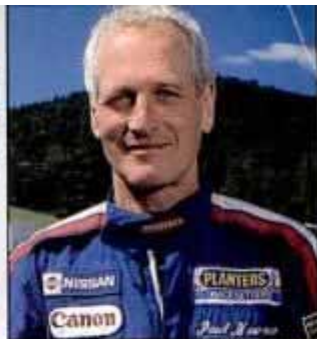


MAY 1988 \$1.95

Popular Mechanics

PAUL NEWMAN
Changing Gears For
The Indy 500



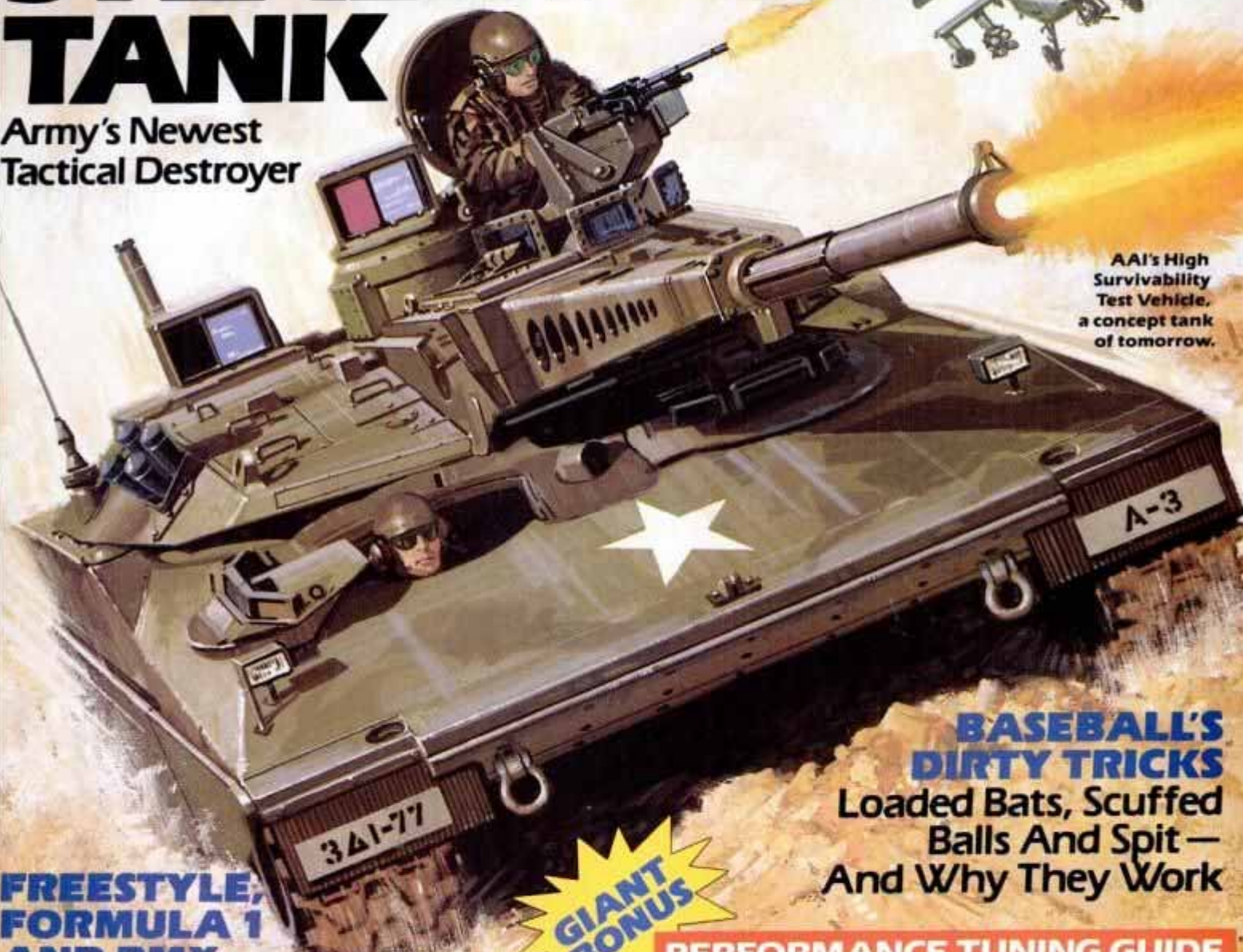
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The box at the right compares Ranger XLT



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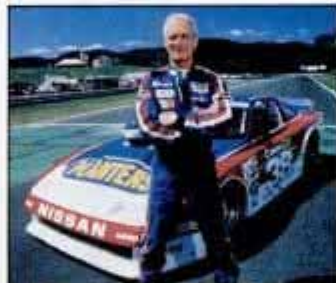




68 COVER STORY

A new generation of agile armor that evades the enemy and increases the U.S. Army's battlefield punch will emerge in the next century.

—PM Illustration by Ed Valigursky



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86 Divide and conquer



78 Talking bike to your kid

PERFORMANCE TUNING GUIDE

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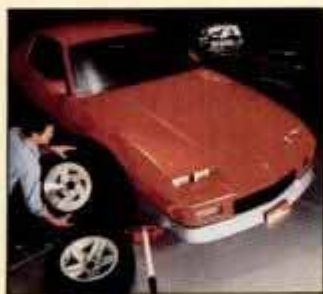
With monochroming, engine detailing, new paints, bodywork basics and that bottomless shine, you're looking hot.

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From do-it-yourself fuel injection to powershifting your automatic, here's how to get ultimate performance.

128 Chassis

Hot wheels, better brakes, just the right size tires, shock treatments and antiroll bars give you sports-car handling on the road.



AUTOMOBILES

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Winning races and setting up race cars come naturally to Paul Newman.

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Our easy-to-build, contemporary room divider is the ideal place for books and collectibles.

91 **Drill Bits**

A comprehensive guide to the latest hole-boring tools.

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15 **Tech Update**

The latest in aviation, energy, fusion, electronics, medicine and entertainment technologies.

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In an age of impersonal computer printouts, the fountain pen is reasserting its technological sophistication and distinctive individuality.

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Low-silhouette, rapid-firing stealth armor is on the fast track in the U.S. Army's drive for rapid deployment.

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78 **How To Talk Bike To Your Kid**

What you need to know when your son gets into totally rad BMX, Freestyle and the hot new Formula One bikes.

82 **Foul Ball!**

Former mound ace for the St. Louis Cardinals, Jim Kaat, delivers the inside pitch on baseball's hijinks.

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EDITOR'S NOTES



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AN INVISIBLE TANK? Well, not quite. But the next generation of battlefield armor will have such a low silhouette (or a low visible signature, as they say around the Pentagon), that it will be much more difficult for enemy radar and infrared detectors to see our tanks. And of course, that means survivability on the battlefield will be greatly enhanced. If you're at all familiar with older-generation armor, you'll be surprised at

the appearance of this new coming generation that will be operational in the next 10 years. . . . Everyone wants a car that runs and looks better. And that's the whole premise behind this month's gigantic Performance Tuning Guide that begins on page 95. In it, you'll find loads of tips on improving underhood muscle, over-the-road handling and visual appeal. The Guide represents months of work by Automotive Editor

Tony Swan, Assistant Automotive Editor Mike Allen, Contributing Editor Norman S. Mayersohn and Contributor Paul Stenquist. If you can't find something in this Guide that will improve your car, I'll hang it up. . . . Since our January 1986 issue, we've run 13 installments of our ongoing hand tool series. The series, written by Shop & Tools Editor Joe Truini, takes an in-depth look at a different category of tool in each installment. This month, the focus is on drill bits (page 91)—those small, but vital tools that are often overlooked in one's toolbox. The newest high-tech bits feature titanium-



Auto Department Editors Allen and Swan.

nitride coatings, alloys that stay superhard, and seemingly last forever. There are some bits you'll recognize as longtime favorites and others that will be new even to the most experienced do-it-yourselfer. If you've got a hole to drill, we've got the bit for the job.

. . . As you read this, opening day for the 1988 baseball season is imminent. For some of us here at POPULAR MECHANICS, opening day is a religious holiday. For a few of the 600 or so major league baseball players of America, opening day 1988 signals the start of the new cheating season. Perhaps cheating is too harsh a term, as author Jim Kaat explains in his article, "Foul Ball!" beginning on page



(L to R): BMX Action Executive Editor Craig Barrette, bike racer Greg Hill, and PM Outdoors Editor Joe Skorupa talking bike.

82. Kaat, a major league pitcher himself for 25 seasons and now a broadcaster for the Minnesota Twins, says that rule bending is part of the game and always has been. Last year it was corked bats and scuffed balls. I can't wait to see what happens in '88. . . . Have you heard a strange language spoken in your home recently? Is your kid walking around saying things like chromemoly, downtube, titanium crank, freestyle and stem? If so, welcome to the wonderful world of high-tech kids' bikes. Depending on whether your kid is into freestyle, BMX or Formula I, his bike may look like a motorcycle road racer, a motorcycle off-road racer, or a gangly conglomeration of salvage-yard parts. But make no mistake. Today's bikes are engineered to a fare-thee-well and are very specialized. To learn the language, check out page 78. 'Til next time.


Joe Oldham



Waiting for the new arrival.

He had been mail ordered some 70 years ago. Been handed down from Everett to Ruby to Mike as their time for such a trustful friend first came, then went away.

Today, the bear rests in his latest home. Awaiting his latest charge. Born, more or less on schedule, just a few short nights ago.

The house. This home was different from the ones the bear had known before.

He thought the difference was all the windows. That made this place seem more spacious than it was. That let the light flood in. That kept the coziness from slipping out.

In part, he was right. The windows were, in fact, something truly special.

The windows. Each of the windows... from the big bay in the living area to the round-topped one he anxiously waited in... was *The Intelligent Window*®. A kind made with just one type of remarkable glass, *Sungate*® coated low-E glass from PPG.

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The arrival. Light shines through the *Sungate* coated glass as the nursery door swings open. A napping infant moves from a mother's arms into an antique crib.

A long-time family friend sits watching from the window. And finally, is lifted from the sill and introduced to Jason.

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FOUR WHEELER OF THE YEAR.

Chevy's new 4x4 is off to a flying start.

Four Wheeler magazine has named Chevy's new full-size 4x4 the 1988 Four Wheeler of the Year.

Not because our big new 4x4 won its class at the Off-Road World Championships.* Or because it's the first all-new full-size 4x4 pickup introduced in this decade. But because the editors of *Four Wheeler* drove it. And loved it.

You can test drive that same Four Wheeler of the Year at your Chevy dealer's.

Do it and you'll feel the winning edge in power from a fuel-injected Vortec V6 with 15 more standard half-ton horsepower than Ford. Feel the precision of the standard 5-speed manual transmission with overdrive. Feel the ease of shifting on-the-fly with Insta-Trac that's also standard. Feel the smooth ride of the double A-arm independent front suspension system.

Test drive a new Chevy full-size 4x4 pickup and you'll feel quality built to last. Quality built to win.

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LETTERS

World-Class Cars

NO ONE HAS to spend that kind of money for a luxury car! I'm referring, of course, to your "Lapping In Luxury" comparison test of the Jaguar XJ6, BMW 735i, Maserati 425i and Mercedes-Benz 560SEL (page 57, Feb. '88). Too bad you didn't see fit to compare an '88 Cadillac Sedan DeVille and an '88 Lincoln Continental with the four European sedans. I think you'll find that Cadillac's new 4.5-liter V8 engine and the Lincoln's computer-controlled suspension would make the American entries comparable in terms of engineering and overall performance. Why weren't they included? Detroit can build cars that are world-class in every respect.

STEVE STONE
TRENTON, MI

While waiting for the '88 models from Detroit, we figured we'd take out the megabuck luxury sedans—cars in a category by themselves because of their prices, not because of their country of origin. In a comparison test of Detroit's latest luxury models coming up in our August issue, we'll be looking to see if world-class value has to start at \$50,000.

Safety Tip

Your article "How To Repair An Overhead Garage Door" was excellent (page 125, Feb. '88). It would have been more complete, however, if you included a paragraph on the dangers posed by the large springs used on either side of the door. Recently, one of my overhead door springs broke with a crack that sounded like a rifle shot and it smashed a hole in the ½-in. plasterboard on the garage wall.

Cheap insurance against injury and damage is the addition of safety wires installed through the springs. I



February '88 issue: Top right-hand corner shows the Mercedes-Benz 560SEL, winner of Super Sedans comparison test.

use lightweight cable and clamps to do the job, and I think these safety wires should be standard equipment on garage door springs!

WILLIAM F. KACZOR
GROVELAND, MA

Bet Your Boots

As someone who has been doing his own front-wheel-drive maintenance for 20 years, I found your article "Servicing Constant-Velocity Joints" (*Saturday Mechanic*, page 147, Feb. '88) to be a perfect review of the importance of periodic CV-joint inspection (and thanks for debunking the split-boot myth).

But there was an omission: boot maintenance.

It's true that CV joints should last the life of the car (which, for me, is 100,000 miles+), but the boots won't last this long unless they're cared for.

At alternate oil changes (more often if the car is getting old), I clean all four boots with a product like Armor-All or STP vinyl rubber protector, massaging the boot well while rotating the wheel. As you implied in your story: As the boot goes, so goes the joint.

DAVID B. CAMERON
UNION MILLS, NC

Radio For Help

It's about time I thanked you for "Shortwave Lightweights" (page 84, April '85) and your mentioning that shortwave listening can be helpful for polishing up knowledge of a foreign language. As a clergyman, I studied German in school because most theological literature is in German. Still, I wasn't proficient enough to use the texts I have in my library—until I started listening to German language broadcasts several times a week over the last couple of years.

P.S.: In addition to QSL cards, many stations offer various items like program guides, calendars and other literature—free.

PHILIP BOHLKEN, PASTOR
OUR SAVIOR
LUTHERAN CHURCH
OOLTEWAH, TN

Gone Fishin'

Jim Bashline's "Reel Value" (page 70, March '88) was an excellent introduction to a fascinating hobby. The workmanship, ingenuity and artistic design that have been applied to such a humble tool as the fishing reel is amazing. Many of the early handmade reels so sought by collectors were constructed with a precision usually reserved for fine watches. Others were equipped with interesting features such as weird level-winds and unusual clutches, often in the Rube Goldberg tradition.

I hope that novice collectors will bear in mind that, as with any antique or collectable item, the values of most reels will not increase rapidly. Prices, as usual, reflect quality and scarcity. There is more to be gained by admiring the beauty and variety of the reels than by considering them merely as investments.

Let me mention that my book, *Antique Fishing Reels*, that Mr. Bashline kindly mentioned, is currently out of print. But readers who

would like a copy can obtain one from me at P.O. Box 133, Villanova, PA 19085 for \$25 postpaid.

STEVEN K. VERNON
VILLANOVA, PA

Electronic Doorbell

"How To Repair A Doorbell" in your January '88 issue (page 103) contained good tips for most readers, but was wasted on me: I've got an electronic doorbell of my own design—surely the only one in town, and maybe the only one anywhere. The buzzer is in the house, but the doorbell pushbutton is on my homemade mailbox which is located on the front gate. My doorbell also buzzes when the lid of the mailbox is lifted, so I'm "paged" when the mail is delivered! My design uses a low-powered transmitter and a receiver such as used for garage door openers.

THEODORE V. LOOMAN
SACRAMENTO, CA

Sharp-Eyed Reader Award

Why do you show left-hand twist drills in the two illustrations that accompany "Saturday Mechanic" in the January '88 issue (pages 115 and 116)? Is it a lack of attention to detail, carelessness, or a deliberate attempt to bug the perfectionist reader? Please render threads the *right* way in your mechanical drawings showing screws, bolts, drill bits and so on.

LAURANCE SAWYER
RINGGOLD, GA

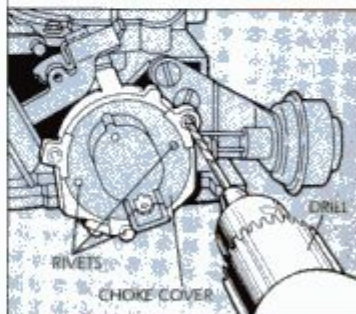


Illustration from *Saturday Mechanic* shows a left-spiral twist drill bit instead of right-hand.

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Or maybe they know that the most impressive thing about Makita cordless tools is what they build.

Reputations.

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TIME MACHINE

75 YEARS AGO: May 1913

Les Gangbusters

In 1913 PM introduced readers to possibly the world's first SWAT team. The Paris police force had its hands full with the "Apaches"—armed robbers who holed up in barricaded buildings. Police countered with effective hardware. Assault teams advanced on hideouts behind folding chrome-steel shields mounted on wheels. Once within range, the gendarmes launched knock-out-gas grenades from handheld cannons. The cannons also fired flame-extinguishing bombs and heavy projectiles.

Would-Be Astronaut

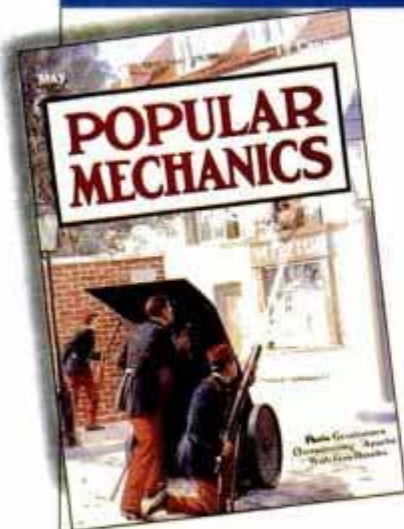
Robert Goddard's pioneering experiments with liquid propellants were over a decade away.



But rocket travel was an obsession in the pre-WWI years thanks to Jules Verne and other writers. This New York man tried to start the Space Age 50 years ahead of schedule by launching himself on a massive skyrocket loaded with 1500 pounds of gunpowder. He intended to descend by parachute. A huge crowd, complete with motion-picture crews, gathered for the launch, but it was not to be. The rocket exploded on ignition and hurled the daredevil 30 ft. Incredibly, though burned and injured severely, he survived.



Blow-up of man's first blast-off.



Smoking out bandits.

50 YEARS AGO: May 1938

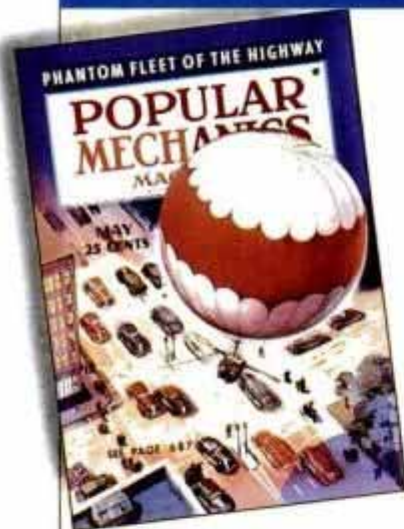
Eye In The Sky

By the 1930s America's mass-production machinery was cranking out automobiles to an eager market. Traffic engineers had to contend with a new phenomenon: urban gridlock. To aid intersection design, they used cameras hung from Goodyear hydrogen-filled balloons that were tethered on guy wires over crossings. The guy wires served as electric cables, enabling shutter operation from the ground. Motor-driven gyros maintained vertical stability for the airborne cameras.

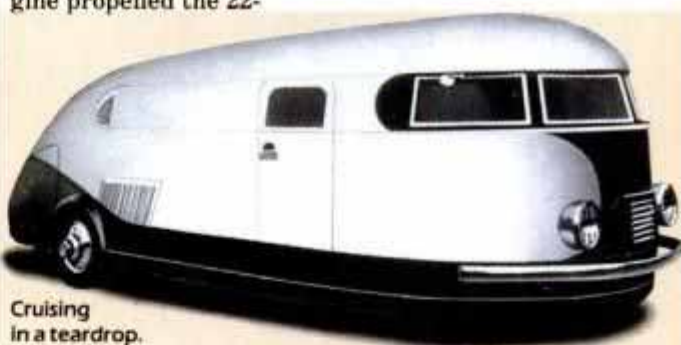
Oddball Auto

"Teardrop" automobiles were forerunners of the VW Bus, although they never achieved widespread popularity. A rear-mounted engine propelled the 22-

ft. vehicle up to 86 mph, averaging 17 mpg. Inside, the car had 6-ft. 4-in. headroom. A periscope allowed the driver unobstructed side and rear views.



Snapping traffic snarls.



Cruising in a teardrop.

25 YEARS AGO: May 1963

New Look At Indy

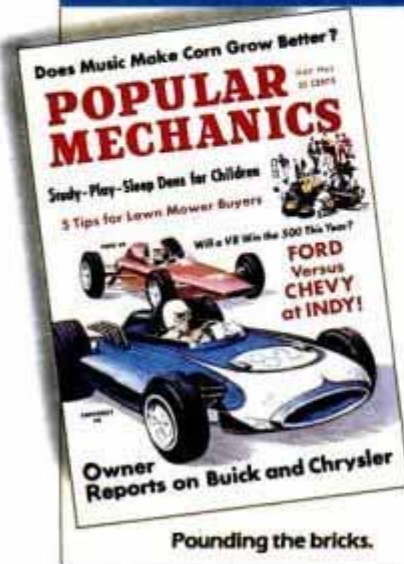
PM's cover story previewed the 1963 Indianapolis 500, a pivotal year for the "Brickyard." Though beefy Offenhauser-engined roadsters had dominated Indy, a change was in the wind. A lean, maneuverable Lotus powered by a rear-mounted Ford V8 took second place in an electrifying finish with Jim Clark at the wheel. The lighter engine burned gasoline instead of a methanol blend, and the car featured independent suspension and a chassis design inspired by Grand Prix machines.

Space Shot

Also in our May 1963 issue, sci-fi ace Robert A. Heinlein detailed NASA's Gemini project. The mission's goals: Send up a 2-man capsule on a modified Titan II ICBM and give the astronauts control of their craft via external jet thrusters so they could dock with an unmanned orbiter. Space walking was also part of it. Heinlein brought Gemini's implications to life with an imagined 1984 rendezvous with a space-station-bound cargo-tanker. **PM**



Riding booster into orbit.



Pounding the bricks.

The new box isn't the real news.

Frankly, we don't expect anyone to flip over Merit Ultra Lights simply because they now come in a box. Oh, sure, it's a terrific package—the Flip-Top® is very handy, and the sturdy sides stand up to all kinds of abuse. What's really exciting is inside. Thanks to Enriched Flavor,™ Merit Ultra Lights delivers real taste satisfaction. And that's great news in ultra low tar smoking.

Enriched Flavor,™ ultra low tar. A solution with Merit.



New Merit Ultra Lights Box.

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0.6 mg nicotine av. per cigarette by FTC method.

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By Pregnant Women May Result in Fetal
Injury, Premature Birth, And Low Birth Weight.**



YEARS FROM NOW IT'LL GET STARTED FASTER THAN YOU WILL.

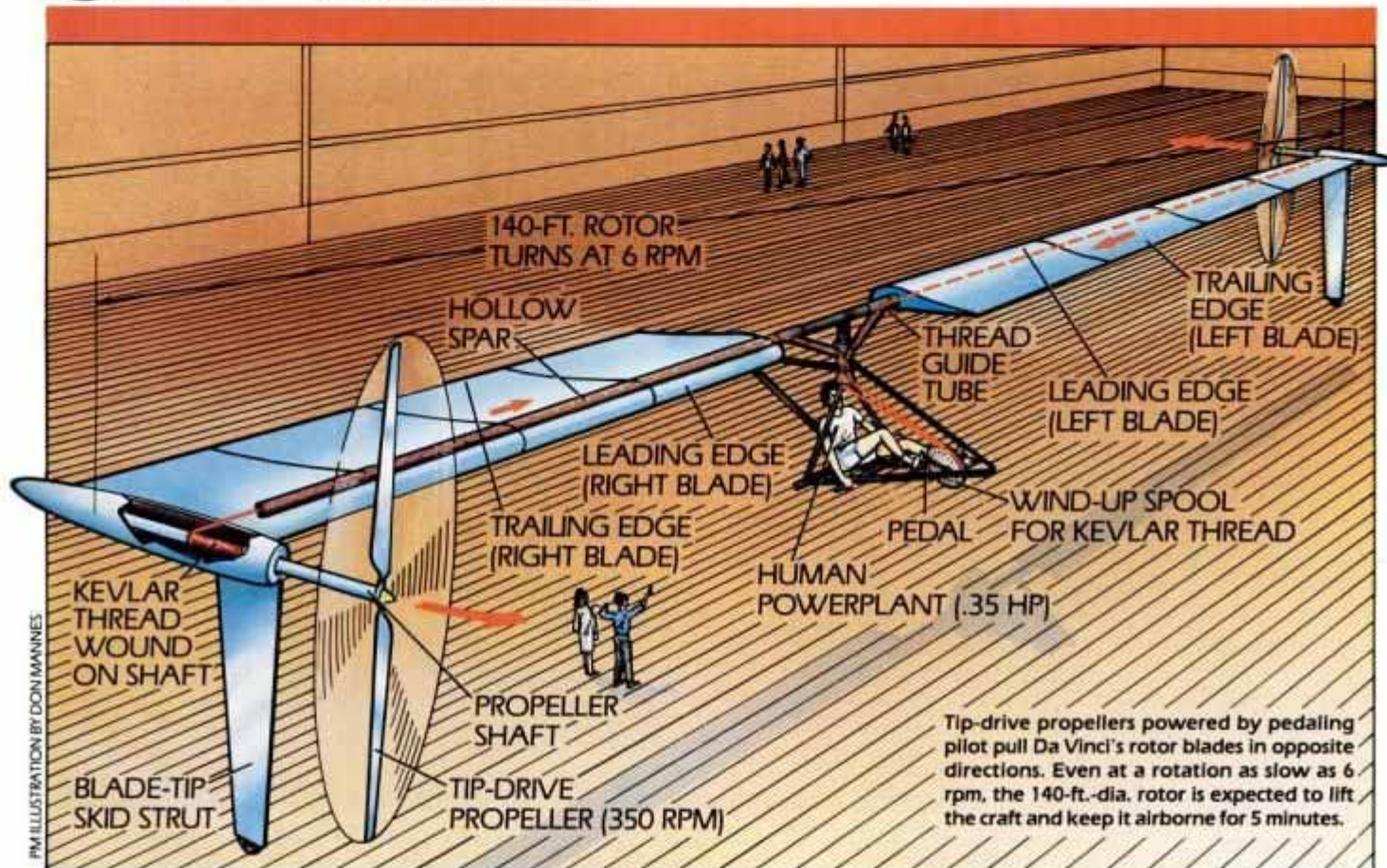
At John Deere, our engines are made to handle stress, so they'll last longer. We also use full-length steel frames where others use half-frames. And welds where others use bolts. That's why our tractors stay young. Even as they grow old. For details, call 1-800-447-9126.



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NOTHING RUNS LIKE A DEERE®



Tip-drive propellers powered by pedaling pilot pull Da Vinci's rotor blades in opposite directions. Even at a rotation as slow as 6 rpm, the 140-ft.-dia. rotor is expected to lift the craft and keep it airborne for 5 minutes.

Human-Powered Helicopter Close to Liftoff

SAN LUIS OBISPO, CA—While human-powered aircraft successes have grabbed headlines, one challenge remains unanswered—putting a human-powered helicopter into the air.

Nine years ago the American Helicopter Society made this offer: Hover 10 ft. off the ground in a human-powered rotary-wing craft for 60 seconds, and you'll win \$20,000. Vertical takeoff is required, and you have to stay within a 30-ft. square. The prize has never been claimed.

A team of California Polytechnic University students has been trying since 1981. Their approach: Instead of spinning relatively short ro-

tor blades at high speeds, generate lift by spinning long blades at a slow speed.

The resulting craft—the Da Vinci 2—features two 70-ft. rotor blades that end in propellers. At 285 pounds (including pilot) Da Vinci 2 is a showpiece for lightweight materials, from the graphite-reinforced plastic-foam rotor blades, to the Kevlar-covered foam propellers, to the carbon-tubing framework that supports the pilot.

Da Vinci 2's drivetrain consists of two lines of polyurethane-coated Kevlar thread. Each thread runs from an elliptical spool at the pilot's feet through each blade and winds around the

shaft of a propeller. To lift off, the pilot pedals, turning the spool and winding in the threads. By putting out 0.35 hp, a pedaling pilot can spin each propeller like a top at 350 rpm. That moves the rotor blades at 6 rpm, enough to levitate. The thread keeps the craft airborne for 5 minutes before it runs out.

Two hurdles still stand between the Cal Poly team and the prize. First, the propellers have been lifting the blade-tips too high. The low rpm of the turning blades doesn't generate the centrifugal force needed to counter the rotor's tendency to form a cone shape. An aileron mounted near the tip of each

blade could bring the coning tendency under control. The Da Vinci team is currently experimenting with a system that would send output from tip-mounted height sensors to aileron servo controllers.

The other stumbling block has been finding a place to try the Da Vinci: the craft will only fly in windless conditions. Last February the team tested the craft in a 1.1-million-sq.-ft. Douglas Aircraft Co. hangar, but the company has earmarked the space to build C-17 transport planes. Despite this drawback, the Da Vinci group anticipates claiming the prize sometime next year.

Editor: Tim Cole
Assistant Editor: Gregory T. Pope
Contributors: John Fine,
Mike Fillon, Paul Ruben

Spinning Oven Crafts Mirror

TUCSON, AZ—The University of Arizona's second-generation rotating furnace has cast its first telescope mirror and is working on another. Spinning puts a naturally concave surface on the furnace's product, saving years of grinding and polishing. Inside, glass melts around hexagonal blocks of ceramic fiber. Once the glass has cooled and hardened, water jets blast away the fiber

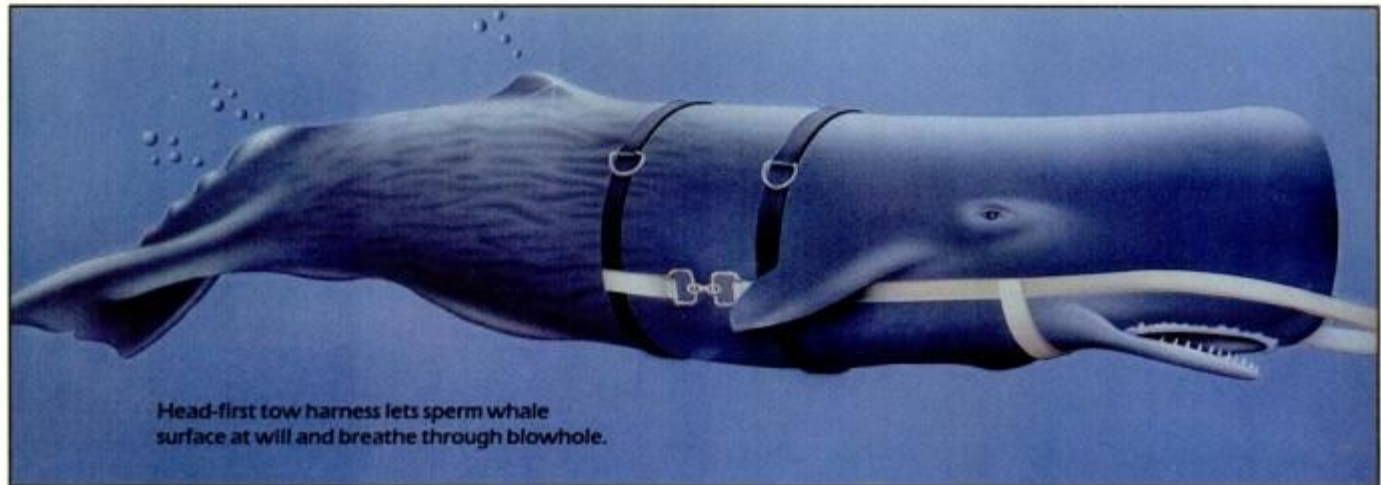


Whipple Observatory got furnace's first output.

blocks. What's left is a lightweight, honeycombed underside that allows air to circulate below the reflector and relieve heat stress.



Furnace does 10 rpm for 24 hours at 1100 to 2000° F.



Head-first tow harness lets sperm whale surface at will and breathe through blowhole.

Whale Rescue Gear Saves Stranded Animals

BRONX, NY—City Island, a small maritime community in this New York City borough, is home base for a team of experts who have developed special harness and flotation gear to save stranded whales and other marine mammals.

North Wind Undersea Institute, founded by Michael Sandlofer, a commercial diver and licensed ship's captain, has been working on special equipment that enables rescuers to tow whales safely out to sea head first.

"In the past they'd tie a rope around the whale's tail and drag it out to sea," says Sandlofer. "The whale would likely drown. It must breathe through the blowhole on top of its head, which was often forced underwater when towed by the tail."

North Wind's whale rescue

harness is double- and triple-sewn nylon, coated with a lubricant to protect the whale's sensitive skin. The harness is secured around the whale's middle. Quick-release buckles enable the animal to be set free by divers in the water or rescuers on a boat.

Stranded or sick whales often must be force-fed with

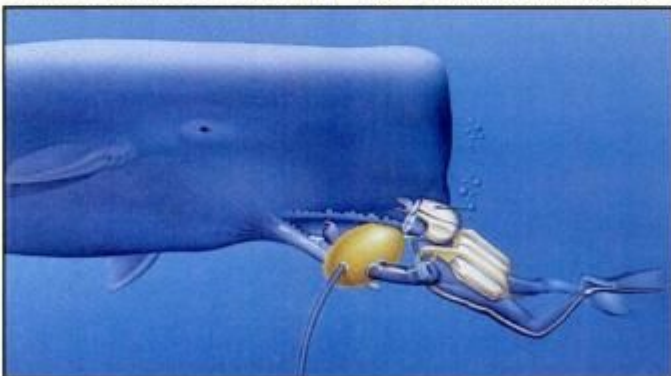
fish containing massive doses of antibiotics. During the process, a sperm whale once clamped down on Sandlofer's arm. Though he was released unharmed, he decided to develop an inflatable collar he could insert in the animal's mouth. The collar, which the diver-rescuer slips over his arm, insures

safe force-feeding.

North Wind's inflatable pontoon rafts transport smaller marine mammals such as dolphins and manatees. The rafts are mobile and insure humane handling of these animals, often relegated to ropes or the iron scoop of a front-end loader.

One of the most important first steps rescuers from North Wind perform at the scene of a whale stranding is keeping the animal's skin wet. Spray equipment with dousing nozzles forms part of North Wind's rescue gear, designed for mobility and quick deployment.

The technology for whale rescue designed by North Wind is simple yet effective, enabling speedy treatment for stranded, sick or net-trapped sea mammals.



Inflatable collar jams whale's mouth open, allowing force-feeding.

UNIVERSITY OF ARIZONA PHOTO

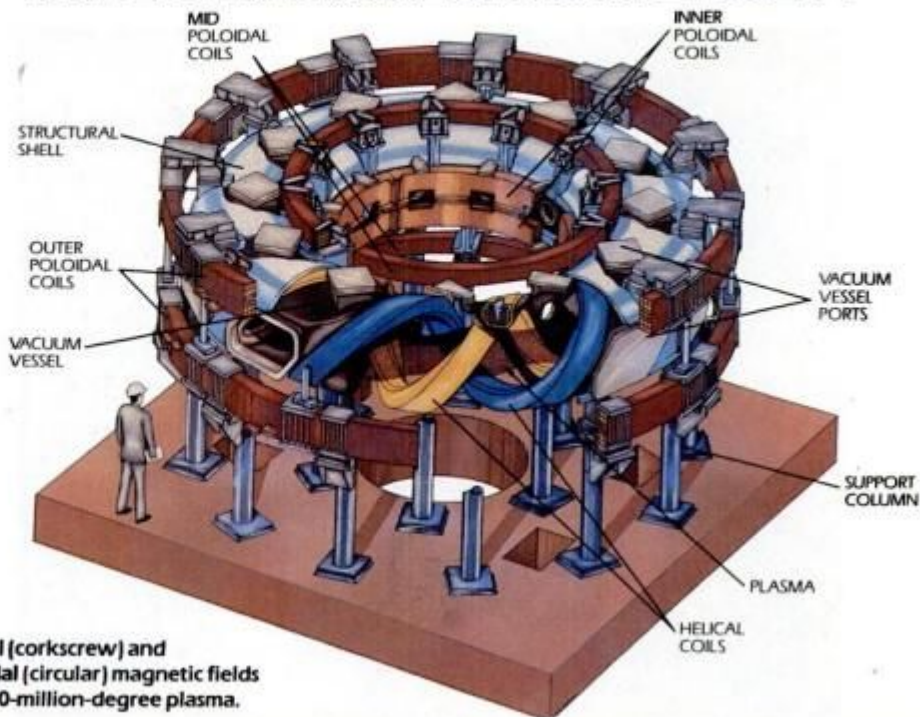
PM ILLUSTRATIONS BY PAUL COCHINAUER

Fusion Power's Latest Twist

OAK RIDGE, TN—The Advanced Toroidal Facility (ATF) is a newly built high-efficiency fusion plant at the National Laboratory.

The plant features an arrangement of external magnetic coils whose combined fields suspend the plasma in a donut-shaped "magnetic bottle." The ATF's coils give the "bottle" a twisted, corkscrew-like shape, which can sustain a higher plasma pressure than the smooth donut shape of a conventional tokamak plant. The ATF will also operate in a steady-state rather than pulsed mode, since it requires no in-plasma current to reinforce the magnetic confinement and drive the fusion reaction.

INSIDE THE ADVANCED TOROIDAL FACILITY



Helical (corkscrew) and poloidal (circular) magnetic fields hold 50-million-degree plasma.

Super Tunnels Bring Wind And Sun Indoors

NEW YORK, NY—Reproducing unusual conditions is the job of new wind tunnels in California and Sweden.

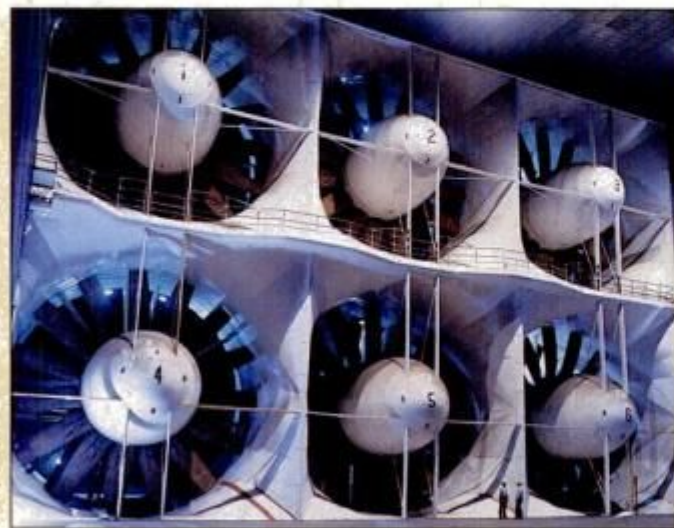
At NASA's Ames Research Center in Moffett Field, California, the world's two largest wind tunnels are now open for business. One 40 ft. high x 80 ft. wide, the other 80 ft. x 120 ft., the two tunnels are in the National Full-Scale Aerodynamics Complex (NFAC).

Full-scale testing—next best thing to actual flight—will be conducted on vertical/short-takeoff-and-landing craft, which require large tunnels. Tilt-rotor aircraft will also be tested there.

Both tunnels operate in the low-speed range: up to 115 mph

for the large one and up to 345 mph for the small. These speeds represent critical takeoff and landing velocities, not just for rotorcraft and low-speed aircraft but also for high-speed craft such as the Space Shuttle and the proposed ground-to-orbit National Aerospace Plane.

Meanwhile, Saab's climatic wind tunnel at its Trollhättan. Technical Center features equipment for the realistic simulation of sunlight. The apparatus consists of 800 lamps that can be switched on or off in computer-controlled cycles. The lamps put out more than 1200 watts per sq. yd., equivalent to the maximum solar radiation at the equator. The equipment can simulate variations in solar elevation of up to 30° from the zenith, and the test chamber's floor can be heated to 85° F above the air temp. The wind tunnel will help in the design of air conditioning compressors and windows. *(Please turn to page 20)*



NFAC's fans put out 130,000 hp and move 63 tons of air per second.



Saab tunnel ranges from -85° to 185° F with up to 95% humidity.

NASA PHOTO

SAAB PHOTO

"If it's tough enough for the Guinness Book of World Records..."

It was a truly incredible journey. From Tierra del Fuego to the Arctic Circle — from the southern tip of South America to the northern tip of North America.

Garry Sowerby made this adventurous, record-setting trip in just 23 days, 22 hours and 40 minutes. And oh, the stories he could tell.

Naturally, to set a world record, Garry Sowerby didn't take chances — he took a Sierra, GMC Truck's ultimate full-size pickup. The comfortable, reliable Sierra Insta-Trac 4 X 4, with standard anti-lock rear brake system (operates only in two-wheel-drive mode on 4 X 4s), not only survived, it thrived. For 15,000 grueling miles — from mud to snow, through jungles and over mountains.

If the Sierra is tough enough to handle a trek like Sowerby's, imagine how well it can handle your everyday needs.



Quality Network



...it's tough enough
for you."

