless innovation called the Puma Disc System. This unique feature consists of three elements that create a laceless/Velcro-less fit: 1. an integrated closure disc that turns for adjustment and clicks into place, 2. a compression unit that replaces the standard tongue, and 3. two side units that are linked to the closure disc by

(Please turn to page 106)



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nylon cords and tighten around the foot. To release or loosen the system, either turn the disc back to the open position or press a hardy quick-release button.

These top-of-the-line Puma sports shoes will retail for about \$125, and will be available in sport-specific models for running, tennis and cross training. Basketball shoes are scheduled to come out in the fall.

Another fitness product with a technically innovative approach is the **SupraBar Cable System**, made by Fitness Tech, of Knoxville, Tennessee. This line of home-training equipment

is an improvement over straight-bar weight systems, which stress tendons and joints by unnaturally restricting movement.

The key to the SupraBar Cable System are the unique rotating grip rings that allow the exerciser's wrists to twist into comfortable positions while working out. The SupraBar unit is available as a stand-alone free-weight bar, adaptable to both standard and Olympic weights. It can also be included as a component of a multipart cable system.

Other components of the cable system are the Cable Curl Bar and But-



The inexpensive Propeller Pitch Gauge dials in the difficult-to-measure prop blade angle.

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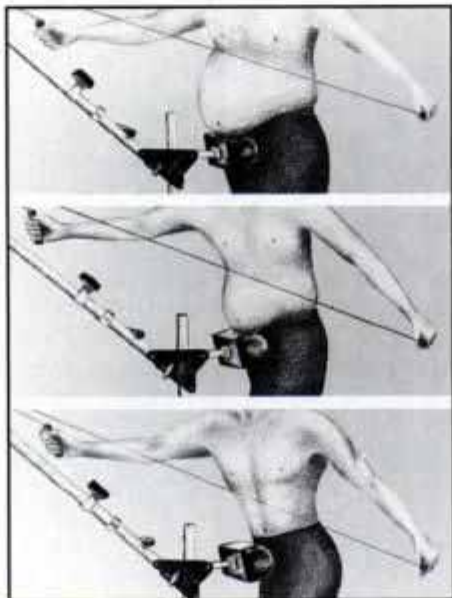
NordicTrack provides a total-body workout.

Unlike most in-home exercisers, NordicTrack works all the major muscle groups including the arms, legs, buttocks, shoulders and yes, stomach.

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terfly, which also use rotating grip rings, and two L-Bars and a dual-handle Spreader, which use pivoting handles similar to upscale jump-rope grips. Each of the components allow freedom of wrist movement to relieve stress and maximize the workout of upper-body muscle groups.

Currently, the cable system is designed to attach to existing cable and weight-stack systems, but the company plans to bring out a stand-alone setup by the end of the year. Price ranges from \$149 for a starter set to \$189 for the complete system.

Although just a small company from North Salem, New Hampshire, Land & Sea is never at a loss for innovative ideas. Two years ago, the company won a POPULAR MECHANICS Design & Engineering Award for its Torque Shift propeller. Recently, it came out with another product of interest: a Propeller Pitch Gauge.

The thing I like about the Propeller Pitch Gauge is that it's a simple, practical, rugged device that not only works, but is cheap. Price is only \$30.

Here's how it works. Using the splines in the propeller's hub as a register for readings, the gauge measures pitch at the industry standard 70% radius over a consistent 24° sector of each blade. It works on any left- or righthand rotation propeller that fits the standard 1-in. prop-shaft spline. This covers virtually every V8 or V6 outboard and most sterndrives.

Why do you need to measure prop pitch? Basically, because the prop is the key to boat performance and pitch is the key to prop efficiency. Efficient, quick-to-plane performance is important to high-speed racers, muscle-boat fanatics, waterskiers, bass-boaters and anyone else who wants a boat to run to the best of its ability.

Today, boaters demand better performance through improved efficiency, and the best and cheapest way to achieve it is at the prop. The Land & Sea Propeller Pitch Gauge helps dial in any boat.

PM

THE PERFECT SWING

(Continued from page 43)

the ball any farther with a metal wood, but perfect weighting can give you greater consistency.

Shafts have come a long way, too. Graphite and titanium shafts are a major improvement over stainless steel. The lighter the shaft the more weight you can put into the club head. The more weight you put into the club head, the more mass is going to strike the golf ball. Also, graphite and titanium shafts taper more rapidly at the bottom than stainless-steel shafts, giving them a lower kick or flex point. The lower the kick point, the easier it is to get the ball up in the air.

About the hottest club today is the oversized driver. A lot of pros say they're getting longer drives using it. Now, everything in golf is closely regulated and there's an upper limit to the dead weight of a club. So how are manufacturers getting club heads so big? Basically, they're eliminating the hosel, which is the up-raised connecting arm on most club heads. The weight saved here is put directly into the club head to make it oversized, and the effect is to increase mass at the point of impact.

Two other reasons account for the oversized driver's growing acceptance: 1. The big club head has a bigger sweet spot to hit, and 2. Its large size makes you *think* it's user friendly, which is half the battle.

Perimeter-weighted irons have been a great benefit to golfers, too. Like the oversized driver, perimeter-weighted clubs give you a bigger sweet spot to hit. Basically, what perimeter weighting means is that some club-head weight is removed from the center of the back of the club face and spread around the outer edge. The result is that if you hit the ball on the toe or heel, you're still going to get maximum distance.

Whether it's metal or wooden woods, or irons of any design, golfers should beware of gimmicks. My advice is to stick with proven name-brand equipment. I personally use Spaulding equipment, for instance.

For years, my swing was considered unorthodox, and I always said that the reason I don't use video to fine-tune my mechanics is that I never had a swing I particularly wanted to see. Well, now I see some other pros swinging in a way that resembles what I've been doing for years, and, frankly, it's not a welcome development. They're becoming tougher to beat, and it makes me wish they'd consider going back to their conventional stroke. **PM**

Boating/Outdoors Editor Joe Skorupa assisted in the preparation of this article.

PM HOTLINES

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You can call the PM computer any day between 6 pm and 8 am (only) Eastern time. The number is (212) 582-8369. Once you're on line, you can leave messages for specific editors, or direct inquiries and comments to a specific department. The department bulletin board also allows you to share your thoughts with other readers who call in.

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NEW CARS



● Chrysler Corporation squeaked through its financial crisis of a generation ago on the strength of two phenomena: Lee Iacocca's persona and the K-car. Iacocca managed to secure some loan guarantees, and the K-car, in its myriad flavors, provided cash flow to service the debt.

But the K-car has served its purpose of keeping the corporation afloat. While other domestic companies have struggled to shorten their product cycles from six or seven years to the Japanese-standard three, the K-car has soldiered on since the early '80s with few refinements beyond a dozen or more spinoffs.

Capital investment that other car companies spent on new cars was spent on developing a new engineering center and bringing the L-H to fruition in just over three years.

Team L-H's target was to produce a marketable car with the feel of a European sports sedan and the sophistication and quality of the best Japanese techmobiles.

Chrysler's back with a vengeance in the form of the Dodge Intrepid, Chrysler Concorde and Eagle Vision, a trio of clean-sheet-of-paper sedans.

But to do so in the incredibly short timespan (by domestic standards) required a new approach. Engineering staff was restricted to only 700 or so, well under half the number usually assigned to a new platform, even in the days of 6- to 7-year product cycles. The team was sequestered in a single building, including the finance and purchasing guys in planning on a day-

to-day basis. Suppliers were brought in before the beginning, to make it easier for them to design and build the parts.

One early decision was to make the L-H with the engine situated longitudinally, rather than the customary fwd transverse. The advantages (better control of engine movement and vibration) outweighed the problems in packaging.

This permitted a very low hoodline, and the positioning of the trailing edge of the windshield well forward of the firewall.

Don't look for anything bigger than a nut or bolt from a K-car to be recognizable on the L-H—with the exception of the familiar 3.3-liter pushrod V6, which has been modified so it can be installed in either north-south or east-west engine compartments. Complementing the more pedestrian (but adequate) 150-hp 3.3 is a thoroughly modern dohc 24-valve 3.5 that churns out over 200 hp.

The L-H platform is embodied in three different guises—the Dodge Intrepid, Eagle Vision and Chrysler Concorde. These will be appearing in some showrooms by August, next to carry-over 600s and New Yorkers. But the new cars will completely replace the older vehicles as soon as pro-



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Here is the Controller's exact distance advantage as compiled by some low-80's golfers.