Garry Sowerby
— Garry Sowerby

You don't have to go for a world record to appreciate all the qualities the Sierra has to offer. The Sierra is much more than a full-size pickup — it's a GMC Truck full-size pickup.

Its toughness and reliability are evidenced by Garry Sowerby's record-setting journey. Its aerodynamic good looks speak for themselves. Its 4' X 8' bed and standard GVWR of 5,200 pounds (including passengers, cargo and vehicle) show its capacity to take care of business.

Its choice of five engines — from the standard 4.3-liter V-6 to the 454 V-8 (all with electronic throttle body fuel injection) to the 6.2-liter diesel — proves its versatility. And its roomy, civilized interior will almost make you forget you're driving a truck.

If you depend on a pickup, buckle up and see your GMC Truck dealer. Don't take chances — take a Sierra.

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GMC TRUCK
IT'S NOT JUST A TRUCK ANYMORE.



Superconductor Motor



Argonne technician chills motor with liquid nitrogen.

ARGONNE, IL—Researchers at Argonne National Laboratory have built the world's first electric motor based on high-temperature superconductors.

The heart of the Meissner



Electromagnets on plate bottom are simply bolts wound with copper wire.

motor is an 8½-in. aluminum plate with 24 electromagnets. Graphite brush contacts allow the magnets to be switched on and off as the plate spins over two diametrically opposed disks made of the new superconductors. The contacts are positioned so that an electromagnet is switched on as it approaches a superconducting disk. The superconductor repels the magnet, pushing the plate and bringing the next electromagnet into position. Scaled-up industrial versions could put out 100 hp by the 21st century.

Foot-Launched Sailplane

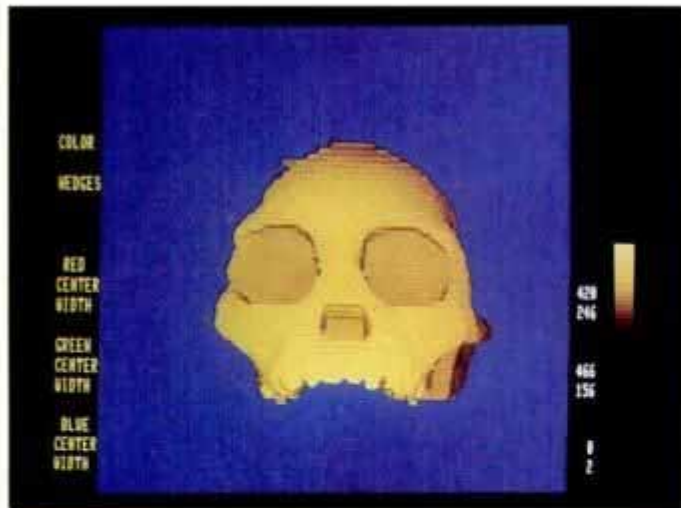
STANFORD, CA—Aeronautic engineers at Stanford University dreamed up this flying wing. Called SWIFT (for Swept Wing with Inboard Flap for Trim), the

craft combines sailplane performance with hang-glider convenience. When the pilot-controlled inboard flap is deflected downward, lift over the front part of the wing increases, pitching the nose up. Prototypes will be tested this summer.



SWIFT's 35-ft. wingspan translates into a 23:1 lift-to-drag ratio.

CAT Scans Leave The Hospital



"Taung Child" skull as reconstructed by CAT scan.

NEW YORK, NY—The technology that revolutionized medicine in the late 1970s is now providing diagnoses in other fields. A CAT scan of a 2-million-year-old skull recently solved a long-standing scientific mystery. The skull belonged to a child of the extinct ape-man species *Aus-*

tralopithecus africanus. The question: Did this creature develop as slowly as a human child? Clues lay hidden in the fossilized upper jaw—permanent teeth that had not yet surfaced when the child died. Rocky debris, petrified bone and teeth differ in density, and a computer can



Petunia in University of Georgia's agricultural CAT scanner.

remove any one from a CAT image. Washington University researchers used CAT scans to find that *Australopithecus* teeth developed more like a chimp's than a human's. At the University of Georgia, experimenters have turned CAT scans on plant

roots, watching undisturbed growth and water uptake.

Meanwhile, quality-control professionals are using CAT scans to test everything from aircraft engine components to food products to corked baseball bats. One advantage industrial CAT scanners have over their medical counterparts is the freedom to train intense radiation beams on their subjects.

(Please turn to page 22)



NASA CAT scan of Shuttle engine's air-injector nozzle.

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CAN'T MAKE ARE EXCUSES."**



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The difference between work and workmanship.

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A DIVISION OF COOPER INDUSTRIES, INC.

1990s Promise Wildest Thrill-Rides Ever

NEW ORLEANS, LA—Amusement-ride engineers are drawing up blueprints for tomorrow's thrills. Currently under development are new technologies that will put riders inside huge arcade games and subject them to unheard-of sensations.

The amusement park hit of the 1990s may be Mega Ball, which re-creates the pinball experience—with you as the ball. On a huge inclined plane outfitted like a pinball machine, you are carried to the top in a round, 4-person



TM ILLUSTRATION BY JERRY LOFARO

On-board monitor helps you aim Top Gun's infrared beams.

bumper car. Once released, you roll down the slanted platform, bouncing off walls and posts. You can even activate the flippers from within the car, thanks to a radio-frequency hookup. Mega Ball is still on the drawing board of a Swiss manufacturer.

Infrared-beam combat adds a video-game feel to Top Gun, which will be installed this summer at Gurney Park in Allentown, Pennsylvania. Hydraulic arms lift 14 rocket ships. With

joystick in hand, you maneuver up, down and sideways, trying to shoot down opposing ships while dodging opponents' beams. If hit, you drop to ground level for one revolution before returning to action. It ends with a battle-royal shootout, leaving only one ship airborne—the top gun.

Water-slide fans will enjoy Flash Flood at Myrtle Beach, South Carolina, and elsewhere. Instead of sending water down the chute at a constant rate, Flash Flood



WATERFUN PRODUCTS PHOTO

Simulating the water blast of a flash flood.

unleashes 175 gallons at once, literally flushing riders helplessly down the ride.

For disorientation aficionados there's Alpha Dynatron—an enlarged 2-ring gyroscope with a seat in the center. A 3-speed motor spins the outer ring in somersaults while you control the side-spinning inner ring with your weight and position, experiencing free-fall weightlessness. This gut-wrencher is still in prototype stage. **TU**



PAUL RUBEN PHOTO

Dynatron's top speed will be 34 rpm for daring riders.



TM ILLUSTRATION BY JERRY LOFARO

Human pinball machine: Rider-controlled flipper at the bottom of Mega Ball fires vehicle back up the table, prolonging ride.

Marlboro Lights



The spirit of Marlboro in a low tar cigarette.

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Now Greatly Reduces Serious Risks to Your Health.**

Kings & 100's Soft: 10 mg "tar," 0.7 mg nicotine av. per
cigarette, FTC Report Feb '85 - 100's Box: 11 mg "tar,"
0.8 mg nicotine av. per cigarette by FTC method.

WHEN YOU SPEND 81 YOU DEVELOP A FEW



First Anti-friction Gearcase



First Lightweight Aluminum Outboard



First Oil Injection for Small HP Outboards



First Full Gear Shifting for Outboards



First Counter Rotation Outboards



First Truly Quiet Operation



First Remote Forward/Neutral/Reverse Shifting



First Power Steering



First V-6 Engine



First Sacrificial Anodes as Standard Equipment



YEARS IN THE WATER WRINKLES.



First Remote Steering



First Electric Starting



*First True
Marine Oil Injection*



First V-4 Engine



First Fiberglass Motor Cover

Our very first day in the water, nearly a century ago, was the day of our very first wrinkle. That was the day we invented the outboard motor as we know it today.

But even a young whippersnapper knows it's not enough to be the oldest. You also have to be the wisest.

And so, from the very first, we at Evinrude have made it our business to create more wrinkles. To make sure that every major advancement in outboard technology comes from us.

For instance, we were the first to conquer corrosion — back in 1921 — when we introduced an outboard motor made with aluminum.

And of course, we can still remember the day we invented, in 1954, the first truly quiet outboard.

Like it was yesterday.

And over the past three decades, when the V-4, V-6 and V-8 motors were introduced — each marking a revolutionary stage in V-block design — they were ours.

Which is why we believe nothing on the water today is as reliable, as durable and as powerful as an Evinrude outboard.

Evinrude. We've stood the test of time, because we're way ahead of our time.

For more information, or the location of an Evinrude Outboard dealer near you, call 1-800-255-2550.



EVINRUDE 

OUTDOORS

BY JOE SKORUPA

ATV Wheels Of Misfortune

I WAS DRIVING a 4-wheel ATV through the forbidding moon-scape of Utah's Canyonland desert last summer feeling like a high-tech cowboy. The frying-pan heat and muscle-tiring pace were turning my 3-day trip into a grueling ordeal, but the payoff was worth it. We were exploring deep wilderness that few get to see, and enjoying every minute.

I remember many things about that trip—goosenecks of the San Juan River twisting through sheer canyon walls, towering sculpted rock formations, a twilight swim in Lake Powell at the end of a parched day, and a night sky filled with impossibly bright stars.

But the strongest memory of all is of a fellow rider flipping his ATV on a rocky, near-vertical slope. I can still see the 600-pound ATV lurching across the incline and rolling on top of him.

My companion bore the pain of his injuries like a Trojan. He was transported by 4x4 truck from the outback to a doctor, while our group pushed on. Several days later we learned he suffered a separated shoulder, cracked ribs and a severely broken ankle. The day we returned to base camp he underwent surgery to implant a permanent steel pin in his ankle.

"My heart bleeds for anybody who's been injured and for any parent who's lost a child. I mean that sincerely," says Kurt Antonius, of American Honda, about reported ATV accidents. "And I feel just as badly for anyone hurt on a set of swings or hit by a car."

The Department of Justice feels bad, too. It recently filed a suit, in conjunction with the Consumer Product Safety Commission (CPSC), in the U.S. District Court in the District of Columbia declaring that ATVs are "immi-



Only 4-wheelers like Honda Fourtrax can blast through the outback.

nently hazardous."

Accompanying the suit was a preliminary consent decree, which is an agreement between all parties involved to resolve the suit's issues voluntarily. The result of the courtroom wrangling was an immediate ban on the sale of 3-wheel ATVs and the removal of unsold 3-wheelers from stores.

I was comparing notes recently with PM's Detroit Automotive Editor Jim Dunne, who several months ago went to the hill country of Nashville, Tennessee, to ride

Suzuki 4-wheelers. We agreed that the first thing any new ATV rider needs is 4 to 6 hours of safe riding instruction.

Safety has been on the minds of ATV manufacturers for many years. Five years ago Honda, Suzuki, Kawasaki and Yamaha banded together to form a continuing, nonprofit ATV safety organization called the Specialty Vehicle Institute of America (SVIA). The SVIA developed a set of guidelines for safe ATV operation and a program for certifying au-

thorized instructors. The guidelines, and how to contact the nearest instructor, are available free of charge.

The guidelines come in two formats: print, which can be obtained by calling (800) 447-4700, and video, which can be obtained for 30-day loan by calling (714) 241-9256.

Since the formation of the SVIA and the increase of authorized instructors, the accident rate has gone down in relation to total ATVs in use. So why all the fuss?

In 1987, through Sept. 4, there were 105 deaths and 63,000 injuries from ATV accidents, according to the CPSC. In the past five years, nearly 800 people died and 271,000 were injured.

Far more people drowned while swimming during a similar period or were injured while bathing. But raw statistics like these, often used by lawyers, reveal little. There are only 2.3-million ATVs in the U.S., while, presumably, the entire population takes baths.

Although it's true that there have been no demonstrations by disgruntled ATV riders or evidence of angry letters flooding into mail rooms, recent media coverage has been critical and regulatory sentiment has been growing.

Last year, the television shows "20/20" and "60 Minutes" aired controversial reports on ATV accident rates and showed film of rider misuse, dealer irresponsibility and interviews with seriously injured riders. They also showed choreographed footage designed to demonstrate the inherent instability of ATVs.

Not only did these broadcasts spur the Justice Department and CPSC forward on their suit, but Congressmen began leaping on the regulatory bandwagon. Even after the preliminary

(Please turn to page 28)



Kawasaki's Tecate 4 isn't likely to get stuck in shifting legal sands.



Pop-up rope hooks on our SE models let you tie down loads. And keep the body lines clean when not in use.

Corrosion-resistant "durasteel" and a seamless bed design help prevent rusting.

A quick-release tailgate is designed so you can remove it in a matter of seconds.

In every corner, you'll find a hidden eyebolt rope hook to make it even easier to tie down cargo.

A Nissan Hardbody gives you the largest cargo volume of any leading compact truck.

The double-wall cargo box is designed so the inner panel absorbs the shock of shifting loads, while the outside sheet metal remains motionless.

We've eliminated bed bugs.

Although you might not realize it, Nissan's[®] been in the exterminating business for over fifty years.

Exterminating shoddy workmanship, inept design, and thoughtless engineering from the truck industry.

Take for example, something as simple as paint. At Nissan, we always match our primer to the paint of the truck. So if you get a scratch, no one will notice.

You'd be amazed how many truck manufacturers overlook this minor detail.



You'll also find the largest cargo volume of any leading compact truck and a hauling capacity of up to 2,000 lbs. After all, if a truck is to haul things with, we think you ought to be able to haul a ton.

And then there's our quick-release tailgate. It's designed to be removed in a matter of seconds. But, if you really want to examine a Hardbody, visit one of our showrooms and talk to a salesperson.

You won't find any pests there either.

Built for the Human Race.

OUTDOORS

(Continued from page 26)

decree banning 3-wheeler sales was announced, U.S. Rep. Doug Barnhard, of Georgia, said his subcommittee on commerce and consumer affairs would press forward its study of outlawing ATV sales, and U.S. Rep. James J. Florio, of New Jersey, said his subcommittee would continue to fight for a recall.

Pressure was mounting from several directions on ATV manufacturers, including internally—sales were off due to the adverse publicity. So, they decided to give up the battle voluntarily,

rather than fight an image-damaging war.

But can the government really legislate behavior?

"You can't believe how many people are injured on ATVs by being hit by cars," says Honda's Antonius. "They're not built for paved-roads, but people still drive them there. Getting drunk, riding double, which is also prohibited, going too fast for conditions, not wearing helmets and kids riding at too young an age—that's why people get hurt."

Outdoorsmen are constantly called on to use their judgment to determine the difference between unacceptable risk and personal safety.

I haven't jumped out of a plane in years, but when I did, people told me skydiving was a much more dangerous sport than, let's say, backpacking. However, I recall one backpacking trip in New Hampshire's Presidential Mountains when a driving rainstorm forced me off an exposed ridge. On the way down, the trails turned to rivers and the steepest descents to waterfalls. I couldn't stop where I was and I couldn't go back.

Every move I made for several hours had a high-risk quotient. A mistake during that descent could have resulted in serious injury and even death. I had to play the percentages and make every move count, all the while wishing I was doing something safer, like skydiving.

"Everyone in the industry is concerned about safety," says Mel Moore, of the Kawasaki division, "but the real issue to come out of the preliminary consent decree is that a privilege has been taken away from consumers by the misuse of riders who don't follow rules."

Most of the terms of the decree cover issues of safety, such as: Notices must be sent to all known purchasers of ATVs informing them of risks associated with the products, retailers must prominently display 4 x 4-ft. signs containing warnings, manufacturers must affix warning labels to all ATVs marketed in this country, and so on.

These are reasonable, if overcautious, terms. But the decree went one giant step further. It banned the sale of a recreational and utility vehicle.

The good thing about the decree is that no inherent defects in ATVs, including 3-wheelers, were found. In fact, according to Rit LaFrancois, of Yamaha's ATV division, the ban on sales of new 3-wheelers will only be in effect until performance standards are finalized.

But even if the ban on 3-wheelers is lifted, there's a strong likelihood they won't be reintroduced. Industrywide, sales have been dropping for the past few years, according to LaFrancois. The models with the fastest growth rate have been the large, utility 4-wheel models used for work and play.

"ATVs are no more dangerous than any other off-road vehicle," says Craig Girona, manager of Stamford Cycle & Sled, in Stamford, Connecticut, and a certified SVIA instructor. "They're no more dangerous than dirt bikes or snowmobiles, for example. The main issue here is operator safety."

Outdoor recreational sports always involve risk, and those of us who enjoy them do so with our eyes wide open. If we choose not to play it safe, to take a chance and go against the percentages, that's our decision and we accept the responsibility. That's the way it is off-road or in the wilderness, unless the government decides otherwise. **PM**



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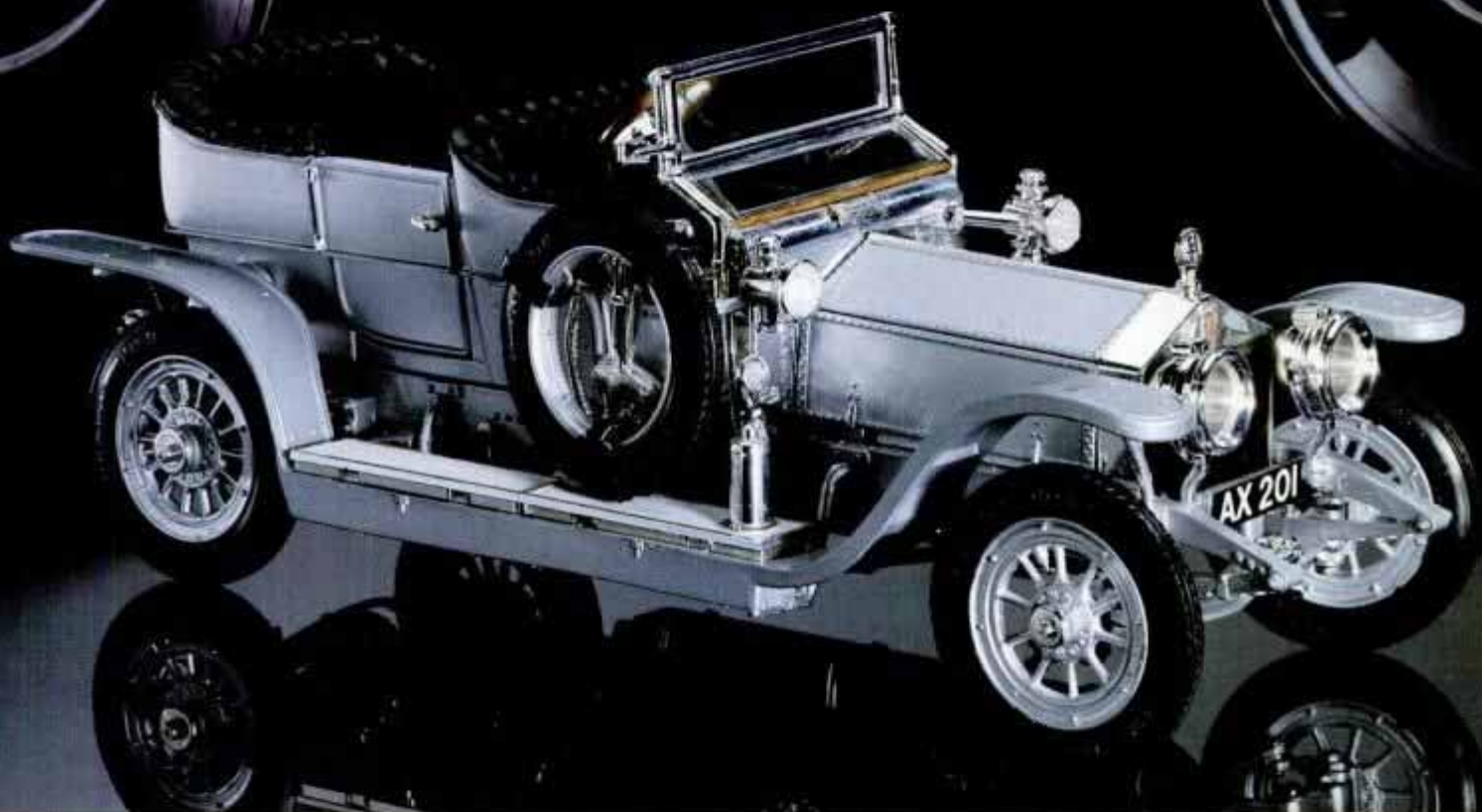
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IMPORTS

BY BILL HARTFORD

Concept Cars Probe The Future



The X25 2-seat sports car, Mitsubishi's latest rolling test bed, is a fast, 100 hp/liter high-tech showcase.

YOU DON'T need a dashboard-mounted plastic compass to tell which direction tomorrow's cars are headed. You'd be getting close, though, if you've seen, say, the '88 Pontiac Grand Prix SE. It's halfway to the future with neat features like a compass display in the center console. No ball floating in a viscous fluid here. Now, if you were in Japan at the wheel of a Toyota Crown, a Japanese home-market model not sold here, you'd know exactly which direction cars are headed: The future's mapped out on a 540-megabit disk. The CD system packs a navigational grid that covers all of Japan. Just punch in and pull up your destination. The system is—you guessed it—all electronic. And that's what's revolutionizing the automobile. Soon, you'll find a navigation screen labeled "satellite global positioning" in your new car, and find that the only things going through the firewall are wires. Already, BMW is using a fly-by-wire throttle system instead of a rod or cable linkage, and every automaker is chipping away at mechanical systems with computer electronics (see "2001: The Inside Story" on page 72).

It's appropriate that BMW's application of fly-by-wire technology is at the ped-



X25 interior is a model of ergonomics, or "kansai," as the Japanese call human engineering.

al that goes to the metal: It was at your itchy right foot where the electronics revolution started. Controlling fuel-air mixture and spark timing with precision became important when automakers'

Nissan ARC-X concept car, smooth on the outside, bristles with microchip brains.



Steering wheel, seat and mirror positions are stored in computer. Phone has voice recognition.



Cathode-ray tube (CRT) displays maps, vehicle position and readouts from phone and CD player.



Twin-cam, 24-valve, 3-liter V6 has 16-bit microcomputer that adjusts for component wear.

priorities had to focus on exhaust emissions and fuel economy. That was in the early '70s and, as they say, the rest is history. The peaseize brain of early computer controls has grown into a central nervous system where synapses are replacing grease fittings. "Intelligent vehicle control" is what we'll be getting from head to toe—from photoelectric roof panels to the systems that determine just how the rubber meets the road. Recent advances in suspension, brakes and steering alone have been astounding, and possible because computer-

controlled components flinch faster and more fail-safe than even a superhuman Indy driver. The days when the independent suspension of a BMW 2002 was the height of sophistication keep slipping further into the past.

When Nissan touched down here with its ARC-X concept car, the term "fully loaded" got a new meaning. The experimental model is so packed with brain power that you'd think it would come with a modern-day equivalent of the riding mechanic from the early days of motor racing. But you don't need an electronics engineer as copilot. The reliability and speed of solid-state systems are amazing. In the ARC-X, for example, large-scale integrated circuit technology (LSI) and a central processing unit (CPU) make instant decisions that control suspension, drivetrain torque split and the select-by-wire automatic transmission (an electrical connection replaces the linkage between shift lever and valve body). A look at today's concept cars shows us that the future may be even closer than 2001. **PM**

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INSIDE DETROIT

BY JIM DUNNE

Olds Ciera Update

OLDSMOBILE plans an extensive facelift for its Ciera models for the 1989 model year, with new sheetmetal that will firm up its body lines and reduce the rake of the backlite for a more formal appearance overall.

Look for this car line to get a couple of new engine options, including a high-output version of the Quad 4 16-valve powerplant and a soon-to-be-announced 3.3-liter V6, coded internally as the 3300.

The tape on this preproduction prototype (photo above right) is used to secure trim panels during shipment.

Olds marketing types expect the styling update to help turn around a serious sales slump in the division's top volume line, which fell from 330,000 in 1986 to 244,000 last year.

Restyled Ranger

Ford's midsize pickup truck gets a fresh face for 1989, one



'89 Ford Ranger has F-150 look.

it shares with the Bronco II. Bright metal details in the grille, larger flush-mounted headlights, new fenders, larger bumper and repositioned turn signals give the front a more massive appearance, similar to Ford's full-size pickup.

This is no coincidence. Though the Ranger has been a strong entry in Ford's current success story, the company wants the magic of its



'89 Olds Ciera to feature a more formal roofline.

best-selling F-series line to rub off on the Ranger.

Ford also plans to give Ranger a little more muscle, in response to Chevy's 4.3-liter V6 S-10 pickup. Look for a bigger V6 Ranger engine in 1989, possibly the 3.8-liter powerplant now available with the Taurus and Sable sedans.

The Eternal Town Car

One of the basic rules of life is that if it ain't broke, don't fix it, which is why Ford plans only a modest facelift for its highly popular Lincoln Town Car in 1989.

The redesign features composite headlights like those on the Mark II, and a plastic-covered front bumper.

Even with the change to a slightly more aerodynamic appearance that's more consistent with the current Ford family look, the Town Car's styling is still the kind that continues to find favor with the big-ticket sedan buyer.

This is hardly surprising, since Lincoln sold an impressive 126,000 Town Cars last year.

And despite the age of the platform, which it shares with the Ford Crown Victoria, the flagship sedan is expected to stay in production with only cosmetic revisions well into the 1990s.

Fiero Killed

Recently, Bob McCurry, Toyota's president in the U.S., said that high insurance rates are a "big contributor" to the 40-percent drop in sales of sporty cars in the last year—cars like Celica, MR2 and RX-7 particularly.

"Insurance costs wiped out the musclecar market in the '70s," says McCurry, who was a vice president at Chrysler at the time. "And now the same thing is happening again."

Indeed. The latest fatality is the Pontiac Fiero, to be discontinued after the '88 model year for reasons including high insurance rates.

They Love CRT

Though it has been a point of controversy, GM claims that 80 percent of Buick Riviera owners like the CRT instrument setup in that car.

Widely panned by the automotive press as a driver distraction, GM nevertheless thinks the CRT is a good

selling feature. That's also a partial explanation for why it appears in the Reatta as standard equipment.

As to the problem with the automotive press, one GM official wryly stated, "We should have waited until the Japanese introduced a CRT. The press would have raved."

Counternoise

A new development in noise suppression zeroes in on counternoise, a technique for canceling out noise vibrations in the air.

The development uses speakers like those in your car radio. They emit sound waves that run counter to the unwanted noise.

One application is in cars with 4-cylinder engines, where thin castings and high speeds transfer unwanted noises. Big speakers project noise on a preset wavelength when the engines reach noise-making speeds. The car's interior becomes quiet-



Lincoln Town Car for '89: Minor facelift for an ageless winner.

er as the speakers kick in. As the engine changes speeds, the counternoise also changes wavelengths or shuts off altogether.

The system is under development at Lotus Cars Ltd. in England.

Olds Silhouette

Rumors persist that Oldsmobile's futuristic Silhouette 2-door coupe will have gull-wing doors and a tiny rear window that can be rolled down for an open-air feeling.

But there is controversy concerning gull-wing doors, as one GM executive pointed out. They leave a high sill at the rocker panel, creating a high step-over for passengers.

That problem rules out many older buyers who don't like to, or can't, negotiate the barrier, according to GM planners. So for now, the gull-wing layout is still being studied.

Model Proliferation

GM president Bob Stempel says that by year's end there may be as many as 40 different brands in new-car showrooms. What this means is that you'll have a choice of 600 or so different models to choose from if you are in the market for a new car.

Even experts who were once able to rattle off specifications like a baseball fan reciting statistics now have reference books on hand at all times.

Look for this phenomenon to continue as manufacturers strive to address specific market niches.

Plastic Car

Chrysler is reportedly working on a car for the mid-1990s that makes wide use of composite materials in place of steel. Both body panels and underbody structure are said to be slated for the lightweight materials.

Chrysler apparently considers itself to be well ahead of the competition in planning uses for these carbon plastics that are of a type far advanced from the fiberglass used in Corvette bodies and suspensions.

Price-Cut Policies

Record profits and improved manufacturing efficiencies would seem to mean an opportunity for lower prices.

While the fact that this rarely occurs isn't surprising, the reasoning behind it may be.

"The old owners feel betrayed when their car is offered in the next model year for less money," according to one GM executive.

Instead of outright cuts, the manufacturers pass savings along by offering the buyer more equipment—power windows, deluxe trim levels, cassette radios—as standard, with only a token price increase.

Top Kick And Kodiak

GM's medium-duty trucks—the Chevy Kodiak and GMC Top Kick—will get brand-new faces when they roll out for the 1990 model year.

The look is intended to suggest sophisticated toughness, covering a range of trucks that includes semis, dumps and delivery vans.

Engine offerings include a pair of V8 diesels—6.6 and 8.2 liters—and two V8s of 5.7 and 7.0 liters. Designed to compete with the Ford F-700 and International 1600 series, GM's new Top Kick and Kodiak entries



GM's medium-duty trucks for 1990.

will range in price from about \$20,000 to just over \$42,000.

The trucks shown here were snapped during severe weather testing last winter in northern Minnesota. **PM**

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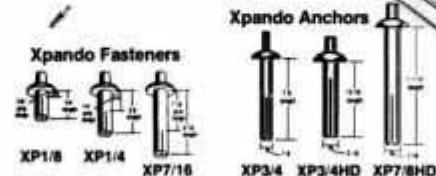
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OLD HOUSE RESTORATION

BY BOB VILA

Restoration Landscaping

SPRING is in the air, and with it comes the itch to get outdoors. So, in honor of the season, this column is devoted to discussing something many of you might not think too much about. But it has a great deal of impact on your home's restoration: namely, historical landscaping.

Finding out how your home's early landscape looked may take a bit of detective work. The first step is making an actual physical inspection of the land, followed by gathering as much documentation on your property as you can find.

This sleuth work can actually be a lot of fun—you'll be amazed at what you'll learn about the early days of your house when you know what to look for.

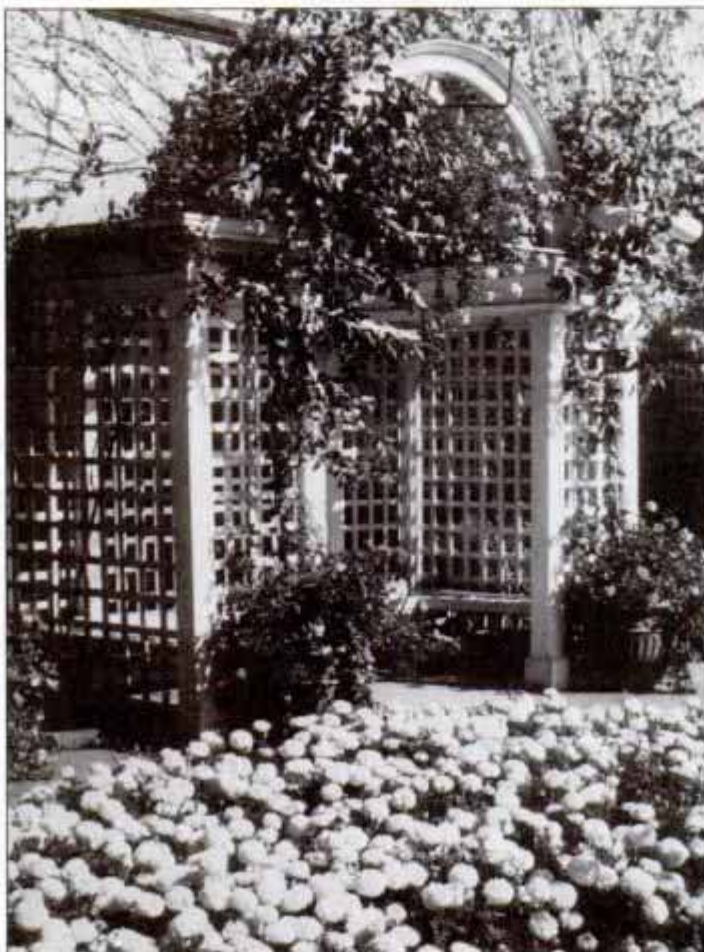
The next thing you'll have to do is decide what time in your home's history you want to return the land to. Although a structure usually has a distinct, obvious date for its restoration, you may have more flexibility with the landscape. Finally, you'll have to find a landscape architect capable of carrying through on this project.

Ghosts of gardens past

Finding clues of what used to be from the ground surface and existing plant material or other landscape features can be surprisingly successful. Begin your investigation close to the house, then work your way out to the perimeter of your lot.

Some of the obvious things you may find include deteriorated stone walls, planter boxes or remnants of old walkways. Be on the lookout for indications of the latter, like pieces of broken rock, which may have been used as

Contributing Editor Bob Vila is host of public television's "This Old House."



Restoring a piece of property can go well beyond the plantings to include structures like retaining walls, walkways, reflecting pools and such structures as the restored 19th century rose trellis surrounding a sitting arbor shown above.

a sub-base for an old sidewalk. Sometimes, thanks to the sloppy work of a previous owner, you'll find footings left in the ground to indicate where a wall used to be.

Finding other signs of the past may literally take some digging. You see, some root structures can live underground for a long time before deteriorating. If a past owner recently removed any trees or shrubs by cutting them off at their base, the roots may still be there. So, turning the top layer of soil may reveal where these plants were.

Examining the grade of the land, too, may tell you a bit about the past. Sometimes people don't backfill

holes properly after something, perhaps a retaining wall or even a plant, is removed. So note any slopes or settling that look unusual—these spots could have contained a structure or vegetation at one time.

After you've thoroughly combed your land for clues to its past, the next step is to check out any historic resources which may show how your house and its surrounding grounds once looked. If your old house is of some value, your local historical society may have photos or sketches of the property that date back many years. The society's library may also have a book or two, written by a local author, that describes your house in all its past grandeur. You can always try the local newspapers, too. They may have done a story or have other relevant information that will help you document your land restoration. If you're very lucky, you may find old photos or sketches of your house done by past owners or family members in a forgotten nook or cranny that tell a great deal about its grounds.

(Please turn to page 36)



When a front porch was restored on this turn-of-the-century house, historical landscaping was recreated as well. Native bluestone was used for the walk and low-profile period plantings and ground cover were added between the walk and porch.



"My desk was only a step away from the Salvation Army."

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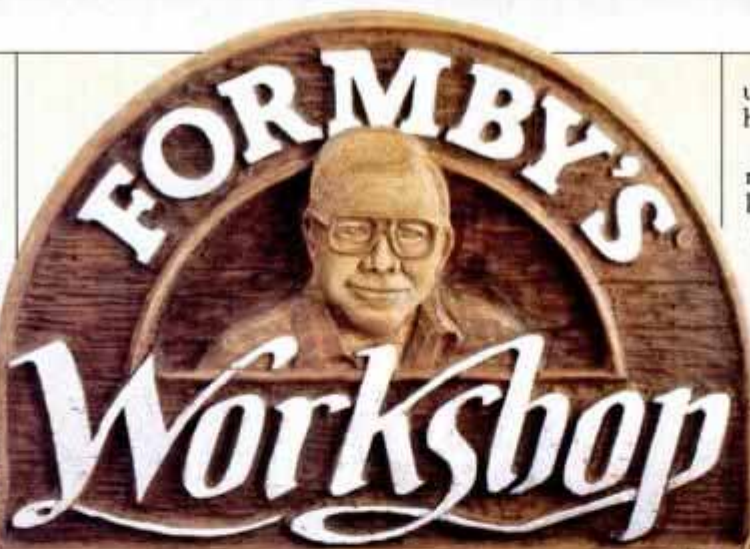
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OLD HOUSE RESTORATION

(Continued from page 35)

Be aware that most of the documentation I've described would exist in an ideal situation. Unfortunately, many of you will probably find little, if any, historical data available on your old house. But you never know until you try. The value of a single old photo far outweighs the time spent searching for it.

Going back in time

Choosing the time in history to restore the land to can be the most difficult part of this project. Your research may show

that there was a time or times when the landscape was totally renovated, or when certain portions were added.

The landscape may have been modernized several times even though the house was not. There may have been a time when your property reflected a great deal of the initial landscape and was compatible with the period of the house itself. For example, you may find that the design of your home's grounds 10 years, or so, after its construction, although not the original landscape, is better suited to your needs today, and you wouldn't want to return it to its original state. This is why it's so impor-

tant to research the complete history of the house, if possible.

Restoration purists, of course, will want to restore the land back to the way it was originally. Lots of folks do this, but are sometimes disappointed at its sparseness by today's standards. Depending on the era of your home, you may find going back to the original landscape just doesn't reflect the level of effort you've put into restoring the interior and exterior of your old house. You can always follow the period strictly in the front yard and take more liberties in the back. The choice is yours.

There are clear differences in landscape design from period to period. I'll discuss just a few of them here. In general, the Colonial period was driven by function. During this time you might see a mixed herb garden near the house, fenced in to keep the animals out. Fruit and vegetable gardens were placed in the most environmentally advantageous spots on the land.

The Victorian era marked the beginning of porches, front stairs and raised foundations. (Surprisingly enough, foundation plantings weren't seen much before 1870. Their improper use is one of the biggest mistakes I see in landscape restoration.) Accent plants, sometimes placed at the corners of bays, for example, were popular. There was great experimentation with plants going on in the early- to mid-1800s. They were imported from all over the world. Many times trees or shrubs were planted individually with lawn around them, producing a very focal, spotty effect.

The period plan

When you're ready to call in a landscape architect to develop a period plan for your property, your local historical society, garden club or state chapter of the American Society of Landscape Architects should be able to lead you to a pro, experienced with historical restoration in your area. The specialist you ultimately choose should be attuned to the peculiarities of your region, well acquainted with local history, and have some knowledge of plant materials used during the period you've decided on.

He or she should be able to fill in some of the "holes" you've probably discovered on your land with suitable plant species. Be aware that the historical plant palette was much more restricted than it is today. Like the early inhabitants of your home, you probably won't have a lot to choose from when replacing bushes, trees and other plant materials. Again, your landscape architect should be acquainted with what was available then, and is available today.

So, now is the time to begin your detective work. You'll be amazed at what secrets to the past the land around your home may hold.

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Investigating The Infinitesimal

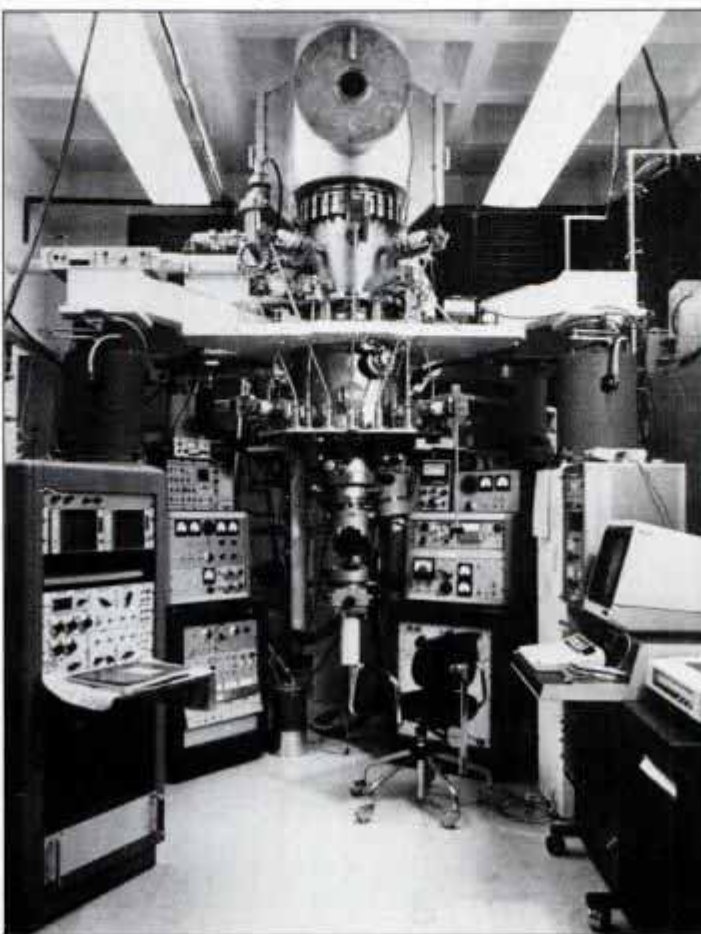
SEEING the unseeable has long been a scientific preoccupation, practiced with equal fervor by the astronomer as well as the biologist. Seeing far or seeing near, the goal of expanding our knowledge of the world remains the same. While 8- and 10-meter telescopes for astronomy are moving off the drawing boards and onto the world's mountaintops in the Soviet Union, Chile and Hawaii, equivalent strides are taking place in the field of microscope technology. Scientists are peering closer than ever before at the molecular structure of our universe.

At Duke University, researchers have modified a tried-and-true electron microscope, similar to the type first developed in the late '30s, to accept a spectrometer and a superconducting lens.

Using liquid helium cryogenics, they are able to increase specimen preservation a hundredfold over readings taken at room temperature. An electron microscope sends a beam of electrons through a thin film of the subject being examined. The specimen scatters them in a unique fashion, and counting the electrons yields information about the specimen's molecular composition.

"However," says Duke anatomy professor Michael Lamvik, "it's like trying to weigh a flour sack that has a hole in it."

Specimen deterioration caused by the electrons constantly changes the values. Keeping the specimen at or near absolute zero (or -460° F) makes the specimen more durable. And when a spectrometer is attached to the microscope column, the scattered electrons can be conveniently counted to judge weight, shape and molecular structure.



Duke University's "cryomicroscope" relies on superconducting technology and spectroscopy for observing molecular structure.

"It's a microscopic way of stepping on the scales," says professor Lamvik.

Similar microscope improvements are taking place at the University of Michigan, where scientists have developed the first positron transmission microscope. Positrons are the antimatter counterparts of electrons and last for only a few billionths of a second. They are produced in the radioactive decay of certain substances.

"Positrons can provide information complementary to electrons to give us a better idea of what's going on in the materials that we are viewing," says James C. Van House, who developed the University of Michigan device in collaboration with physics professor Arthur Rich.

The microscope uses positrons in a way similar to the way an electron microscope uses electrons. A beam of positrons is directed at a thin film of the specimen being studied. Positrons emerging from the opposite side pass through magnifying lenses and onto a detection device where they are counted and analyzed.

The positron transmission microscope is considered supplemental to the standard electron microscope, providing an additional piece of information about the specimen being studied. It also paves the way for a positron re-emission microscope proposed by University of Michigan scientists. They hope that the absorption and re-emission of positrons will furnish an even greater under-

standing of the atomic lattices that form a given material.

"Hyper" Computing

What's next in the field of supercomputing after Cray and ETA? Experts point to Hypercube, a parallel processor invented at CalTech now being developed by the Jet Propulsion Laboratory. A parallel processor solves immense computing problems by parceling out pieces of the problem to linked "nodes" within the computer. The computer can then work on these individual pieces simultaneously rather than answering each problem step-by-step.

These "concurrent" computers are expected to propel us into the next era in computer science, and Hypercube technology is being explored by companies like Intel, N-Cubed, Floating Point Systems and Ametek in addition to several software firms. Already Hypercube is under consideration at the Department of Energy, the Strategic Defense Initiative Organization, the Joint Tactical Fusion Program, NASA and the U.S. Air Force. **PM**



TV camera forms part of U of M's positron transmission scope.

CAR CLINIC

BY MORT SCHULTZ

Out Of Print

I RECENTLY purchased a 1986 Dodge Ram 50, which came without an owner's manual. A Dodge dealer gave me an order form which I dutifully filled out and mailed, along with a check, to Dymet Distribution Service in Strongsville, Ohio. I got the check back with a letter stating that the manual is no longer available and won't be reprinted. What's a second owner who's interested in doing simple maintenance tasks supposed to do?

FRED MACK
EAST DURHAM, NY

J. L. Freeman, who heads the Chrysler Motors publications department, says that auto manufacturers are obligated by law to supply an owner's manual with every new vehicle. An additional supply of manuals is also required to fill requests from those like yourself. Once the supply is depleted, that's it. Another printing is not usually made. The inventory for any one

manual is generally sold out in about 18 months.

One solution to your problem is to contact the vehicle's original owner, if that's feasible, to find out if he or she has the glove box manual.

A manual that you should be able to get from your dealer is the factory service manual. It's the best reference for anyone who wants to do his own maintenance. The only other thing I can suggest is to buy a general repair book, such as MOTOR Auto Repair Manual (Motor Publications, 555 W. 57th St., New York, NY 10019). It could very well provide you with the information you want.

Solving The Unsolvable

I've been told that the problem I have with a 1986 Ford Taurus is unsolvable. At times in stop-and-go traffic the car's 3-liter V6 engine hesitates and jumps as if it were starving for gas.

It has been this way since I got the car. Does this have

something to do with the cooling fan that seems to work overtime?

PATRICK F. GROSS
EDMONDS, WA

I doubt if it has anything to do with the cooling fan, but that doesn't mean the condition is unsolvable.

In stop-and-go driving, when the fuel supply is less than a quarter of a tank, gas can slosh away from the fuel pickup. This results in frequent but momentary periods of fuel starvation which you feel as flat spots in engine performance. You have two ways to go: You can keep the fuel supply from falling below one-quarter of a tank, or you can install a new fuel pump and pickup as described in technical service bulletin (TSB) 87-22-17.

Dog Days

I dread the summer. For the past three of them I haven't been able to drive my 1984 Volvo 760 GLE (V6 engine) in slow traffic with the air conditioner turned on. If I do, the engine overheats. My

mechanic tells me he's checked every possible cause, and his advice is to keep the a/c turned off in traffic. Is there no better solution than this?

PETER BRENNAN
DENVER, CO

There are a number of things that should keep a Volvo from overheating with the a/c on in slow traffic.

Make sure fan belt tension, coolant level and coolant mixture are up to par. Volvo recommends only a 50:50 solution of Volvo type C antifreeze and water.

Make certain the air guide behind the spoiler is open, and the a/c condenser and radiator are free of debris.

So far so good? Then, test the electric cooling fan to make sure it's working. Locate the thermal switch at the upper left side of the radiator. There are two wires. With the ignition switch on, disconnect the two wires and touch their terminals together, bypassing the switch. The fan should start. If it doesn't, the fan or fan circuit is bad. Also, make sure the ignition timing is set at 23° BTDC, plus or minus 1°, with the engine running at 2500 rpm and vacuum disconnected.

If none of the above help, there are these modifications to try:

■ *Install a different fan switch (part No. 1274962-8), which will activate the fan at a lower temperature (196° F). Use a new rubber bushing (part No. 1274048-6) with the new switch. Along with the new switch, change to a 189° F thermostat (part No. 273480-4).*

■ *A new expansion tank pressure cap (part No. 1357390-2) will increase the boiling point of coolant.*

■ *Install a new water pump pulley (part No. 12710455). This will also require a different drive belt (part No. 966976-3). The new pulley will increase pump speed.*

(Please turn to page 45)

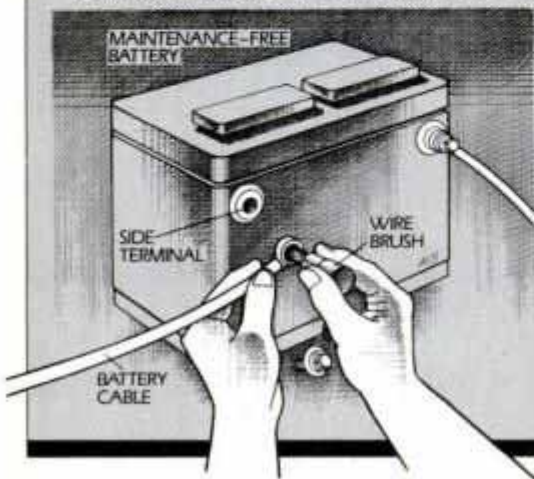
Invisible Enemy

If you're under the impression that your battery doesn't need tender loving care, because it's called maintenance-free and has side cable terminals, you'll be impressed with some contrary statistics. Atlas Supply Co. reports these survey findings: "Sixty-eight percent of positive battery cables and 56 percent of negative cable ends were corroded, and of these 22 percent of the positive and 24 percent of negative were severely corroded."

This doesn't necessarily indicate outright neglect. More likely, it probably indicates that the owners didn't look closely enough during their periodic inspections.

Don't get complacent just because you don't see corrosion. Unlike corrosion that forms on top of post-type batteries, corrosion that develops on side-terminal batteries builds up under terminal connecting bolts.

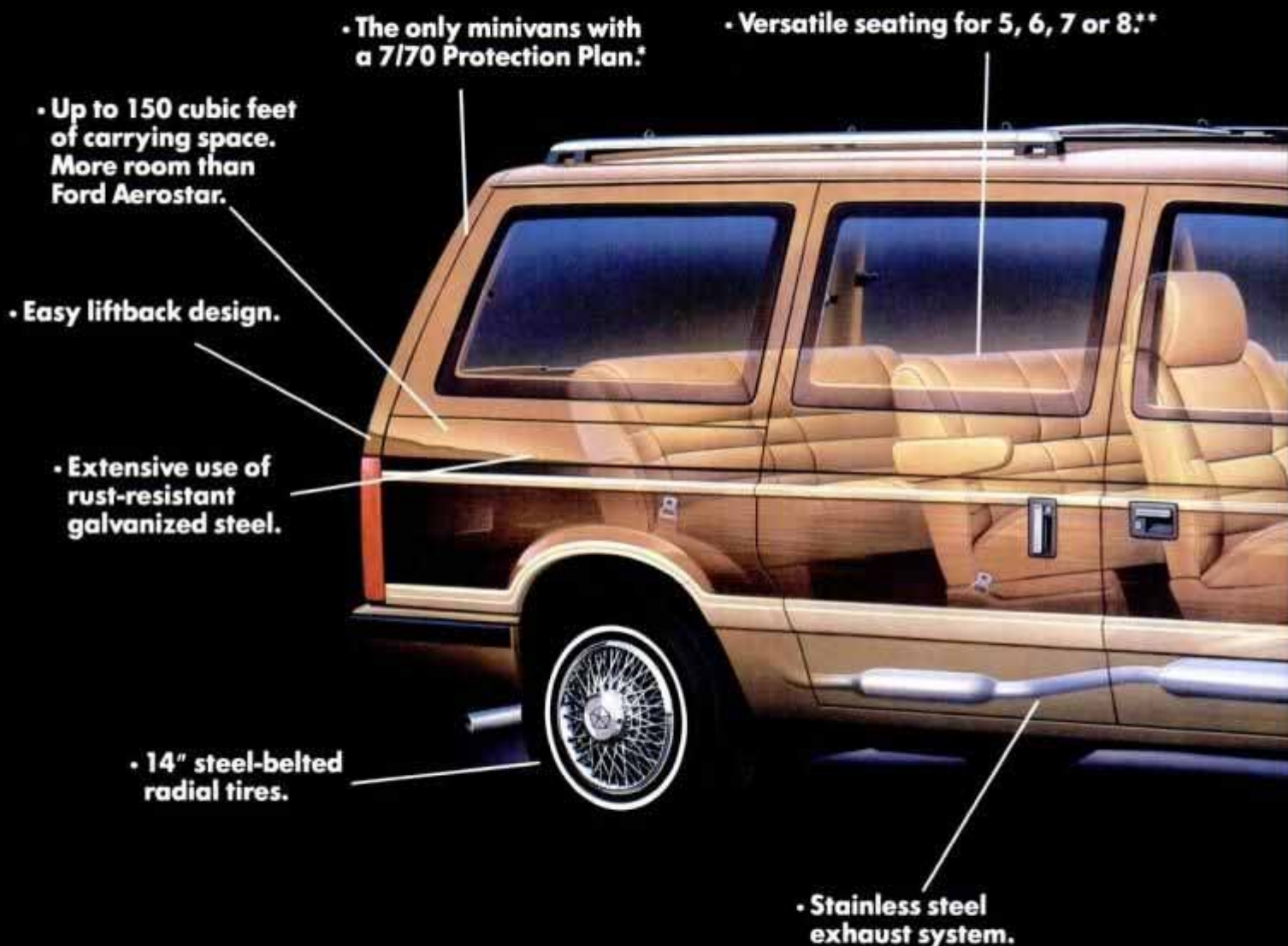
Since the starter motor, engine computer system and other electronic units rely on the battery for voltage that can be interrupted by corroded cable terminals, you should unscrew terminals from the battery every six months. Clean the bolt, both sides of the cable terminals and the pads on the battery with a baking soda/water paste and a wire brush. Reconnect cables snugly and then spread a thin layer of petroleum jelly over them, to retard corrosion until your next inspection.



PLYMOUTH THE PRIDE'S INSIDE.



VOYAGER. THE



PLYMOUTH GRAND VOYAGER LE

*J.D. Power and Assoc., 1987 Compact Truck CSI/customer satisfaction with overall product quality and dealer service on 1986 models. *Protects engine and powertrain for 7 years or 70,000 miles and outer body rust-through for 7 years or 100,000 miles. See limited warranty at dealer. Restrictions apply. **Seating for 8 available only on Grand Voyager SE with 3.0L engine, auto, trans. and front bench seat. †With optional heavy-duty trailer towing package.

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• Excellent all-around visibility.

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Car-like handling.

• Voyager offers the choice of a powerful new fuel-injected 2.5 liter or V-6 engine.

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• Power disc brakes.

• The only minivans with front-wheel drive.

• Easy step-up.



7/70

Division of Chrysler Motors

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NEW SPECIAL VALUE PACKAGE GIVES YOU AUTOMATIC TRANSMISSION AT NO EXTRA CHARGE WITH A 2.5 LITER ENGINE, A SAVINGS OF \$549.††

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The #1 minivan in owner satisfaction just got a lot more satisfying.^o Because now Plymouth Voyager offers a value package that includes automatic transmission, air conditioning, AM/FM stereo, rear window defroster, deluxe sound insulation and more. A package that saves you \$549. You also get Voyager's front-wheel drive, outstanding car-like

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††Based on traditional sticker prices of separately purchased options. *J.D. Power & Associates 1987 Compact Truck CSI/customer satisfaction with overall product quality and dealer service on 1986 models. BUCKLE UP FOR SAFETY.

Getting "Forgotten" Parts

I have a 1968 Chrysler Imperial in dream condition. What I need is a check valve (part No. 3004626) for a brake vacuum booster. I've tried Chrysler parts departments and wrecking yards without luck.

ANDREW KOLLAR
ENUMCLAW, WA

Since the number is still listed by Chrysler, one would expect the part to be in stock. But the part is not to be found in the Chrysler supply system. So, to find a source for you, I went to Hemmings Motor News. One of the places listed in the publication that I called has the part. It is Vintage Auto Parts, 24300 Highway 9, Woodville, WA 98072. The toll-free number outside the state of Washington is (800) 426-5911. Since you live in the state, call (206) 486-0777.

In case this outfit sells out all their check valves for the '68 Imperial vacuum booster by the time you reach it, Hemmings can be ordered from Box 196, Bennington, VT 05201. The publication usually has about a dozen pages of listings for Chrysler (Mopar) parts for sale.

Lip Service

I'm having all kinds of trouble with the transfer case of a 1983 Ford Bronco, which was manufactured 2/82. The shift gear and fork have been replaced three times. The fork keeps wearing out the lip on the gear. I've had the best transmission shop in town working on it after three Ford dealers failed. The last fork and gear lasted less than 250 miles. What's wrong?

CALVIN CALDWELL
CALHOUN, GA

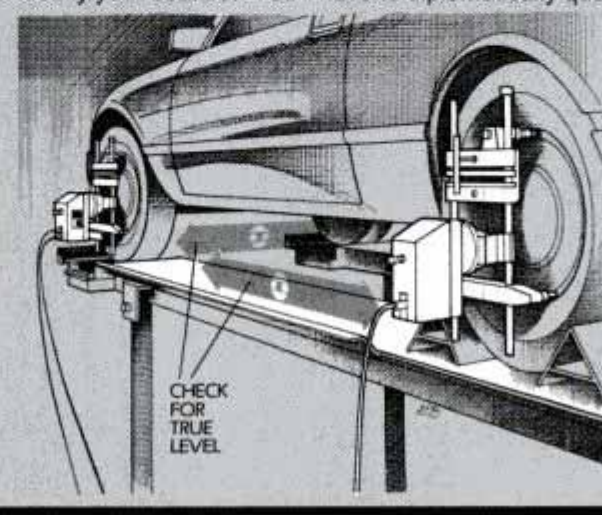
It sounds like lack of lubrication. But before I explain the necessary repair steps, let me quibble a bit. The plastic lip is not wearing out. It's melting. Inadequate lubrication between the fork and gear causes the fork, which is aluminum, to rub against the plastic gear and create heat buildup. When the lip melts away, the fork comes into contact with a steel washer. Subsequently, the fork gets worn away. Broncos built after 2/7/83 have new parts installed that provide improved lubrication between the fork and web and hub assembly of which the gear and lip are part. Trucks built on or before this date will benefit by having these parts installed. They are:

- A new web and hub assembly (part No. E2TZ-7B066-A).
- A new reduction fork assembly (part No. E1TZ-7289-B).
- A deflector (drip clip) that attaches to the front half of the transfer case. Lubricant bounces off this drip clip and onto

Aligning The Aligner

Sections of concrete floor on which a wheel alignment rack sits can be disrupted by variations in seasonal temperature, throwing the rack out of level. When this happens, inaccurate camber and caster readings result, which means car wheels may not be set accurately. Knowing this, a diligent shop owner will occasionally test side-to-side and end-to-end level at each corner of the rack with a carpenter's level and shim a low side to make it even. But you have no instant index as to who has been diligent and who hasn't. So the question becomes, what about those who don't take this precaution?

Unless you've got a lot of time to spend on research, the direct approach is usually your best bet. You'll have to diplomatically question the shop owner or manager when you bring your vehicle in for alignment.



One good question to ask is when was the last time the alignment equipment manufacturer pulled a routine calibration check. Evaluate his reply and judge whether you should have an alignment job done at his shop. After all, it's your tires that are at stake.

the web and hub assembly and fork. The part number is E4TZ-7A174-C.

- A new front half of the transfer case (part No. E4EZ-7005-D) which has the groove to support the drip clip.

In addition to all this, the amount of required lubricant has been increased from 7 to 9 pints of DEXRON II. Unfortunately, you can't get more than 7 pints of lubricant into the case before it overflows the hole. What you have to do is fill the case and screw in the fill-hole plug. Then, remove the speedometer gear, which is on top of the case, and add the additional 2 pints. If this becomes a pain, you can get a new rear case half (part No. E4TZ-7005-C).

At this point, you may be wondering if Ford will pay all or part of the cost of the repair. I don't know. In your favor is the fact that you apparently complained about the condition to a Ford dealer while the truck was still under warranty. (I hope you kept documentation.) Against you is the fact that you didn't have a Ford transmission shop work on it. You have nothing to lose by trying. Work through a dealer or call the Ford district office and plead your case. It's in Atlanta: (404) 763-6440. **PM**

DO YOU HAVE A CAR PROBLEM?

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

SERVICE TIPS

- If you own a 1985-86 Honda Prelude Si or 1986 Accord, the countershaft flange nut in the automatic transmission may work loose.

If you don't attend to it immediately, the transmission could be ruined. Get the car to a dealer and let him determine if your car is one of those affected as outlined in TSB 87-007.

- A bunch of 1986-87 Chrysler Motors 4-door models built before 3/1/87 have sluggish or erratically operating right-rear electric door locks. Dealers are empowered to replace motors in doors with more powerful motors.

The new one carries part No. 4467252, and the authorization is TSB 08-20-87 Revision A.

- Don't let anyone tell you it's impossible to get a 1987-88 Nissan Sentra or Pulsar E16i engine purring like a kitten while it's running at idle. There's a new TSB—TSB88-001—that takes a Nissan mechanic by the hand and leads him down the path of righteousness.

- Owner complaints of various kinds of noises from EFI systems are being addressed by car manufacturers, and "Car Clinic" will continue to bring information about repairs to your attention. This one concerns fuel-line knocking or hammering from the multiport fuel-injection system of 1987-88 Chevy Celebrity 2.8-liter V6 engines. TSB 88-109-6E advises dealers to try and eliminate the noise by replacing the fuel-feed pipe and expansion chamber assembly with a new one (part No. 10115809).

BY STEPHEN A. BOOTH

Getting The Big Picture

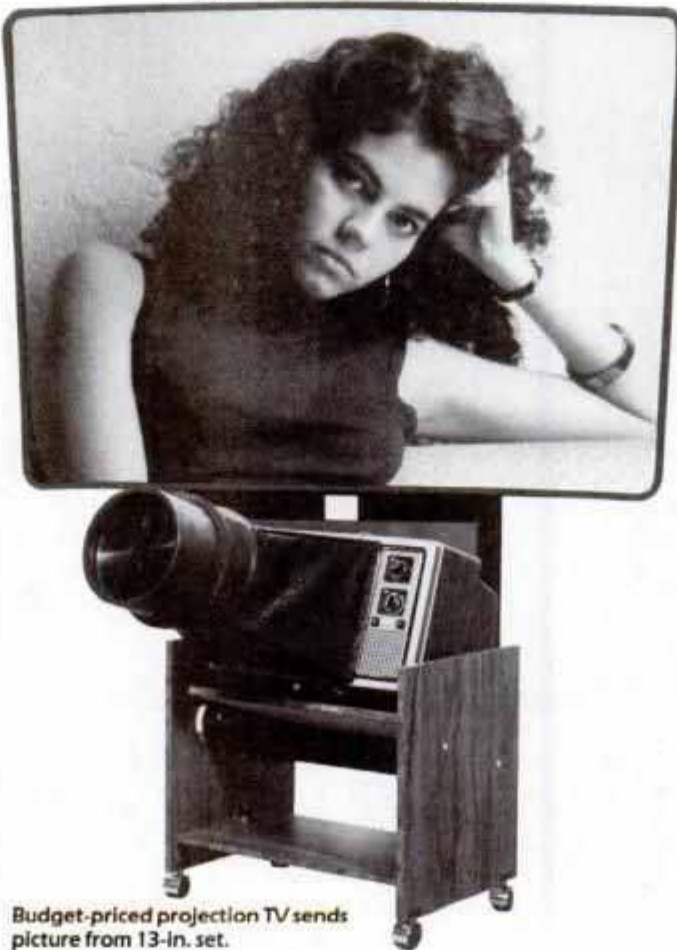
DO YOU sometimes wish your 13-in. color TV would bulk-up and give you a 6-ft.-wide picture? Well, awake, dreamer. You can make your wish come true—for under \$1500. As Expand-A-View prexy Bill Bergfeldt likes to say, the bumblebee isn't supposed to fly, but does so nonetheless.

What Expand-A-View offers is an amazingly simple retrofit package that enables a 13- or 14-in. TV to project an image on the company's 50-, 60- or 72-in. diagonal screens. It isn't perfect, but it's amazingly good, especially when you consider the much greater cost of comparably sized, 3-tube front projection TVs.

Bergfeldt's system begins with an 8-in.-dia., f/2.0, fresnel lens assembly that attaches to the TV with Velcro straps. A floor stand aims the TV at the proper projection angle. Also necessary is a converter switch that inverts the picture on the tube so that it's projected right-side-up on the outboard screen. You can buy a preconverted TV from the company, or have your local TV shop install the switch on your own set. Though the set will operate normally when you change the switch position, this is likely to void your manufacturer warranty.

The key to Expand-A-View's effectiveness is in the company's new high-gain screens.

Normally, a single-tube TV would not have the necessary brightness to project a visible image. But where 3-gun sets use screens with a gain-rating of 10, Expand-A-View's 30-pound screens boast ratings of 18 or more. And yes, you can use a remote control even though the TV set has its back to you: The infrared beam reflects off the aluminum screen to reach the TV.



Budget-priced projection TV sends picture from 13-in. set.

Compared to a direct-view tube TV, Expand-A-View's projected image is a bit on the soft side—though brighter and no softer than the screen image of most front-projection TVs. Ultimately, the sharpness and brightness of the little TV determines the quality of the large-screen image. For off-center viewing by large crowds in large rooms, the system ought to be raised or ceiling-mounted.

For more information, including a dealer near you, contact Expand-A-View at 119 E. 51st Terr., Kansas City, MO 64112, (816) 561-1896.

Play Ball!

It was a long, long winter, but baseball's back and all is well with the world. In case you haven't already noticed, this month's issue celebrates

the arrival of spring with a very informative—if somewhat offbeat—view of the game by former pitcher Jim Kaat, who now provides the TV and radio commentary for the world champion Minnesota Twins. (See "Foul Ball!" on page 82.) What has this got to do with electronics? Hang in and you'll see.

Kaat's story is a no-holds-barred look at baseball's outlawed practices, among them the use of corked bats. One player often accused of the deed last year was Howard Johnson, third baseman for the New York Mets. Though HoJo's bat passed X-ray exams with flying colors, the shadow of doubt is hard to shake. But in the course of researching this month's story, PM turned up some information that might clear the ballplayer's name.

It seems that a micro-

processor chip, not cork, might be responsible for Johnson's 36 homers.

Throughout the winter preceding the '87 season, Johnson practiced his hand-eye coordination on a computerized, audio/visual device called START (for Sports Technique And Reaction Trainer), from Innovative Training Products of Syosset, New York. Quite simply, the briefcase-size machine recreates real game situations in smaller settings.

In Johnson's case, the START computer and three red lightbulbs were set up at the distance of a pitching mound from home plate, where two batting tees were placed in the expected location of an inside and outside pitch. The three lights at the mound would indicate, randomly and unpredictably, an inside, outside or knockdown pitch. Upon seeing a light flash, Johnson had half a second to react appropriately—about the speed of an 80-mph fastball. A buzzer kept time.

How did HoJo do? According to the manufacturer, his reactions improved to 0.4 second—the equivalent of hitting or ducking a 100-mph fastball.

Johnson also used START to hone his base-stealing skills. With a major league 12-ft. lead, you have 1.2 seconds to get back to first safely on a pickoff throw. This winter, he worked on his fielding.

START was originally developed for tennis, and has been used by Ivan Lendl and Martina Navratilova. It's driven by a variety of ROM computer cartridges, so depending on the sport and the drill, the system ranges in price from \$1400 to \$2500. This should drop as the number of individual, team and institutional customers increases. (Please turn to page 48)



When You Play Hard
You Need A Battery That Works Hard.



Eveready Super Heavy Duty Batteries.
All the power you need to get the job done.
Even when it's play. At a price that isn't heavy duty.

EVEREADY.

ELECTRONICS

(Continued from page 46)

Three Strikes

Although I wouldn't trade season's tickets for a projection TV, I've got to admit it's the next-best thing—especially if the set's hooked up to a satellite dish. Trouble is, dish owners won't be able to tune-in on a daily baker's dozen of pro games anymore. Satellite TV has taken a called third strike, at least where baseball's concerned.

As it is, you need a descrambler to watch many popular programs these days. Now, the confederation of finan-

cial interests known as Major League Baseball plans to scramble all feeds, directly from the parks. And the scrambling system used is not compatible with the one intelligible to household decoders. If this were not enough, a court in Minnesota recently ruled that picking up a feed and showing it for commercial gain is illegal—and fined three Twin Cities area bars for doing so last year.

Until the program owners offer a package that permits you or your local tavern to pay to view these games, all you can do is enjoy what's available on local broadcast, cable or radio. If you want to see more baseball and need a

laugh, check out two videotapes at your rental store. "Funny Side Up" [Scotch/3M, (800) 328-5727] delivers 45 minutes of major-league bloopers. "Not So Great Moments In Sports" [HBO Video, (212) 977-8990] runs 54 minutes and is worth the money if only for Gaylord Perry's spitball seminar.

Whatever you do to kill time between ballgames, do not attempt to cork a bat. Master craftsmen Rosario Capotosto did the one that illustrates Jim Kaat's story. Ro burned a drill bit in the process, and lost his sense of humor when machining block cork into a dowel. "Bat doctoring," he insists, "is a good way to drive yourself batty. Just building the jigs is a challenging job, and I don't recommend it as a weekend diversion!"

Busy Signals

Happily, the videophone format-war that was brewing between Mitsubishi and Sony ("Electronics," page 50, Feb. '88) isn't going to happen. A ministry of the Japanese government has gathered all the parties at the conference table to work out their differences. Details are not yet available, but you can rest assured that one company's videophone will "talk" compatibly with another's.

Meanwhile, in case you were wondering if a videophone gives outside parties an opportunity to spy into your home, 1984-style, the answer is no. Only you control the output from the videocamera in the phone. But this doesn't mean your domicile will be entirely impervious to electronic intruders, any more than your telephone can currently reject nuisance calls.

In fact, the videophone might breed a whole new type of obscene phone call—a video equivalent of the "breather." Until the manufacturers of videophones install modesty panels over their screens, your only defense against the phone-flasher is to take the video part of the videophone off the hook. Or, you might invest \$50 in another new device called Privacy Plus.

According to Marchetta Distributors, which sells the unit, the device protects you from unwanted calls by requiring the caller to enter a 4-digit access code after making the connection to your line. This code is available only from you, and you can change it. If the code is not entered in 10 seconds, the call is terminated.

Privacy Plus patches between your phone and its modular wall jack. To order, call Marchetta toll free at (800) 547-8921. No access code is needed.

Late News

The National Bureau of Standards has withheld approval of the Copycode system, proposed by CBS as a way to prevent digital audio tape recorders from copying CDs. Stay tuned. **PM**



\$300 to replace. \$10 to repair.

Now there's a wood filler for the big jobs, indoors or out. High Performance Wood Filler by Minwax. It won't shrink, crack or fall out. It hardens in 15 minutes and can be sanded, planed, drilled, painted or stained.

If the wood is soft because of rot, prepare a rock-solid base with High Performance Wood Hardener.

Send today for our free 30-page booklet, *Tips on Wood Finishing*. Minwax Company, Inc., Dept. PM-097 P.O. Box 426, Little Falls, NJ 07424.



High Performance Wood Filler



We gave 'King Kong' Bundy a HEADSTART™ computer and he learned to use it in 23 minutes! (with no instruction book, previous computer training, or help from his coach)

'King Kong' Bundy is no dummy.

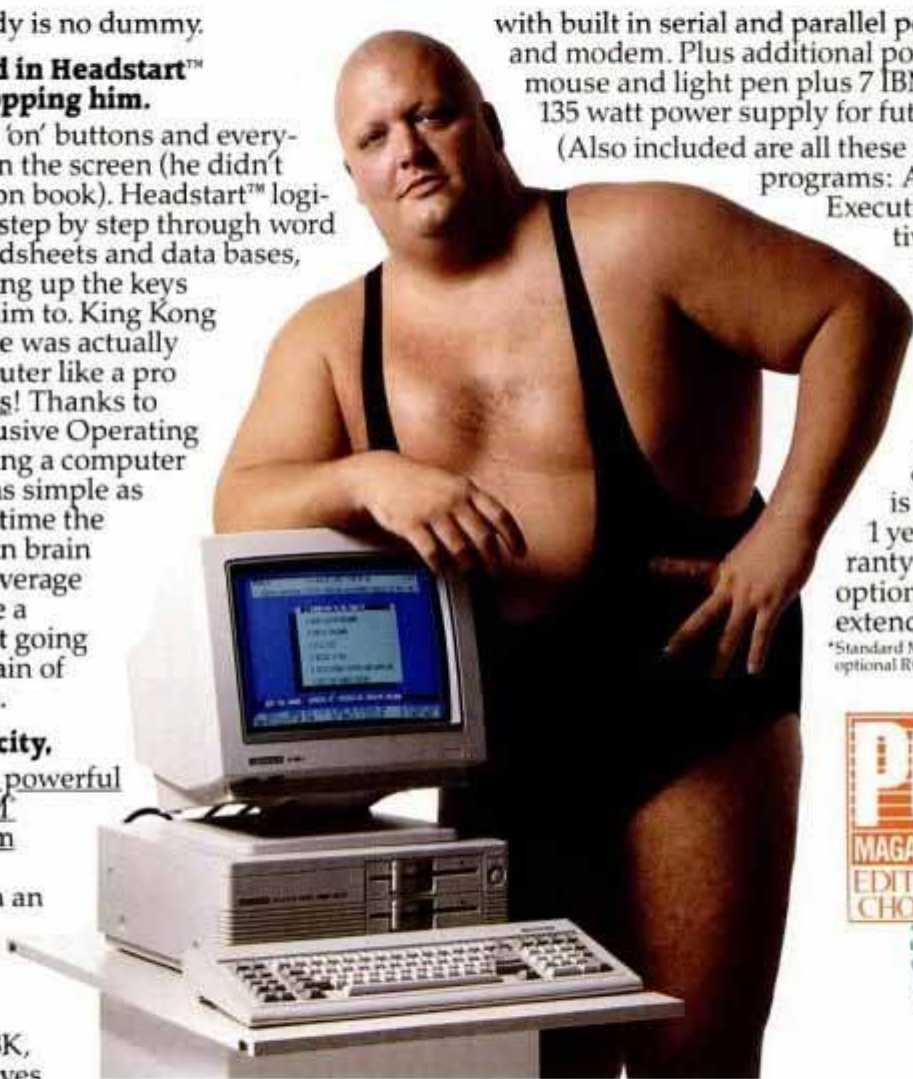
Once he plugged in Headstart™ there was no stopping him.

He pressed the 'on' buttons and everything was there on the screen (he didn't need an instruction book). Headstart™ logically guided him step by step through word processing, spreadsheets and data bases, simply by punching up the keys Headstart™ told him to. King Kong couldn't believe he was actually operating a computer like a pro in only 23 minutes! Thanks to Headstart's™ exclusive Operating Environment (using a computer all by yourself is as simple as A-B-C). It's about time the computer's built-in brain was used so the average guy or gal can use a computer without going through a mountain of instruction books.

For all its simplicity,

Headstart™ is a powerful and complete IBM® compatible system for under \$1,000.*

It's packed with an ultra fast 8 MHz Intel 8088-2 processor, 512K RAM memory expandable to 768K, two 360K disk drives



with built in serial and parallel ports for a printer and modem. Plus additional ports for 2 joy sticks, mouse and light pen plus 7 IBM® slots and a hefty 135 watt power supply for future expandability.

(Also included are all these free software programs: ATI;™ Skill Builder, Executive Writer;™ Executive Filer;™ MyCalc;™ Hot Pop-Up™ Services, plus over \$1,000 in bonuses and discounts for accessories and software.) Of course, Headstart™ is backed by a free 1 year limited warranty and an exclusive optional low cost extended coverage offer.

*Standard Monochrome monitor, optional RGB Color monitor, extra.



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TOYOTA

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TOYOTA QUALITY
WHO COULD ASK FOR ANYTHING MORE!

WORKBENCH BASICS

BY ROSARIO CAPOTOSTO

How To Apply A Wax Finish

MOST factory-built furniture has a wax topcoat that adds a rich luster to the wood's surface while protecting the finish. Therefore, it's important to maintain a protective wax finish on your furniture including shopbuilt projects.

There are many liquid and spray-on furniture polishes available, but the one recommended by professional furniture finishers is old-fashioned paste wax. This is usually a blend of carnauba wax, beeswax and turpentine. When applied and buffed properly, paste wax forms a surprisingly hard, durable protective coating.

A waxed piece that has grown dull and flat can often be revived by simply buffing the surface with a soft, dry cloth. If this fails to restore the luster, then it's necessary to re wax.

Apply paste wax with a soft, water-dampened cloth.



To obtain a professional-quality wax finish on wood furniture, all you need is some paste wax, a soft, dry cloth, and some elbow grease.

Spread on a *thin*, even coat and allow it to dry about 20 minutes. Don't overapply the wax. A thick, heavy wax coat

will be nearly impossible to buff out. Once the wax has dried, buff the surface by rubbing briskly—don't spare

the elbow grease—with a soft, *dry* cloth. An electric polisher with a lamb's wool bonnet can also be used.

Stop buffing when the surface acquires a uniform, highly polished sheen. A simple thumbprint test will determine if more buffing is needed. Push your thumb on the surface. If a clearly visible thumbprint is left, continue buffing. Wait about one hour and then apply a second wax coat. Buff the second coat to a lustrous sheen.

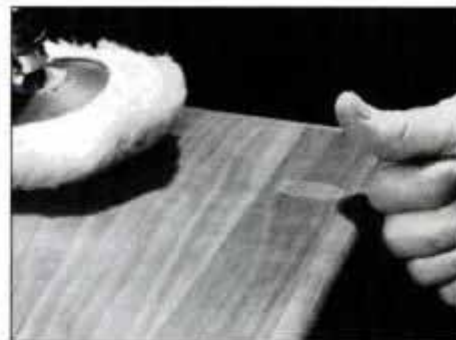
If a furniture piece has several coats of old, dirty wax, it's best to clean off the wax and start from scratch. Use naphtha or mineral spirits on a soft cloth to remove built-up wax safely on pieces finished with varnish, shellac or paint. On lacquered surfaces, use mineral spirits. Naphtha may dull a lacquer finish. Once the surface is clean, apply two coats of wax. **PM**



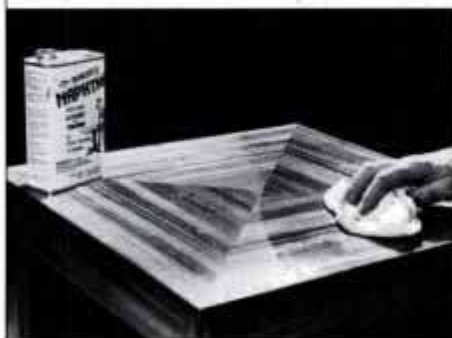
A highly polished surface is achieved by rubbing briskly with a soft cloth. Be sure to apply a thin coat. Don't overapply the wax.



An electric drill fitted with a polishing bonnet speeds the buffing process. A right-angle drive accessory converts the drill into a polisher.



If you can press a thumbprint into the wax coat, then more buffing is required. The final wax coat should dry hard and reflective.



Use naphtha or mineral spirits to clean the surface prior to waxing. Rub gently with more solvent to entirely remove the old wax.



Apply paste wax with a soft, water-dampened cloth. Apply an even coat and allow the wax to dry for about 20 minutes before buffing.



Hand-rubbing will be more effective if you wrap the cloth around a firm rubber sanding block. The blocks are sold at paint stores.

AUDIO

BY FRANK VIZARD

Hi-Fi For Video



Kenwood's remote-controlled receiver offers 125 watts per channel and many video functions.

HERE'S AN update on the increasingly sophisticated hi-fi receivers used to anchor audio/video home entertainment centers. Among the most feature-laden of these units is Kenwood's KR-V126R machine. The list price is \$650, not too bad considering what you're getting for the money.

The KR-V126R pumps out 125 watts per channel and has most of the audio features found in any comparable receiver. Less common, though, is the inclusion of three modes of surround sound, one of which is for use with videotapes encoded with Dolby surround sound.

Flexibility, though, is really the receiver's chief attribute. The 20 presets of the KR-V126R allow you to program stations not only from the radio, but also from broadcast and cable TV channels. Alternatively, the presets can be used to classify radio stations by musical category. If, for example, jazz is the category selected, the receiver will display those stations preset for jazz. The KR-V126R can also be preset using the station's popular name or call sign.

From a recording standpoint, the three video inputs offer a great deal of flexibility. There's also an Audio Injection feature that makes it easy to add a soundtrack onto a videotape.

The KR-V126R also sports a built-in 7-band equalizer with its own spectrum analyzer—a particularly useful tool if you're making cassettes for a dramatically different environment, such as a car interior. The equalizer also has 10 preset positions, five of which are fixed, so that specific equalization for different types of music remain on file in the receiver's memory.

Bits 'N' Pieces

"Two bits" used to be slang for 25 cents, but in audio these days it's used to differentiate a new class of compact disc players.

An extra two bits is what the newest CD players from Technics, Onkyo, Akai, Pioneer and Sony have over their 16-bit counterparts.

So what does an extra two bits buy you? Simply put, the

extra two bits mean better decoding of the digital information on the compact disc, particularly as it relates to the fidelity of low-level musical information.

To understand the significance of this you must remember how CD players work. Digital-to-analog converters (DAC) translate the numbers encoded on the disc into music. Standard 16-bit CD players sample the music in sections represented as 16 digits in length. If the sampling window were widened to 18 digits, the encoded music could be decoded more accurately.

The effectiveness of 18-bit CD players can be seen in their signal-to-noise (S/N) specifications. The older 16-bit CD players generally achieve a S/N ratio of 93 dB—not shabby by any means. The 18-bit CD play-

ers, however, achieve S/N ratios of 103 dB—truly remarkable.

The 18-bit CD players also have more going for them than just an extra two bits. Technics' SL-P990 model, for example, sports two DACs for each stereo channel. The idea is to eliminate any distortion that might occur at the zero

crosspoint between the positive and negative voltage swings of the signal, as it changes from digital to analog form.

Digital crossover distortion might not be high on your list of world problems, but the SL-P990 does have a number of features that will make your life easier. Chief among them is an edit guide that automatically computes the songs and the playing times that will fit on each side of a selected blank tape. Tapers will also like the "Auto Peak Level Search" feature. This scans the entire disc for the highest signal peak, thus allowing you to set your record levels accurately.

The Technics SL-P990 lists for \$825 and has a lot of convenience features and internal engineering that justify the price. The same may be said of the other 18-bit CD players on the market. Prices may vary somewhat according to the inclusion or exclusion of certain features. In any event, for the first time—at least in my mind—there's a very quantifiable difference between CD players.

Stealth Radio

"No Radio" is a sign of the times, particularly in urban areas where a note to that effect is a common site on car windshields and windows. Many of these car owners

(Please turn to page 57)



Technics' SL-P990 (above) is one of the first CD players with improved, 18-bit sampling. Sharp RG-F816 (below) deters car stereo thieves with pop-out module.



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AUDIO

(Continued from page 52)

have cassette receivers that pull out of the dashboard for safekeeping. The only problem is that heavy, bulky car radios are a chore to carry around.

A more lightweight approach is being adopted by Panasonic, Technics and Sharp. The CQ-E430 and CQ-E410 from Panasonic and its sister units from Technics are installed so that the amplifier section of the cassette receiver remains in the dashboard. This means that you remove only the lightweight tuner and cassette sections. These removable units list for \$400 and \$500, respectively, and have a variety of features consistent with other removable units in this price range.