CONTROLLER®	220 yards
#3 Wood	190 yards
#4 Wood	180 yards
#5 Wood	170 yards

Now test the Controller's accuracy against your 3-iron. Purposely hit a shot off the *toe* of each club and watch what happens. Your 3-iron will *hook* the ball violently—the Controller will keep it down the middle! The same is true with *heel* shots. Your 3-iron will *slice* the ball violently—the Controller will automatically keep it on course!

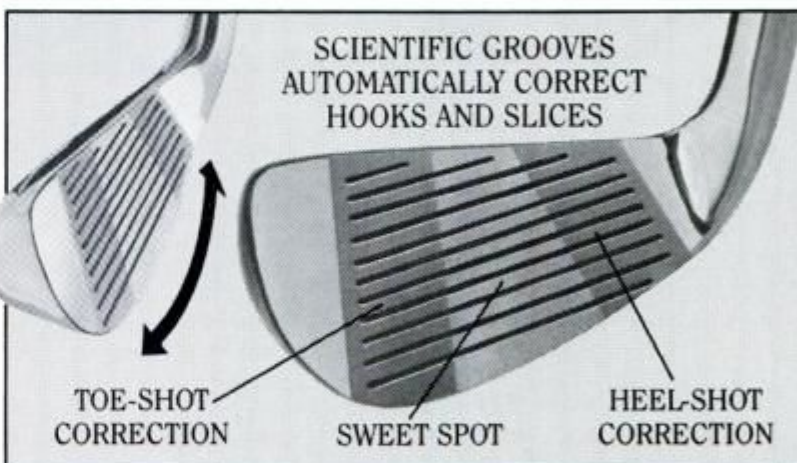
THE GREATEST STROKE-CUTTER IN GOLF

These scientific breakthroughs make the Controller driving iron the most powerful strokecutter in golf. We believe the club will transform the game. First of all, it obsoletes fairway woods! The Controller not only hits 30 to 50 yards farther than fairway woods, it automatically corrects hooks and slices! Here's how it works.

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The Controller has an *invisible curve* across its hitting surface—a curve that's going to revolutionize your game. *No other iron has it!* Hit a shot off the Controller's sweet spot and it will go straight, as it would with an ordinary iron. But even pros hit off the heel and toe.

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- its smaller head size (versus a wood) boosts clubhead speed...
- its 100% carbon-graphite shaft model adds even more clubhead speed...
- it lets you carry more wedges and putters without exceeding the 14-club limit (by eliminating your #3, #4 and #5 wood)...

The Controller is new and supply is limited. You must act now and remember, you are completely protected. If the Controller doesn't cut 5-10 strokes off your score, you may return it (undamaged, of course) for a prompt refund of its price.

FREE!

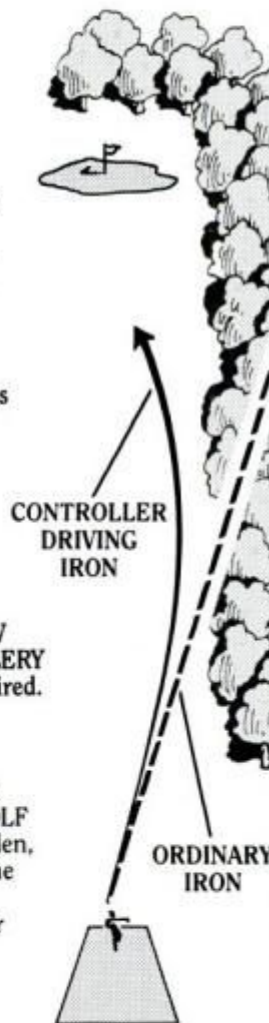
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duction is ramped up, probably less than a year.

All this background is nice—but you're probably wondering what the car is like. I got a chance to drive one of the few P0 engineering prototypes for about 45 minutes one gray spring morning near the Chrysler Technology Center in Auburn Hills, Michigan. P0 signifies a vehicle hand-assembled with parts fabricated with production tooling, but not with production process, nor on the regular assembly line. These cars are usually pretty awful in terms of fit and finish, and they've often been flogged pretty thoroughly by the engineering staff. The two examples I drove (one with either engine) were no exception.

In spite of mismatched colors, a lot of dings and scrapes on the paint and the abbreviated stick time, one thing was obvious from the start—Chrysler has a potential success on its hands.

The Intrepid and Vision I drove have the potential to meet the best in the world on Lee Iacocca's much-ballyhooed level playing field. The

cars that come to mind are the Taurus, Accord and Camry—cars that have redefined what a midsize family car has to be like to be competitive.

Specifically, ride and handling are excellent, with dead-flat cornering, a total absence of fwd understeer, and well-balanced spring and damping rates. The steering provides good feedback, perhaps even better than many Asian imports. Wearing 225-section tires on 15-in. rims, there's plenty of rubber for spirited cornering and powerful braking. The ABS manages to avoid making you feel like you've stepped on a running chain saw when you tramp on the brake pedal.

Both engines provide entrance-ramp-capable levels of acceleration. The 3.5 seems only marginally faster than the more conservatively rated 3.3—my suspicion is that this engine will get uprated for more steam relatively shortly.

Ergonomics are excellent, with wonderful seats, plenty of room everywhere (including the rear, which can be used to haul people you actually like) and a cavernous trunk containing a full-size spare. Considerable at-



NASCAR Winston Cup star Richard Petty checks signature decal on special edition Pontiac Grand Prix that will bear his name. Winner of 200 races and seven championships, Petty will retire after this season.

tention was paid to the feel of the controls and switches.

The interior is tasteful and well done, and so unobtrusive others have called it plain. I disagree—it simply doesn't call attention to itself. IP layout is simply wonderful, with big, clock-face-size dials and gauges, and everything easy to find and watch.

Stay tuned for a full road test—we can hardly wait. And to the staff of Team L-H, well done.

—Mike Allen

Richard Petty Special

The end of the 1992 NASCAR Winston Cup racing season will also mark the end of one of its most remarkable driving careers. After 35 seasons—the last 11 of them spent driving Pontiacs—and a record 200 victories, 7-time champion Richard Petty will call it quits.

To commemorate Petty's achievements and his final season, Pontiac will offer a limited edition of the Pontiac Grand Prix—The Richard Petty Grand Prix.

While this doesn't bear any more resemblance to Petty's Winston Cup Grand Prix car than any other current Pontiac Grand Prix, its limited edition status does give it some appeal as a collectible, particularly to Petty fans. Pontiac plans to limit its run of the Petty Grand Prix to 1000 cars.

The treatment is purely cosmetic, available on the Grand Prix SE coupe in three body colors, which are, appropriately, red, white and blue. The graphic package includes special pinstriping, Richard Petty Edition decals on doors and rear-end panel, Richard Petty Edition wheel centers in color-keyed, cross-laced alloy wheels, a cloisonne dash panel logo and, most important, a Richard Petty signature decal on the trunklid.

The commemorative cosmetic package adds about \$400 to the cost of a Grand Prix SE. Manufacturer's suggested retail price for a Richard Petty Grand Prix, which includes GM's 210-



Next-Generation Tempo Revealed

● Although there will be a number of small cosmetic distinctions, this is the basic shape of the next Ford Tempo, due to be introduced in the United States for the 1995 model year.

Captured by the spy photographer's lens undergoing final testing in Germany, the car is the next generation of the Sierra—Ford of Europe's popular compact—which is due to roll out as a 1993 model in European markets.

Ford plans to create a North American version of the car, using the same plat-

form and basic sheetmetal, to replace the current Tempo platform.

Whether Ford will attempt to federalize any of the Sierra's European powertrains for U.S. use isn't clear. However, it seems certain that Ford will continue to offer the 3.0-liter Vulcan V6 introduced as a Tempo option for the current car.

Ford has offered Ford of Europe cars in North America in the past under the Merkur brand name. However, any future offerings will be made with existing U.S. nameplates.

PHOTO BY STOP PRESS/AUTO BILD SYNDICATIONS



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With extensive revisions to cylinder heads and fuel system, Mustang Cobra 5.0-liter V8 is targeted for 275 hp. Handling should match muscle.



hp dohc 24-valve V6 and 5-speed manual transmission, is \$19,957. The package can also be ordered on cars equipped with a 4-speed automatic transmission.

Mustang Cobra

Chevrolet and Pontiac figure to make the big ponycar headlines when the next generation of Camaros and Firebirds comes along this fall. But Ford is poised to prove there's still plenty of life left in its current Mustang platform, offering the Mustang Cobra as proof.

Developed by Ford's Special Vehicle Team, with plenty of help from ASC and the racing specialists at Jack Roush Engineering, the Mustang Cobra represents a top-to-bottom reengineering of a platform that dates its origins to the old Ford Fairmont.

But there won't be anything about this new hot rod that'll remind anyone of the Fairmont, or, for that matter, even performance editions of the current Mustang. Unveiled at the Chicago Auto Show, this Ford revival of the Cobra badge features stiffer spring rates, revised shock absorber damping, stiffer antiroll bars and harder suspension bushings to provide knifedged handling.

The Mustang Cobra will ride on big sticky 245/45ZR17 tires mounted on 7.5 x 17-in. cast-alloy wheels, and braking will be enhanced by vented rotors at the rear, as well as the front.

As you'd expect, there is more muscle to go with the improved handling. Ford elected to use its veteran 5.0-liter V8, rather than the new 4.6-liter modular V8, but with extensive modifications. Included under this heading: Bigger intake and exhaust

ports, bigger valves, new roller rocker-arms and a revised intake manifold.

The fuel pump and injectors have increased flow capacity to feed the horses, and Ford's EEC-IV engine-management computer has been reprogrammed to make the most of all the revisions.

Ford sources aren't saying yet what the most means in terms of absolute numbers, but the target is 275 hp—about what GM expects to extract from the Camaro and Firebird versions of the 5.7-liter LT-1 V8.

More muscle means more driveline stress, so the Mustang Cobra will also have a beefier clutch, upgraded 5-speed manual gearbox and tougher driveshaft.

Mustangs have traditionally provided exceptional performance bang for the buck, and the Mustang Cobra promises to continue this tradition—but only just. Ford insiders expect the manufacturer's suggested retail price for this limited-edition Mustang—the total run will be 5000 cars—to top the \$20,000 mark.

Look for the Mustang Cobra to show up in selected Ford showrooms in early 1993.

Ford Muscle Truck

The sales figures aren't the kind that nudge corporate bottom-line numbers up or down appreciably, but the image value of Chevy's 454 SS pickup

is something else again. The sporty muscle truck has added enough pizzazz to the Chevy lineup to prompt a Ford response. And here it is.

Ford plans to call it the F-150 Performance Pickup Truck. That may not sound quite as snappy as 454 SS, but early indications are that this too will be a hot hauler.

Power is delivered by a heavily massaged Ford 5.8-liter V8 through a recalibrated 4-speed automatic to a limited-slip rear differential. Ford Special Vehicle Team members are playing with final drive ratios as we speak.

The PPT (our name for it) also promises to have handling that may just be best-in-class. Working with 3-time driving champion Jackie Stewart, the SVT development troops added stiffer front and rear antiroll bars, double shocks (Monroe performance models) at the rear wheels and added high-performance Firestone Firehawk GTA radials and new cast-alloy wheels.

Although the development team retained the same spring rates, anticipating that there might be times when someone would actually use their PPT to haul cargo, ride height has been substantially reduced. This gives the truck a low, lean and mean appearance, which is set off nicely by its special front airdam with integrated fog lamps.

Bob Rewey, VP of sales operations for Ford's North American Automotive Operations, says, "This is the perfect machine for owners who enjoy driving as much as they love pickups."

Based on what we know so far, we're inclined to agree. But we'll have to wait until early next year to find out. **PM**



Ford's limited-edition F-150 Performance Pickup Truck will roll out in early 1993.

90° even-fire pushrod V6 engines. Buick supplies Brayton with raw crank forgings, block (cast iron) and head (aluminum) castings, ignition systems and electronic fuel-injection management. Brayton builds or buys the gear-drive cams, titanium intake valves, roller lifters, Garrett turbos and other components.

In addition to the new boost allowance, Brayton has developed a 7-butterfly intake manifold that helps driveability. It smoothes power, helps speed off corners on road courses, doubles the mileage under caution-flag cruising and makes pit exits easier and more controllable. Valvetrain components have also been engineered with an eye to increased reliability.

The price, low by Indy standards, is \$83,500 including the new manifold. Rebuild cost is less than half that of a Cosworth or Chevy-Ilmor V8. The twofold goal is to get more top teams using Buicks and to get finishes to match their strong qualifying. It's also interesting to note that Brayton's son drives for a competing team that uses Chevy power.

The others

Other engines? Though sophisticated by most other standards, the DFS/DFV Cosworths and Honda-based Judd V8s are old hardware at Indy. No word from Judd, but Truesports, which had been using the Judd V8, has Scott Pruett sitting in front of a Chevy Indy V8 this season.

Porsche dropped out awhile back, and Alfa, after a disappointing season with Patrick Racing and Danny Sullivan, appears to have left IndyCar racing for the foreseeable future.

Chassis tech

The chassis that will carry all these engines, new and not-so-new, has subtly changed, too.

According to U.S. design team member Chris Barry, the Lola chassis hasn't made the same leap forward as the XB engine. In fact, the Lola T9200 is a short step from last year's T9100 model—carbon fiber and aluminum monocoque with carbon-fiber body panels, fabricated steel uprights front and rear, steel suspension links and inboard springs.

The wheelbase is the same as '91, a long 111.5 in., allowing for greater footbox crush space and lower polar moment (greater concentration of mass around the center of gravity). Chassis track dimensions change with camber and new suspension links.

Speedway brake rotors, also fabricated from carbon fiber, are smaller than those used on road courses, but

use the same potent 6-piston AP calipers. Wheels are made by Lola with vent cutout area prescribed by USAC. Minimum weight, too, is set by USAC at 1550 pounds dry.

The T9200's transmission case is fabricated by Lola with internals supplied primarily by Hewland. For Indianapolis, most cars use 5 speeds, switching to 6-speed boxes for road courses. But not everyone follows this formula. A.J. Foyt, for example, has been known to show up for qualifying with only two gears, a strategy aimed at reducing mechanical power losses.

The new Penske also uses carbon-fiber tubs and body panels, with 4130 chromemoly steel uprights front and rear. Gearbox casing material has been switched from magnesium to aluminum, to improve rigidity. The Penske gearbox has six speeds for all circuits. At Indy, Penske drivers will use two top gears: one for heavy fuel loads, and a higher cog when the fuel load lightens.

Like the Lolas, the Penske cars will use carbon-fiber discs at Indy, but switch to cast-iron rotors for road courses. The same 4-piston Alcon calipers are used for all applications.

The Penske has a slightly narrower nose, noticeably higher side pods and lower rear cowl, thanks to the smaller dimensions of the Chevy B engine. Like the Lola, drag has been decreased and downforce increased, with most of the downforce gain attributable to the new side pods. Although the Penske's horizontal front wings will be essentially the same as last year's Indy setup, the new cars will have a dihedral on road courses.

On-board data acquisition and driver adjustable fuel map aren't new, but become important in optimizing the chassis/engine combination.

Tires

Goodyear will still be the standard rubber at the Speedway, supplying Superspeedway Eagle radials. Fronts measure 10 in. wide, 25.5 in. high. Rears will be 14 in. wide, 27.1 in. high at the right rear and 26.92 in. high at the left rear. All the tires will be mounted on 10x15 wheels front, 14x15 wheels rear. A set of these will set you back about \$1200, mounting and balancing not included.

Goodyear has a new sidewall treatment for '92, but won't talk about what changes—if any—lie behind the snappy new graphics.

So even though there's a fair amount of internationalism in chassis technology, this still boils down to a battle between the Detroit giants: Chevy versus Ford versus Buick. What could be more appropriate? **FM**



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HOME IMPROVEMENT

PROBLEM SOLVER OF THE MONTH

BY JEFF WILLIAMS, Contributing Editor



AMHOME Building System

● The future of housing and home construction has been touted for years. Innovative home builders have brought us urethane foam igloos, laminated panels and geodesic superstructures all with their own problems. For the most part, we build homes today the same basic way we've done it for 50 years.

Carl Hebinck, inventor and owner of the AMHOME patent, saw the light—through a foam coffee cup—that may well change all this. After scalding his lip on a hot cup of coffee, served in a foam cup, he set about a 4-

year trial to incorporate super-insulative components into an acceptable construction system. Like many, he tried to bring 1990s technology to the stodgy world of construction.

The system is made of 9 $\frac{3}{8}$ -in.-thick, rigid, expanded polystyrene foam walls. These 4-ft. \times 8-ft. foam panels are cored with 5 $\frac{1}{2}$ -in.-dia. cavities on 4-ft. vertical centers. The top of the panel is channeled with a 6-in. \times 8-in. continuous horizontal cavity. For special custom conditions, the size and frequency of these cavities change to accommodate greater loads.

Once the panels are temporarily raised and shored, the cavities are



The foam panels are cut to create the hollow post (shown above) and beam cavities that will be filled with concrete later.