Sharp, however, has the most lightweight approach to theft protection. All the key operating controls of Sharp's RG-F816 cassette receiver are centrally mounted on a 2-in. rectangular front panel that pops out to render the unit useless.

Once the control module is removed, a bright yellow-orange warning sign becomes visible and indicates that the RG-F816 is inoperable. Unfortunately, a thief may have to break the window first to see the sign.

The RG-F816 lists for \$350.

Mini-Discs

Hi-fi companies are betting that the new 3-in. compact disc format will become the darling of home entertainment. The 20-minute mini-CDs retail for around \$4, a price many expect will help stimulate the sales of CD players. Existing CD players must use an adapter to play the mini-CDs, but the drawers of some new CD players are being molded so that they will play both standard size and the mini-CDs without an adapter.

While the 3-in. discs are likely to find their way into home and portable audio products, their use in car CD players at this point seems ill-advised.

CDs are dropped into most home audio units but car players suck in the disc, a motion that is likely to dislodge the mini-disc from its adapter.

Since there is no easy way to remove the jammed mini-CD from the player, you will have to return to your auto-sound dealer for help. At this point you might experience warranty problems because chances are the adapter you used was not made by the company that made the CD player. You'll be in bigger trouble if more companies follow the lead taken by Pioneer—which recommends that the mini-CDs not be used with its products at all.

The mini-CDs also present a problem for home and car CD changers, so don't expect a solution to the problem of mini-CDs anytime soon.

Hi-Fi Legend

Bose Corp., the well-respected loud-speakermaker, is using the expertise gained in developing autosound systems for Delco/General Motors and applying it to cars from the Acura division of Honda. The Bose/Acura system now available as an option in the Legend is similar in many ways to the system developed for Delco, but the Japanese have fine tuned it just a little.

One example of this fine tuning (no pun intended) is the AM/FM cassette receiver. Performance-wise, it seems to be on par with comparable Delco units, but the Alpine-made unit in the Acura has some nice extras. I particularly liked the volume control, a toggle switch that juts out from the control panel for easy use. In our test car, though, the volume control proved a mite redundant since the same type of switch also appears higher up on the dashboard just behind the steering wheel.

Just below this second volume control is another button which advances the tuner to the next preset station in either direction. In the tape mode, this same button advances the tape in the desired direction to the next selection. I think every car should have these types of controls on or near the steering wheel. The convenience they offer is wonderful and they make for safer driving. Unfortunately, the operating controls of most radios require you to glance away from the road for the second or two that could make all the difference in the world.

The Acura system is a 4 speaker array comprised of two 4.5-in., full-range drivers in the doors and two 6 × 9-in. full-range drivers in the rear deck. Each speaker is powered by its own 25-watt amplifier, capable of 50-watt peaks. Each of the four speaker/amplifier assemblies also contains an electronic equalization circuit that contours the sound to the interior of the Acura Legend.

The Acura system also deserves kudos from a design standpoint. Speakers are installed in the doors without sacrificing legroom or map pockets, a feat largely due to the downsizing of the amplifier—a development that occurred some 18 months ago but which has not worked its way into many cars until now. In addition, the rear speakers are effectively hidden from view—no flag-waving logos in evidence for a change.

PM's ears found the soundstage to be placed slightly behind the driver, an impression caused perhaps by the large, assertive 6 × 9-in. speakers in the rear deck (most Bose systems have uniformly sized speakers throughout the car). While the sound is far from unpleasant, the slight shift to the rear is noticeable. Like other Bose systems there is no way you can make an adjustment since there is no front/rear balance control. **PM**

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PHOTOGRAPHY

BY STEPHEN A. BOOTH

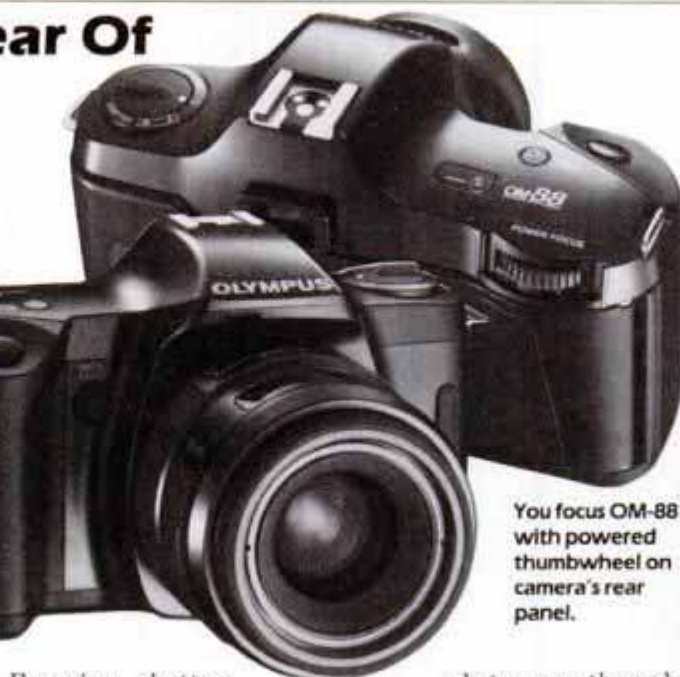
1988: The Year Of The Bridge

THE LINE between single-lens-reflex 35mm cameras and their auto-everything, compact rangefinder cousins has been blurring for some time now. But 1988 will be remembered as the year when camera manufacturers erased the distinction completely.

Step up and shake hands with the "bridge" camera.

This merging of versatility and automation gelled during the recent Photo Marketing Assn. show in Chicago, where cameras for the new model year make their debut. Count Kyocera, Olympus, Chinon, Pentax and Canon among the avant garde.

As you're probably aware, the small, lightweight 35mm compact rangefinder offers point-and-shoot simplicity.



You focus OM-88 with powered thumbwheel on camera's rear panel.

Focusing, shutter and aperture settings, even film advance, rewind and speed selection are automated. What the auto-everything rangefinder has lacked, until recently, is the ability to vary the focal length of the built-in lens, and to match the viewfinder image to the image the lens sees. Single-lens-reflex cameras let you change lenses at will, and

what you see through the viewfinder is what the lens will get. Although many SLRs offer a great deal of computer-driven automation, they are bulkier and heavier than compacts.

To bridge the gap, camera makers have introduced bifocal or dual-lens compacts in the past two years. These point-and-shooters give you a choice between a moderate

wide-angle 35mm lens and a "portrait" telephoto 70mm setting. Meanwhile, many of the same manufacturers have introduced SLRs with interchangeable autofocus lens systems. What's been lacking is a small, lightweight 35mm camera with computer-programmed exposure automation and a built-in, autofo-



Sharp, in-focus picture of double subject, like that above, was taken with new Chinon with triple-beam focusing. In top photo, a camera without the new feature focused on the background between the subjects.

cus lens that offers a broad variety of focal lengths you can see through the viewfinder. Finally, it's here.

In a sense, it was here last year in the Pentax IQZoom (see "Photography," page 28, Nov. '87). This neat little compact sports a 35- to 70mm zoom lens plus a viewfinder and flash that track with the lens. This spring's introductions from Kyocera ("Photography," page 50, March '88), Olympus and Chinon build on the basic Pentax design but in most cases either offer greater focal length (105mm in the case of Olympus) or more automated and creative options. Most strikingly, the "bridge" cameras don't resemble their

PM Tips For Better Pictures

EVEN THE most advanced auto/program camera must rely on the photographer to choose the right film for the job in order to take full advantage of its exposure capabilities. Films are rated by the International Standards Organization. Higher ISO values indicate more sensitivity to light—that is, the film is able to capture an image with less exposure to light.

The price we pay for greater sensitivity, or speed, is image quality. Grain and contrast increase with higher-speed films. Use slow films, such as ISO 25, 50, 64 and 100 for optimal quality.

Motion stopping, particularly under low light, requires fast films such as ISO 400, 800

Choose The Right Film

and 1600. These films are often far too sensitive for daylight shooting.

The camera, therefore, will be greatly limited in its expo-



sure range. Medium-speed films, ISO 100 and 200, are ideal for general daylight and flash photography.

Keep in mind that changing the ISO setting on a camera will effect exposure and not the film's sensitivity. A discrepancy of more than twice between the values may require special processing.

The photos seen here were taken with 400-speed film. Carry a roll of ISO 400 film in your camera case even when planning to shoot in daylight. The extra speed may come in handy for shooting with telephoto lenses, or in the shade, or to obtain the fastest shutter speed possible for action shots. ISO 400 films will even help out for "available darkness" shooting.

—Armand Ensanian

film-shooting forebears. With the exception of the Pentax and Canon entries, the new models look more like a cross between binoculars and video camcorders—with a right-side hand-grip and all.

You'll get an upfront view of these hybrids—along with hands-on field tests—in upcoming columns. For the meantime, suffice to say the Kyocera Samurai, Olympus Infinity Super Zoom, Chinon Genesis, Pentax IQZoom-70 and Canon Sure Shot Multi Tele are worthy of your consideration if you're looking for a camera that can "do it all" with a minimum of fuss. If you're looking for a bit more creative control, you might give the Olympus OM-88 a tryout. Basically, it's an SLR with power focus—another bridge, if you will. It does not focus automatically, but instead of turning a focusing ring on the lens, you manipulate a thumbwheel until the camera tells you that your subject's focused. The camera sells for \$380, including a 50mm f/2 lens.

Hocus-Focus

If point-and-shoot compacts have one failing, it's in the unintentional misuse of their autofocus operation.

Sometimes, usually when shooting two or more people, the user fails to target one of the subjects within the viewfinder's focusing brackets. Instead, in a misguided attempt to compose the scene, the photographer has the focusing brackets aimed at thin air. As a result, the camera mistakes the background for the subject, focuses accordingly, and makes a blur of the desired image. The out-of-focus picture of the two boys, shown opposite, occurred because the brackets were beamed on the gap between them.

Camera maker Chinon has come up with a solution to this problem. Instead of having a single infrared focusing beam tied to the central brackets, the company's Auto 3001/MAF camera (\$350) boasts a triple-beam system that spans the viewfinder area. The closest object to the camera that is sensed by any of the beams is the object that will be in focus. In this design, Chinon is playing on the odds that the desired subject is usually the one closest to the camera. It's not a foolproof assumption, but it is one that probably will yield correctly focused pictures more often.

Creative Options

Another criticism often leveled at compacts is that their preprogrammed simplicity inhibits creativity in the cause of accuracy. You can't use specialized lenses, or lens filters for that matter. The latter claim is no longer true.

Cokin, the French company known for its camera and video filters, has come up with a system for point-and-



Cokin creative filters fit compact cameras.

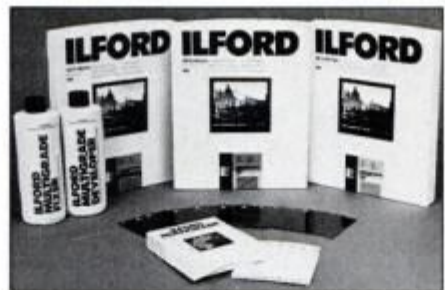
shoot cameras. Basically, the filter holder is attached to the bottom of the camera with Velcro fasteners, and square filters are simply slipped into the holder.

Nearly a dozen creative filters are available, for a variety of special effects. The first system was designed for Minolta cameras, but will work with most other compacts on the market. The filter holder costs \$20 with one filter.

B&W Is Back

I must admit that the percentage of black-and-white photo entries to last year's contest—25 percent—surprised me a bit and delighted me a lot. Real men shoot b&w for the challenge (but this doesn't explain why three of the four honorably mentioned b&ws were shot by women).

Photo companies are once again pay-



New Ilford paper offers faster processing.

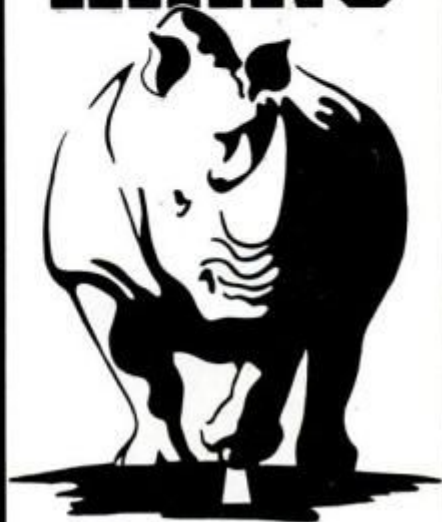
ing serious attention to b&w. For example, Kodak's new T-Max 100 and 400 films soon will be joined by a film rated at ISO-3200 (and capable of being pushed to ISO-50,000!). Fuji now offers its ISO-400 Neopan Professional in the U.S., Agfa weighs in with Agfapan, and Ilford offers XP-1 (which can be processed in color chemistry and shot at ISO-200 to 1600).

To make b&w shooting easier, Kodak has resumed processing the films in its labs. If you run your own darkroom, Ilford's new Multigrade III paper will make the job go more quickly.

Ready, Aim, Fire!

Get your cameras cleaned and loaded. Next month's issue features a special report chock-full of summertime photography tips from the pros. **PM**

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HINTS FROM READERS

Grit Aids Removal



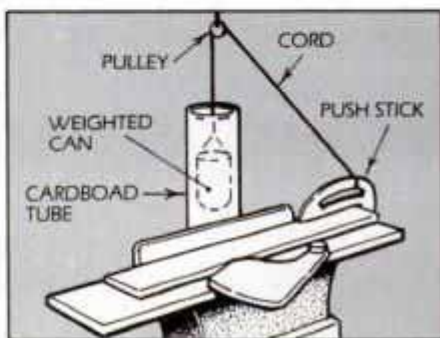
If you're like me, you've discovered that at least one of the wood screws to be removed in a repair project simply refuses to budge. Instead of exerting that extra bit of torque that may cause your screwdriver to slip out of the slot and ruin the head, try sprinkling a small amount of abrasive grit into the slot. This will help the screwdriver stay in place by providing better traction. Extra leverage can be obtained by using a screwdriver bit installed in a brace, or, if the driver shaft is square, fitting a wrench to the shaft.

—Walter Burton

Push-Stick Holder

One frustration for woodworkers is to begin jointing a long board only to find that the push stick, necessary for safely completing the pass, is somewhere else in the shop. This idea solves the problem. Attach the push stick to a cord which runs through a pulley mounted on the ceiling. On the other end, secure a weighted can. To keep the can from hitting anything, set up a cardboard tube for it to ride in. Now the push stick is available for use and automatically retracts until the next time.

—Robert Tupper



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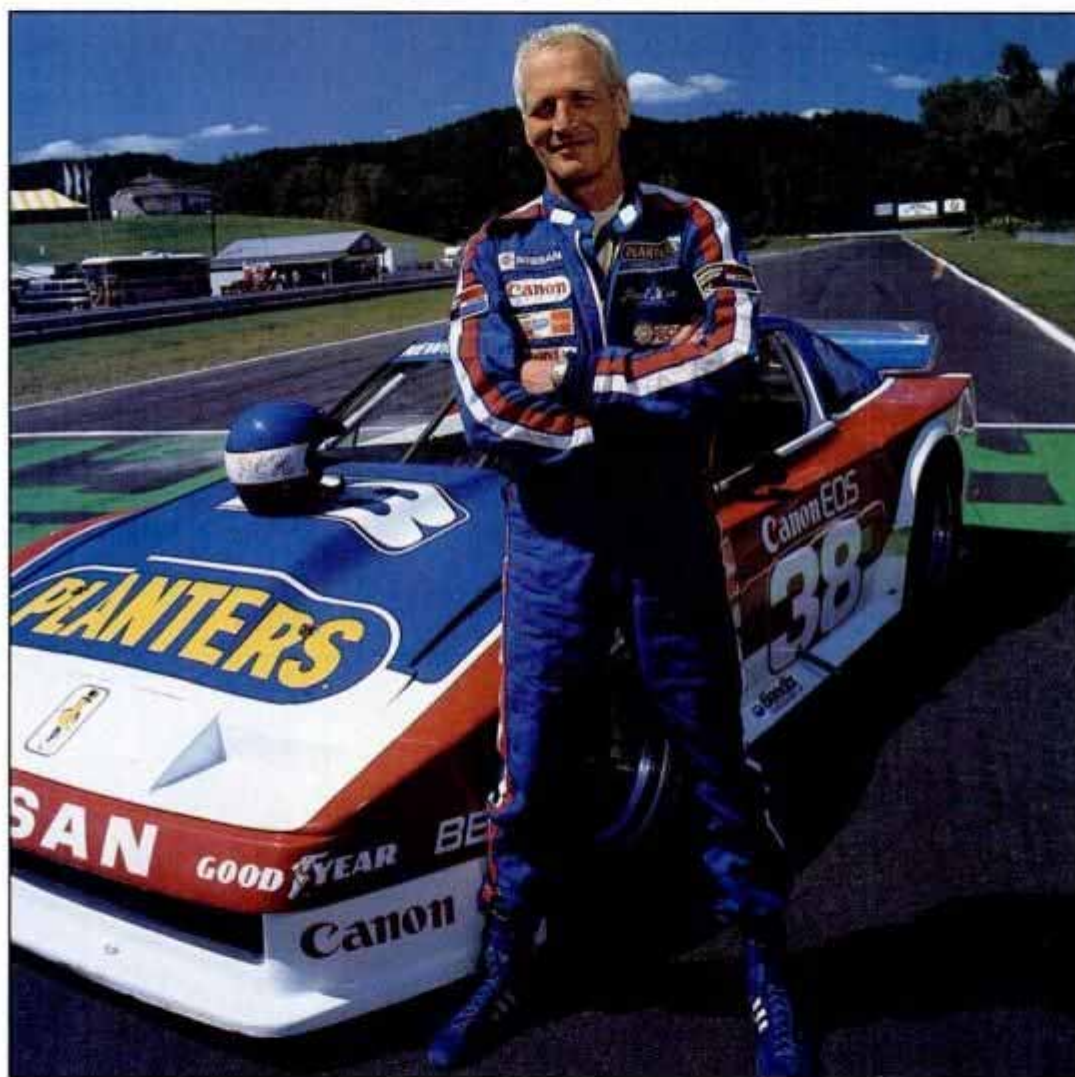


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LEADING MAN



THE PIT AREA at Indianapolis Motor Speedway, alive once again with the aural sensations of horsepower

after eleven months of raceless hibernation, teems with celebrity spectators on Memorial Day weekend, each one eager to make small talk with the racing legends who have come to contest America's 500-mile classic. But there is one star in the crowd, proprietor of the most recognizable pair of blue eyes among all of today's screen actors, who is here for more than visibility. Carrying the weighty credentials of a National Champion-

Winning races also comes naturally to Paul Newman.

BY NORMAN S. MAYERSOHN
Contributing Editor

ship driver—and team owner of what is almost certainly the strongest driver/car combination at the Brickyard—Paul Newman has come to Indianapolis not to socialize, but to win.

In feeding the hunger of fans, Newman's second career, in auto racing, has repeatedly been given the once-over-lightly treatment. But to dismiss these fast-lane activities as some personality short circuit or a Walter Mitty weekend lark would be an unfortunate error. The urge to compete on a race course hooked him years ago, when acting and racing intersected in the 1968 film, "Winning."

LEADING MAN



And with typical Paul Newman determination, he'll be at it until he's mastered every subtlety.

The fact of the matter is, Newman's attraction to motorsports is completely free of the motives that attract most participants. Already at the peak of his profession and financially secure (to understate things a trifle), Newman is hardly here for the glory, the public acclaim or the winner's payout. His life's long list of accomplishments won't wither if he fails to become the SCCA Trans-Am champion this year, or if his team's Indy effort comes up short.

Why race, then?

"Why not?" Newman shoots back, effectively turning aside the question of a sports writer who certainly never sampled the thrill of 600 horsepower

under his right foot, or mastered a 150-mph corner, or saw his team's driver take the checkered flag.

The determination to excel that propelled Paul Newman to greatness in his acting career shines through in his Indy racing partnership as well. As co-owner with Carl Haas of the team that employs Mario Andretti, Newman is a key member of a true front-row operation. Formed in 1983, the Newman/Haas/Andretti triumvirate won the CART Indy car championship in 1984. It doesn't hurt, of course, that Haas is the American importer for the Lola racing chassis, owner of the team that dominated Can Am racing in the late '70s and former employer of luminaries like Jackie Stewart and Alan Jones.

This season, for the first time in six years, the question of Andretti's annual contract renewal made a generous contribution to the yearly game of musical driver seats. Porsche courted Mario to shoe its new Indy car entry, and it was clear there were serious deutsche marks involved.

No doubt Newman tried every form of persuasion to keep Mario, short of a promise for the leading role in his next film, as Andretti is a key to Newman's enthusiasm for the team.

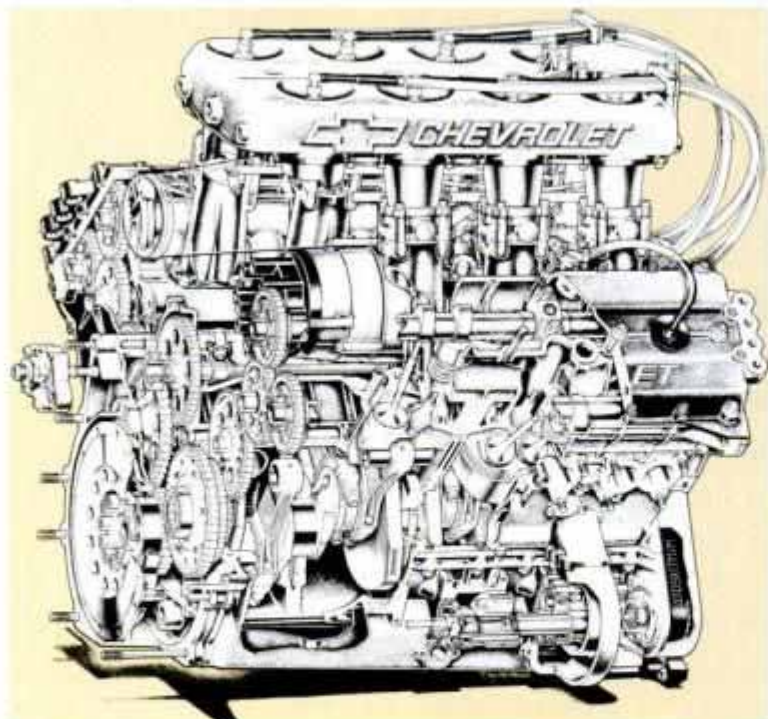


Together for their sixth season, Newman confers with Andretti and partner Carl Haas.

Larger than life in his own profession, Paul Newman still has *his* heroes, and Mario is one of them.

But in the end, the decision was based largely on potentials. The Porsche's early outings were abysmal, and it was clear the car's aerodynamics were thoroughly outclassed. With no promise from Porsche to plug the German V8 into a competitive March or Lola chassis, the 48-year-old Andretti reckoned his best chances for another championship remained with the Newman/Haas team.

Even though he's a co-owner of the



CHEVROLET ILLUSTRATION

Power for the Newman/Haas Lola is supplied by the 2.65-liter, 32-valve Chevrolet Indy V8. Built specifically for this racing series, it offers compact packaging, light overall weight and low internal friction. The drive system for the four overhead camshafts is located at the rear of the engine, reducing the variations in valve timing caused by crankshaft torsional flex. Compared to the Cosworth V8, it offers higher output and a wider powerband.



TM PHOTO BY HUMPHREY SUTTON

With Chevy Indy power and Lola T8700 chassis, Mario Andretti qualified the Newman/Haas entry (right and above) on the pole eight times in 1987. However, engine reliability gremlins caused DNFs.



Newman at Indy, 1987. Stress for team owners often runs higher than it does for drivers.

operation, Newman's rigorous schedule demands prevent him from being part of the day-to-day decision-making. His experience in competition is a valuable contribution to the team, and when the time comes to quit his own driving career the Indy car effort will make good use of his talents.

"Paul relates well to Mario," Carl Haas explains, referring to the two drivers speaking a common dialect of the racing world. "The more he gets involved, the happier we'll be."

And for a team financed by outside sponsorship, Newman's participation

in sponsorship decisions can be a powerful influence. Amoco Ultimate lubricants has signed on to back the team this season.

To imagine how Newman might see his part in running a racing team, consider his feelings about being on the management side of a motion picture camera: "Directing is wonderful . . . I get to play all 29 parts."

The Newman/Haas team's position as a leading Indy 500 contender is strengthened by the return of master engineer/aerodynamicist Tony Cicale. The Lola chassis is a known plus, too, having carried Mario to eight pole positions and two wins and Bobby Rahal to the CART series title. Chassis sales spurred by that success put the Lola in an even count with the previously favored March cars.

Good luck is always a factor in the success of a race team, and Andretti's good luck account is far from overdrawn. He hasn't won at the 2.5-mile Indy oval since 1969. All too often in 1987 his commanding qualifying performances and early domination of races culminated in DNF showings due to crashes or engine failures. Some of the blame clearly falls to the Chevrolet Indy V8, a purpose-built racing engine developed in England

by the Ilmor Engineering group. The 2.65-liter, 32-valve engine is widely acknowledged to offer a broader powerband and higher peak output than the Cosworth V8, but reliability has not been its strong point.

After a winter's worth of development at VDS Engines in Texas and preseason testing, Haas is confident that the team's first-year teething woes with the Ilmor-Chevy are behind them. Coming right to the point, Haas sums up the cold reality of major league racing. "If we weren't optimistic that the problems were over, we'd be looking elsewhere. Porsche has always been strong on engines and the Judd/Honda will be promising, but I don't know of any engine with better potential than the Chevrolet."

The role of Paul Newman as a team owner doesn't presage his retirement from driving any more than his work as a film director spells his departure from acting. In fact, he's abandoned his annual ritual of pronouncing each season to be his last behind the wheel. Now it's simply, "As long as I don't slow down I'll keep going." A considerable achievement when you recall that many of the racers in his rear-view mirror are 40 years his junior.

Even at an age—63—when many



PHOTO BY HUMPHREY SUTTON

LEADING MAN



people are counting the days until Social Security checks start showing up in the mailbox, Newman still has plenty of enthusiasm for the Nissan 300ZX Turbo he drives in competition. With Sports Car Club of America National Championships in D/Production, B/Production and GT-1 under his belt, he will concentrate on the Trans-Am category in 1988. By any measure, this is no amateur undertaking.

Ambitious plans for a 12-race schedule in the coming year will require a delicate balance between the time commitments of Paul Newman the actor and Paul Newman the race-car driver. Referring to his hiatus from acting since filming "The Color Of Money," Newman unleashes that audience-melting grin and complains half-kiddingly, "My avocation is slowly becoming my profession." He claims to be seriously looking for the next movie role, and the supporting evidence is nearby—a shoulder bag with four thick paper stacks that look a lot like scripts.

The seriousness at this level of competition doesn't mean that Newman can't enjoy himself at it, though. He arrives for a prerace practice session at Connecticut's Lime Rock course in an outrageous bright orange Plymouth Superbird, one of those hemi-engined, high-winged caricatures of NASCAR speedway machinery from the early 1970s. Looking very fit, but without the excesses of the health club suntan and bulges, he taunts his crew and the other drivers while leaving his Hollywood personality outside the pit gate. Requests for autographs from the throngs of admirers are gently, almost apologetically, denied.

Immediately Newman's role as part of the Bob Sharp racing enterprise is apparent. Consulting on each detail of the chassis setup and every change to the car, he stores the information for comparison with the behavior he'll feel on the track. The same power of concentration that allows him to step convincingly inside a

character's psyche when the cameras roll let him block out all distractions here. Nothing but a cool, professional command is evident as Newman snakes into the driver seat, entering through the window and between the roll cage tubes with enviable agility.

The Newman-Sharp Racing effort is centered around the Nissan 300ZX 2+2 built last season specifically to take advantage of its longer wheelbase. With a steel-tube chassis and pop-on body panels, there is precious little you can call a Nissan here, save for the engine block, cylinder heads and a handful of trim pieces.

In 1988 Trans-Am racing, they'll use a special aluminum alloy block, homologated for racing by Nissan but actually cast in the U.S. by Rodeck, a dragster engine foundry. The lightweight 2.8-liter V6 engine helps to shift 65 pounds rearward in the car, improving its front/rear weight bias and, consequently, its handling. Team engine builder Jim Coleman is tight-lipped with power figures, hav-



PM PHOTO BY HUMPHREY SUTTON

ing been well trained in his apprenticeship with drag racing's secretive Bill Jenkins, but if you persist the very conservative figure of 600 horsepower at 21-psi turbo boost slips out.

After qualifying on the pole and winning the first race of the '88 season



PM PHOTO BY SIBEL TILGHMAN



PM PHOTO BY NORMAN S. MAYERSON



PM PHOTO BY HUMPHREY SUTTON

at Sebring, Newman-Sharp Racing set up winter development testing farther south in Florida, at West Palm Beach. Almost alone on the track, Newman's prowess as a testing driver surfaces quickly. Learning the fast line while simultaneously adjust-

ing the brake bias and front and rear sway bar action, he nicks tenths of a second off the lap times. Turbo boost is also driver-adjustable in the test sessions, though it is not permitted during the race.

The actor/racer proves to be consis-

tent each lap, as a radar gun check of his cornering speeds confirms. And when he comes into the pits, he's able to download a wealth of data on the car's actions. All those years of memorizing film scripts haven't been wasted.

Newman's precise answers to crew chief Gene Crowe's questions need no prompting. "The gearing is tall in Second and Third, and we're pulling 7800 rpm in Fifth at the end of the straight." A check against the on-board recording tachometer proves Newman to be spot-on accurate.

Climbing out of the car, Newman's memory for statistics proves uncanny. He remarks that his lap times are under the course record, and the track's own listing verifies it. Only when he reads over to the column with the lap record-holder's name does his memory take a jolt—Jim Fitzgerald, his teammate, teacher, co-driver, fellow prankster and casualty of a fatal crash at the end of the '87 season. The talk was that Newman would quit driving when Fitzzy died, but those close to the team don't believe he ever considered it.

Ask Newman what style of a driver he is and his answer reveals the lessons of 15 years of experience. "I'm a laster," he says, knowing that you've got to be running when the race ends in order to win. The tracks he likes are those where smooth driving pays off—finesse, rather than berm bashing, is his preference.

Equally impressive are Newman's powers of observation when Sharp takes practice laps in the car. Paul switches roles without missing a beat, tuning into the engine pitch, gear-change points and chassis behavior. When Scott pits, he's able to share impressions of areas for improvement and interpret what the younger driver feels but can't easily define.

To watch Paul Newman at the race track, it would seem by comparison that his moviemaking is just a job—that racing is where his heart really lies. In reality, of course, he applies that same relentless effort and energy into acting. When he acknowledges the payoff of that hard work you can't help but perceive that the illumination in those famous blue eyes is steely determination.

"I've been acting professionally since 1951, and seriously, I've just caught on to what acting is in the last few years. I figure about by the time I'm 80 I'll have this racing figured out."

PM



PM PHOTO BY HUMPHREY SUTTON

As fans press close for a look (top left), Newman settles in for business behind the wheel of his Trans-Am car (top right). His Trans-Am car (at speed, above left) will be the focus of the team's attention in '88. Speeds in practice are monitored with a radar gun (left). Scott Sharp, Newman and the late Jim Fitzgerald (above) ponder strategy at Lime Rock Park.

Power Mapping

RACE-CAR tuning ain't what it used to be. When Paul Newman's Nissan pits during a practice session, the swarm of mechanics who descend on it still take the temperature of tires and brake rotors, fiddle with spoiler angles and set the suspension adjustments. But the car's new custom-built engine management system, which controls both the sequential fuel injection and distributorless ignition, is now fine-tuned by plugging a laptop computer into the dashboard. Alterations to the fuel delivery and ignition curve graphs, or maps, are made instantly on the keyboard with no need to change a memory chip. Using such hair-splitting adjustability improves both response and economy, vital now that a rules change has dropped the maximum fuel cell capacity from 31.7 gallons to 28.0.—N.M.



A laptop computer quickly alters the program of the engine management system.

PM PHOTO BY NORMAN J. MAYERSON



COVER STORY

Low-silhouette, rapid-firing stealth armor is on the fast track in the Army's drive for rapid deployment.

TANKS FOR

BY NICK NICHOLS

THE ARMOR mission has remained the same. Knock out hardened concentrations of enemy troops, tanks and aircraft in a lethal game of decision, maneuver and firepower.

But in the next century, this crucial role—particularly in the light divisions—will be performed by a new generation of agile armor that evades the enemy and increases the U.S. Army's battlefield punch.

They're called light tanks, and they'll be airlifted with the so-called rapid deployment forces of the U.S. Army Central Command, adding needed staying power to ground troops committed in the early stages of some future war. Low, sturdy, lethal, they'll precede, augment and bolster the main battle tanks that will hold the line on the high-technology battlefield of tomorrow.

Army planners are in the midst of

Cadillac Gage has adopted the 105mm gun on an air-transportable hull.

selecting the aptly described "stealth" tank of the next century. So far, three strong contenders—all in the 20-ton weight class—have emerged to vie for the title. The most traditional of the trio is the Cadillac Gage Commando Stingray, a 4-man model that bears an uncanny resemblance to the 55-ton General Dynamics M1A1 Abrams main battle tank. FMC's Close Combat Vehicle, Light

(or CCVL) pares the crew down to three through the integration of an autoloader. It also features a "hunter-killer" sight system similar to that pioneered by the prototype High Technology Test Vehicle/Light pictured above. The most technologically advanced candidate is the Teledyne Continental Motors entry, dubbed the AGS for Armored Gun System. Using an extremely low-profile,



CADILLAC GAGE PHOTO



The sleek, low-slung lines of the High Survivability Test Vehicle, a prototype tank, has given Army planners a new direction for future armor.

TOMORROW

AAI PHOTO

front-engined hull as its platform, the Teledyne AGS mounts a turretless overhead gun (see diagram on page 71) serviced by an automatic loader, thus diminishing the crew complement to just two.

The three contenders have emerged following a prolonged debate by Army planners focusing on what the next-generation armor should achieve. The debate began in

1982, when the U.S. Army began a sweeping reorganization of its combat forces under the "Air Land Battle" initiative. One major item on the agenda was the development of several light infantry divisions to shore up the rapid deployment force, an unofficial pairing of the 82nd and 101st Airborne divisions.

As originally conceived, these light fighters were to be tasked with hold-

ing the line for their beefier brethren should the "balloon go up" in Central Europe. They were also foreseen as a more effective reaction force for "medium- to low-intensity environments"—a Pentagon euphemism for Third World brush fire wars and crises like the one in Grenada that resulted in "Operation Urgent Fury."

In rendering these troops strategically mobile, they were to be stripped of their conventional main battle tanks, armored fighting vehicles and self-propelled artillery pieces, as these iron leviathans are too large to be deployed quickly by existing military air transports. Instead, a Lilliputian light tank, a militarized dune buggy (called a "Fast Attack Vehicle") and a new-generation high-tech attack and utility helicopter, the once (and future?) LHX, were put on the drawing board to take their place.

But when push came to shove, the light divisions were indeed relieved of all their tracked support vehicles, but

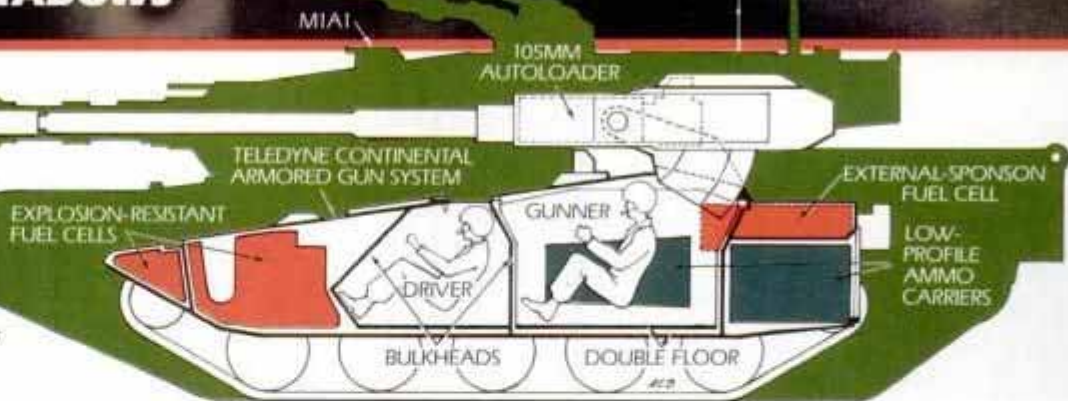
FMC's version uses hunter-killer sight and autoloading 105mm gun.



FMC PHOTO

OUT OF THE SHADOWS

The Teledyne Continental Armored Gun System is shown superimposed over the silhouette of a much larger—and much more visible—General Dynamics M1A1 main battle tank. Crew is down to just two.



PH ILLUSTRATION BY ADOLPH BRITMAN

for various reasons the new equipment never came on line—thus relegating this nation's first wave of the revitalized rapid deployment force to paper-tiger status.

The critical nature of the situation has not escaped the attention of newly installed Army Chief of Staff, General Carl Vuono, who recently announced that his service is in the market for a C-130 air transportable tank to infuse the light divisions with some staying power.

The search for a light battle tank is not new. In fact, Vuono's program, called the Armored Gun System, or AGS, is actually the resurrection of a series of efforts which officially began in 1976 with the Army-sponsored Armored Combat Vehicle Technology analysis. The idea behind this exer-

cise was to increase the tank's strategic mobility and battlefield survivability by minimizing its physical signature. The catch was to reduce size without sacrificing the firepower.

The Marine Corps, too, had been attempting to define its need for a light tank and in 1978 the two services tentatively linked their fates in the Advanced Antiarmor Vehicle Evaluation (ARMVAL).

Under ARMVAL, the Army's Tank Automotive Command went through several intriguing exercises. They first reconfigured the M551 Sheridan Airborne Reconnaissance Vehicle to accept the innovative overhead gun (OHG) pod. The weapon rested flat along the top of the turretless chassis for transport and maneuvering, then popped up from behind

cover to deliver fire. This gun was replaced by the ARES 75mm smooth-bore cannon, which was mounted on the Sheridan test bed—now called ELKE, or Elevating Kinetic Energy Vehicle. The next developmental step was HIMAG, or High Mobility/Agility test vehicle. The program married the ARES overhead gun pod to an all-new chassis.

The increasing awareness of the need to configure armor for an anti-aircraft role led to the placement of the 75mm smooth-bore gun on a refined version of the HIMAG chassis in a cleft turret, allowing the gun to dip well into the hull for a 40° elevation. This resulted in the High Survivability Test Vehicle/ Light (pictured on page 69), which also incorporated improved "hunter-killer" sights, laser range finder, fire control computer and a severely raked frontal armor to fend off bow-on assaults.

But military threats are constantly changing, irrespective of logic or convenience. After all this development work, military intelligence revealed advances in Soviet armor that now rendered the 75mm gun incapable of achieving frontal kills on front-line Soviet tanks. A 105, they said, was now the bottom line. Complicating the drive for the light tank, the 20-ton platform was deemed too unstable to absorb the recoil generated by a standard 105mm cannon.

While the Army vacillated over the caliber controversy, the Marines continued to search for a light tank to assist the leathernecks in their job of mounting amphibious assaults. Unconvinced that the hypervelocity 75mm ARES gun couldn't do the job, the Marines continued to develop the 75 for its own development vehicle, called the Mobile Protected Weapons System (MPWS). In contrast to the Army's perceived need for a 105mm tank destroyer delivered to the theater by C-130 Hercules parachute extraction system, the Marine Corps en-

A test tank demonstrates the increasingly important anti-aircraft role.



U.S. ARMY PHOTO

HIDDEN FIREPOWER



POP-UP OVERHEAD GUN



The overhead gun reduces tank profile by lying flat along a turretless chassis for maneuvering, and popping up from behind cover (left). The overhead gun has an obvious edge in concealment.

U.S. ARMY PHOTO

U.S. ARMY ILLUSTRATION

visioned a vehicle that could be deployed from ship to shore and throughout the beachhead by CH-53E helicopter. In effect, the Marines were looking for an amphibious "bunker buster." Hence their reliance on a lighter vehicle with smaller caliber armament.

Despite these conflicting objectives, the Army and Marine Corps were forced into a joint search for the light tank in 1981. Unable to resolve crucial differences, however, the collaboration ended and the Marine Corps pursued the notion of mounting several different light-caliber cannons, including the ARES 75mm, on their highly successful LAV-25 amphibious 8x8 wheeled vehicle.

After the Marine Corps and the Army went their separate ways, the Army research and development staff successfully demonstrated the technology to mate a 105mm gun to a relatively light armored platform. This led to renewed interest in the light tank issue. Following budget debates and spending cuts—and a near disso-

lution of the whole effort—the quest has led to the present effort at selecting the 20-ton tank of tomorrow.