Once the walls are raised and filled with concrete, the roof framing is a fairly typical use of engineered beams and rafters.

The AMHOME building system is a radically different approach to creating a new home. The resulting appearance, however, can be extremely traditional as this classic Southern home design (left) shows.

filled with $\frac{3}{8}$ -in. reinforcement steel and 5000-psi concrete. (Conventional pavement concrete is about 3000 psi.) When the concrete is cured, the temporary supports are removed and the roof assembly begins.

Once the rafters are in place, the voids between them are filled with 9-in. rigid polystyrene foam insulation. This foam is topped with a foil radiant heat barrier, which is covered in turn with conventional plywood nailed to the top edges of the rafters. Because there is a 1 $\frac{1}{2}$ -in. space above the foil, there is a live ventilation chamber between the radiant barrier and the roof deck. This allows superheated air to be drafted out, extending the life of the shingles.

The result is an astounding R-40 wall and an R-50 roof system. A typical AMHOME stands in the Florida panhandle. It is a bilevel design with 2300 sq. ft. of living area. The average summer electrical bill for air conditioning is less than \$30. In the coldest climates, a utility bill for heat should not exceed \$1 per day.

Interior and exterior finishes are the whim of the owner. Wood nailers can be recessed and laminated to the polystyrene panels and drywall, or siding can be attached to those nailers. Each door and window opening is



To achieve R-50 in the roof, foam panels are placed between the rafters and covered with foil. Then plywood is installed.

designed with a vertical concrete column on either side, making installations solid and simple.

When it is complete, I liken the structure to a parking garage with traditional concrete post-and-beam construction. According to the engineering calculations for shear strength, the AMHOME system is eight times stronger than concrete block and twice as strong as wood framing. Wind loads have been engineered to 190 mph and the AMHOME design has passed.

Average construction time for the shell of a standard AMHOME package ranges from five to nine days. Cost is slightly higher than conventional R-19/R-30 (in the walls and ceiling, respectively) construction and considerably less than what conventional techniques would cost to achieve the same structural and energy-efficient performance. And, in these days of heightened environmental awareness, consider this: 1 cu. yard of raw oil will produce enough polystyrene to build 10 AMHOMES.

As you can see from the photos, the AMHOME system accommodates conventional architecture. The highest compliment is that once complete, an AMHOME looks like the house that you grew up in. And, I was very impressed by the quietness once inside. Even the surrounding construction noises were nearly imperceptible.

Each AMHOME is fitted with double-glazed, insulated, solid PVC frame windows, a whole house fan, a fresh-air intake to the central heating and air-conditioning plant and an electrostatic air filter. It is critical to introduce fresh air into a house that is this leak free. Many folks with asthma and allergies will find this design yields a cleaner living environment.

Designing the interior of the AMHOME is easy. Because the pitched roof is the insulated and structural envelope, the entire height of the interior shell becomes usable living space. There are no hot attics or dead air spaces inside the shell. The lofted spaces are excellent for playrooms, offices or casual living areas. If the perimeter walls are slightly higher and the roof pitch steep enough, the lofted areas become anything you want them to be. With the roof structure bearing on the perimeter walls and occasional ridge posts, the floor plan can be adjusted for nearly any combination of rooms or wide-open space.

As mentioned before, the primary building component is expanded polystyrene, which brings up questions about fire rating and longevity. The expanded polystyrene used by AMHOME is flame retardant and non-

allergenic. When exposed to direct flame, it will melt, without giving off toxic gases. It will not contribute to fire. Expanded polystyrene is non-nutritive, will not support bacterial growth and is not inviting to bugs. Expanded polystyrene is also UL-listed and manufactured to comply with most building codes. The system has been well received by VA, FHA, conventional lenders, property appraisers and building officials.

Insulation, structure, architectural appeal, livability and longevity are all inherent to the AMHOME design. The ease of handling lightweight com-

ponents allows for do-it-yourself folks to become involved. And, professional builders should welcome the technique once they get past the newness of the concept.

For information, write to AMTECH Patented Homes Corp., P.O. Box 1492, Land O' Lakes, FL 34639; or call (800) 393-3626. **PM**

Jeff Williams is the host of "The POPULAR MECHANICS House Doctor," a satellite broadcast radio talk show about home improvement. Anyone interested in submitting problem-solving products for review in future issues of this column should send information to Jeff Williams, 4275 34th St. S., No. 340, St. Petersburg, FL 33711.



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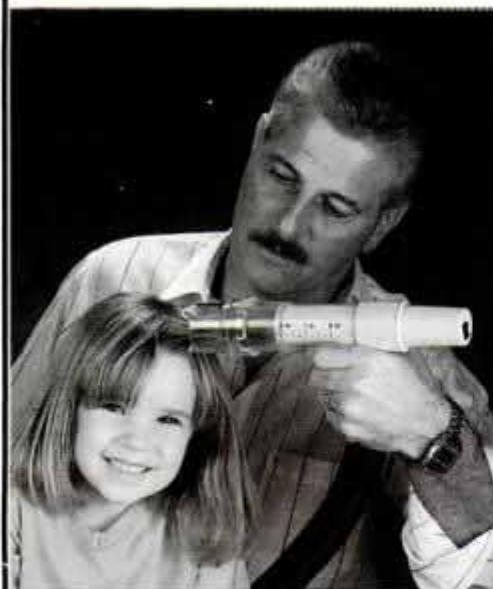
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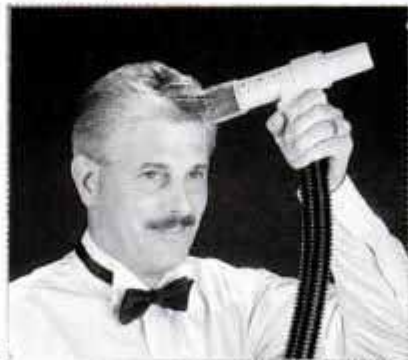
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THE RESCUE OF BOX TOP 22

(Continued from page 52)

before he could deflate his chute. Luckily, none of the group was knocked unconscious and carried away into the darkness.

As Macauley's men struggled toward the wreckage, a second group of five parachuted from the same C-130. The plane then made a third pass to drop survival gear and toboggans loaded with supplies. With parachutes attached, the toboggans didn't stay put on the ground. One blew right past a SARTECH at 40 mph. The team retrieved only one toboggan, which got stuck in a snowbank.

Life amid the wreckage

Approaching the crash site, Macauley saw there was nothing left of the aircraft but a big section of wing and a portion of the tail. He called out. A voice from inside the tail responded, saying there were 11 still alive there.

Macauley and his men set to work immediately, covering the entrance with a parachute and checking on the condition of the survivors. Outside, they found two more, who had been too badly injured to move after the crash. The other survivors had covered them with sleeping bags and surrounded them with snow walls. By now, they were nearly covered with snow, but miraculously still alive.

The SARTECHs set about erecting their 3-layer-thick arctic tent and Macauley called for more SARTECHs to be dropped to help in treating the survivors.

The SARTECHs that responded had the most harrowing jump of all. Departing the Edmonton C-130 only 800 ft. off the ground, Master Cpl. Jim Brown said it was pitch black as he descended. He had just enough time to check that his chute had deployed and to turn so that he would land traveling sideways. The landing knocked the wind out of him and he was dragged over the snow before he recovered and released his chute. One in his group suffered broken ribs, and another a broken nose.

Finding themselves in total darkness, they regrouped using glow sticks and helmet lights. The wreckage was nowhere in sight. Brown formed his men into a circle facing out, then radioed Warrant Officer Macauley to pop a flare. One of the men spotted it, and they formed up in a line. Then they leapfrogged forward, having the two at the rear of the line walk to the front and stand there to keep the rest from wandering off course. It took an hour to cover the 100 yards to the crash site. Soon afterward, the Go-Tracks arrived, bringing extra medical sup-

plies and a warm place to treat the survivors.

While Macauley worked to stabilize the patients, Blair back in Edmonton continued to worry about getting a helicopter to the crash site. The Canadians were still reassembling the Twin Huey at Alert, when the American team launched its Pave Hawks on the 3-hour trip from Thule, which would require inflight refueling from a pair of U.S. Air Force HC-130s.

The Canadians were airborne before the Americans arrived, and made three flights to the crash site in marginal visibility using night-vision goggles. They carried out all of the 13 crash survivors and six SARTECHs to care for them. Then the Huey developed mechanical problems and landed for good at Alert. Eighteen SARTECHs and four Go-Track drivers still needed a ride back.