The turning point came when General Vuono entered the picture. As former head of the Training and Doctrine Command, he was fully cognizant of the urgent need for a light tank. Being further aware that the Army had already invested over \$30 million in searching for a suitable vehicle to deploy with the light divisions, Vuono vowed to see one of the candidate AGS systems fielded.

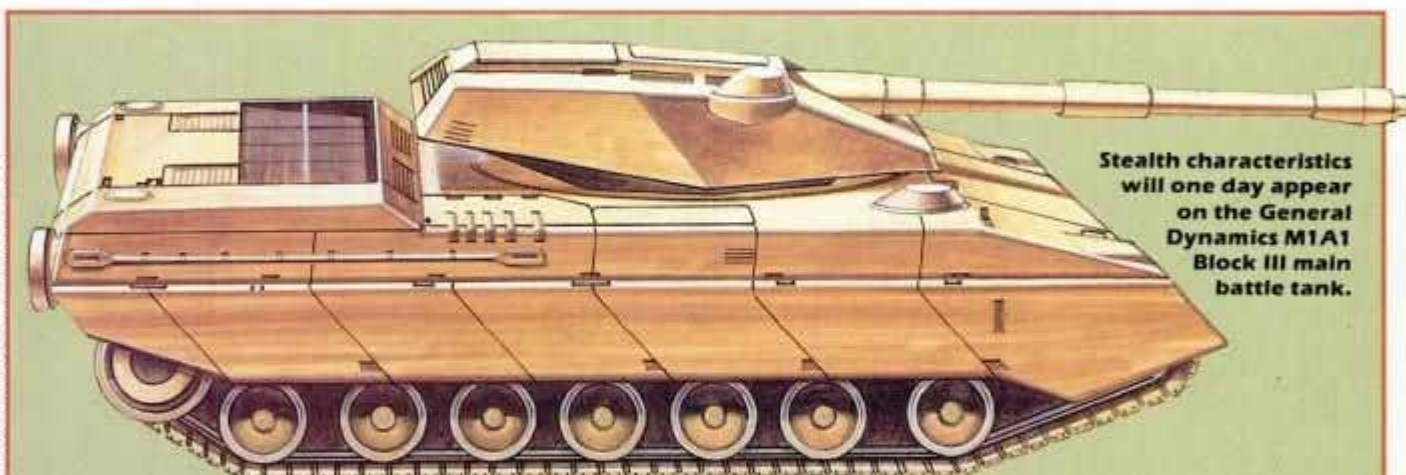
Ideally, Vuono has indicated he'd like to see the Army get around 700 of the new tanks by the early 1990s, with a price tag of around \$700 million. The three vehicles under consideration for the light tank title are nondevelopmental "off the shelf" vehicles, owing to Vuono's desire to avoid an endless and expensive pursuit of equipment that's not quite ready for fielding.

But now, while the manufacturers are patiently waiting for the Army to issue its official requirements for AGS (as well as some assurance that all-im-

portant funding will be forthcoming), a curious thing has happened. The Army and Marine Corps have announced that they will once again cooperate on an AGS. Even more surprising, the Marines have announced that they are willing to set aside several of their key requirements to see a vehicle adopted in a timely manner. These include helicopter deployment and fully amphibious operation. What will the Marines do with a tank that can't be transported by CH-53? Or, that can't be autonomously piloted ashore during an assault? Insiders hint that the Marines may not be looking for the entire AGS system—just a few good turrets mounted with the 105mm cannon. These AGS turrets could then be mounted on the trusty LAV-25 amphibious vehicle, giving the Marines the heavy-hitting helo-transportable gun system they've always wanted.

It appears that in the trench warfare of military budgeting and Congressional oversight, brains go much farther than brawn. **PM**

PM ILLUSTRATION BY ADOLPH BROTHMAN



Stealth characteristics will one day appear on the General Dynamics M1A1 Block III main battle tank.

The Next Heavy Hitter

While development continues on the low-profile Armored Gun System, General Dynamics is looking over the horizon at the main battle tank our forces will drive into the future. The M1 Block II already boasts a satellite-based land navigation system, thermal sights and viewers, laser range find-

ers and improved fire control. The Block III version, aside from aerodynamic Motown styling, is expected to reduce crew size through the use of automatic loading, increase smoke generation for better concealment, improve refueling turnaround and benefit from a peppier turbine engine and powertrain. Physical characteristics will still be lean and mean, the way today's tankers like it.—T.C.



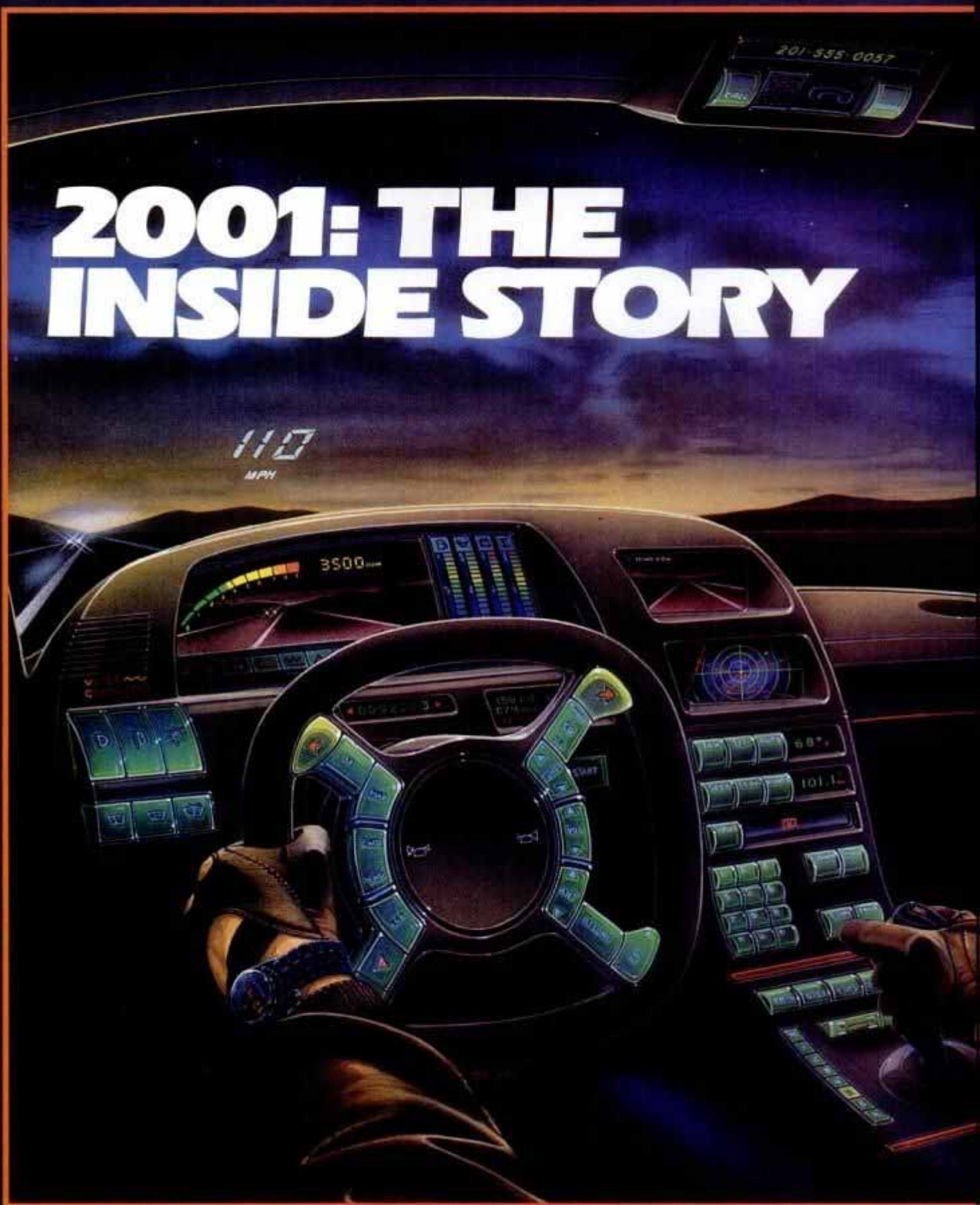
CAR OF THE
FUTURE

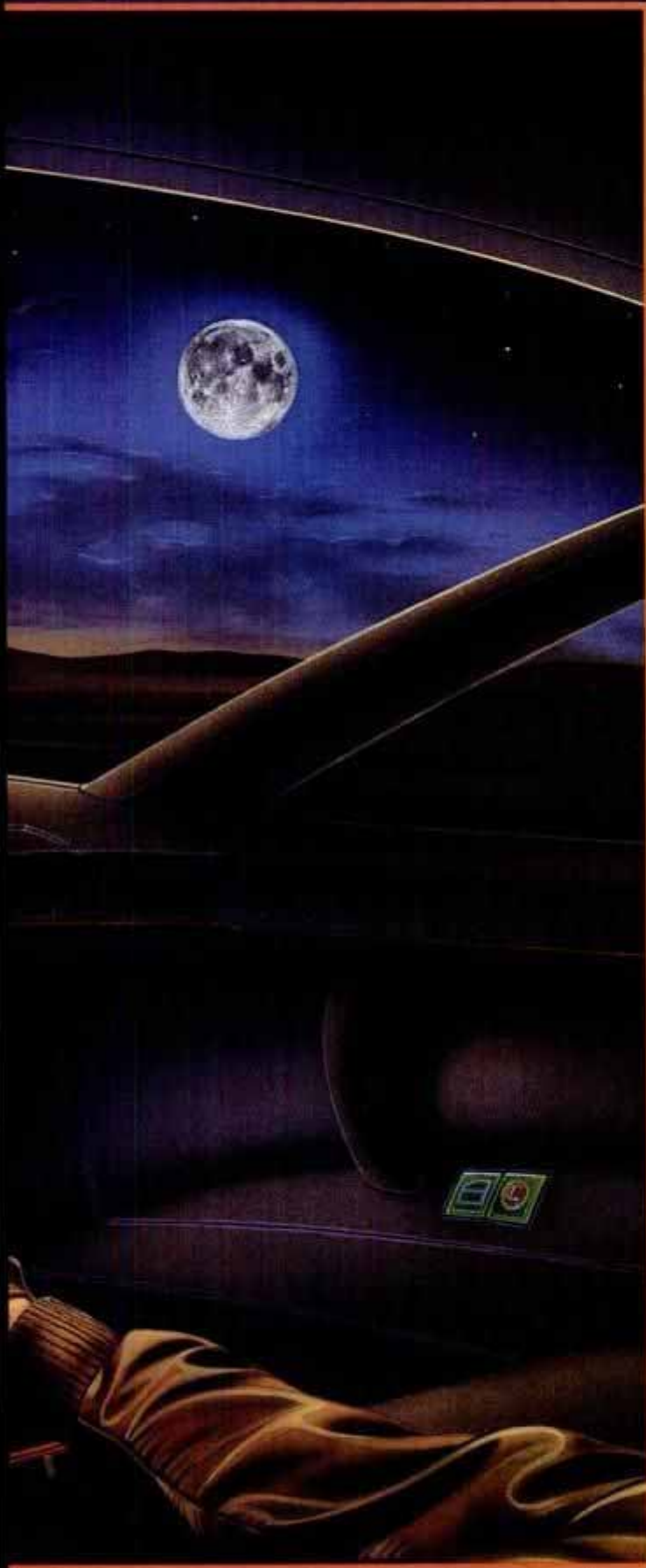
PART 5 OF A SERIES

2001: THE INSIDE STORY

110
MPH

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When we get into the next century of automotive interiors, only the occupants will remain unchanged.

BY JOHN LAMM; PM Illustration by Jeff Mangiat

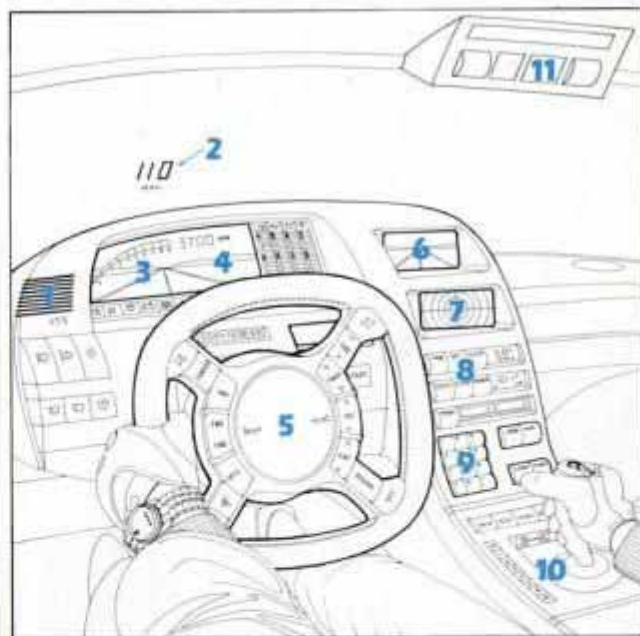
HAVE YOU looked inside any of the new cars you've seen on the road lately—cars like the Pontiac Grand Prix, Olds Cutlass Supreme, Honda Civic or Ford Taurus?

The changes inside these cars are as significant as the changes outside, with new concepts in seating and instrumentation drawn up to an old idea whose time finally seems to have come: Cut the glitter, forget the chrome and let form follow function.

Even so, what we see now is only a hint of what we'll have inside the cars of the early 21st century. But the foundations are being laid right now, and the advances have more to do with attitude and clear thinking than hardware. To discuss it, we first need a definition.

Ergonomics: The study of the interaction between man and machine.

In describing the development of the interior of the new Taurus and Sable sedans, Ford's publicity material expanded on this fundamental definition, suggesting that ergonomics "... means locating switches within easy reach, control functions that are easily un-



The 21st century cockpit: 1. Voice command input, 2. Heads-up display, 3. Digital tach, 4. Infrared TV monitor; 5. Steering wheel controls include turn signals (top left and right), computer On-Off (upper left), navigation display On-Off (left above), all-wheel drive On-Off (left), Voice command On-Off (below left), sound system (right) and cruise control (below right); 6. Rear-view TV monitor, 7. Satellite navigation, 8. Radio and climate controls, 9. Computer keypad, 10. 6-speed transmission, 11. Cellular phone.



CAR OF THE FUTURE

derstood . . . and clear instrumentation. Ergonomics evaluates reach, hand/eye movement, frequency of use, field of view, control design logic and numerous other design-based characteristics affecting the driver."

An easier way of thinking about it is that good ergonomics makes the difference between a car that treats you like a friend and one that's a festival of irritating idiosyncrasies. And that's why the discipline of ergonomics is at the center of planning for interiors in tomorrow's cars.

This matter of designing automobiles for easy use is an old story for some automakers, a current one for others and a dawn endeavor for still more. Mercedes-Benz, for example, has long been studying how to best configure its interiors to be used by their owners. As a result, you won't find the gauges on a Mercedes instrument panel obscured by the steering wheel. Though the German company has a steering wheel that will adjust in and out, it has long refused to use a wheel that tilts up and down just to make certain that "steering wheel obscuration"—to use an ergonomic term—doesn't happen.

Detroit was once a great offender of proper ergonomic principles, but the Motor City now has ergonomic leaders of its own, Ford prominent among them. But advanced or not, every carmaker in the world has developed a much higher consciousness of this discipline than ever before, and positive results are already beginning to show up inside the new cars we're seeing today.

Seating provides an excellent example of this trend. Seats used to be fairly standard—and uninspired—items for most automakers, differentiated from one car to the next mainly by their upholstery. But not any more—and certainly not in the future.

Perhaps the biggest change in interiors of the past five years has been the increasing quality of car seats, not only in basic form, but also in adjustability. Possibly the best current examples are the front bucket seats in the new Pontiac Grand Prix and Oldsmobile Cutlass Supreme. They're among the best in the world, from an automaker that used to provide some of the worst seats in the business. In tomorrow's cars, reclining backrests, good lumbar supports and movable side bolstering will become commonplace, as will details like individually adjustable thigh supports.

Memory power seats are already in top-line cars, allow-

ing drivers to tailor an optimum driving position that returns to its setting at the push of a button. And as the microchip memories of new cars expand, expect this individualizing of seats to increase. Just by using your personalized key to unlock the door, for example, the seat will go to your preset position, a position that includes distance from the wheel, seatback angle, lumbar stiffness, side bolster angle, thigh cushioning, steering wheel position and rear-view angle.

You can also expect the radio to zip to your favorite station at your favorite volume with the climate controls dialed in just so—as you like it.

A little further into the future, we'll see seats that will automatically—and very gradually—adjust themselves over the course of a long drive to combat fatigue. That's *real* user friendliness.

One other likely change in seating is more connected with the future of aerodynamics than with ergonomics. To accommodate faster windshield angles that will lower rooflines and thus reduce frontal area, seatbacks will be laid back a trifle more, though you won't see this as much in family sedans. It's a theme that works better with personal cars—coupes, specialty sedans and sports cars.

There was a tendency in the past half decade by some automakers to solve ergonomic problems by moving as many switches as possible very close to the driver. Several models have a great variety of controls mounted on pods within fingertip reach of the steering wheel. There are also show cars featuring steering wheel hubs littered with function buttons.

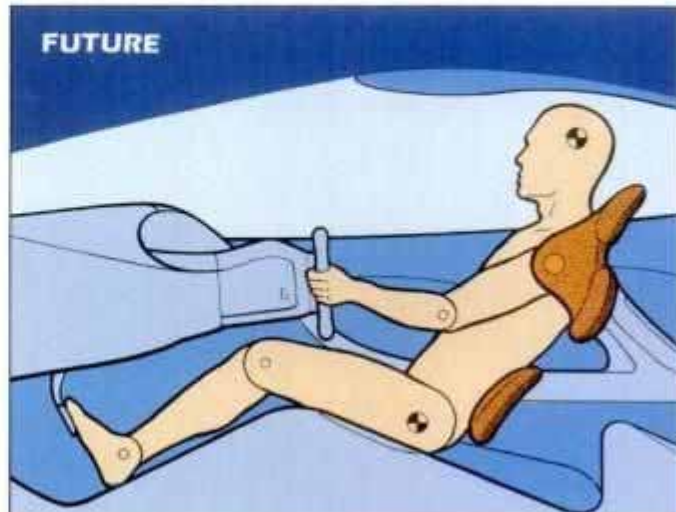
The idea seems sound, but in practice can be almost as confusing as a dash strewn with buttons and knobs. It has to be done right: In the future, expect to see frequently used switches positioned near the steering wheel—the 1988 Pontiac Grand Prix is a good example—with those used less frequently, such as climate controls, kept on the dashboard.

There has also been quite a bit of confusion the past five years over the use of digital displays. Initially, automakers jumped in quickly, because there are numerous advantages to using digitals, from their high-tech appearance to the fact that they are light, simple, compact and accurate.

However, many new car owners objected to the overuse of digital gauges, so in the future (Please turn to page 148)



Although seating has improved dramatically in terms of comfort, basic driving position still tends to be generally upright.



More seatback rake and near-horizontal steering column angle will allow lower rooflines for better aero in sporty models.



The Write Stuff

In an age of impersonal computer printouts, the fountain pen is reasserting its technological sophistication and distinctive individuality.

BY DAVID LANDER; PM Photos by Brian Kosoff

Symbol of lasting value, the fountain pen is a classic hand tool. It's designed and built to be used time and time again. And a pen's fluid mechanics make a long stretch of writing less tiring than grinding out the equivalent number of words with a hard-driving ballpoint.

Besides this utilitarian virtue, fountain pens also boast a high degree of craftsmanship, with handsome exteriors often fashioned with precious metals, rich lacquers, fine woods or other natural materials. It is this combination of function and form that raises the fountain pen's status to that of a cherished personal accesso-

ry. A fountain pen aficionado will no more lend you his pen than a pipe smoker will share his meerschaum. Indeed, fountain pens often become valuable, functioning collector's items on a par with wooden hand planes, tinplate trains and vacuum-tube radios.

Because they are not disposable commodities, fountain pens should be considered as much an investment as a good ratchet set, miterbox or binoculars—and their cost reflects this fact. Currently, prices range from below \$100 to \$1000 or more for new pens, depending on performance and adornment. Good performance begins at \$25, without frills, improves around the \$50 mark

The Write Stuff

and begins to receive cosmetic embellishment between \$75 and \$100.

Thereafter, performance and fashion keep pace owing to the increasing use of specially crafted parts, costly materials and hand-worked finishes.

Improve your writing

Like many other better mousetraps, the fountain pen is an American innovation: The first practical version was developed and marketed by Waterman founder Lewis E. Waterman just over a century ago.

People already had been using pens for more than 5000 years. The earliest were hollow straws or reeds that could hold small amounts of liquid. Later came instruments crafted from feathers, with hardened shafts and slit tips. The use of these quills prevailed for more than 2000 years, and they are the source of the name pen, from *penna*, which is the Latin word for feather.

The advantage of Waterman's in-

vention is that it contained its own ink supply, eliminating the need for an omnipresent inkwell. These early fountain pens had to be filled with an eyedropper. Later came built-in pumping devices that draw ink through the pen's tip up into its body, then self-contained, throwaway ink cartridges.

Ironically, the ballpoint—which employs a thick, viscous ink fed through a tube to a porous, rolling ball—captured the minds and hearts of America at the very time fountain pen manufacturers were making quantum leaps in technology and quality. The 1940s and '50s were a breakthrough period in automated manufacturing and improved materials, according to James D. Kukuk, manager of product engineering at the Parker Pen Co. Advances in areas such as injection molding provided closer tolerances, thereby improving consistency and integration of fountain pen components. This virtually eliminated problems such as leakage and uneven metering (inconsistencies in ink flow). Today's materials and methods of fabrication make the pens better still.

When cosmetic embellishments are stripped away, a fountain pen con-



sists of a nib, a collector, a filling system and a reservoir—the place where fluid ink is stored.

For modern pens there are two kinds of filling systems. One is the piston system, whose screw-driven plunger draws ink through the nib for storage in a rigid reservoir. The filling operation and storage well closely resemble those of the syringe portion of a hypodermic needle. A variation of this is the pump-loading system with flexible reservoir. Here, finger pressure on a metal bar expels air from a flexible sac-like reservoir, thereby creating a vacuum that draws ink through

the nib and into the sac. So called "cartridge" fountain pens dispense with the filling system: The convenient, disposable cartridge serves as both the filling system and the reservoir.

Most modern pens are classified as "convertibles." They sport one or the other type of traditional filling system, which you can remove and then replace with a cartridge. This versatility offers two benefits. If you travel, you can leave the ink bottle behind and more easily portage a brace of cartridges. And the piston or pump "converter" enables you to flush the pen at will—and flushing is the cornerstone of fountain-pen maintenance. Because



Fluid Dynamics

What's blue or black or red all over, contains fungicides, bactericides and is sometimes drunk by children?

The answer is ink, and though the fluid used in today's fountain pens can have a formula as complex and closely guarded as Coca Cola's, the writing stuff is distinctly not recommended as a beverage.

Fountain-pen ink consists primarily of distilled or deionized water and organic dyes. The latter are as salt-free as possible to prevent the ink from crystallizing, which would corrode a pen's metal parts and clog its feed system.

Chemicals known as surfactants are also included to control ink's surface tension. Too much surface tension would impede even metering—the consistent flow of ink—as well as drying, which is a function of both evaporation and the ink's penetration of the paper. Too little surface tension might cause ink to saturate the paper from front to back or to spread laterally, a phenomenon known as feathering. Forrest E. Beck, a former chief chemist for the Parker Pen Co., likens fountain pens to incubators. When carried in a breast pocket, he explains, they are warm,

dark and moist containers—an ideal breeding place for germs. This is the reason for adding fungicides and bactericides. Since microorganisms differ throughout the world, so do the biocides in inks destined for particular regions.

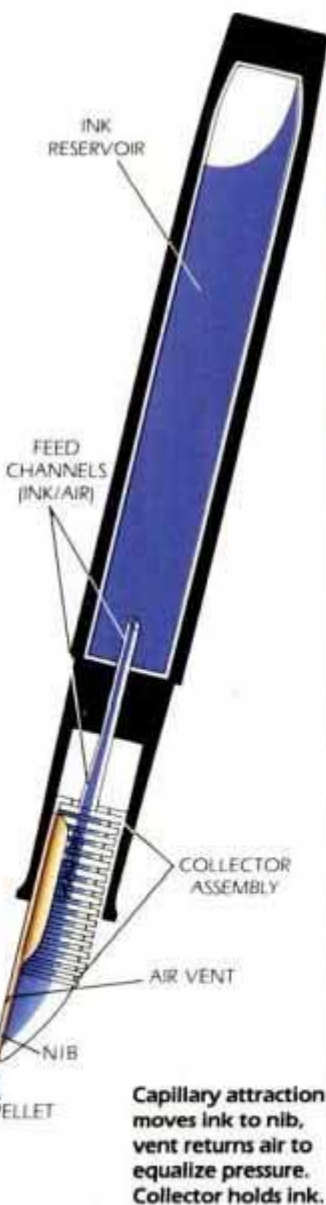
Beck says that when he was with Parker, the company received periodic phone calls from frantic customers whose children had just swallowed ink. Though he doesn't recommend imbibing the stuff, the chemist says that in his three decades at Parker he never heard of ill effects produced by ingesting ink. He credits this to rigid federal regulations governing all U.S. manufacturers.

Dyes determine whether an ink is washable, or classified as "permanent."

Beck points out that "restorable" better describes ink in the latter category since even so-called permanent inks will fade in sunlight and can be washed out of paper. When fumed with sulfur, though, an iron sulfide forms on the faded ink line and it reappears, though usually not in the original color. —D.L.



ANATOMY OF A HAND TOOL

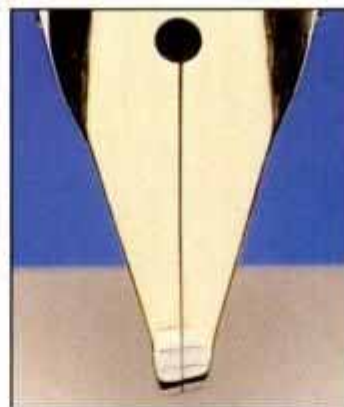


Capillary attraction moves ink to nib, vent returns air to equalize pressure. Collector holds ink.

Pen prices and features vary (from left above): Elysee Lapis (\$55) with gold nib, lacquer barrel. Brass-shelled Sheaffer Targa (\$80) with inlaid nib for heavy writers. Sterling silver Parker 75 (\$110) with 14K nib shares contoured grip with plastic-barrel, steel-nib Lamy Safari (\$25). Piston-fill Omas Paragon (\$300) with 12-sided, gold-banded barrel. Ornate nib on opening page belongs to Mont Blanc Diplomat (\$280). Hand-tooled Waterman Le Man 100 convertible (\$400) mates briarwood and gold. Limited-edition Pelikan Toledo (\$495) boasts hand-engraved sterling sleeve with 24K overlay.



Filling systems (above) include piston with rigid reservoir, pump with flexible sac, and cartridge. Parker oblique nib (right) angles pellet for lefty writers.



they lack converters, pens that use cartridges only can't be flushed. (Generally, cartridge-only pens are less expensive than their bottle-fed brethren. Some, though, have top-quality nibs, components and finishes, meriting higher prices.)

Manufacturers recommend that you flush a pen periodically to prevent clogging. This can be caused by crystallized ink or by paper particles that might be drawn into the system. According to Nunzio De Pietro, master pen mechanic at New York's Art Brown & Bro., you should flush your pen with a solution of room-tem-

perature water laced with a few drops of clear ammonia. If the pen isn't used regularly, you should flush it before taking on a fresh load of ink. To reduce the intake of paper particles—and to promote smoother writing—use a hard-surfaced, calendered bond paper, the higher the "rag" or cotton-fiber content, the better. Never put nib to soft, pulpy papers.

The reason for periodic flushing becomes more evident when you get to the business end of the fountain pen: its collector and nib. This is where fountain pens give a physics lesson to other systems.

Capillary attraction

The physical principle that enables fountain pens to function is called capillarity. Capillary attraction is best illustrated by the medical device used to draw a drop of blood from a person's fingertip: Once the skin is pricked, blood enters the tubelike container and flows upward, against the force of gravity.

In a fountain pen, that same attraction of a liquid's molecules for those of a solid tube combines with gravity to feed ink along the narrow channels from the reservoir to the nib.

These feed channels make what Parker's James Kukuk calls "intimate contact" with the nib, enabling ink to flow into the slit that bisects the lower portion of the nib.

At the same time, a vent or hole at the top of the slit feeds air back to the reservoir, ensuring equal pressure inside and out. If atmospheric pressure outside the reservoir is greater than within, the ink won't flow and the pen won't write. But if the inside pressure is greater than external pressure, the ink will gush out of the pen. It's the collector's job to prevent just this kind of unpleasant, and increasingly rare, occurrence.

The collector is the finned, comblike component usually visible at the back end of the nib. Kukuk describes this fail-safe device as a "quicker picker-upper." Under normal atmospheric conditions, a cushion of air separates it from the ink-feed channels. But any rapid change in ambient pressure (such as might occur in airplanes) eliminates this cushion, making the collector—rather than the nib—the path of least resistance for the ink.

Surface tension holds the liquid between the collector's fins, instead of letting it flood out through the nib. When the pen is turned nib-upright, the excess ink flows back into its reservoir.

Nib-picking

Collectors and nibs are precision instruments, and slitting a nib requires more precision still. Tolerances at Parker limit any variation to

(Please turn to page 160)



Greg Hill (above) and Pete Loncarevich [opposite], top BMX racers, demonstrate "radical air" over a camelback jump. Hill rides a Robinson Pro Team and Loncarevich a Haro Group 1 RS1.



HOW TO TALK BIKE TO YOUR KID

What you need to know when your son gets into totally rad BMX, Freestyle and the hot new Formula One bikes.

BY CRAIG BARRETTE; PM Photos by Rich Cox

THERE comes a time in every father's life when his 12-year-old wants a bike. Not just any bike, but one he can be proud of, one that says something about his world and how he fits into it.

If you're a dad, you know this is an important moment and you want to

participate in the buying decision. But there's a big problem. You know precious little about the world of 20-in. wheeled bikes. Ten-speed and balloon-tire models, the bikes of your youth, are as dated as dinosaurs.

Time to brush up on the geometry of chrome-moly frames, rear-triangle

platforms, full-body fairings and other totally awesome developments in the world of kids' bikes.

BMX Bikes

BMX stands for bicycle motocross and the basic setup—small frame, high handlebars, single gear and



Freestyle stunts (above) require special brake-cable routing, as on this Mongoose Decade Pro. At right, Haro pro rider, Loncarevich (right), gets into racing action with Eddy King, on a Diamond Back Reactor.



knobby tires—was introduced about 15 years ago. Within the past decade, BMX and spinoff bikes, such as Freestyle and Formula One models, have completely dominated the 20-in. bike scene.

BMX bikes are built to ride on dirt courses. The well-groomed tracks are twisting courses of hump-back hills and steeply banked turns. Up to seven competitors ranked in age and skill race against each other in 30- to 40-second sprints. Local events can lead to regional, state and national championships.

Although customization is possible, good bikes can be purchased off the rack. Entry-level, racing-quality bikes begin at about \$180. Anything less is better for neighborhood riding than competition. A common mid-range price is \$250. Top-of-the-line bikes cost around \$550.

BMX bikes are deceptively simple. They have a single-speed gear and one side-pull brake in the rear. But weight and frame geometry are vital. A single degree of variation in the steering-head angle—the degree of front fork tilt

—can be felt on the race track. A good BMX fork angle is about 72°, as on the Haro Group 1 RS1 (\$550-\$590), or 73°, as on the Robinson Pro Team (\$550). Hardcore racers can go up to 76° on the Diamond Back Reactor (\$550-\$590).

Frames also come in various sizes. The 3-pound mini frames, for boys 8 years and under, is 15-in. from top of seat tube to handle-

bar stem. Junior frames, for boys 8 years to 12 years, are 16 in. to 17 in. and weigh about 4.5 pounds. And the regular or standard frame, for boys 12 years and older, is 17 in. to 18 in. and weighs about 5.5 pounds.

Quality frames on the market today are made of 4130 chrome-moly, a light, strong steel alloy. Steel and tri-moly frames, can be found on budget bikes.

Choices of wheel sizes range from tubeless rims of less than an inch in width for the smallest tykes, to 1 $\frac{3}{8}$ -in. rims for juniors, to 1.75-in. rims for older kids.

A good BMX wheel has 36 spokes and sealed bearings. The most widely used tread is a knobby pattern called Comp-III, by Tioga, of Glendale, California.

Choosing frame size and fork angle are personal decisions. Best approach is to test ride several models.

Freestyle

Within the past couple of years, an offshoot of BMX bikes has exploded in popularity. It's called the freestyle bike and it's built for performing skilled acrobatic stunts.

The main reason for freestyle riding's booming popularity is that "stylin," as it's called, can be done on any street corner or parking lot. Organized freestyle events, like BMX races, can lead all the way to a national championship.

Freestyle riding falls into two categories—ground and ramps. Ground or flatland riding consists of a rider performing a complex routine of wheelies, hand-





Front brakes, as on the GT Pro Freestyle (above), are vital for balancing stunts. At left, the sleek fairings on Hutch Superbike designed by Dan Hanebrink (left) are breakthrough F1 components.

stands and many intricately balanced maneuvers. Arms and legs fly in a blur of high-speed motion as the kid hops all over the bike.

Ramps, on the other hand, are sloped wooden structures that propel riders into the air where they do high-flying tricks. As with ground riding, the mindboggling maneuvers defy description.

The main differences be-

tween a freestyle and a BMX bike are bolted-on platforms and pegs. Platforms are mounted on the front forks and rear triangle (on the frame near the rear axle). Top-tube pegs are an integrated part of the frame just below the seat.

The GT Pro Freestyle Team Model (\$550-\$600), for example, has front and rear bolt-on, flip-down plat-

forms. The Mongoose Decade Pro (\$350) has 1-piece pegs that screw into front and rear mountings. Bolt-on platforms are a bit more versatile because they flip out of the way when not being used for "stylin." Screw-on platforms need to be removed to accomplish the same thing. Dyno Pro Comp (\$500) and Haro Team Master (\$620-\$690) have bolt-on platforms. Di-

amond Back Strike Zone (\$385-\$415) has a rear peg that's an integrated part of the frame.

Another distinctive feature on freestyle bikes is the front and rear brakes. Many freestyle stunts involve handlebar spinning. Standard brake-cable routing would wrap around the head tube and lock up the wheels. Good freestyle bikes run the front-brake cables through the forks and use a rotor spinning device for the rear brakes—both of which prevent cable entanglement.

Wheels vary, too. Currently, 48-spoke wheels are most popular. As with BMX bikes, good competition freestyle bikes begin around \$200, while high-tech machines go for \$600.

Formula One

There's an all-new model on the 20-in.-wheel bike market called Formula One, or F-1 bikes.

The prime movers in Formula One bike development are Haro, of Carson, California, and Diamond Back, of Newbury Park, California. These companies simultaneously premiered the new models for

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FOUL BALL!

Outlaw pitches. Loaded bats. Rabbit balls. A former major league mound ace delivers the inside pitch on baseball's hijinks.

BY JIM KAAT

FROM THE very first pitch this Opening Day, many of us will begin measuring the 1988 baseball season against the milestones achieved last year.

One that stands out is the record 4458 home runs. And although 645 more balls left the park than in 1986, major league pitchers chalked up 25,099 strikeouts—the highest ever for a season.

Meanwhile, 1987 was memorable for a more dubious sort of achievement. Three players were penalized under the rules that prohibit the defacing of balls or the use of freak bats. That rule against pitching a ball that has been roughened, wet, polished or otherwise tampered with entered the books in 1920. Through 1980, a period of 60 years, only two pitchers had ever been disciplined. That number was matched last season alone, when Joe Niekro of the Twins and Kevin Gross of the

Phillies each received a 10-day suspension for bringing to the mound an abrasive that might be used to scuff the ball—sandpaper in the case of Gross, an emery board in Niekro's. And when a bat that shattered in the hands of Houston's Billy Hatcher on the night of Sept. 1 was found to contain something other than the legal ash wood, Hatcher got an involuntary vacation with pay and his manager got to pay a fine.

There's no doubt that the subjects of illegal pitches and doctored bats received more attention in 1987 than in any season before, despite the fact that they had to share the limelight with questions about the allegedly livelier ball.

From my perspective in the broadcast booth, from talking to players off-camera and from my own experience in the game, I believe that the percentage of

pitchers and batters who break the rules on a consistent basis is actually very small. At the same time, I believe that because of certain changes in the game over the past 20 years or so, there is probably a greater tendency and temptation today to look for an edge, whether it's a legal one, like the split-fingered fastball, or trying to simulate the splitter's movement by loading the ball.

It's a fact that batters are muscling up, swinging lighter bats and swinging them more aggressively. And why not? The effective strike zone is smaller

BACKGROUND PHOTO BY BILL ASHE



During 25 seasons as a major league pitcher, author Jim Kaat compiled a 283-237 won/lost record and a 3.45 earned-run average with 2461 strikeouts. Along the way, the 6-ft. 5-in. lefthander earned 16 consecutive Gold Glove awards—a number matched only by Brooks Robinson. Today, he serves up the color commentary on TV and radio for the world champion Minnesota Twins.



Resourcefulness is evident in the baseball scofflaw's tools of the trade (from top). Would-be sluggers stuff "super" balls or cork (as in cutaway) into a hole bored through the business end of a bat. Slippery Elm lozenges and K-Y Jelly reduce friction when applied to a ball. This enables a pitcher to release the ball without spin, causing the spitball's sudden drop. By adding friction to the ball's travel, a pitch will veer deceptively. It's done by cutting the ball with a sharp item, such as a concealed tack, or by scuffing it (as depicted here) with abrasives such as emery boards.

FOUL BALL!

than ever before, so a pitcher really has a tougher time keeping the ball off the fat of the bat.

What the pitchers are throwing, from amateur ball to the majors, is more off-speed stuff and breaking balls, including the split-fingered fastball. Fewer pitchers are challenging the batter with natural, live, trust-your-stuff fastballs, especially during the late innings of a close game. Have you noticed the inordinate number of late-inning, often game-winning home runs hit off a breaking ball? That kind of pitch loses its crispness when the thrower gets arm-weary, and it tends to hang. The same goes for split-fingered fastballs, scuffballs and even sliders, although these take their toll in swinging third strikes too, especially with more batters swinging wildly instead of merely trying to make contact.

Speaking of the fences, they keep getting closer and closer in today's ballparks. Besides these factors, last summer's relative high temperatures and humidity might have turned a few flyball outs into home runs.

Dr. Robert Watts, a mechanical engineer at Tulane University, actually computed how far a ball will travel on a hot, humid day compared to a cool, dry one. Watts says that a ball might



Although Gaylord Perry (bottom left) made no secret of throwing spitters, knuckleballs are the usual trademark of Twins' pitcher Joe Niekro (above). But when umps nabbed Niekro with an emery board last summer, he was suspended for leaving a different mark on the ball. Dr. Joel Hollenberg (below) gathers wind-tunnel data on '87 ball.

carry 20 ft. farther under warm, moist conditions, where the air density actually decreases, thereby exerting less drag.

Watts' research goes beyond climate systems and carbon-dioxide depletion in the atmosphere.

All the talk about trick pitches, corked bats, livelier balls and whatnot last year sparked a good deal of research and speculation in many science labs all

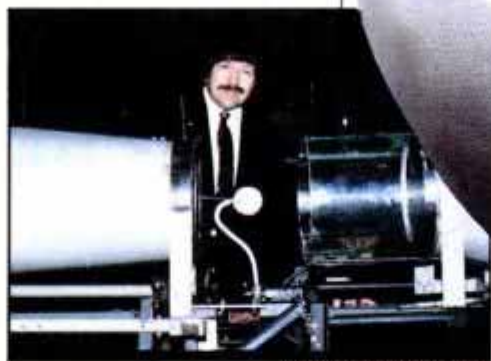


PHOTO BY JOANNE SAVIO

around the country.

Last year, the belief was widespread among baseball professionals that the ball was livelier than in 1986. I believe so myself, from the miracles I've seen flying out of places that are not hitter's ballparks.

Nonetheless, the leagues conducted lab tests around mid-season, and announced that the ball's coefficient of

restitution was no different than in 1986. Size and weight were also within the tolerances permitted. The coefficient of restitution is a measurement of how well—or how poorly—the ball bounces back upon hitting a hard surface. After being fired by machine and colliding at an initial velocity of 85 ft. per second—58 mph—a major league baseball must show a coefficient of restitution between 51.4 and 57.8 percent. If it's any higher, the ball is too lively.

If it's any lower, it's something that only a pitcher could love.

If the '87 ball didn't have more hop, then another ball-related factor might account for why so many missiles went into orbit. Dr. Joel Hollenberg, of the prestigious Cooper Union engineering school in New York, speculates that the stitches might impart some extra mileage.

Since the early 1980s, Hollenberg has studied the aerodynamic forces that

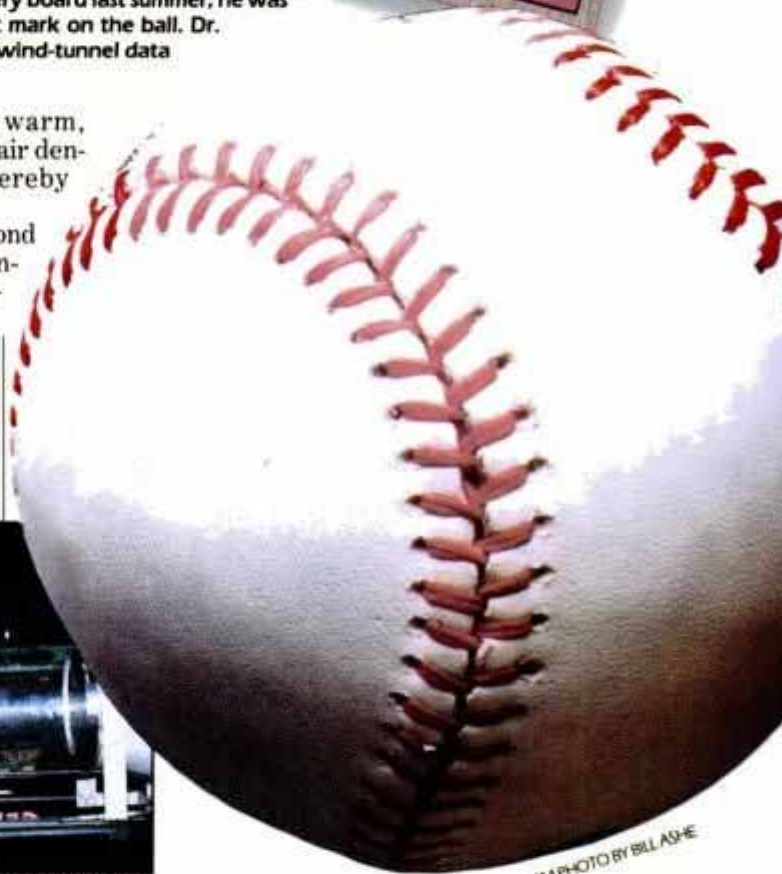
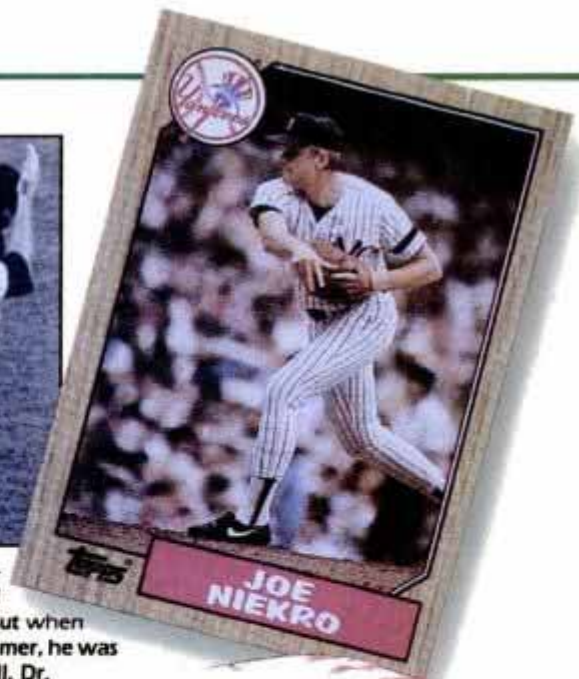
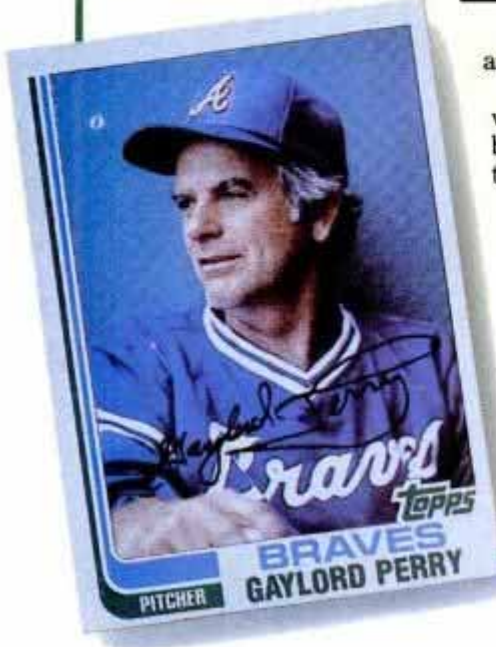


PHOTO BY BILL ASHE





Divide And Conquer

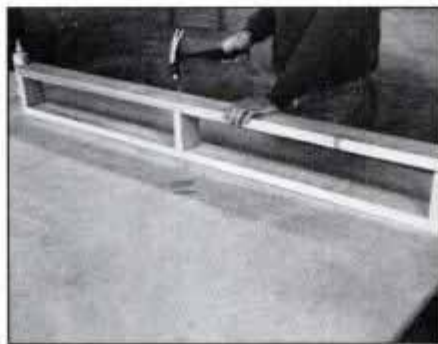
Our contemporary room divider is the ideal place for books and collectibles. And, it's easy to build.

BY NEAL BARRETT

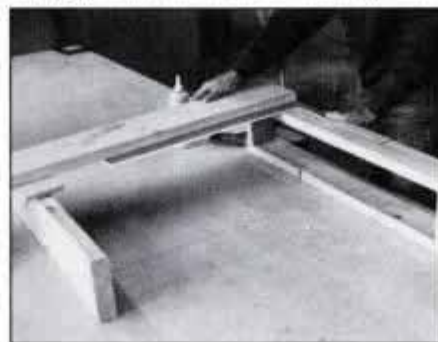
MOST bookshelves are designed to sit flat against a wall. This makes sense if you're trying to maintain one large open space. But it's not uncommon for both homeowners and apartment dwellers to need distinct spaces in the same room. This combination bookcase and room divider fills this need. Freestanding and finished all around, this piece can be placed anywhere to hold books and collectibles while separating areas of the room that may have different functions. And, it can be moved along with the rest of the furniture when the inspiration comes to redecorate. We got this clever design from a booklet called *The Breathing Room Book*. It's loaded with innovative storage projects for just about every room in the house. It costs \$1.95 ppd. from Western Wood Products Assn., Yeon Building, 522 S.W. Fifth Ave., Portland, OR 97204. Plan sheets for most of the projects are also available for 75 cents.

The construction is even more straightforward than the design suggests. All that's necessary are a few basic tools and the skill to measure and cut to a line. If your shop isn't equipped with a table saw or radial-arm saw, a portable circular saw can be used for all the cuts. Be sure to use a sharp, smooth-cutting blade and have a fence attachment on hand for ripping. The joinery is simple and the entire unit is fastened with nails and glue. We also opted for wood that's available just about everywhere: No. 2 common pine.

Be aware when buying your mate-



1 Use 3½-in.-wide ¾ pine stock for the base frame. Cut each piece to exact length, apply glue and nail with 8d finishing nails.



2 Glue and nail the uprights to the base. Use blocks to support the uprights. A 2-ft. steel square ensures accurate assembly.



3 Tack temporary strips to the upright tops to ensure consistent spacing. Leave nail heads exposed for easy removal.

rial, however, that this grade of wood is not normally used for indoor furniture. If possible, go to the lumber dealer and pick out the best pieces for this project. Then, stack the wood in an environment with the same humidity as that of your house. Place ¾-in.-sq. stickers between the layers and let the lumber dry completely—it may take at least two weeks—before starting construction. When stacking, place the stickers about 12 in. apart and keep each row of stickers directly above the last. On the top board, it's helpful to lay a last row of stickers and place a very heavy board on them to ensure that the boards will dry flat.

Note that two different thicknesses of boards are needed—full ¾-in.-thick pine (called 1-in. stock) and 1⅜-in.-thick stock. The thicker stock is usually called ¾. You may find that the ¾ pine at your local dealer is less than 1⅜ in. thick. If so, simply adjust the dimensions shown accordingly.

Starting construction

First, crosscut 3½-in.-wide ¾ stock to length for the base frame pieces. Then, mark the position of the center block on the long frame pieces and assemble the base frame with 8d finishing nails and glue. The ¾ stock is used for the frame uprights (C and D) as well. Cut these six pieces roughly to length. Rip the corner uprights to 6 in. wide and the center pieces to 5 in. Then, mark each piece squarely and cut to exact length.

Prepare for securing the uprights by marking their positions on the base frame. Lay the frame, edgewise down, on the worktable. Set up scrap blocks to the same height as the frame to support the ends of the uprights. Then, glue and nail the uprights to the frame (photo 2). Use a 2-ft. steel square to ensure that the uprights are fastened squarely to the base.

To keep the upright tops in line, tack spacer strips first across, then along the upright free ends. Make

Color photo: J.R. Rost
Black-and-white photos: Neal Barrett
Technical art: Eugene Thompson
Design: Czopek and Erdenberger
Photo stylist: Gabe Herrick

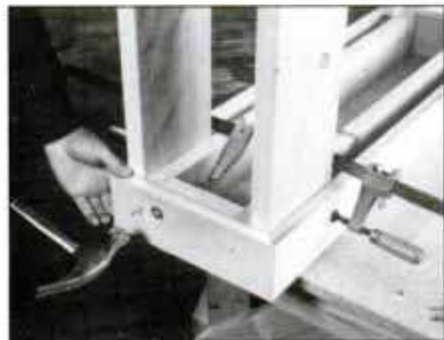
ROOM DIVIDER

sure that the spacing at the top is the same as at the bottom (photo 3).

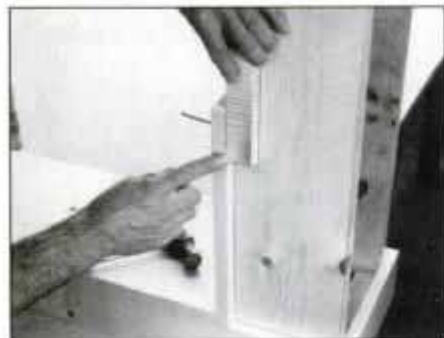
Next, roughly cut to length the $\frac{3}{4}$ -in. thick \times $3\frac{1}{2}$ -in.-wide base trim boards. Hold each piece in position on the base frame and mark for the miters. Because these pieces will be visible in the finished case, you'll want to get the miter joints just right.

After marking, cut the miters with a miterbox and check for fit with the base. Then apply the glue.

It's helpful to have a small clamp on hand to hold these pieces in position as you nail. If you don't have a clamp handy, then, before applying the glue, drive a few finishing nails through the base trim so that their points just poke through. The points will help keep the pieces in position while you drive the nails.



4 After cutting base trim to length using a miterbox, install with nails and glue. Clamp holds the work in place while nailing.



7 Use a $\frac{3}{4}$ -in.-thick spacer block to align the shelf support with upright. Have nail started in board before assembling.

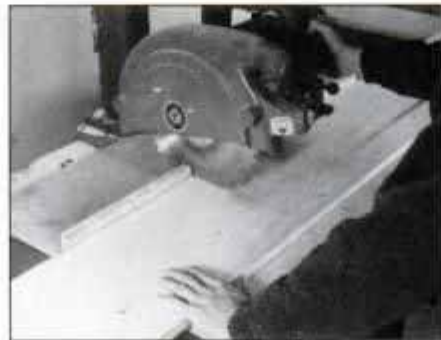


10 After installing the upper trim in the same manner as the base trim, nail up through the top shelf for a tight joint.

Making the shelves

The shelves are ripped from 1x12 pine. Before ripping, check the width across the base—it should be 11 in. Then, use your circular saw to rip the stock to correct width. Prepare enough stock for all the shelves and shelf support pieces (H) at the same time. Determine the correct length of the shelves by measuring the distance between the uprights. Then, cut the shelves squarely to length.

Glue and nail the two lower shelves to the base, making sure that their edges are flush with the base trim. Then, crosscut the shelf supports to length. Position the first shelf support using a piece of scrap $\frac{3}{4}$ -in.-thick stock to ensure correct overhang at the uprights (photo 7). Lightly mark lines near each edge of the piece to aid in positioning the nails. Partially drive a few nails in the support piece,



5 After ripping stock to width for shelves and shelf supports, crosscut to length on a radial-arm saw or portable circular saw.



8 The second row of shelves rests on shelf supports. Make sure shelf edges are flush with the supports. Glue and nail in place.



11 Installing end boards leaves a recess for the upright trim. Cut to exact width and length. Nail and glue in place.

apply glue and secure the first support using the scrap piece as a positioning gauge.

After the first row of supports are fastened, glue and nail the next tier of shelves to the tops of the supports. Repeat this procedure for the remaining shelves and supports. When you reach the top shelf, remove the long spacing strips to make the nailing easier. After the top shelves are installed, remove the short spacers.

Completing the fascia

Install the top trim boards in the same manner as the base trim. Make sure the top trim sits firmly on the top shelf and, after nailing to the uprights, nail through the top shelf from underneath into the trim.

The two vertical trim boards at the ends should now be ripped to width and cut to length. Check the dimen-



6 Install the bottom shelves so their edges are flush with the base trim. Secure with glue and 8d nails. Set all nails with nailset.



9 You'll need to remove the long spacers from upright tops when nailing the top shelves. Then, remove the short spacers.



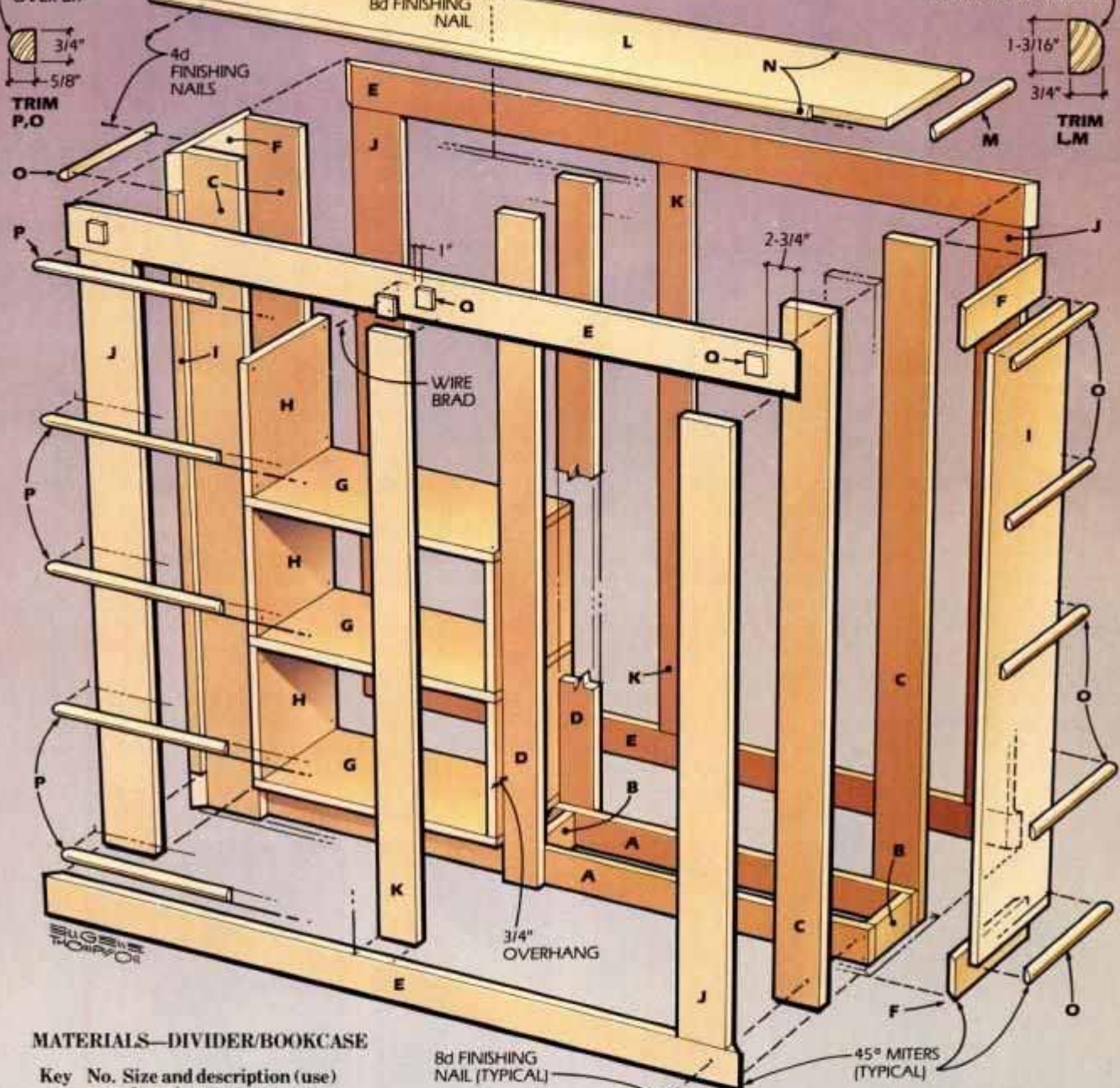
12 The top is cut to exact size from $\frac{3}{4}$ pine stock. Make sure its edges are flush with the top trim before installing.

ROOM DIVIDER/BOOKCASE

12-1/2" DEEP x 59-15/16" HIGH X 68" WIDE

ROUT WITH 3/8"-DIA. ROUNDING-OVER BIT

ROUT WITH 9/16"-DIA. ROUNDING-OVER BIT



MATERIALS—DIVIDER/BOOKCASE

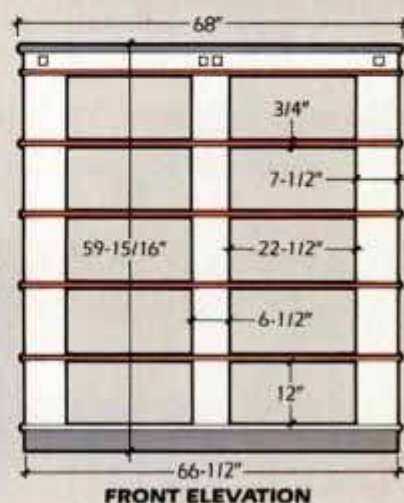
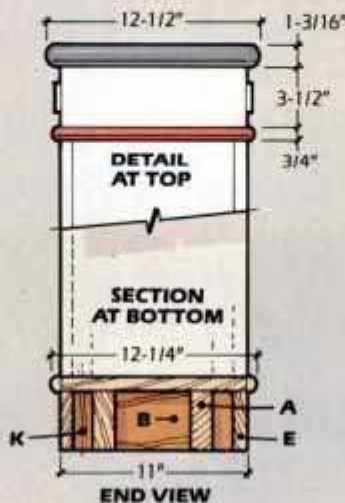
Key No. Size and description (use)

- A 2 1 1/16 x 3 1/2 x 65" pine (base side)
- B 3 1 1/16 x 3 1/2 x 4 3/4" pine (base end/spacer)
- C 4 1 1/16 x 6 x 58 3/4" pine (corner upright)
- D 2 1 1/16 x 5 x 58 3/4" pine (center upright)
- E 4 3/4 x 3 1/2 x 66 1/2" pine (front trim)
- F 4 3/4 x 3 1/2 x 11" pine (side trim)
- G 10 3/4 x 11 x 24" pine (shelf)
- H 16 3/4 x 11 x 12" pine (support)
- I 2 3/4 x 11 x 51 3/4" pine (end trim)
- J 4 3/4 x 6 x 51 3/4" pine (corner trim)
- K 2 3/4 x 5 x 51 3/4" pine (center trim)
- L 1 1 1/16 x 11 x 66 1/2" pine (top)
- M 2 3/4 x 1 1/2 x 12 1/2" pine (top molding)
- N 2 3/4 x 1 1/2 x 68" pine (top molding)
- O 10 3/4 x 3/4 x 12 1/4" pine (shelf molding)
- P 10 3/4 x 3/4 x 67 3/4" pine (shelf molding)
- Q 8 1/4 x 1 1/2 x 1 1/2" pine (block)

Misc: wire brads, 4d finishing nails, 8d finishing nails, glue, 120- and 220-grit sandpaper, mineral spirits. Muralo paints: Alabaster (No. 116A-16P), Gray Mood (No. 116B-4D), Carnival Red (No. 2A-1A), White (No. 18164).

8d FINISHING NAIL (TYPICAL)

45° MITERS (TYPICAL)



ROOM DIVIDER

sion across the ends first. This trim must overhang $\frac{3}{4}$ in. on both sides. After cutting to size, use the $\frac{3}{4}$ -in.-thick scrap piece to accurately position each board in the same way you lined up the shelf supports.

The remaining boards to install are the corner and center trim pieces. These must fit precisely into the recesses formed by the shelf support pieces and end boards. Measure the widths accurately and rip to the outside of the marks. If the pieces fit a little too tightly, trim the excess with a hand plane. Be sure to nail through the shelf supports and end boards as well as nailing through the trim face.

Finally, cut the case top from $\frac{5}{8}$ x 12 stock. Lay it in position and check that its edges are flush. Then glue and nail it in place.

Installing the molding

The five horizontal bands accenting the shelves and top are cut from pieces of half-round molding. You'll need two widths for the job— $1\frac{3}{16}$ for the top and $\frac{3}{4}$ for the shelves. If you're unable to find half-round molding in these sizes at your local lumber yard, you can make the trim yourself with your router.

Before starting the trim, however, is a good time to check the entire piece for flush joints and perform some preliminary sanding with 120- followed by 220-grit sandpaper. This job is eas-

ier to do with the molding off.

The $\frac{3}{4}$ -in.-wide molding is made from a length of 1x12 or 1x8 stock. Clamp the board to the edge of your worktable and install a $\frac{3}{8}$ -in.-rad. rounding-over bit in your router. Adjust the bit depth so it will cut a radius that's flush with the surface of the stock. Then, rout one edge of the board to create one half of the molding profile. Simply flip the board over and rout from the other face to finish the half round. If your router bit includes a pilot, don't be tempted to use it as a guide for this operation. After the first cut is made, the pilot will no longer have a proper edge to run against and the next cut will go too deep. Equip your router with an edge guide instead (photo 13).

After each half-round is cut, set your table saw fence or portable circular saw guide for a $\frac{5}{8}$ -in. rip and cut the trim off the board. For the top trim, use $\frac{5}{4}$ stock and a $\frac{9}{16}$ -in.-rad. rounding-over bit. Rip to $\frac{3}{4}$ in. wide.

Prepare for installing the molding by first marking square lines around the end columns and across the middle columns at the shelf positions (photo 15). Install the long pieces first. Temporarily tack each piece in place and mark for cutting the miters. Then, use a miterbox to make the cuts.

After marking the short end pieces, fasten the long pieces in place with glue and 4d nails. Then, carefully cut each short piece to fit and install.

The final trim pieces to be applied

are the decorative blocks placed over each column. It's best to use a table saw to cut these $\frac{1}{4}$ -in.-thick squares. First rip a 20-in.-long piece of stock to $1\frac{1}{2}$ in. wide. Then, resaw the stock to $\frac{1}{4}$ in. thick. Crosscut the eight $1\frac{1}{2}$ -in.-sq. blocks from this strip.

A stop block fixed to the table saw or radial-arm saw makes this job go faster. Don't use the table saw fence for a stop block. The piece can jam between the blade and fence and get thrown back at you. Install each block with glue and wire brads as shown in the drawing.

Set all nails and fill with wood filler. Then, give the piece a final sanding with 220-grit sandpaper.

Finishing the unit

We finished our room divider/bookcase to highlight its visual elements while allowing the wood grain to appear as subtle surface decoration. The main part of the case was given a pickled finish. This imparts a bleached quality to the wood. Use Muralo Alabaster oil-based paint, thinned 30 percent with mineral spirits. Let the paint soak into the wood for about five minutes and then, wipe off with a clean rag. Allow to dry overnight.

The top piece, its trim and the base were given two coats of high-gloss Muralo Gray Mood. The shelf trim was painted with high-gloss Muralo Carnival Red and we used Muralo high-gloss white for the decorative blocks. **PM**



13 Make the molding with your router and rounding-over bit. Use a $\frac{3}{8}$ -in.-rad. bit for the shelf trim and $\frac{9}{16}$ -in. bit for the top.



14 After routing both corners to make the half-round profile, rip the shelf trim to $\frac{5}{8}$ in. Top trim is ripped to $\frac{3}{4}$ in. wide.



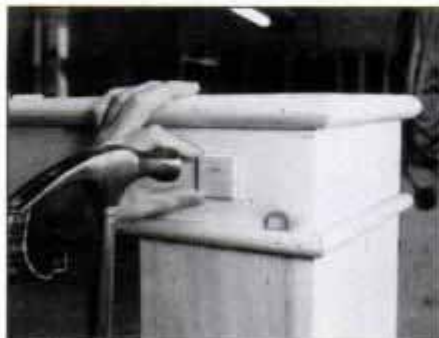
15 Use a square to lay out molding position around end columns and across center column face. Miter trim to length.



16 After marking and cutting miters, install with finishing nails and glue. Install long pieces first and cut short lengths to fit.



17 The decorative blocks are crosscut from $\frac{1}{4}$ -in.-thick stock to $1\frac{1}{2}$ -in. squares. Use a stop block for accurate cuts.



18 Install blocks with glue and wire brads. Don't nail too close to edge nor place two nails on the same grain line.

DRILL BITS

While twist drill bits are designed for drilling holes in metal, they're also commonly used to bore holes in wood and plastic. To bore large diameter holes in wood there are several bits available including spade, Forstner and auger bits. Selecting the right bit depends on the workpiece, the size of the hole and the required quality of the hole. Some bits produce perfectly round, smooth, flat-bottom holes. But in some cases, such as rough carpentry work, a superprecise hole isn't needed.

Here, we've collected 23 bits to handle virtually every hole-boring job. However, it's not likely that you'll need every bit shown. Instead, add bits to your toolbox as you need them and remember that price is a good indication of quality. In other words, you get what you pay for.

What's new?

Tool makers have recently developed some exciting and truly unique drill bits. The newest of these is Black & Decker's Bullet bit (see No. 1). The bit's built-in pilot point helps it cut quicker and minimize walking—the tendency of the bit to wander off course.

Step drills (No. 5 and No. 6) allow you to drill several different size holes with the *same* bit. They're designed for drilling in thin materials, especially metals and plastics. Other new bits include: a carbide-tipped brad-point bit (No. 7), improved spade bit (No. 14), and Vermont-American's new split-point masonry bit (No. 2).

Also, note that many manufacturers are now offering titanium-nitride-coated bits. These gold-colored bits boast superior performance over standard high-speed steel bits. Now let's take a look at each of the bits shown.

1. Bullet bits—The unique design of the Bullet bit allows it to outperform standard twist-drill bits—especially when drilling metal. In fact, according to Black & Decker, the Bullet bit will drill four times faster and last seven times longer than standard high-speed steel (HSS) bits. The titanium-nitride-coated Bullet bit, also shown, lasts

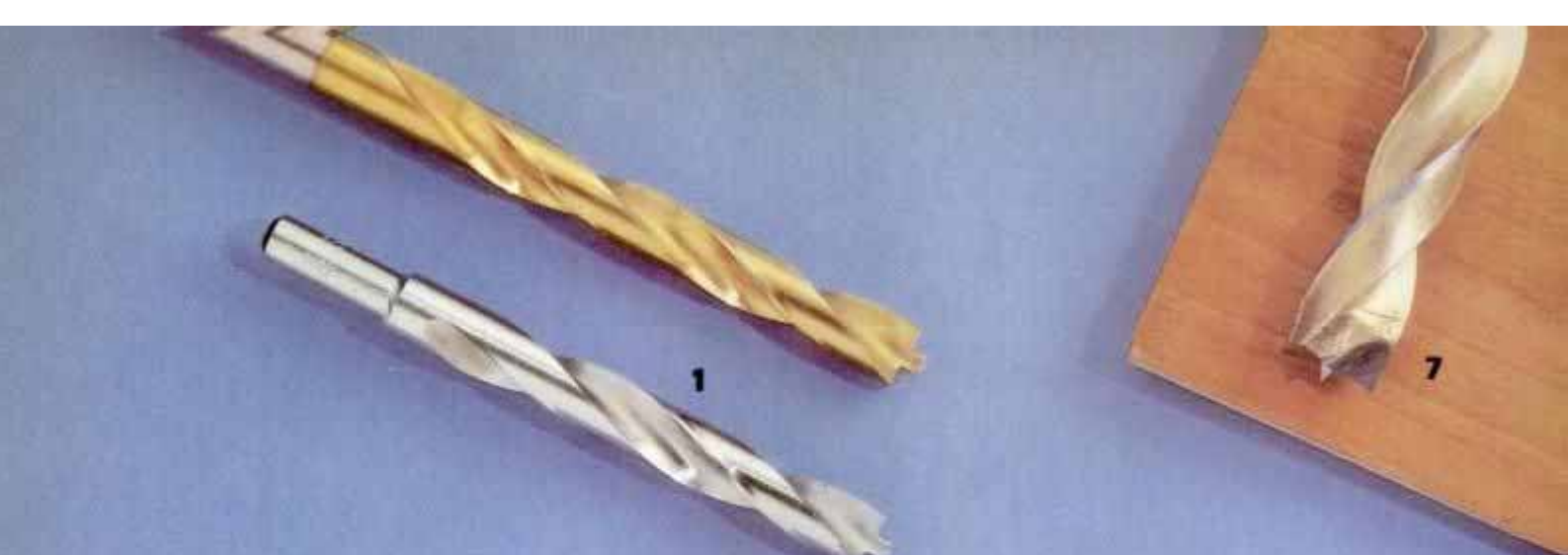
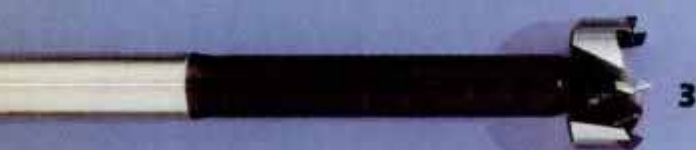
14 times longer than a standard bit, according to B & D.

The pilot-point tip ensures no-walk starting and an enlarged flute chamber hastens chip removal to prevent jamming. Acute-angle cutting edges mean faster drilling and, more importantly, no binding and lockup as the bit breaks through the backside of the workpiece. Bullet bits come in 29 sizes ranging from $\frac{1}{16}$ in. (\$2 for two HSS bits; \$1.80 each for titanium-coated) to $\frac{1}{2}$ in. dia. (\$15.50 for HSS; \$26.65 for titanium-coated). Contact Black & Decker, 10 N. Park Dr., Box 798, Hunt Valley, MD 21030.

2. Split-point masonry bit—Up to now, boring a hole in concrete, brick, cement block and plaster has been a slow, laborious process. The new bit shown, called Lickety-Split, features an aggressive cutting, split-point, carbide-steel tip that bores three times faster and lasts 10 times longer than regular masonry bits, according to Vermont-American. Lickety-Split bits come in five sizes from $\frac{3}{16}$ in. (\$2.80) to $\frac{1}{2}$ in. (\$5.05) dia. Contact Vermont-American, Box 340, Lincolnton, NC 28093.

3. Multispur bit—For precise holes in fine woodworking, try a multispur bit. Designed for drill press use, it features a rim-guided cutting head that makes it easy to bore angled and overlapping holes. The cutting head has rows of sharpened teeth and a $\frac{1}{8}$ -in.-long center spur for smooth, nearly flat-bottomed holes. The 1-in.-dia. bit shown costs \$18.75, plus shipping, from Garrett Wade, 161 Avenue of the Americas, New York, NY 10013. Other sizes range from $\frac{3}{8}$ in. to $1\frac{1}{2}$ in. dia.

4. Hollow-spiral auger bit—Also known as a ship-head car bit, this 18-in.-long bit is used for deep boring in large timbers, telephone poles, docks and bridges. The bit features a single-twist, hollow-center design and a screw-point tip that holds the bit on course. The bit's chuck-end is tapered to fit a hand brace. Just above the tapered end, the bit's shank is hex-shaped. To use the bit in a portable electric





drill, simply hacksaw off the tapered end. The $\frac{3}{4}$ -in.-dia. bit shown costs about \$19.85 at hardware stores. It's also available in sizes ranging from $\frac{1}{4}$ in. (\$15.70) to $1\frac{1}{2}$ in. (\$37.50) dia. Contact Irwin Co., Box 829, Wilmington, OH 45177.

5. Step drill—The Unibit step drill shown (model No. 4) can drill 12 different size holes from $\frac{3}{16}$ in. to $\frac{7}{8}$ in. dia. The high-speed steel bit has a sure-starting point and a single flute. The bit's multiple-step design enlarges the hole a little at a time. Simply stop drilling when the desired size hole is made. Designed primarily for drilling in steel, copper, brass, aluminum and other thin metals, Unibits can also be used to bore holes in plastics, composition boards and thin wood. The bits' high prices are offset by the fact that you need fewer bits and by the convenience of not having to change bits so often. The No. 4 Unibit shown costs about \$39. The No. 1 Unibit (\$18.50) drills 13 different size holes from $\frac{1}{8}$ in. to $\frac{1}{2}$ in. dia. For details on the entire Unibit line, contact American Tool Co., 301 S. 13th St., Suite 600, Lincoln, NE 68508.

6. Titanium-nitride step drill—Vermont-American recently introduced its own version of the step drill, called the Drill Tree. It's similar to the Unibit mentioned above, except that it has two cutting flutes and a titanium-nitride coating that stays sharp six times longer than HSS step drills, according to the maker. The bit shown (\$17.95) will drill 13 holes ranging from $\frac{1}{8}$ in. to $\frac{1}{2}$ in. dia.



DRILL BITS

A 9-hole Drill Tree— $\frac{1}{4}$ in. through $\frac{3}{4}$ in.—costs about \$30. Contact Vermont-American, Box 340, Lincolnton, NC 28093.

7. Carbide-tipped brad-point bit—Regular high-speed steel brad-point bits, such as No. 15, are extremely popular with woodworkers. Garrett Wade now offers durable carbide-tipped brad-point bits that will outlast HSS bits many times over. The bits have supersharp carbide cutting edges and a center spur that eliminates walking. These are excellent bits for boring very hard, exotic woods. The $\frac{3}{4}$ -in.-dia. bit shown costs \$13.60, plus shipping, from Garrett Wade, 161 Avenue of the Americas, New York, NY 10013. Eight other sizes are available: $\frac{1}{8}$ in. to $\frac{5}{8}$ in. dia.

8. Left-hand bit—Notice something odd about this $\frac{3}{8}$ -in.-dia. bit? That's right, it has left-hand spiraling flutes. This unique bit is used to extract broken bolts, screws and threaded studs. Operate the bit counter-clockwise in a reversible drill. In most cases, the left-handed drilling action alone will loosen the broken piece. Otherwise, use a straight-flute screw extractor. The bit shown costs about \$11. Other bits range from $\frac{1}{8}$ in. to $\frac{5}{16}$ in. dia. Contact Vermont-American, Box 340, Lincolnton, NC 28093.

9. Forstner bit—For fine woodworking and cabinetmaking, the Forstner bit is in a class by itself. However, don't be fooled by imported Forstner-type bits. This is the genuine Forstner bit invented by Oregon gunsmith Benjamin Forstner and patented in 1886. The bit is now made by Connecticut Valley Manufacturing, Box 3200, New Britain, CT 06050.

Contrary to popular belief, the bit's circular flange only guides the tool. The actual cutting is done by two hori-

zontal, hand-sharpened edges. Use Forstner bits in a drill press to bore perfectly flat-bottomed holes, precise angular holes, overlapping holes and any fraction of a hole in the workpiece edge. Like most unique, quality tools, Forstner bits are not cheap. The $1\frac{1}{2}$ -in.-dia. bit costs \$34.84. Sizes range from $\frac{1}{4}$ in. (\$20) to 3 in. (\$100) dia. plus shipping. Write to the manufacturer or call toll-free (800) 336-0076.

10. Mortising chisel—It may be hard to believe, but this woodworking bit bores square holes. Use it in a drill press to bore a series of overlapping holes to form a mortise to accept a matching tenon. The tool consists of a wood-boring bit housed in a hollow, square chisel. Chuck the bit in the drill press. A special yoke (not included) attaches to the drill press and clamps onto the chisel. As pressure is applied, the bit removes a vast majority of the stock and the chisel cuts the round hole square. The $\frac{1}{2}$ -in.-wide mortising chisel shown costs \$52.50 postpaid from Constantine's, 2050 Eastchester Rd., Bronx, NY 10461.

11. Solid-center auger bit—This 1-in.-dia. wood-boring bit (\$11.85), also known as an electrician's auger bit, is designed for rapid, if not smooth, boring. It's most often used to bore holes in house framing to run electrical wires. The $9\frac{1}{2}$ -in.-long bit features a deep, chip-clearing spiral flute and a quick-start screw-point tip. A sharpened cutter, located near its tip, scribes the wood and speeds the boring process. It can be used in either a hand brace or electric drill. For use in an electric drill, simply cut off the bit's tapered end to expose the hex-shaped shank. Other sizes range from $\frac{1}{4}$ in. to $1\frac{1}{4}$ in. dia. Contact Irwin Co., Box 829, Wilmington, OH 45177.

12. Heavy-duty expansive bit—Here's an improved version of the old reliable expansive bit (No. 19). This

versatile woodworking bit is infinitely adjustable for boring holes from $1\frac{3}{8}$ in. to $3\frac{1}{8}$ in. dia. A sharp center point ensures accurate, nonslip boring. Although it is similar to a regular expansive bit, it cuts cleaner and more precisely. It's \$68.50 postpaid from Garrett Wade, 161 Avenue of the Americas, New York, NY 10013.

13. Circle cutter—Also known as a fly cutter, this tool cuts large holes in wood, sheetmetal, brass, copper, aluminum and plastic. Designed for drill press use only, it features a pilot twist-drill bit and a replaceable high-speed steel cutter. The tool adjusts to cut holes from $\frac{7}{8}$ in. to 4 in. dia. Operate the cutter at 500 rpm and wear eye protection. It's \$11.50 postpaid from Constantine's, 2050 Eastchester Rd., Bronx, NY 10461.

14. Spade bits—The $\frac{5}{8}$ -in.-dia. Irwin Speedbor 88 spade bit shown is one of the most popular woodworking bits in use today. Spade bits are fast-cutting, inexpensive and easy to sharpen with a file. Use spade bits in a portable electric drill or drill press.

Irwin recently introduced an improved spade bit (see the $\frac{3}{4}$ -in.-dia. bit shown) called the Speedbor 2000. The new bit has two protruding spurs that scribe the wood for faster cutting and a sharpened, horizontal groove on each side for cleaner holes.

Both styles are available in 17 sizes from $\frac{1}{4}$ in. to $1\frac{1}{2}$ in. dia. Speedbor 88 bits cost between \$2.25 and \$4.15. Speedbor 2000 bits cost slightly more: \$2.40 to \$5.55. Contact Irwin Co., Box 829, Wilmington, OH 45177.

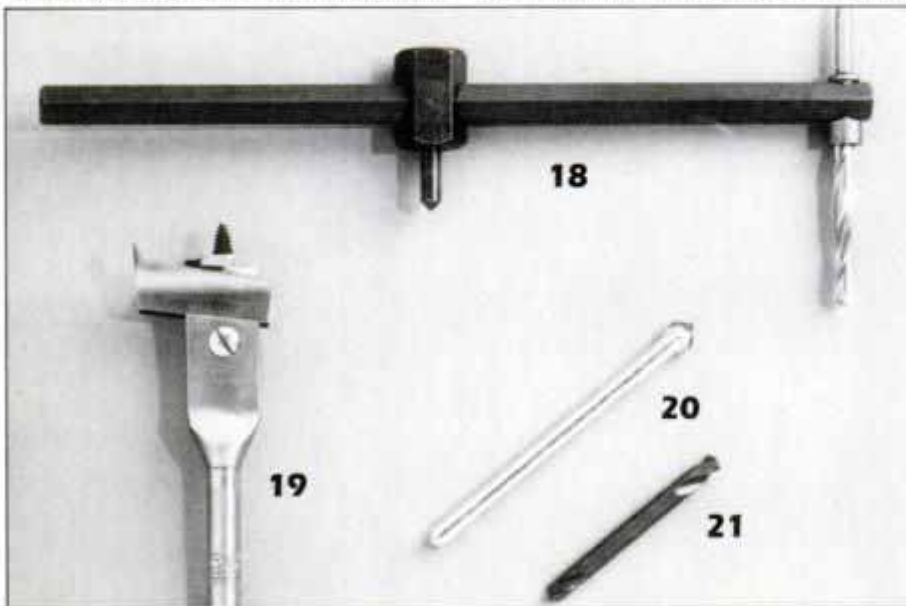
15. Brad-point bit—A favorite of many woodworkers, a brad-point bit features a sharpened center point for quick, sure starts and two cutting spurs that scribe the wood for fast, smooth holes. The high-speed steel bit also features extra-deep flutes for fast, clog-free boring. A 5-piece set costs \$38.70 postpaid from Garrett Wade, 161 Avenue of the Americas, New York, NY 10013. It includes $\frac{1}{4}$ -, $\frac{5}{16}$ -, $\frac{3}{8}$ -, $\frac{7}{16}$ - and $\frac{1}{2}$ -in.-dia. bits.