Alaska Air Guard Maj. Ron Parkhouse, flying in the lead Pave Hawk, said the view through the ITT AN-VIS-6 goggles approaching Alert was "like we were on another planet." Flying in a snowstorm over glaciated, mountainous terrain on a pitch-black night with low ceilings made depth perception and forward visibility just about impossible. Parkhouse quietly wished he was in another line of work at about the time he spotted a dim light from the crash site and landed in the blowing snow. He said without the latest generation of goggles, it would not have been possible.

By the time the Alaska Air Guard helicopters arrived at the crash site, many of the SARTECHs had not slept or eaten much in nearly two days. The Pave Hawks evacuated all of the SARTECHs and the drivers, and also airlifted out the bodies of the dead—each making two trips back to Alert. Of the 18 people on board the Hercules when it went down, four had died shortly after the crash due to injuries. The pilot, Capt. John Couch of Edmonton, who had flown many search-and-rescue missions during his career, had organized the survivors and gotten them into shelter. He was lightly clothed and died of exposure before help could arrive.

The rescue aircraft and crews from Canada and the U.S. dispersed quickly to their bases after completing their mission at 82° north latitude. For most of them, it had been the most difficult mission in memory. "This is the farthest north a rescue has ever been carried out [by the Canadian military]," said Ritchie, a 20-year veteran of SARTECH duty. "What made it such a big thing was to get that many people out from so far north." **PM**

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HUBBLE COMES THROUGH

BY ABE DANE, Science/Technology Editor



WFPC image of M87 (left) shows increasing brightness toward core, which emits plasma jet. Jet is shown in more detail by Hubble's Faint Object Camera (above).

dio astronomers soon discovered that similar emissions from other points in the sky indicated a great many other jets scattered about the universe. A basic question remained: What sort of powerhouse could send such a violently energetic, yet tightly focused beam of material streaming across the heavens?

When Hubble came into the picture, the prevailing theory was that gigantic black holes were responsible for the jets. On the face of it, the idea seems strange, since these superdense objects are characterized by voracious gravitational fields that don't let *anything* out, including light. But the theory held that certain very large black holes have what might be called messy eating habits. As stars, gas and other matter are sucked in, they crowd together around the hole, forming a disc-shaped cloud of superheated material that spins toward it like a flattened whirlpool. Magnetic fields contained in this rotating disc generate a perpendicular electric field that spews jets of plasma out like axles from the disc's hub.

It's never been possible to verify this theory because of the limits that optical distortion from the Earth's atmosphere places on the resolution of ground-based telescopes. With Hubble's Wide Field/Planetary Camera (WFPC), however, Lauer and his colleagues were able to see

● With the harsh glare of publicity from its initial defects now mercifully diminished, astronomers are beginning to consider the Hubble Space Telescope for what it is, rather than for what it might have been. And what it is, new findings demonstrate, is a way to see the universe more sharply than ever before.

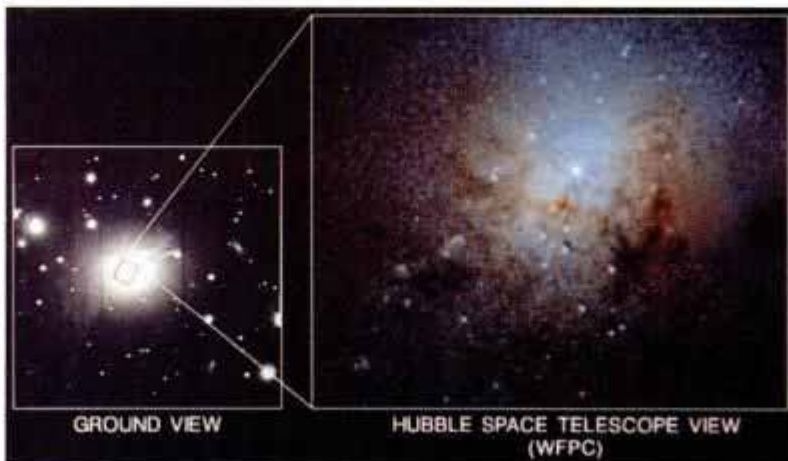
Eager to prove the telescope's worth, Hubble researchers have targeted some of the most puzzling spots in the universe, hoping for a big breakthrough. Although its primary mirror's spherical aberration severely limits its ability to make out faint objects, the telescope has already produced significant headway in our understanding of some of the sky's brighter mysteries.

Big squirt

Last June, for instance, a team led by Dr. Tod Lauer of the National Optical Astronomy Observatory at Kitt Peak took a look at M87, a large elliptical galaxy about 52 million light years away. Also known as Virgo A, M87 is the

dominant galaxy in the Virgo Supercluster—a stupendously huge conglomeration of galaxies on the outskirts of which lies our relatively modest Milky Way. It is the brightest galaxy within 75 million light years of Earth. But the most peculiar thing about M87 is a tremendous jet of plasma that squirts from its center and stretches straight out into space over a distance of 4000 light years.

When first discovered in 1915, the jet was unlike anything astronomers had ever seen. Around 1950, radio telescopes found it to be emitting very strong radio and X-ray radiation. Ra-



Hubble makes globular clusters in NGC1275 visible as blue dots.

into the heart of M87 about 10 times more clearly than any previous observers. "It was night and day," Lauer told me. What they saw comes very close to proving that there is in fact a black hole about 2.6 billion times as massive as the Sun lurking in the center of M87.

The main indication of this is the fact that stars grow sharply more concentrated toward the center of the galaxy, suggesting that some tremendous force is drawing matter inward toward a point. Where earlier observations had left open the possibility that this increasing density might level off at a plateau, Hubble shows a definite cusp, or peak, of brightness. There, stars are about 1000 times closer together than in the neighborhood of Earth.

Lauer points out that although the new data is quite persuasive, one final piece of evidence is needed to complete the case for the black hole theory. High-resolution spectroscopy, which must wait for a repair of Hubble's optics scheduled for 1993 (see [Tech Update, page 16, Apr. '91](#)), will make the conclusion all but inescapable. For the moment, says Lauer, "It looks like a duck but we haven't heard it quack yet."



Computer simulation of crash that might have created globular clusters in NGC1275.

Something old, something new

Hubble's powerful gaze has not only bolstered existing theory, but has also turned up something totally unexpected. When focused on the more distant galaxy NGC1275, Hubble's WFPC found approximately 50 young globular clusters.

Now globular clusters are in themselves nothing unusual. More than a hundred of these tight, spherical clumps of 100,000 to 10 million stars have been found orbiting our own Milky Way Galaxy. But all of the globular clusters astronomers have seen up till now—at least, all of those comparable in mass and compactness to those at the center of NGC1275—

have been absolutely ancient. Typically, they have been on the order of 10 to 20 billion years old, leaving their origins lost in the primordial days of the universe.

The clusters in the heart of NGC1275, on the other hand, radiate a youthful blue glow, which according to astronomer Dr. Jon Holtzman of the Lowell Observatory in Flagstaff, Arizona, shows them to be no more than several-hundred-million years old. "Such objects have never before been seen," he says. Ray Villard, a spokesman for the Space Telescope Science Institute, compares the find to stumbling across a live dinosaur in the Amazon jungle today.

The implication is that conditions similar to those that gave birth to the more typical, elderly clusters in the early days of the universe must have been recreated relatively recently in NGC1275. Astronomers had already suspected that this huge elliptical galaxy was the product of a collision between two smaller ones, which could have brought about a suitably violent setting. Support for this idea comes from the fact that all the young clusters in NGC1275 appear to be the same age, and so could easily have resulted from a single smashup. **PM**

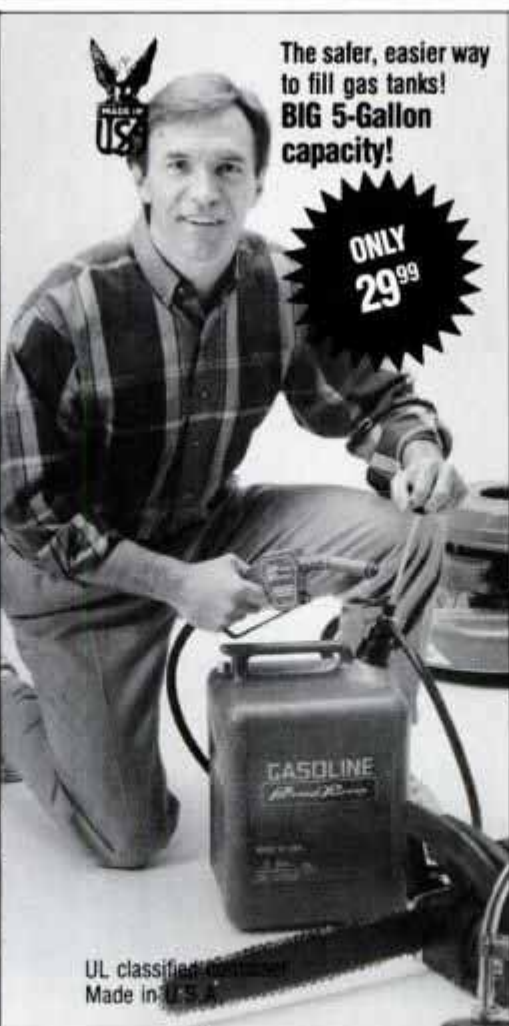
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DETROIT SPY REPORT

BY JIM DUNNE, Detroit Editor



'94 Cadillac DeVille

● Cadillac will go to a more massive appearance in the styling of its all-new 1994 DeVille sedan. Rounded lines and a better balance between hood length and deck overhang are the primary features of the change. The new car will retain its V8 engine and front-wheel drive, but look for an sohc version of the 4.6-liter Northstar V8 engine under the hood and horsepower in the 220 range.

Though this prototype is heavily disguised, some details are visible. Bumpers are plastic covered, with no chrome visible at the front or rear. The blacked-out grille is a typical Cadillac eggcrate design. It will be a chrome finish, not painted.

'93 GMC Sonoma

Look like an import pickup? That's the direction that GM seems to be going with its compact pickup styling of the future. Rounded fenders, sloping hoods and severe sculpturing along the sides are features of the imports that show up on this prototype of a 1993 GMC Sonoma.

Note the blister over the rear wheel. A similar bulge occurs over the front wheel, though it is not evident in this photo. Chevrolet's S-10 pickup has similar sheetmetal lines, but the grille insert for the Chevy is unique.

At the center is the traditional Chevy bowtie insignia.

Electric Steer

Look for the first use of electric-powered steering to show up on the electric cars Chrysler and Ford are preparing for the 1995 model year. Though not a true "steer-by-wire" system, the vehicles will use an electric motor in place of the hydraulic pump used in conventional systems to power the steering assist.

There will still be a mechanical connection between the steering wheel and the road wheels. That is unchanged from today's arrangements. But, an electric motor will boost the effort when heavy pressure is needed to turn the steering wheel.

The advantage of electric steering



over hydraulic is energy conservation, a high priority in electric-car design. With hydraulic power assist, the engine must be running and pumping while the car is in use. With the electric setup, electric power is only used when boost is needed, mostly during parking or low-speed turns.

Plastic Pullback

GM's plastic panels on its sleek minivans may not be around for much longer. The Chevy Lumina APV, Pontiac's TransSport and Olds' Silhouette use plastic panels for all vertical portions of their exterior skin. But GM

may pull back on that design when the 1995 models are introduced. Not because the plastic is wrong. But because the vans will be built on the same production lines as steel-bodied sedans, and the use



1993 GMC Sonoma minipickup shows import styling influence.

of steel for both vehicles makes assembly steps simpler. GM plans a styling change along with the new body material. The front ends will have a windshield that is more upright, with a small bulge extending forward over the engine compartment. The often-criticized "shovel nose" profile will be abandoned in favor of a more conventional hood bulge.

No Yoke

Look for the name "Scotch yoke" to show up as a possible new engine design for autos. The term refers to the way pistons push a slide arrangement before turning a crankshaft. In this engine, cylinders are opposed. The flat layout saves space under the hood. The Scotch yoke is also said to be more efficient than the standard automotive engine, mainly because it loses less power to friction.

The engine design is not new, but it is being rediscovered by researchers in the U.S. and overseas as a way to make a car's engine compartment even smaller. In automobiles, it is still a curiosity, and there are no plans to install it in an American or Japanese production car in the next five years at least.

Wired Backlite

That maze of wires you see on the rear window of the Infiniti J30 contains a radio antenna plus a telephone antenna in addition to the familiar defogger. That's all in addition to the mast antenna for the AM/FM radio that sticks up out of the fender. At the top of the rear glass is a simple radio antenna that augments the car's FM receiver. At the bottom is the antenna for a built-in cellular telephone.

No pigtail antenna is needed here, so there are no damage problems in the automatic car wash. In the center of the backlite are wires for the defogger. Look for this system to be copied by other luxury sedans as cellular phones become more common and FM reception is refined.

Baby Seats

Chrysler is selling those integrated baby safety seats to more customers than expected. Grandparents are choosing the baby seat in their Chrysler vans so that they won't have to lug around a portable seat and set it up each time they visit their grandchildren. Chrysler reports that rental fleets are ordering integrated baby seats, too. Some 30% of Chrysler vans going to fleets are equipped with the safety seats. Look for the integrated baby seats to show up in Ford and GM vans just as soon as they can get a good supply into production. **PM**

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GHOSTBUSTERS

BY FRANK VIZARD, Electronics Editor



● It's the rare person that is able to drive around looking for ghosts, but that's exactly what two people did as part of a television research project. No, they weren't part of a show on poltergeists, but perhaps they should have been, as they found ghosts virtually everywhere. But unlike previous close encounters, these ghosts were eliminated.

We all know these ghosts very well. These ghosts appear on our televisions when reception is poor. Sometimes they come alone or as a pair. At its worst, it seems as if there's a bus load of ghosts inhabiting the screen.

The researchers, working for the National Association of Broadcasters (NAB), tested 106 locations in the Washington, D.C., area. At each location, they checked the signal quality from one VHF, one low UHF and one high UHF (channels 4, 20 and 50). Ghosts were found at every location.

The good news is that while ghosts are almost everywhere, they're on the verge of extinction. The ghost-hunting researchers were testing a

variety of systems designed to eliminate ghosts. And yes, they found one that works really well.

Where do ghosts come from? Normally, TV signals travel in a straight line between the transmitter and receiver. However, when there is a short signal path between the transmitter and the antenna, the same signal can reach the TV antenna over a different and longer echo path. This echo path develops as the TV signal is reflected off buildings and other objects. What you see on your TV screen is the main image and a number of weaker echoes caused by the reflections.

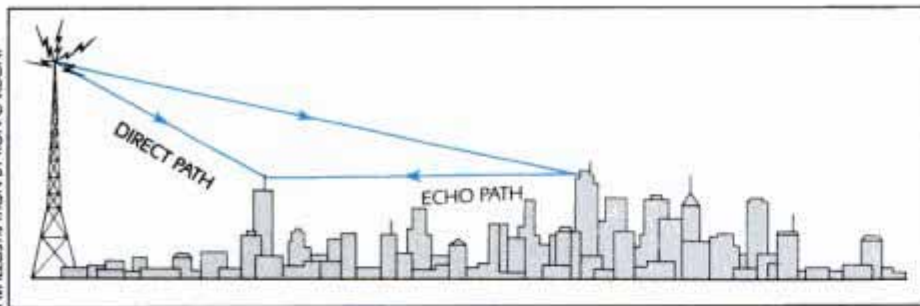
Who do you call to kill a ghost? In this instance, you call Philips Laboratories in Briarcliff Manor, New York. Scientists working in this facility overlooking the Hudson River built an electronic ghostbuster that not only eliminates stationary ghosts (something a Japanese team had already done in 1988), but also removes moving ghosts. And this system also worked well in weak signal areas at

The ghost-filled picture at left is electronically processed to yield the ghost-free picture at right.

the edge of a television broadcaster's range.

At the heart of the system is a special Ghost Cancellation Reference (GCR) signal broadcasters transmit in a hidden portion of the TV field. By the time the GCR signal reaches a receiving antenna, it has undergone the same ghosting distortions as the television picture.

The received analog signal is then changed into digital form using an inexpensive 8-bit converter. Once the signal is in digital form, it can be easily manipulated. The signal is then compared to the original GCR signal. Based upon this analysis, settings are made for a ghost canceling filter. The filtered signal, with ghosts removed, is converted back to analog for normal viewing. This whole process is done electronically in 1 second. This processing speed is what makes the Philips system so effective. The ghost



Ghosts appear when a TV signal creates a second, longer echo path after being reflected off buildings and other objects. Ghosts can appear singly or in huge numbers if a lot of reflections are involved.

canceling filter chip is produced by Philips, as are the mathematical algorithms and processing software that control the system. This system outperformed four others in NAB trials to win the ghostbuster title.

How soon before this ghostbusting technology shows up in your living room? If you're hooked up to a cable TV system, then you may be ghost-free very soon. A division of Philips called Magnavox CATV Systems is already selling "Vector," a rack-mounted piece of electronics incorporating Philips' ghostbusting technology. Designed for cable operators, Vector essentially wipes clean the over-the-air signal received by a cable system before it is sent down the line to your home. Each Vector unit costs about \$4000. Cable systems do sometimes produce their own ghosts, but the problem isn't as noticeable as over-the-air ghosting. Assuming your local cable-TV operator is interested in supplying a ghost-free picture, then Vector is probably a part of your future.