16. Titanium-nitride bit—Vermont-American offers a full line of titanium-nitride-coated twist drill bits. The superhard bits have many advantages over standard high-speed steel bits—especially when drilling metal. The main advantages are that they stay sharper longer and cut easier.

According to Vermont-American, their titanium-nitride bits last six times longer than HSS bits. The bits also stay cooler at high speeds and require less pressure.

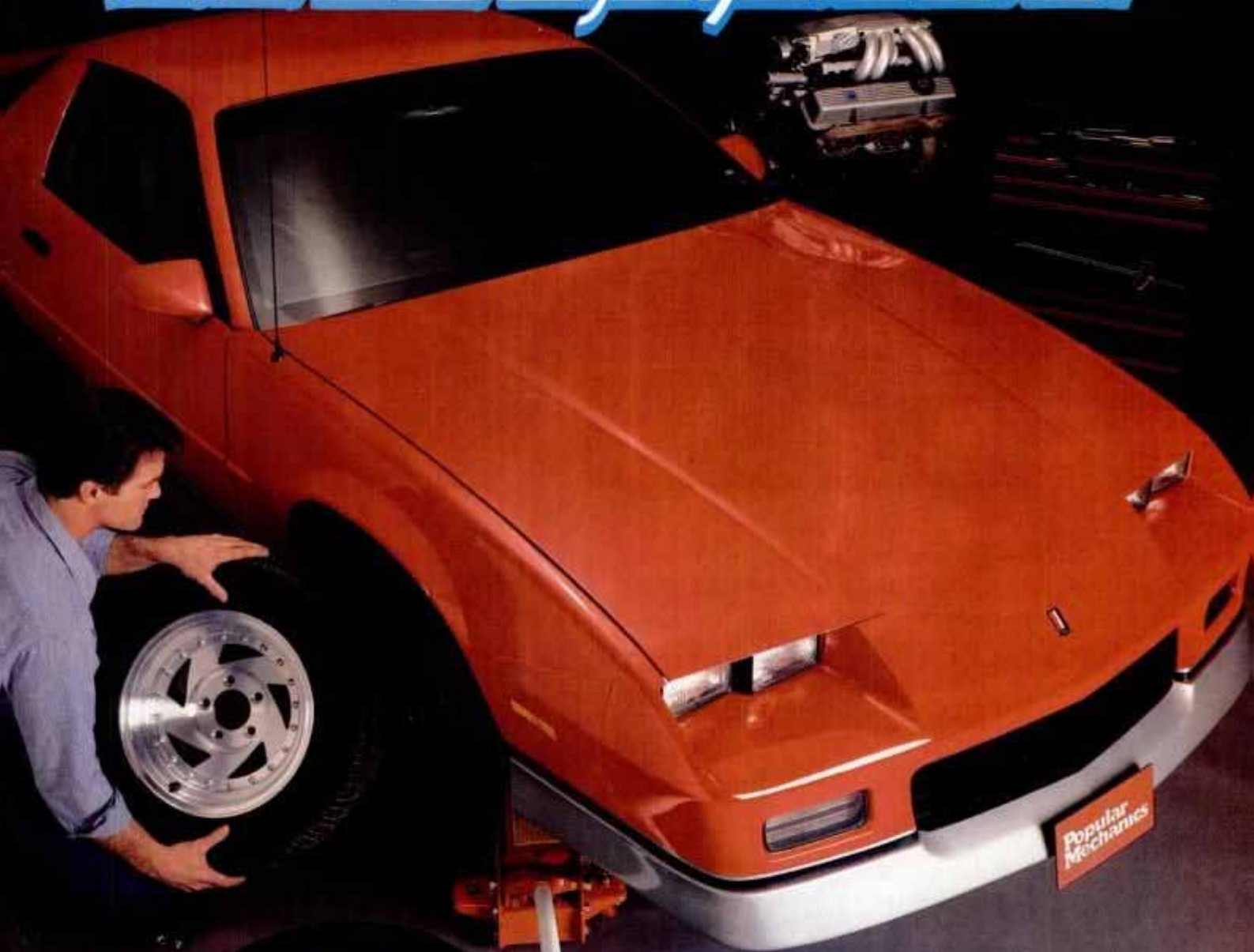
Titanium-nitride bits aren't cheap, but may be economical for anyone who does a lot of drilling. Available in 29 sizes from $\frac{1}{16}$ in. (\$1.75) to $\frac{1}{2}$ in.

(Please turn to page 149)



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PERFORMANCE Tuning Guide

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Cover: A wider wheel/tire combination is usually the first step on the road to a true higher performance machine. Next step for this Camaro is the 350 TPI engine in the background.
PM photo by Bill Ashe

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Whether it's new, near-new or a veteran of many summers, there are two ways of looking at your car. You can do as most car owners do, and regard it as a marvel of modern technology, complete and ready to go as is. Measured by most transportation criteria, this is true of virtually every car sold in this country.

But as a PM reader, you belong to a much more select group, individuals who view all automobiles, humble or high zoot, as opportunities for improvement and/or self-expression. And when it comes to performance, mere adequacy simply doesn't get it.

Performance, of course, has become a much more comprehensive concept than it was in the 1-dimensional

heyday of big-inch V8s and clouds of vaporized rubber. Although 0 to 60 mph will always be an important part of the equation, today's idea of performance also includes handling and even appearance—how well the car performs at the hamburger stand or just sitting in your driveway.

The complexity of today's cars has more than kept pace with the perception of performance as a total vehicle concept, and this is a mixed blessing. On the positive side of the ledger, our cars are more technologically sophisticated than ever before, which equates with more efficient and generally better. But the down side of all the emphasis on black boxes and preprogrammed combustion is that cars seem more forbidding to work on than at any time in

the century-plus they've been in use.

While it's hard to deny that some aspects of maintenance and repair have gotten beyond the capabilities of feeler gauges and trouble lights, we believe there are still ample opportunities for the Saturday mechanic to improve every aspect of his car's performance. That's every aspect—including under the hood. Regardless of the car.

And that's what our 1988 Performance Tuning Guide is all about—a broad collection of how-to stories aimed at helping you make your car per-

form the way you really want it to—to look better, go better and handle better.

For the sake of continuity, the stories fall under three general categories: Appearance, Powertrain and Chassis.

Before launching into the suggestions for improvements, however, we suggest that you make sure that you begin your project (or projects) with a car that's in the best possible operating condition. Accordingly, we've provided a checklist, "Before You Begin," which specifies the systems in your car that should be in good-as-new condition before modifications get underway. (Even if you decide that this isn't the time for car projects, this checklist is a good guideline to keeping your car in optimum health.)

From there, you may decide to skip over the appearance suggestions and go straight into the realm of horsepower—the most extensive category in the guide, by the way.

Or you may decide your car's muscle quotient is okay for now and what you really need is refinement in the handling department.

Then again, maybe a pretty face is more important after all.

Whichever way you decide to go, we've got you covered. **PM**



Without resorting to wild sheetmetal changes or radical wheel/tire theatrics, you can see by this illustration how a standard Camaro Sport Coupe can become one-of-a-kind.

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BEFORE YOU BEGIN



PM ILLUSTRATION BY SKIDMORE SAHRATION

IF YOU WANT your car to leap to attention when you crack the throttle and tenaciously hug the apex when you steer into a switchback, your maintenance procedures should be more than just a series of parts and lubricant replacement exercises. Although the renewal of worn parts is necessary, that's not enough to keep your machine in combat-ready condition.

Listed below are 20 items that should be checked and possibly corrected *before* making any high-performance modifications. Performance modifications on a car that's not in peak running order make as much sense as the old practice of mail-order brides: It seems easy, but you never know what you'll wind up with.

1. Battery Condition And Voltage
Batteries don't last forever. Perform

a voltage check, both at rest and under load, when servicing your car. It's also essential that you keep terminals free of corrosion, which can increase circuit resistance, thereby reducing available voltage.

2. Sparkplug Condition
Don't just toss those old plugs away. Study the color and condition of the electrodes and insulator. Look for inconsistencies. If one cylinder is oiling, its plug will be greasy or black. If it's not running properly, its plug will be darker or lighter than the others.

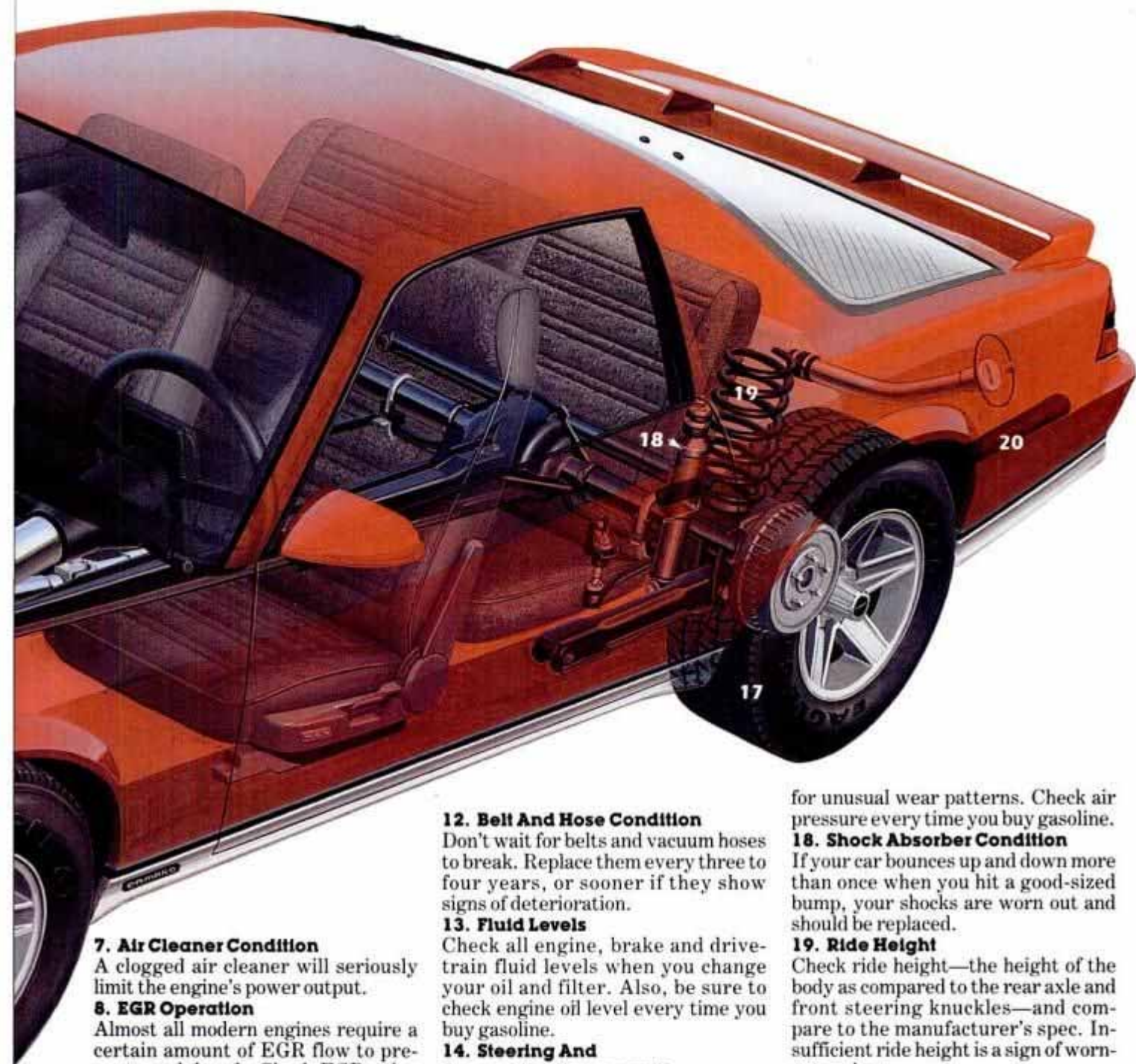
3. Cylinder Compression And Leakage
A compression test will reveal a cylinder

that doesn't develop full compression. A leakage test will help pinpoint the problem.

4. Idle Speed
Before you can correctly make other adjustments, idle speed has to be set to manufacturer's spec.

5. Ignition Timing
Incorrect ignition timing can cause loss of power and, in more extreme cases, even engine damage.

6. Distributor Cap, Rotor And Plug Wire Condition
If ignition voltage meets with high resistance or a short on its way to the plug, spark voltage will be lowered and the cylinder could stop running.



7. Air Cleaner Condition

A clogged air cleaner will seriously limit the engine's power output.

8. EGR Operation

Almost all modern engines require a certain amount of EGR flow to prevent spark knock. Check EGR valve operation.

9. PCV Operation

If the PCV valve doesn't keep crankcase pressure in check, performance will suffer.

10. Inlet Hot Air And Manifold EFE

The inlet hot air system, found on most cars, ducts heat to the air cleaner when the engine is cold. The Early Fuel Evaporation system heats the intake manifold with exhaust or electric coils. If these systems are not functioning, you'll lose cold-engine driveability.

11. Cooling System Integrity

Leaking hoses, a corroded cooling system and/or worn-out coolant can wipe out internal engine components. An annual flush and refill is your best insurance.

12. Belt And Hose Condition

Don't wait for belts and vacuum hoses to break. Replace them every three to four years, or sooner if they show signs of deterioration.

13. Fluid Levels

Check all engine, brake and drivetrain fluid levels when you change your oil and filter. Also, be sure to check engine oil level every time you buy gasoline.

14. Steering And Suspension Components

Steering and suspension components, including tie-rod ends, ball joints, control arm bushings, idler arms and pitman arms, should be checked every time you're under your car.

15. Wheel Bearing Lubrication And Condition

Clean, examine and repack the front wheel bearings of rear-drive cars and the rear wheel bearings of most front-drive cars following manufacturer's specifications.

16. Brake Pad And Lining Wear

Check the thickness and condition of brake pad and shoe friction material periodically. Examine drums and rotors for signs of deterioration, uneven wear or heat cracking.

17. Tire Pressure And Wear

Keep an eye on your tires and watch

for unusual wear patterns. Check air pressure every time you buy gasoline.

18. Shock Absorber Condition

If your car bounces up and down more than once when you hit a good-sized bump, your shocks are worn out and should be replaced.

19. Ride Height

Check ride height—the height of the body as compared to the rear axle and front steering knuckles—and compare to the manufacturer's spec. Insufficient ride height is a sign of worn-out springs.

20. Exhaust System Condition

A leaking exhaust system can fill the car with deadly carbon monoxide fumes. Check all joints and seams periodically, particularly if there's an increase in engine noise, a symptom that might indicate a problem.

All of these checks can be done with hand tools, so don't be intimidated if your car is computer controlled. Aside from wrenches, sockets, a compression tester and the like, the most important tool is the factory-authorized service manual from the dealer. Not only does it spell out the intervals for maintenance (you'll do well to perform your maintenance earlier), and correct specifications for settings and tolerances, it also specifies the correct lubricants and filters.

PM



Painting over chrome, side-view mirror housings, and other trim can give your car a European-style flair.

MONOCHROMING FOR THE EURO LOOK

THE FIRST time the 1-color treatment appeared on the European show circuit, it looked like the entire car had been dipped in a huge vat of white pigment. Only the glass escaped.

Though it was popularized by Germany's AMG custom shop, monochroming actually has its roots in the dechromed hot rods of the '50s. Today it's become automotive high fashion, especially among high-ticket customizers.

The most popular trim treatment is the black-out look, achieved by simply replacing the bright finish of chrome moldings with a matte or semigloss black coating. This is an effective way to personalize your car's appearance without departing radically from the original color scheme.

Refinishing the chrome of bumpers and grillework to match the color of the body panels requires more disassembly, but smartly updates the look

of the car. Alloy wheels, too, are even more stylish when color-matched to the body paint.

Getting paint to adhere to a chrome-plated surface is a nearly impossible task. For heavy-gauge parts like bumpers, complete stripping by a plating shop ensures the best surface for the paint to bite. Roughing up the plated surface with commercial sandblasting is almost as good, but if any of the chrome starts to lift during this process it must all be removed before proceeding.

After straightening the bumper and removing any dents, it's ready for an etching primer that will assure good paint adhesion. Be sure the primer is appropriate for the paint you'll use for the final color coats.

Smaller chrome-plated trim pieces will keep their color coat longer when treated to powder coating, a process available at many plating shops. Pow-

der coatings are electrostatically sprayed, offer better adhesion than conventional painting, and are less likely to dull or peel.

Parts to be powder coated must be disassembled for spraying and sandblasted to roughen the surface for the coating to grip. The final step of the process requires baking, so the parts must be able to withstand 400° F. Clear powder coating is also available for preserving polished metal surfaces. Far more durable than clear coats, it's a long-term solution to keeping copper, brass and aluminum pieces free of corrosion. **PM**

SOURCE LIST

- Ditzler/PPG Automotive Finishes, P.O. Box 3510, Troy, MI 48007
- Du Pont Refinish Products, 2000 S. Garfield, Commerce, CA 90022
- R-M Products, 14108 Artesia Blvd., Cerritos, CA 90701
- Sperex Corp., 16131 S. Maple Ave., Gardena, CA 90248



Instant-on radar: How it works. How to defend yourself.

Instant-on radar—sometimes called “pulse” radar—has been around for years. But it’s being used more frequently now as radar operators try to defeat detector users. Here’s how it works.

First things first

Ordinary radar and instant-on radar use exactly the same type of radar beams. In fact, most radar guns can operate either way. It’s just a matter of which buttons the operator pushes.

How ordinary radar works

In an ordinary radar trap, the radar gun is aimed at traffic and it continuously transmits a beam of radar waves. The effective range for the radar to “see” your speed is less than a half mile for most cars, longer for trucks.

How radar detectors work

A radar detector is a radio receiver tuned to radar frequency. A high-performance radar detector is sensitive enough to pick up the radar waves before you drive within speed-measuring range. It’s as simple as that.

How instant-on radar works

The instant-on radar trap is set up just like an ordinary radar trap. The only difference is that the gun doesn’t transmit until the operator pushes a button. So there is no radar signal for a radar detector to find.

Then when you’re within speed-measuring range, the operator triggers the beam. Hence the term “instant-on.” The radar reads your speed within a fraction of a second, too quickly for a human to respond.

Your only hope

Because instant-on radar is faster than your reflexes, your only defense is to identify it before you are within its range. You must detect it when the operator zaps the traffic ahead of you. For this, your detector must reach out for distant radar signals.



The Kustom Signals HR-12 and KR-11, two of the many radar units that can be operated in an instant-on, or “pulse” mode.

You’re looking for weak radar that lasts only a few seconds. Finding even one such “pulse” is cause for alert. Finding a series of them, each stronger than the previous one, indicates you’re approaching an instant-on radar trap that’s picking off traffic ahead.

Same old strategy

Identifying instant-on radar before you come in range is the only defense today, just as it was when we first introduced Escort. That’s why our warning system, used on both Escort and Passport, tells you both the strength of the signal and the length of it. You need to know both to defend yourself.

Nothing but the truth

Our warning system indicates signal strength two ways: by a meter for a visual check, by a variable-rate beeper if you prefer to listen. The length of the signal is indicated by the duration of the alert. Knowing signal strength and signal length of every radar encounter is the only way to find instant-on radar before it finds you.

Escort and Passport are the most effective radar-warning instruments available. But don’t take our word for it.

In 1987, *Car and Driver*, *Popular Mechanics* and *Roundel* each published independent tests of radar detectors. And each gave us the highest ratings. Call toll-free and we’ll send reprints of the complete tests, not just excerpts or quotes.

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DOING IT WRONG

When you understand that instant-on radar is nothing more than ordinary radar being turned on and off, the threat loses its mystery. Defense comes down to detecting the radar before it’s strong enough to find you.

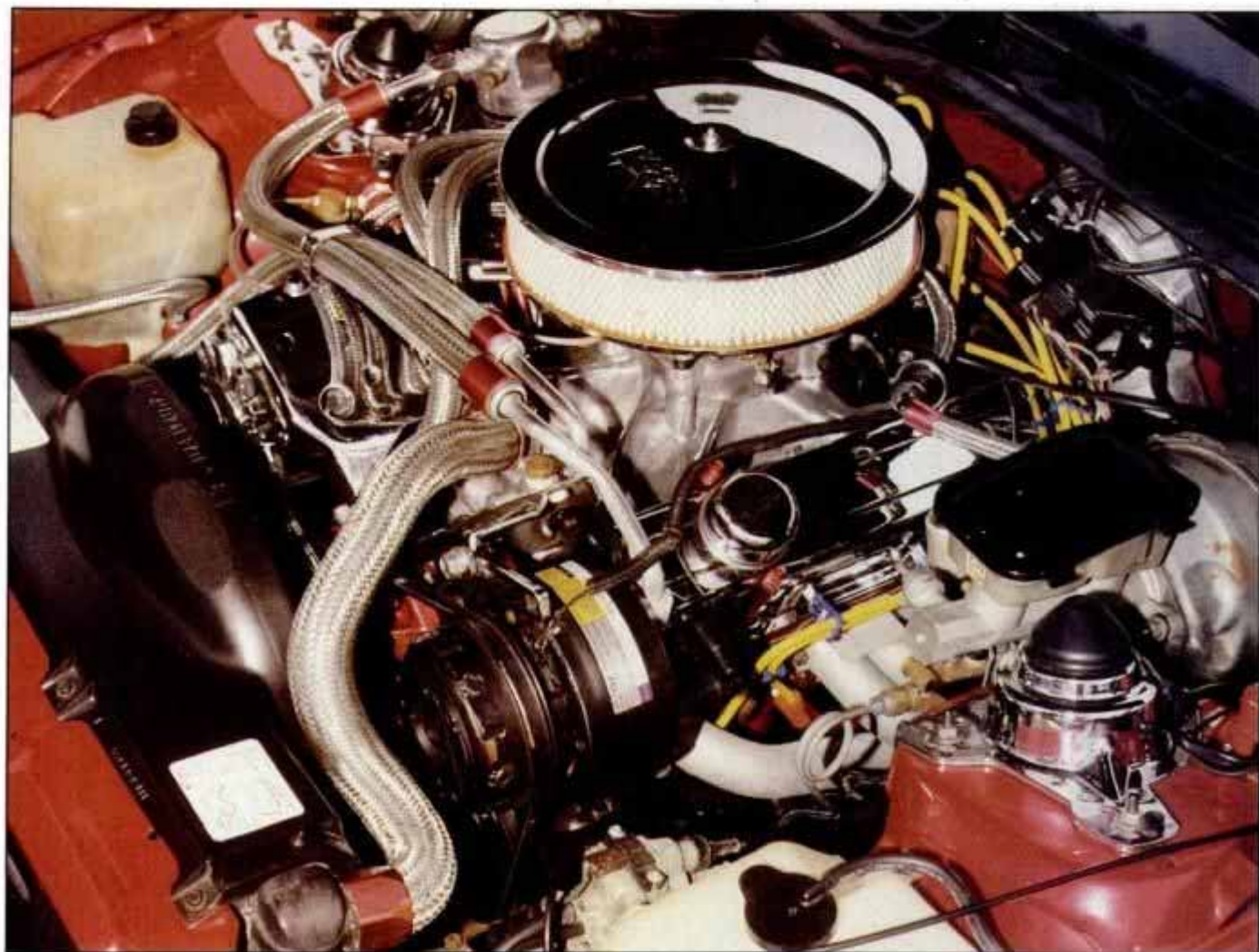
Baloney breakthrough. Yet one detector maker has added a feature it calls “Pulse Protection” to one of its models. Here’s what it does:

When this unit detects the sudden presence of a high-strength signal, a “P” appears on its display and it sounds a special alarm. This is your “Pulse Protection.”

The fine print. Unfortunately, the sudden presence of a high-strength signal describes an instant-on encounter when you’re within range. True protection from instant-on depends on responding to weak signals, but “Pulse Protection” doesn’t respond to weak signals.

The maker says this feature “tells you when you’re being shot at.” And that’s the problem. When you’re being shot at, it’s too late.

ENGINE DETAILING



WHENEVER gearheads gather to check out a new machine, sooner or later (usually sooner), the hood goes up. Some of us take pride in the drab but efficient look of well-maintained stock equipment. But the gathered heads are more likely to nod with approval when the engine shows the extra care that goes with underhood detailing.

There's no end to the help available if you want to add a little underhood sparkle. From polished valve covers to braided steel hoses and chrome air cleaner housings, hundreds of detailing highlights make the engine bay a sight to behold.

If your choices are smart, the cosmetic improvements can also result in functional gain. One look at the underhood cleanup program in progress by Detroit car makers makes it clear that tidy layouts are not only more appealing to look at, but easier to work on.

A little color under the hood makes a big difference. Start with the spark-plug wires—quality silicone jacket cables are available in flashy yellow, blue and other hues, adding a bright focal point and improving ignition performance, too. Use wire looms and separators to keep wires away from exhaust manifolds—and each other.

Nothing adds a dressed-up look faster than chrome. Valve covers or breather caps are available for most engines in chrome steel as well as polished or black-highlighted cast aluminum. For an exotic look, track down aluminum covers with gold, red or blue anodized finish.

Show-quality chrome engine accessories are also available in ready-to-install form, including alternators, fuel pumps, power steering reservoirs and covers for the timing chain and brake fluid reservoir. Replacement air cleaner housings in chrome

If it don't go, chrome it. If it's a hose, braid it. If it's aluminum, anodize it.

or anodized aluminum add a welcome custom touch. If you're reluctant to fool with the vacuum hoses and inscrutable widgets that live under the air cleaner, look for a replacement housing *top*.

The ultimate cosmetic enhancement is a set of braided stainless-steel or nylon fuel and water hoses with contrasting anodized ends. This high-tech aircraft equipment can be costly, but you can get the look with easily installed slip-on hose covers. **PM**

SOURCE LIST

- Accel Performance Products, Route 139, Branford, CT 06405
- Edelbrock Corp., 411 Coral Circle, El Segundo, CA 90245
- Moroso Performance Products, Carter Dr., Guilford, CT 06437
- Mr. Gasket Co., 8700 Brookpark Rd., Cleveland, OH 44129



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NEW PAINTS FOR A HOT LOOK

IT USED to be that you could get a Model T Ford in any color you wanted, as long as it was black. Henry's flivvers were painted, often using a brush, with the cheapest cellulose-and-carbon-black paints he could buy. It made *his* life simpler, and also made life simpler when it came time to repair or repaint.

Lacquer-type paints came into their own in the hot-rod era of the '50s. The solvents in lacquers melt their way into the layers of paint underneath them, providing what is essentially a single layer of color right down to the primer. It was easy to keep sanding out the bugs and dust, applying additional coats of lacquer in the driveway, until your Kandy Apple flames looked righteous. Rodders who covered their flames with clear to protect the delicate gradations of yellow and orange discovered that the clear overcoat gave a deeper look and more shine.

Acrylic resins replaced cellulose in the '60s, providing better durability. It was still possible, especially with solid, nonmetallic colors, to achieve a creditable spot repair with a spray can of touchup paint. All you had to do was sand, prime, sand, paint, sand a little more, and polish out the sanding scratches with rubbing compound.

Those days are past. A few years back the auto manufacturers had to meet new clean-air requirements for painting cars. Making a layer of paint (and most had switched to acrylic enamels by then) containing pigment or metallic content flow evenly and dry shiny required a lot of volatile thinners in the paint can. And it's those thinners that were exactly what was forbidden.

But by using a coat of clear over the pigmented layer, a layer that wasn't required to be anything *except* shiny, the auto manufacturers discovered that the overall finish was shinier and deeper-looking than they could achieve with single-layer paint—particularly with metallics, since the orientation of the flakes of aluminum in the base coat was less random.

Here comes the bad news. Drive-way touchups are a thing of the past.

Aside from the fact that the newer aftermarket paint systems designed for these base coat/clear coat finishes often contain toxic chemicals in their formulation, it's much more difficult to apply them properly. Blending a new base coat over an old, original clear finish, and then blending the new clear over both of them is difficult for even a full-time professional in a proper spray booth.

It used to be you could sand out a minor imperfection in the middle of your repair, and continue on. Now the only alternative is to wait until tomorrow, sand the whole mess off the side

of the car, and (sigh) start over.

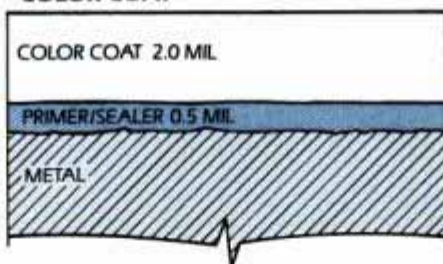
The good news is that your car will look better, longer. The clear overcoats in use are *hard*—they'll stand up to more scratches and sunlight. Just remember to take it easy when polishing with abrasive rubbing compounds or waxes containing "cleaners" (a polite word for abrasive). Once you've ground down to the base coat, which is easy to do on high spots like the sharp corner of the fenders, you'll have to repaint the whole panel.

Still want flames? Or maybe just a strobe stripe, over the top of the factory base/clear? No problem—just mask off the stripe and apply the paint as if you were repainting the entire panel. But you *must* use a paint that is compatible with the original. What's compatible? Well, you can't use a lacquer over anything except lacquer without the danger of blistering the original paint. That has always been true. *Some* base/clear systems can be used over either original or refinish lacquers or enamels. You may have to use a sealer between the old and new paints. *Always* use products from the same paint manufacturer.

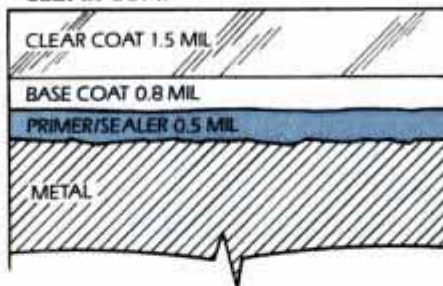
Your best resource is the counter-man at the automotive paint supplier. He'll be up to date on the paint systems on your vehicle, and which products will and won't work. The directions are right on the side of the can, right under the paragraph that says "For professional use only." You don't have to be a professional, but you *will* have to know a lot more than you needed to for lacquer.

Remember the pearlescent colors from the '50s? By applying a middle coat of paint containing ground mother-of-pearl or mica flakes between the base and clear coats, it's possible to achieve a startlingly subtle effect. Look at a new Cadillac Allante, or some Volvos, for an example of pearl's flip-flop effect, making the colors change as you walk past the car. **PM**

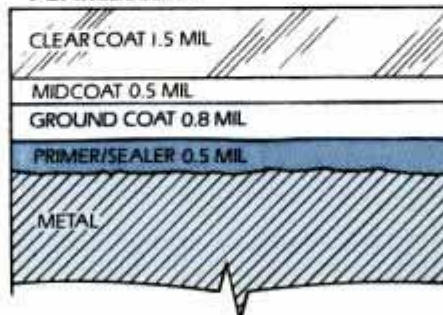
COLOR COAT



CLEAR COAT



PEARLESCENT



Average thicknesses are shown for different paint jobs. In pearlescent, the midcoat is filled with mica flakes or ground oyster shells for a more luminous effect.

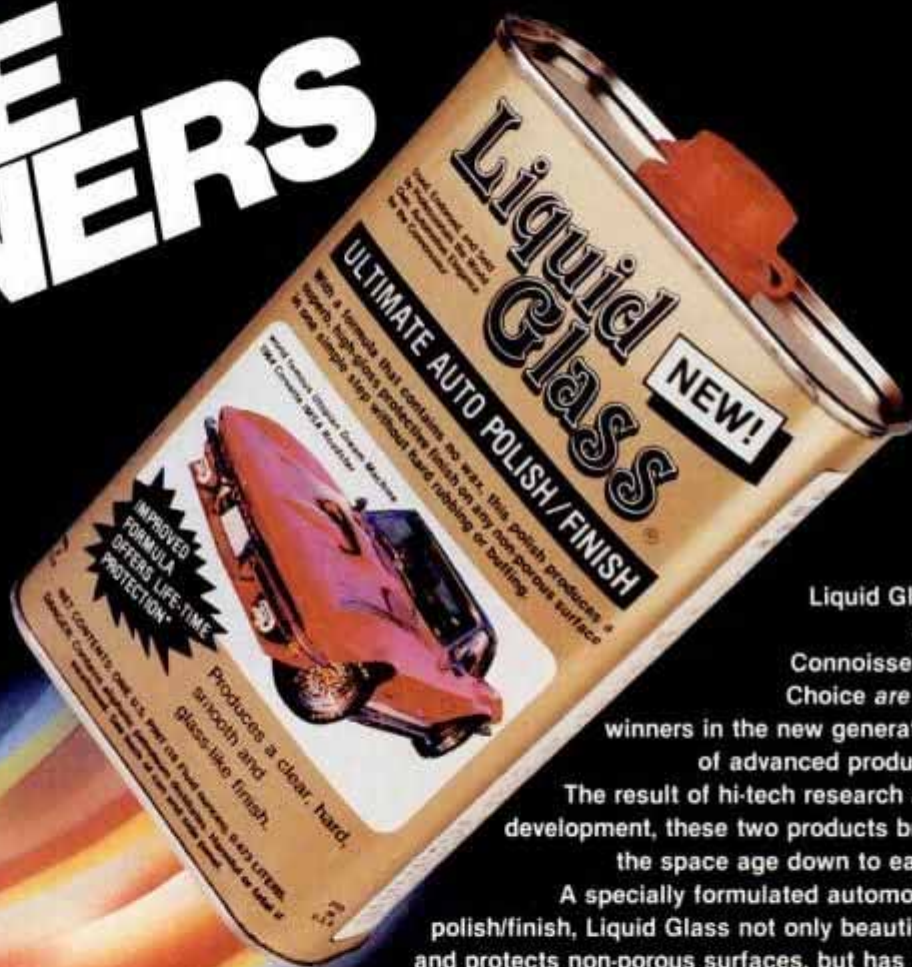
SOURCE LIST

- Automotive Refinish Products, Du Pont Co., Wilmington, DE 19898
- PPG Finishes, P.O. 3510, Troy, MI 48007
- Sherwin Williams, 101 Prospect Ave., N.W., Cleveland, OH 44115

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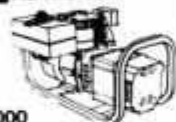


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PERFORMANCE Training Guide

SHAPING UP SOFT BODIES



Clean the repair area with a grease, tar and oil solvent. Wipe off any of the excess.



Mix equal parts of the flexible parts repair material on a nonporous surface.



Smooth pinholes or uneven areas with some flexible parts putty and a body squeegee.

SOFT plastic parts have helped make cars less susceptible to minor body damage. But repair procedures that worked on the old hard plastics don't work on the new thermoset plastics. But structural adhesives do. The most widely used product is called 3M Flexible Parts Repair Material (No. 05900). In addition, you'll need some aluminum 3M Autobody Repair Tape (No. 06935 or 06936).

Thoroughly clean the repair area with solvent. Then, with No. 180 sandpaper, remove paint from the area surrounding the damage. Clean at least a few inches of plastic on each side. Then use a No. 50 grit disc or No. 50 sandpaper and a half-round file to enlarge the damaged area. Taper an inch in each direction. Make sure the surface, front and rear, is free of dust and debris and apply autobody repair tape to the back side of the repair.

Apply a light coat of the repair material over the damage. Do not overlap paint. Continue to apply the material until the patched area is slightly above the surrounding plastic.

After the mixture has cured for about half an hour at 70° F, contour with a curved-tooth body file. Then sand using No. 220 sandpaper on a sanding block until approximately level with the surrounding area. Finally, feather the edges of the repair with No. 320 paper. If pinholes or minor imperfections remain, fill them with 3M Flexible Parts Repair Material. For touchup painting of the repaired area, make sure you use paint and primer that have elastomeric (flexible) properties.

If the repair is in an area where structural strength is important, such as along bolt holes, clamp the damaged sections, and clean and prepare the area as described above. Then apply adhesive to the back side of the damaged plastic and lay a piece of fiberglass cloth on top of the adhesive. Coat with adhesive. Then, after allowing 30 minutes to cure, repair the front as above.

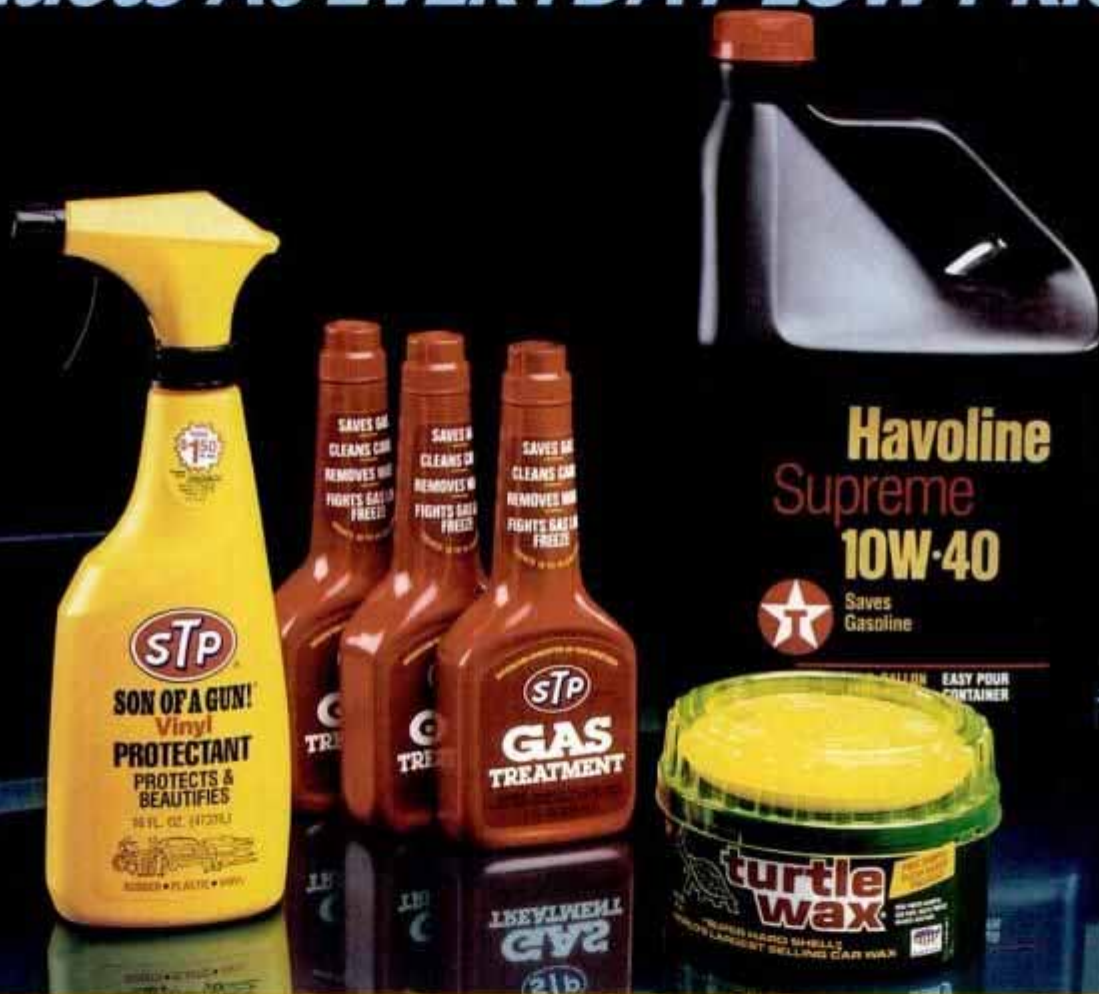
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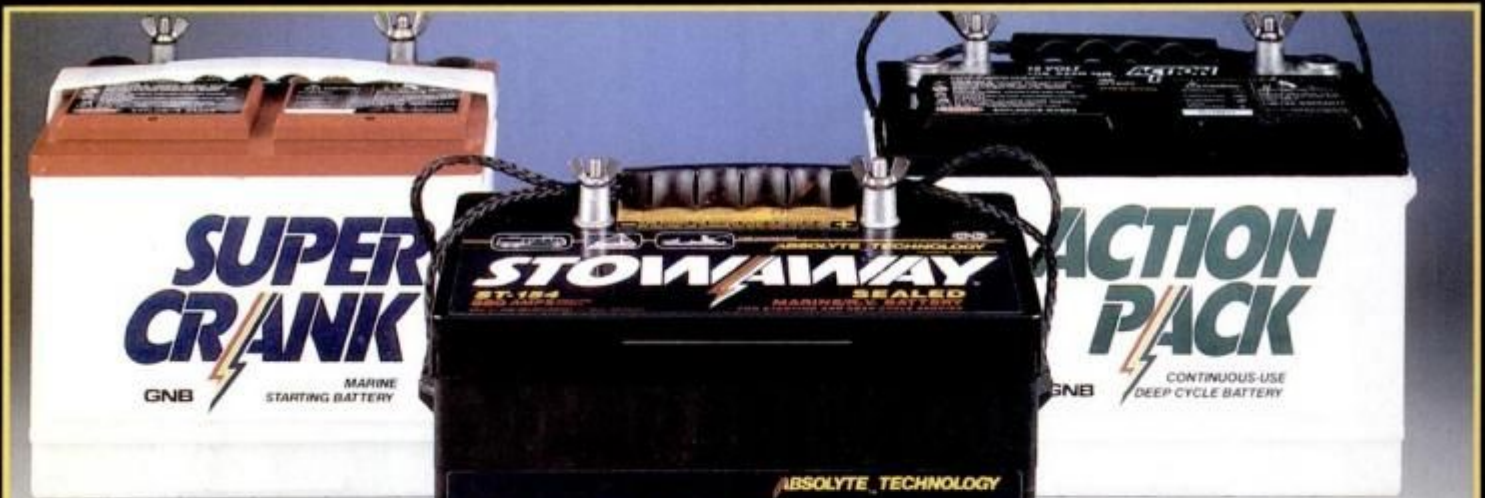


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A BOTTOMLESS SHINE

MOST CAR buffs are almost as concerned about appearance as they are about performance. And it goes almost without saying that perceptions of appearance start with the car's skin—a level of finish that's both lustrous and, all too often, elusive. Searching for that 6-ft.-deep shine, they studiously ponder the wide assortment of waxes and polishes available and expend considerable elbow grease trying to make them work.