If you're not connected to cable, then you'll have to wait until the Philips ghostbusters are built into televisions. It may be a year or more before ghostbusters are integrated into television production runs. Presumably, Magnavox TVs will have the technology first, but it will be licensed to other manufacturers. More than likely, the technology will appear in more expensive models until development costs are amortized. In the meantime, start saying goodbye to those television ghosts.

Flying Video

If you're already into flying model airplanes, you can put more fun into your hobby by adding a small video camera to the craft. One tiny camera that seems to do a good job is available from a company called Supercircuits.

The Supercircuit camera, called the PC-2ex, weighs only 2.3 ounces and is less than 2 in. square, so it doesn't take up a lot of room. Its small size also means that the camera's power requirements are minimal as well

—only 95 milliamps, 9 to 13 volts DC. Horizontal resolution is 240 lines, roughly the equivalent of VHS tape. List price is \$197.

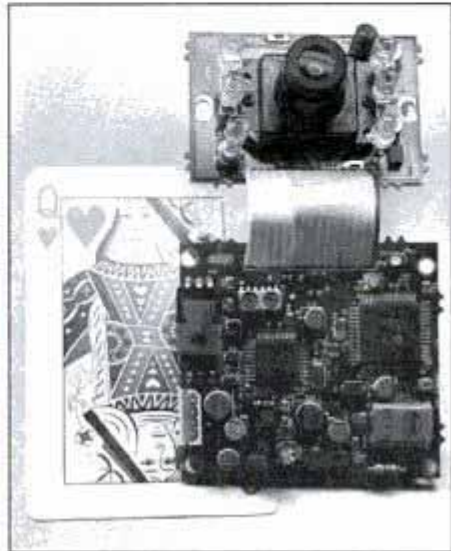
The idea is to combine the PC-2ex camera with an amateur video transmitter. These transmitters have a range of up to 2 miles. You can then watch and record what the plane sees on a small monitor and VCR.

You might also consider using a standard 8mm video camera, provided the model plane you're using is large enough. A tape we saw that was produced by some New Zealand enthusiasts contained stunning scenery shots. This idea can also be adapted for model-car use.

For more information on the PC-2ex, transmitters and installation,

contact Supercircuits at 1403 Bayview Dr., Hermosa Beach, CA 90254; (310) 372-9166.

Meanwhile, aircraft of a different sort are the concern of Fox Electronics and Technology in San Jose, California. The Air Vixen FX4 reveals the presence of traffic surveillance airplanes by detecting the digital altimeter reading generated by all aircraft. The Air Vixen FX4 detects aircraft flying at altitudes under 3500 ft. List price is \$270. **PM**



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Kawai's Superboard features a digital mixer and chorus effects.

The band-in-a-box idea flaunted by these keyboards has actually been around for the better part of the century—both the player piano and the cheesy "Rhythm Ace" of motel lounge notoriety being obvious examples. The '90s spin is the addition of today's inexpensive computer memory, and with it, the idea takes on new life.

The basic idea behind most electronic keyboards is to make the instrument itself an active collaborator

in the music-making process. Unlike synthesizers, which are a different animal altogether, personal electronic keyboards are generally not designed to create new sounds. Instead, they are geared toward providing a full ensemble of digital band members to back up the live musical performer.

This is done by adding preprogrammed rhythms, automatic harmonies and intelligent accompaniment to a lead part that the user plays. This lead "voice" is picked from a wide palette of tone colors which have been stored in the keyboard's memory. Once a lead voice is chosen, the fun begins. Virtually all electronic keyboards feature some kind of rhythmic accompaniment, ranging from rock and R & B beats to tango, ballad, waltz and even the occasional fox trot. Choosing one of these rhythms pro-



Key in a number to select any instrument sound you like.

vides the basic backbeat, which is then layered with either manual or automatic accompaniment. The lowest octave or so of the keyboard is usually reserved for manual accompaniment, which can be played in one of several styles.

Auto accompaniment is another important feature. By pressing a single note, auto accompaniment plays a



Four drum pads let you add your own percussion sounds.

preprogrammed musical phrase that follows the chosen rhythm and musical key. When all the automatic rhythms and accompaniments are in motion, the sound from these keyboards can be surprisingly full. Sounds are heard through either built-in speakers, headphones or an external sound system.

Although electronic keyboards appear under many different brand

(Please turn to page 126)

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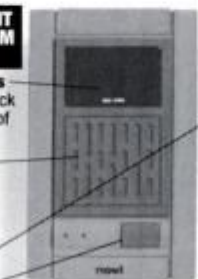
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ually shifting background chords.

Above and beyond its elaborate simplicity, though, the FS800 points the way to a more creative musical approach, where the player can be actively involved in composition and sound design. For example, rather than simply provide preprogrammed auto rhythms, the Superboard allows the user to create up to 85 new phrases, which can be used in the same way as the existing ones. In addition, the player isn't limited by the rhythmic patterns stored in the machine. Four separate drum pads on the top panel can be assigned any percussion voice in the machine's memory. This means that drums can be played manually and recorded, just like a digital drum machine. Once the keyboard has been programmed to the player's satisfaction, a real-time recorder can record up to three complete songs, or a total of 3500 notes.

This emphasis on more ambitious musical aspirations, as opposed to simple accompanied playback, seems to be the direction that electronic keyboards are leaning toward. Many of them feature a jack—called a MIDI (musical instrument digital interface) port—for interfacing with other electronic music gear or personal computers. By connecting a MIDI-equipped instrument like the FS800 to a PC, an entirely new world of musical possibilities opens up.

One of the most intriguing applications is musical education, in the way of software that will actually teach basic to advanced musical skills. A currently popular expression of this idea comes from Software Toolworks, whose "Miracle System" is a computer-age alternative to the dreary piano lessons foisted on many an unwilling young student. A small keyboard connects to a Macintosh, Apple or IBM-compatible computer, which administers a series of tutorials in notation, sight reading, fingering technique and other basic musical skills. The clear advantage to this electronic approach is that the student can learn at his or her own pace, with the computer keeping track of the overall progress in any area. List price is \$480. For aspiring players who don't own a PC, the Miracle System is also available in a Nintendo-based version, albeit with less elaborate capabilities and somewhat cruder video graphics, for a list price of \$380.

As the worlds of microchip music and MIDI continue to unfold, it's clear that a new kind of musical democracy is in the making. Using one of these electronic keyboards, almost anyone can be a band leader or even a composer, easily and inexpensively. **PM**

AUDIO (Continued from page 124)

names, the market is dominated by a handful of manufacturers. Casio, which was the first to popularize the concept here in the U.S., offers a wide line of products, ranging from the miniature \$99 Rapman (complete with a digital DJ wheel for "scratching") to full-size stereo models that feature all the trimmings.

Yamaha, a maker of virtually every kind of musical instrument imaginable, is also quite active in this arena. Several models in the company's PSR line feature the same FM synthesis sound-producing technology used in Yamaha's professional synthesizers. One of the more energetic manufacturers is Kawai, whose experience as a maker of both acoustic pianos and electronic synthesizers is apparent in the company's line of personal keyboards.

Perhaps no machine shows off the progress of this technology better than the Kawai FS800 Superboard listing for \$599. A full-size (48 x 17 x 6 1/4-in.) stereo unit featuring a 61-note keyboard, the Superboard combines the "one-touch" thinking of a personal electronic keyboard with the flexibility of a true synthesizer workstation.

Naturally, the FS800 can produce music with only the slightest inter-

vention from the actual player. A lead voice is chosen from a palette of 100 16-bit sampled sounds, which can be combined and treated into many more sonic possibilities. Several different auto-accompaniment modes are featured on the FS800: The player can either play melody with the right hand and one-finger chords with the left, chords with the right hand and bass sounds with the left, or one finger on the left hand to trigger entire chord progressions. The auto-accompaniment phrases are chosen by way of a feature that Kawai calls "one finger ad lib." Seventeen hundred of these phrases are stored in memory, many of them detailed enough to feature contin-



Casio's miniature Rapman lets you scratch your musical itch.

EXHIBIT (Continued from page 56)

in the machine's copper tub, an electric motor rocked the entire tub back and forth.

Nearby, a 1922 handheld electric vibrator is matched up with its PM advertisement claiming, "Our combination outfits give you three of the greatest curative agents—Vibration, Faradic and Galvanic electricity."

Many of the names devised for new electrical products emphasized the greater cleanliness housewives could achieve by using tools with new abilities. One such clean machine on display is the Air-Way Sanitary System, a lightweight electric vacuum cleaner of 1920.

Out on the farm, however, the dream outstripped the reality. A PM article on electrical farming reported in 1929 that, "Electricity is this new chore boy that is changing the age-long habits of Earth's oldest industry." But despite the promised benefits, the cost of running long-distance power lines to rural homes and farms was often prohibitive before government-sponsored electrification programs and subsidies began taking place in the mid-1930s.

In the meantime, PM helped out underserved rural readers by offering plans for various types of generators and reviewing the available commercial models. We located a wind-driven Zenith "Wincharger" for the exhibit, hooking it up to an old car battery and a Zenith 6-volt radio especially designed for use with this type of generator. Yet all the while, PM pitched the advantages that complete electrification could bring to the dairy, the poultry barn and the sheep-shearing operation.

So, has electricity eliminated drudgery, as PM once promised? You be the judge. But the next time the lights go out, remember that it was in part through widely read magazines like POPULAR MECHANICS that many Americans were convinced to buy into the new power system that changed the way the world worked. **PM**

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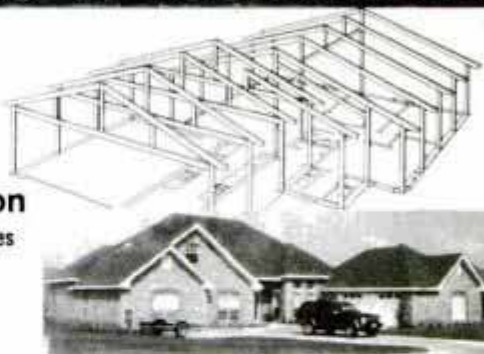
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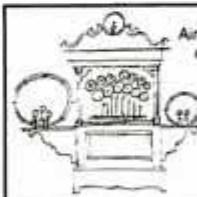
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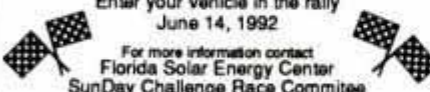
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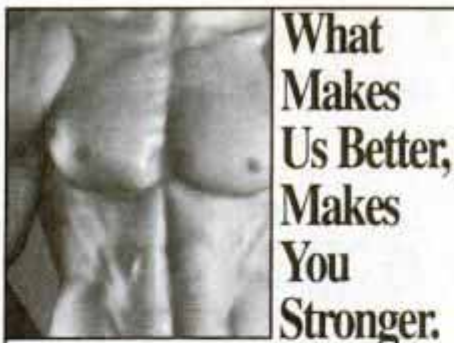
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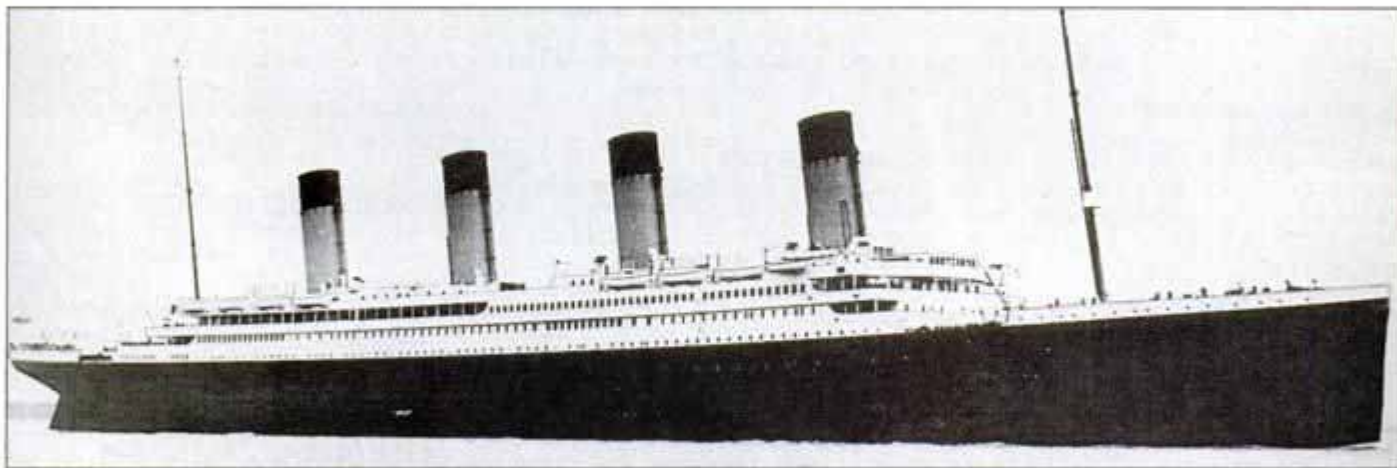
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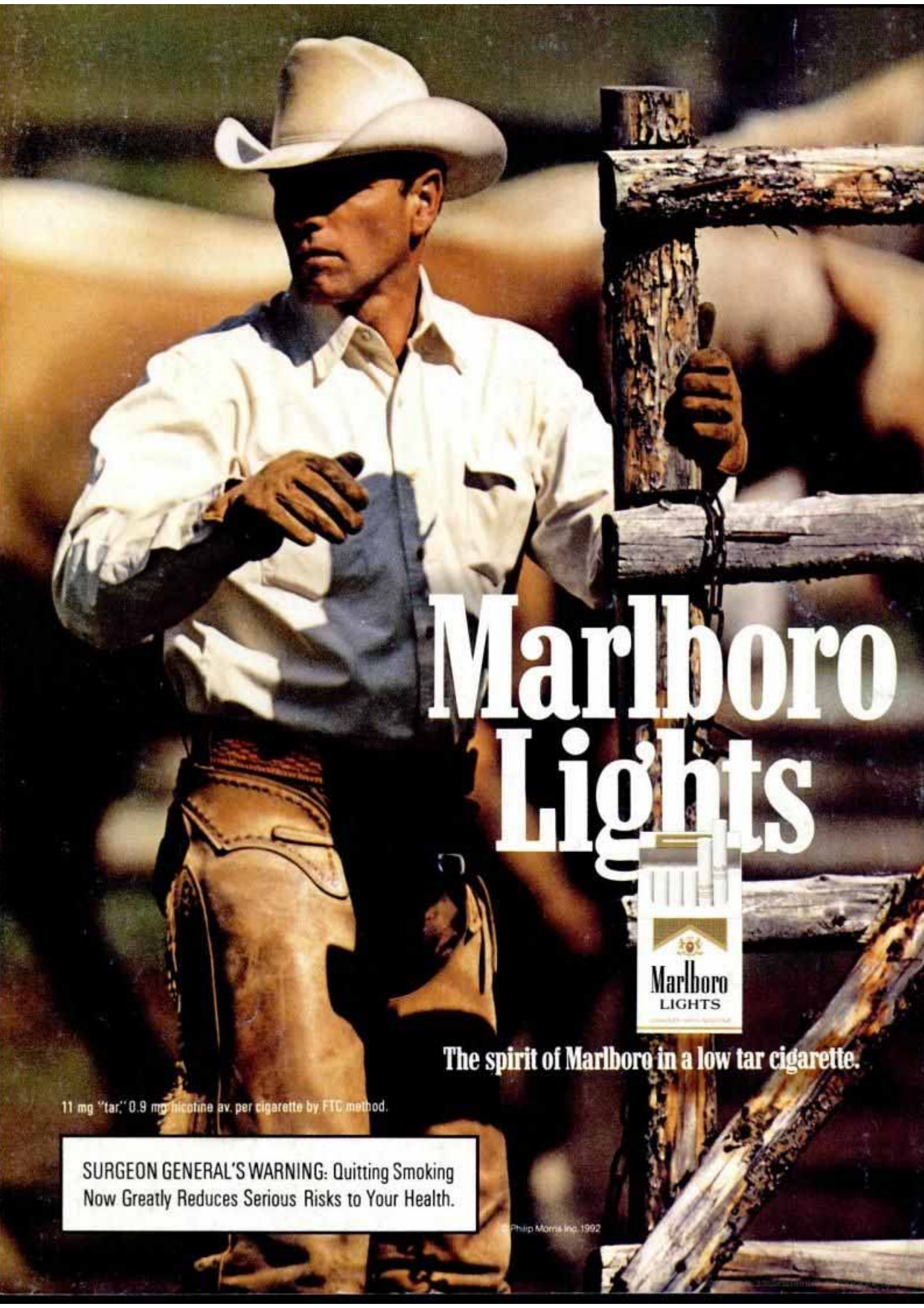
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