To provide our readers with a real high-performance waxing technique, we huddled with one of the country's top detailers, John Herman, operator of a Baltimore-based chain of detailing shops known as The Wax Man. John has developed a 3-step wax operation for use in his establishments that restores the paint's smoothness and natural oils, protects with a polymer layer and then lays on a brilliant surface shine.

Four products are needed in order to carry out and complete the Wax Man process: bug and tar solvent, a fine-grit polishing compound intended for hand application, one of the widely available polymer sealants and a pure carnauba wax.

If your paint is metallic, substitute a liquid metallic-paint polish. The carnauba wax must be free of abrasives or it will remove the polymer sealant. Some products currently available that use the word carnauba as a brand name contain abrasives, so take care in your selection. Abrasives can be particularly damaging to the clear-coat finishes, removing the exterior coating that gives the paint its sheen. However, there are new products available, such as Armor All's low-abrasive Car Wax Paste, formulated to avoid this problem.

After removing any stains with the solvent, apply polishing compound to a 2-ft.-sq. area with an overlapping, circular motion. The instructions on most products of this type will tell you to use a damp cloth or rubbing pad. (Don't rub hard on sheetmetal edges as you could remove the paint.)

The next step is to buff off the polishing compound by rubbing lightly with a soft polishing cloth.

Once the car has been completely



Apply compound or wax with a circular motion. When dry, buff with a soft cloth.

polished, wash it with warm water and dry it with a chamois that has been soaked in clean water and wrung out. As you dry, wring the chamois out from time to time, to prevent the formation of streaks and water spots.

Next, apply the polymer following the directions on the can. This product, sometimes called resin glaze, is a liquid and is available in spray bottles and pour containers. The latter type is applied with a rag. The polymer dries to a haze and then is buffed up to a hard finish with a soft polishing cloth. The hard polymer surface will protect your car's paint job for six months to a year.

After the polymer has been buffed, apply the pure carnauba wax on top of it. Use a soft, damp cloth or applicator pad and work in sections of about 2 ft. sq. Allow the carnauba to dry to a haze, then polish with a soft, lint-free polishing cloth.

If you started the operation with paint that was in good condition, the resulting shine should appear to be about 6 ft. deep. **PM**

SOURCE LIST

- Armor All Products Corp., Irvine, CA 92713
- Blue Coral Inc., 5300 Harvard Ave., Cleveland, OH 44105
- Liquid Glass, P.O. Box 1170, Teaneck, NJ 07666
- Meguiar's Inc., One Newport Pl., Suite 375, Newport Beach, CA 92660
- Mothers Polish, 5436 Industrial Dr., Huntington Beach, CA 92649
- Priority One Premium Car Care Products, 1345 Bennet Dr., Longwood, FL 32750
- Starbrite, 3650 Hacienda Blvd., Bldg. F, Ft. Lauderdale, FL 33314
- Turtle Wax Inc., 5655 W. 73rd St., Chicago, IL 60638

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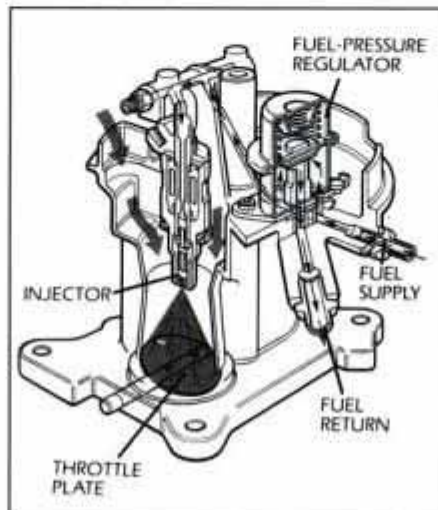
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INSTALLING THROTTLE BODY FUEL INJECTION

FUEL INJECTION. The words alone promise peak horsepower with lightning-quick throttle response. And it delivers that promise, not just in race cars, but in most of today's new models. And soon you'll be able to bolt the advantages of electronic fuel injection onto recent carburetor-equipped V8 engines.

Set for release in the fall (and in full production by next year), the replacement EFI unit has been developed by the makers of those legendary Holley 4-bbl. carburetors that top nearly every hot-rod engine built. The system is designed as Throttle Body Injection (TBI), so it will bolt directly to the existing intake manifold once the original equipment 4-bbl. carburetor has been removed. Of course the power gains will be even greater if an aftermarket high-performance intake manifold is installed at the same time.

The Holley TBI can offer a boost to your car's go-power on two fronts: air flow and electronic control accuracy. With a pair of 2-in. throttle bores, it will move 670 cu. ft. of air per minute (at 1½-in. manifold vacuum), placing it in the same category with the preferred 4-bbl. carbs and up to 25 percent better than the original-equipment carburetors. And because of the 3-range adjustability of its Electronic Control Module (ECM), it permits the fuel delivery to be matched accurately



Throttle-body injector replaces 4-bbl. carb. has better throttle response, more punch.

to the engine's requirements. Factory TBI systems can't be adjusted by the owner in this way.

Kits under development now (for 1981 and earlier Chevrolet 305 to 350-cu.-in. V8s, Ford 302 to 351 and Chrysler 318 to 400) include throttle linkage and fuel fittings for each application. The factory mechanical fuel pump is replaced by an electric pump, ensuring a continuous supply of pressurized fuel.

An adjustable regulator precisely controls fuel pressure. A return line to the fuel tank must be installed.

Control of injector operation relies on input from several sensors. The Throttle Position Sensor (TPS) is fitted to the throttle body and reports to the ECM.

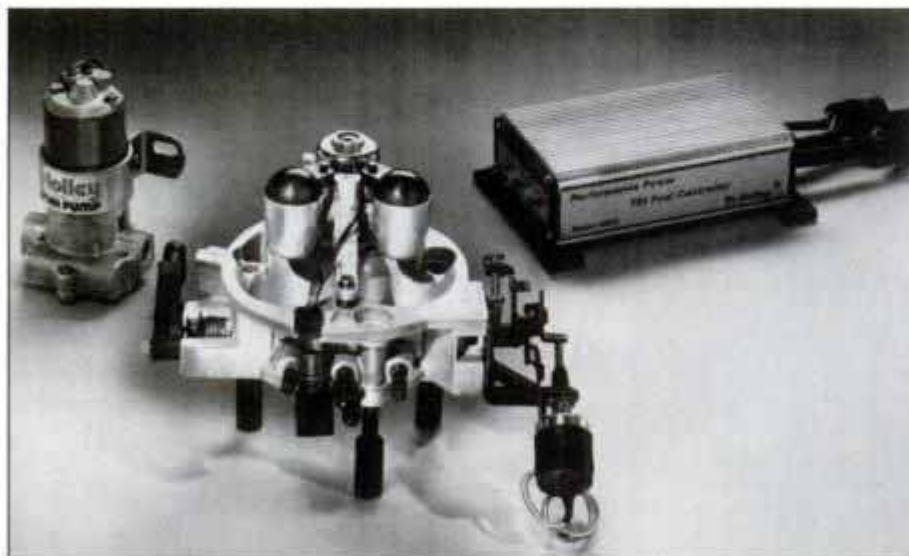
Engine temperature is read by a coolant temperature sensor mounted in an intake manifold water passage. Engine rpm, or tach signal, is picked up from the ignition coil. An adjustable fast-idle solenoid provides extra rpm for warmup periods.

All of the components are tied together by a foolproof wiring harness supplied with the kit. To isolate the sensitive electronics from underhood heat and vibration they recommend mounting the ECM inside the passenger compartment.

Once installed, the TBI system can be tailored for peak performance. Three ranges of adjustability—idle mixture, part throttle and wide open throttle—are set using screw-and-locknut settings. This can be done using seat-of-the-pants tuning, but the ideal method will be to set the idle mixture with an exhaust gas analyzer. The partial and full throttle mixture can then be adjusted on a rear wheel dynamometer.

Holley comes to the project with considerable TBI experience acquired over the past two years with its replacement EFI system for General Motors 1.8-, 2.0- and 2.5-liter Fours. This single-bore unit is a straightforward parts swap, mating to the factory-supplied electronic sensors and controls. Besides offering an increase in CFM capacity, this 4-cylinder TBI is also California Air Resources Board certified.

For V8 engines that have performance modifications, the Holley TBI allows custom tuning not possible with original-equipment fuel systems. Future possibilities include a twin TBI application, the equivalent of dual 4-bbl. installations in years past. Holley's goal is to market V8 kits with a single 2-bore TBI unit and all the required support equipment for under \$500. **PM**



Electric fuel pump replaces stock mechanical pump, and the control unit installs under dash.

SOURCE LIST

■ Holley Replacement Parts Division, 11955 E. Nine Mile Rd., Warren, MI 48090

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CYLINDER HEAD SHAPEUP

A GOOD valve job is hard to find. And if the valves don't seat, your engine will idle rough, waste fuel and lack power.

The problem is that it's difficult to correctly grind a seat using the portable equipment that most machine shops use. The solution? We've found that those shops most likely to grind seats and valves correctly are the ones specializing in high-performance work with a good reputation among the local racers.

A valve seat that doesn't shroud the valve can help wake up the engine by allowing the cylinders to fill more completely. What we're talking about here is the hot-rodder's 3-angle valve job, a procedure that will add little to the cost of a proper valve grind, and could easily add 20 "free" horsepower to a small-block engine. If you're handy with a wrench you should also ask your machine shop to deliver your heads unassembled. Then you can check the seats and assemble the heads yourself. Have your machinist check the valve springs for you and provide an installed height dimension and some shims.

You'll need a lapping stick and a jar of valve lapping compound, which can be purchased at auto parts stores. You'll also need a valve spring compressor, which can be rented.

To check a valve seat, smear a little valve grinding compound on the valve face. Insert the valve in its guide and position the lapping stick on the valve. Place one hand on each side of the stick, palms in and fingers extended. Move your hands back and forth so the stick spins between them. Half a dozen times back and forth should be plenty, unless there's something out of round. Remove the valve and wipe its face. If the valve face was ground properly, the seat area should be seen as a gray circle that is uniform all the way around the face. It should be positioned within approximately 0.010 in. of the outer circumference.

Now, wipe the grinding compound off of the valve seat in the head. You should find a gray seat area of the same width as that on the valve face.



Valve lapping requires polished technique.

Make sure the gray area extends all the way around the valve pocket and is uniform. This is where you're most likely to discover a problem.

If the seat area is not uniform—as indicated by varying shades of gray—repeat the lapping procedure as necessary until you have a good seat. If the seat doesn't even come close to completing a circle around the pocket, no amount of lapping is going



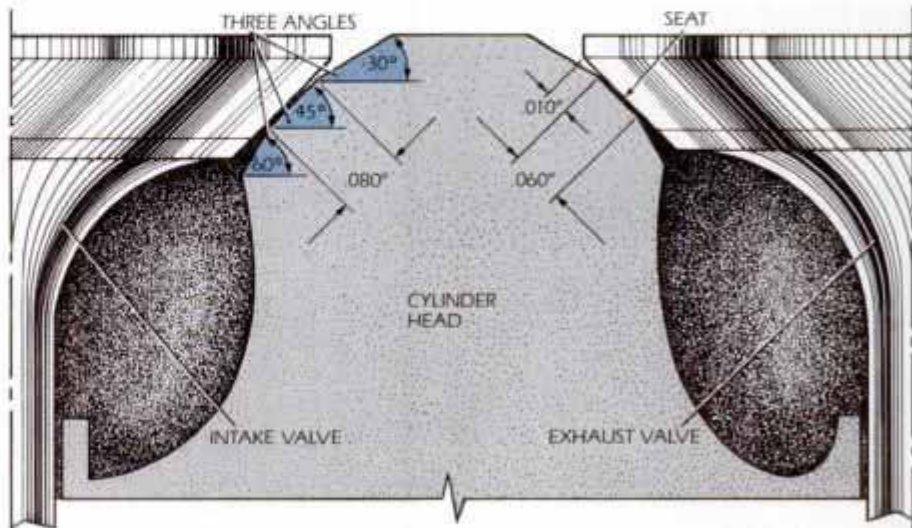
Check valve spring installed height.

to bring it in: The machine shop will have to regrind the seat.

Once all valves have been seated, scrub the head thoroughly with hot, soapy water to remove any remnants of the machine shop's grinding abrasives, as well as your valve lapping compound. Use a small bore cleaning brush to clean the guides. Dry immediately and coat with a light film of oil to prevent surface rust. Place each lubricated valve in its guide.

Double check the installed height dimension against a specifications chart. You'll find a chart in the engine chapter of most service manuals.

Assemble the head using new valve seals. You'll find instructions and pictures in your service manual. When you're finished, inspect each spring assembly carefully to make sure keepers and retainers are fully seated. **PM**



Three-angle valve seats can contribute significantly to improved engine performance.

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DEEP BREATHING INTAKE SYSTEMS

ON ALL 4-STROKE engines—particularly on carbureted 4-stroke engines—intake manifold design can contribute greatly to power output and efficiency. Yet original-equipment intake manifolds are a compromise.

Rather than optimizing all the variables that can affect engine tune, manufacturers must balance cost and production concerns with other design criteria. As a direct consequence, most standard-equipment manifolds severely restrict the performance potential of a given engine.

Aftermarket suppliers are not ruled by the same constraints as the original-equipment boys. They're free to pursue performance optimization within the limits of what will fit on the engine and under the hood (and, in recent years, within the limits of state engine emissions inspections).

Intake manifold modifications improve performance because the way fuel and air are delivered to the cylinders has a great effect on how well the engine runs. If distribution is equal-

ized, fuel droplets are kept in suspension, cylinders are filled to optimum and engine performance is improved substantially. And, because the engine runs more efficiently at any given speed, fuel economy can actually be improved by swapping your old Detroit manifold for an aftermarket street-performance model. Of course, if you decide to utilize your engine's new-found power all the time, the tank will empty rather quickly.

The other side of the coin, of course, is that an aluminum intake manifold can lop off 40 or 50 pounds of your car's overall weight.

Although aftermarket engineers use a wide range of tricks to improve manifold performance, the most spectacular results are achieved by tuning the inlet runners.

Tuning an intake manifold simply means adjusting port cross-section area and length to a size that fills cylinders most efficiently at a given engine speed, thereby causing torque output to peak at that rpm.

Tuned manifolds are available in

both single-plane and dual-plane/split-plenum designs. Because the dual-plane/split plenum manifolds divide the manifold runners into two groups by splitting the area under the carburetor (called the plenum chamber), they transmit a stronger vacuum signal to the carb at light throttle. This is important in terms of maintaining good low-speed driveability. Thus, this type of manifold is usually better for street-driven cars.

One of the current leaders among street intake manifolds is Edelbrock's Performer model, which is available for a range of carbureted engines. Rather than tuning to a single engine speed, the patented Performer design uses two different port sizes.

Those for inboard cylinders are tuned for a lower engine speed than those for outboard cylinders. Thus, cylinder filling is optimized over a broad range rather than for a narrow band. The happy result is a very flat torque curve.

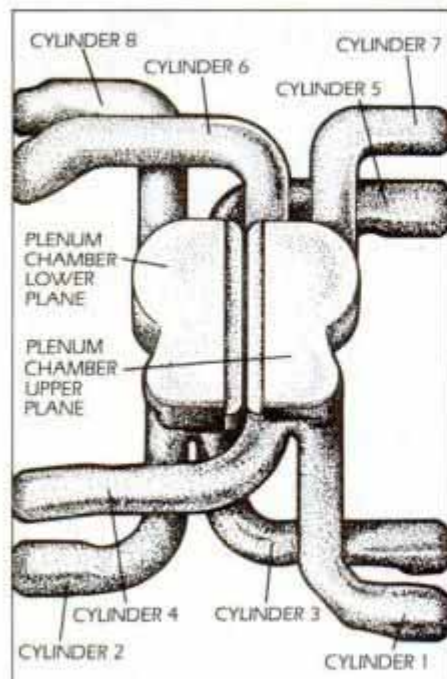
An Edelbrock spokesman claims gains of at least 18 lbs.-ft. for the average application and gains of 25 to 30 at the maximum. That's horsepower you can really feel.

(These figures are for replacement of the manifold alone with all emissions equipment reinstalled and the stock carburetor used.)

Because the Performer manifold includes all the vacuum hookups of the stock unit and EGR accommodation, installation is relatively easy. Some care is required, however, as a botched intake gasket can ruin performance and, in some cases, damage your engine. Instructions provided with the manifold should be supplemented with the manifold installation and removal procedure found in your car's service manual. **PM**

SOURCE LIST

- Edelbrock, 2700 California St., P.O. Box 2936, Torrance, CA 90509-2936
- Holly Carburetor Div., 11955 Nine Mile Rd., Warren, MI 48090
- Offenhauser Sales Corp., 5232 Alhambra Ave., P.O. Box 32218, Los Angeles, CA 90032
- Weiland Automotive Industries, 2316 San Fernando Rd., Los Angeles, CA 90065



Intake-runner arrangement of a typical tuned intake manifold for a V8 engine with split-plenum/dual-plane design.



Cutaway of a high-performance manifold: The passage under the plenum is for exhaust heat, which is needed to maintain driveability in cold-weather conditions.



Edelbrock Performer is an aftermarket manifold for small-block Chevy V8s. Note provision for EGR and manifold vacuum port.



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CHOOSING HIGH-PERFORMANCE OILS

LUBRICATING oil keeps your engine alive. And if your engine is a high-output design that revs freely, lubrication is critical. But good lubrication isn't the only thing you're looking for in a motor oil. Oil also helps to cool moving parts, seal piston rings, control foam, resist corrosion, inhibit foaming and more.

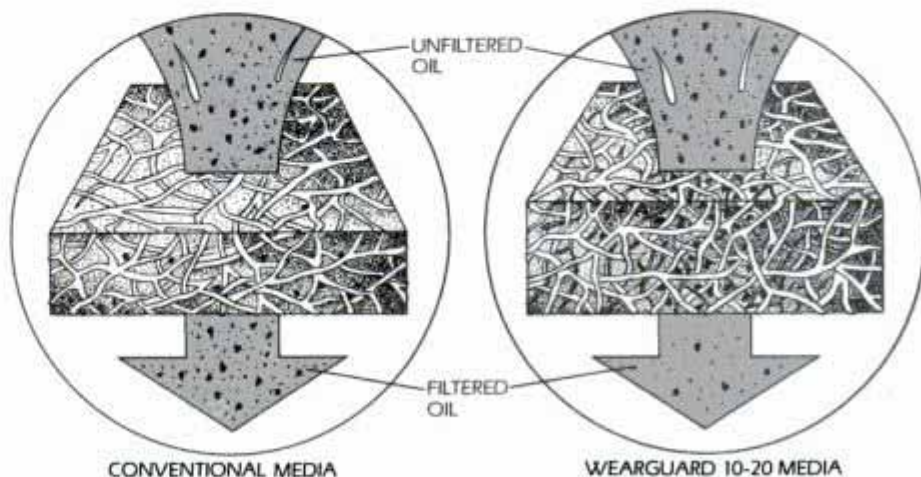
Just changing your oil and filter at the manufacturer's recommended intervals may not be enough. Our advice is to disregard suggested oil change intervals and change your oil and filter every 2000 to 3000 miles.

But don't use just any oil off the shelf of the local discount store. The oil you pour should be of the correct viscosity for your driving conditions, and it should be a premium product.

You'll find an oil's viscosity rating on the top of the can. A multigrade, like 10W-30, is usually best for most cars. High-mileage engines might benefit from a 20W-50 viscosity oil, but high-performance engines probably will not. According to Valvoline expert Norm Hudecki, there's a horsepower penalty when heavy oils are used in high-rpm engines. Heavy oils offer more resistance to moving parts and can "drag" an engine down. Even at 6000 rpm, a speed exceeded by many passenger car engines, the horsepower penalty of a 20W-50 oil versus a 10W-30 is close to 2 percent, a significant amount.

When it comes to finding a quality product, look for the API service rating on the top of the can and stick with major suppliers. As we go to press, the premium rating for gasoline engines is SF. If you purchase brand name oil with this designation, you can be sure you're getting the additives the American Petroleum Institute recommends for gasoline engines. By the time you read this, the new upgraded SG oils should be available. These will have more resistance to sludge buildup than the SF oils.

Most of the major brands also offer high-performance SF or SG oils that contain additional additives designed



Fram's Wearguard 10-20 filtering media traps more contaminant particles from oil flow.

to deal with the stress of high temperature, high-speed driving and/or the severe speed and temperatures that turbocharger shaft bearings have to contend with. Those marked "Energy Conserving" reduce friction, increasing horsepower—and improving mpg—slightly compared to similar oils without the additive.

Oil intended for racing applications is better yet, providing it is of the

can maximize desirable characteristics. Tests demonstrate that synthetic oil flows extremely well in cold temperature and resists the high temperatures generated in turbocharger shaft bearings and in high-performance aluminum engines (aluminum engines transfer more heat to the oil than cast iron types).

Most makers of synthetics claim oil-change intervals can be extended. We still recommend that you not exceed 4000 miles or the manufacturer's suggested interval, whichever is less.

Mobil 1 is the most widely available synthetic and is available as 5W-30 or 15W-30. Three Indy entries used Mobil 1 15W-30 last year.

Red Line Oil, another synthetic, is very popular with racers (10 of 22 winners at last year's Sports Car Club of America National Championships at Road Atlanta used Red Line). This company manufactures a product called Race Oil intended for racing use only that does not include low-temperature antisludging additives. Red Line's Motor Oil is intended for everyday passenger car use. Laguna Seca Raceway's Assistant GM, Art Glatke, tells us he's been running Red Line Motor Oil in his van for 161,000 miles.

Just as all motor oils are not the same, oil filters are not of equal quality. Some offer advantages over others in terms of filtering efficiency and contaminant capacity. In general, the premium offerings of the nationally



On every oil container you will find the API service rating and SAE viscosity rating.

manufacturer's recommended viscosity and is API-rated. (You have to be sure you're getting the additives you need for daily beating about town.)

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PERFORMANCE Turning Guards HIGH-PERFORMANCE OILS

advertised brands are best. In laboratory testing by a consumer magazine, the top performer was the new Fram Wearguard filter, made by Allied Automotive Aftermarket Division.

The number two spot went to Lee. However, the new Lee Maxi Filter was not available at the time this test was conducted. Based on the performance of the previous Lee filter, we expect it to be a top-notch product.

In addition to their great Wearguard filter, Fram markets a racing filter that allows high-capacity, high-pressure flow. This filter is just the ticket for racing engines with somewhat large clearances and high-pressure lube systems. They are not well suited to passenger car use as maximum flow takes priority over contaminant filtration.

In other words, they're designed for people who drive at 200 mph and change their oil every day.

Be sure you're buying the correct filter for your car. Size compatibility and good sealing aren't the only criteria. Some filters have an internal valve that opens to bypass oil when the pressure differential gets too high—when the oil is too cold, for example, or the filter element is plugged. Other engines rely on a bypass filter built into the block to achieve the same purpose. Mixing and matching could cause trouble. **PM**

SOURCE LIST

Oils

- Amoco (Ultimate Synthetic), 200 E. Randolph Dr., Chicago, IL 60601
- Amsoil, Inc. (Synthetic), Amsoil Building, Superior, WI 54880
- Burmah-Castrol Inc., 401 Hackensack Ave., Hackensack, NJ 07601
- Chevron (Sub-Zero Fluid Synthetic), 575 Market St., San Francisco, CA 94105
- Conoco, Inc. (Conoco DNC-600 Synthetic), P.O. Box 2197, Houston, TX 77252
- Gulf Oil (Gulf Super Duty II Synthetic), 575 Market St., San Francisco, CA 94105
- Mobil (Mobil 1 Synthetic), 150 E. 42nd St., New York, NY 10017
- Motorcraft, 3000 Schaefer Rd., Dearborn, MI 48121
- Neo Oil Co. (Synthetic), 2865 Gundry Ave., Long Beach, CA 90806
- Pennzoil, 700 Milam St., Pennzoil Pl., Houston, TX 77001
- Quaker State Oil Refining Corp., P.O. Box 989, Oil City, PA 16301
- Red Line Oil (Synthetic), 3450 Pacheco Blvd., Martinez, CA 94553
- Valvoline Oil Co., Lexington Administration Bldg., Lexington, KY 40507

Filters

- Allied Automotive (Fram), 105 Pawtucket Ave., East Providence, RI 02916
- Lee Filters, 29425 Chagrin Blvd., Pepper Pike, OH 44122
- Motorcraft, 3000 Schaefer Rd., Dearborn, MI 48121
- Purolator Products Inc., 970 New Brunswick Ave., Rahway, NJ 07065

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SUPERCHARGING FOR MORE POWER

THE ULTIMATE power-boosting accessory may well be the Roots-type supercharger. It's this type supercharger, coupled with nitromethane fuel, that enables top-fuel dragsters to top 280 mph in about 5 seconds from a standing start.

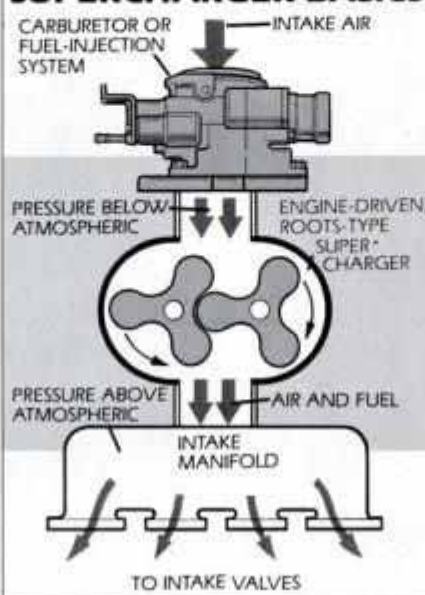
While Detroit has been standing almost still on street supercharger development, a number of automotive aftermarket companies have been producing them for some time. Dyer Machine Service of Summit, Illinois, is usually credited with introducing the supercharger to the street performance market some 13 years ago.

The problem to overcome in adapting a Roots blower to a street-driven automobile has always been packaging. However, the current compact setups marketed by Dyer and several others will fit under the hood of many vehicles without modification, allowing retention of stock accessory drives and cooling system hardware. These kits come with virtually everything needed for the conversion.

(If you want something a little more ostentatious than a small blower that fits under the hood, some of these companies will sell you a big blower that sticks up *through* the hood.)

K.F. Industries, Inc. offers a supercharger kit for Chevy 2.8-liter V6

SUPERCHARGER BASICS



Spinning rotors push air into manifold at pressure higher than atmospheric.

engines in S-10 pickup trucks and Blazers that, unlike other kits, retains the original emissions-control equipment—including the black box—and has been certified by EPA and CARB for street use. By the end of the summer, K.F. will have a kit for the Fiero version of this same engine.

Initial tests show 6-second 0-to-60 clockings.

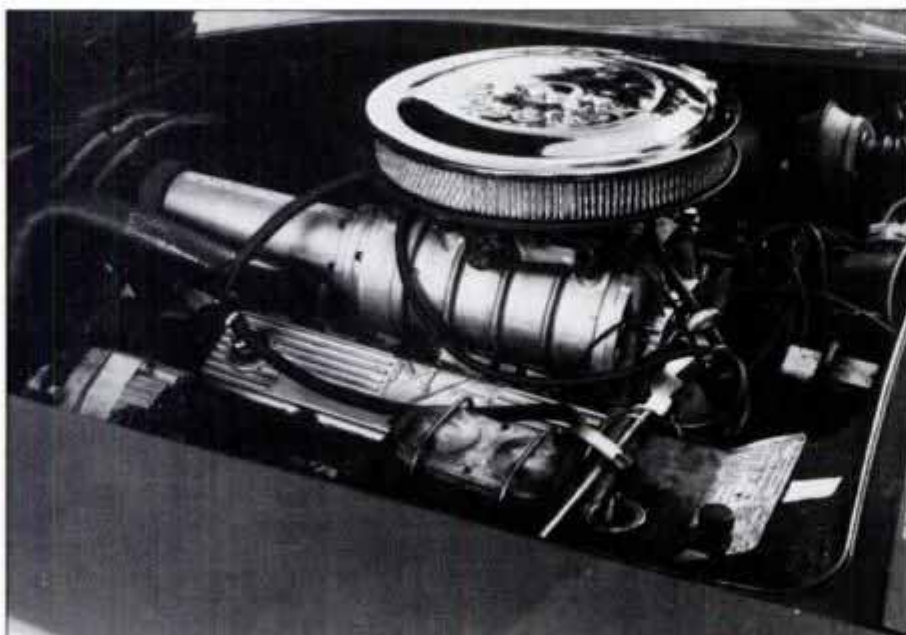
The purpose of a supercharger is forced induction: packing air and fuel into the cylinders in greater quantities. Because the air/fuel mix is delivered at a higher density and in a very turbulent state, it will burn more efficiently. Thus horsepower gains are realized both in terms of better cylinder filling and improved combustion.

In terms of what you feel, a Roots-type supercharger differs from a turbo in that there is virtually no boost lag at low speed because the blower is driven directly off the crankshaft. Nail the throttle and go!

Because a supercharger delivers more air than the engine uses per revolution, the intake becomes pressurized. "Backflow compression" is what the engineers call it. The ratio of air pumped in by the supercharger versus air used by the engine remains approximately constant throughout the rpm range. Therefore, engine torque is maximized over a broad range and performance is spectacular.

Of course, like anything that increases cylinder pressure and output, a supercharger increases stress on engine components. The ideal conversion includes a complete high-performance engine rebuild, but the cost is prohibitive for most. You should also know that a supercharger can be damaged by a serious backfire. Aftermarket kits include pop-off valves designed to vent backfire pressure to the atmosphere, but in extreme cases that may not be enough to prevent damage.

You should also realize that, in states where emission inspections include an original-equipment underhood check, the inspector will gleefully ground you. The exception to this, of course, is the K.F. installations, which come with verification of emissions certification. **PM**



B&M supercharger on '71 Corvette: Note stock alternator mount and radiator hose.

SOURCE LIST

- B&M Automotive, 9152 Independence Ave., Chatsworth, CA 90241
- Blower Drive Service, 12140 Washington, Whittier, CA 90606
- Dyer Machine Service, 7665 W. 63rd St., Summit, IL
- K.F. Industries Inc., P.O. Box 842, Jamul, CA 92035

COMPUTER TUNEUP

IT USED to be that cars had mechanically operated systems like carburetors, distributors with mechanical advance mechanisms and automatic transmissions with hydraulic/vacuum control. It was easy to make improvements—there was no end to the ways that cars could be “optimized.”

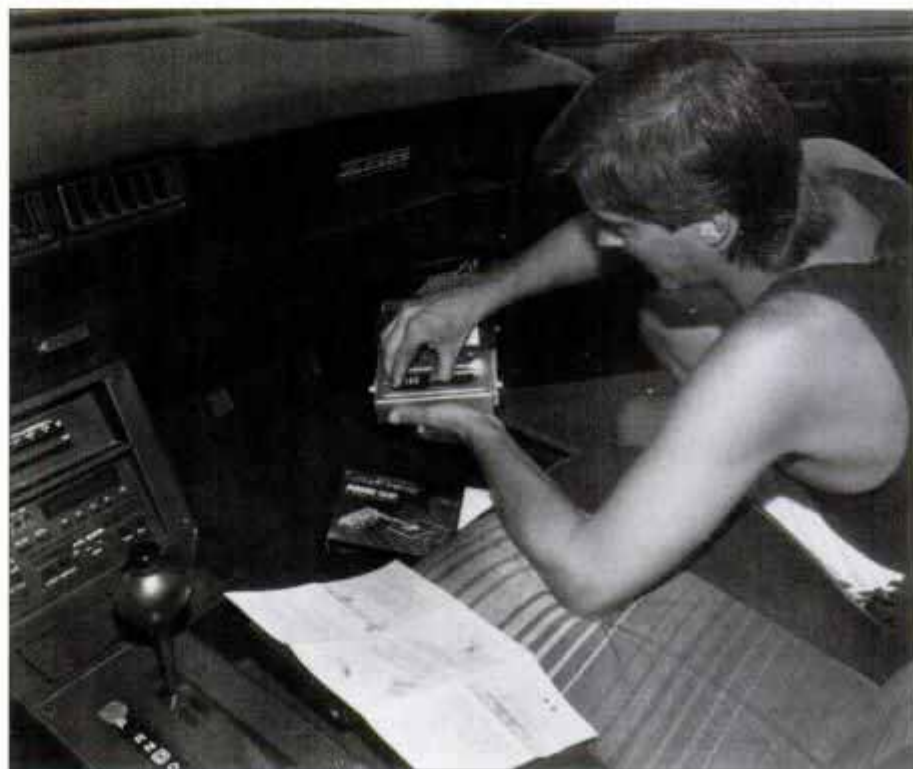
Times have changed. You can't look at the computer chip in a fuel-injected car and see how it works. Electronics is something you have to take on faith—you can't just wiggle something to see what else it moves. But there is a chip you can replace to get more performance from your engine. It's called a PROM, an acronym for Programmable Read Only Memory. Several kinds of information are stored in the PROM, and all can be changed.

Transmission shifting points, for example, can be moved to higher rpm under full throttle for increased acceleration. Shifting them higher under part throttle would increase driveability on some vehicles, especially smaller-engined cars with a full load or towing a trailer.

The spark-advance curve, particularly on cars without a knock sensor, is set with the ignition retarded far enough to keep from blasting holes in the piston crowns on lower octane gasoline. In some vehicles, if you're willing to burn expensive premium 92+ octane gasoline, there's a lot of room for improvement.

The all-important “knock map” programs the computer to keep fuel delivery and spark advance at just the correct values, constantly checking airflow, temperatures and exhaust gas oxygen levels. The intent is to keep the air/fuel ratio as close to perfect as possible, and the spark advance at the edge of knock for best power. Carburetors and distributors can only approximate these ideals. The knock map takes into account many more factors, and keeps the engine much closer to the edge.

How can an aftermarket PROM, with a different knock map, improve on what the car manufacturers have spent so much development time and money on? Well, willingness to burn better gas helps, and remember that richer mixtures burn slower and are less prone to detonation. Trading off lean mixtures for more spark advance can yield more power at the expense



Electronic Control Module is usually under dash or behind kick panel. PROM is easily replaced: High-performance chip plugs in.

of fuel mileage. Add in higher shift points, and suddenly the old adage about speed being expensive comes around again: You might very well burn more gas. This is likely if you spend much driving time on the part of the knock map that trades fuel for spark knock.

A replacement PROM is about \$100. That's pretty cheap compared to a new camshaft or carburetor. Also, you might need to replace the thermostat, because the new knock map is biased toward cooler combustion chamber temperatures.

The speed advantages range from a few car lengths to over a half-second in the quarter, according to Hyper-tech, manufacturer of the PROM shown being installed above.

Most replacement PROMS avail-

able now are for GM cars. Ford applications should be available soon.

Replacing the PROM itself is about as tough as replacing a fuse. Find your Electronic Control Module (ECM). The instructions with the chip will tell you where it is, but it's probably under the seat, in the kick panel or under the dashboard.

Pull the ECM out to give yourself enough room to work on it. It's not necessary to remove the umbilical cable attaching the ECM to the engine's wiring harness. Open the access panel on the ECM, and you'll see the original PROM in its socket.

Don't remove the new PROM from its packaging until you're ready to install it, as a stray spark of static electricity can erase the information stored on it. With your finger, touch a grounded part of the car to dissipate any static electricity, and lift out the old PROM. Pry gently if necessary, but lift straight out and don't bend any of the pins. Repeat the grounding procedure, and push the new PROM into the socket. **PM**

SOURCE LIST

- Automotive Digital Systems, Highway 155 So., Tyler, TX 75703
- Hypertech, 2104 Hillshire Circle, Memphis, TN 38134

MORE SPARK FOR ANY ENGINE

IGNITION upgrades are available in many shapes and forms, from capacitive-discharge controls to complete replacement distributors. Although care must be taken to avoid problems of compatibility with the computer controls of the very recent models, performance gains can be made with almost any car. And Accel Performance Products does offer a drop-in replacement coil for General Motors High Energy Ignitions (HEI) that installs quickly and won't cause the computer to revolt.

The Accel HEI Super Coil delivers higher voltage to improve starting and throttle response, yet requires no modifications for installation—even the color code of the wires is identical to stock equipment.

High-powered ignitions and high-output sound systems often won't co-exist peacefully in the same automobile without extraordinary measures. The Radio Frequency Interference (RFI) radiating from sparkplug wires can make the stereo all but useless—unless those wires are designed specifically to suppress the static.

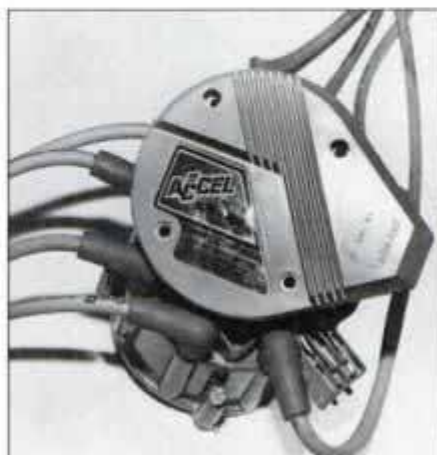
For many years, the most effective and widely used method for combat-

ing this problem has been the fitting of carbon-core static suppression sparkplug cables. The shortcoming of this type of wire is its fragile nature. Rough handling while performing a tuneup will cause internal breakage and gaps in the conductor. High underhood temperatures, particularly in the crowded engine bays of new cars, break down both the conductor and its insulator jacket.

Today's high-quality silicone insulation can tolerate far higher temperatures, up to 500° F. It's also far more resistant to damage from fuel, oil and grease, and its bright jacket adds an attractive touch of color.

However, though it's clearly superior to original-equipment wire jackets of years past, it isn't impervious to damage. If allowed to rest against an exhaust manifold, it *will* burn through. Furthermore, the silicone jacket is much more vulnerable to mechanical damage from mishandling.

For maximum RFI suppression, a graphite conductor wire is still the top of the line. Structurally, the newest aftermarket cables are vastly improved over the old carbon-core wires. The conductor itself is con-

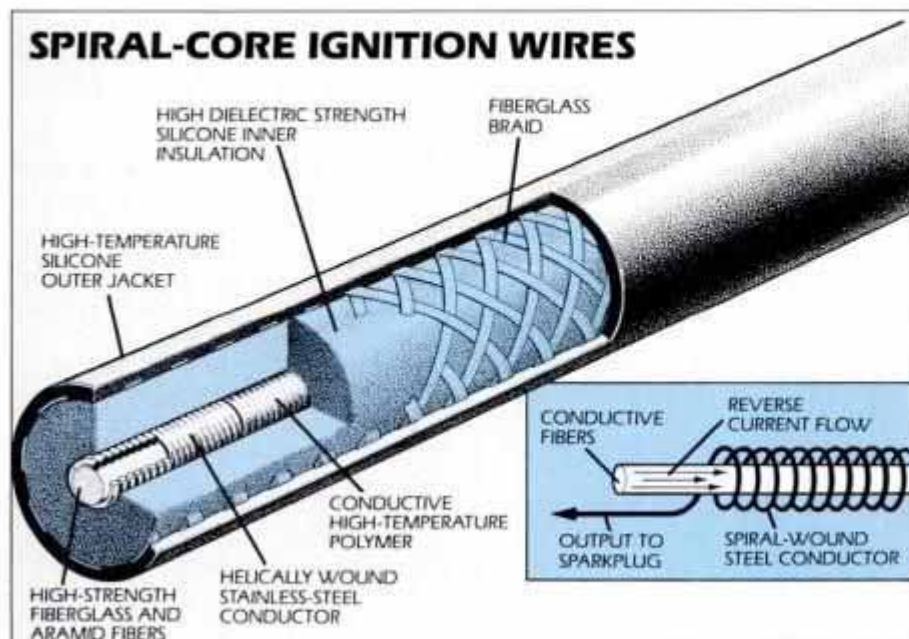


Accel coil generates high-voltage spark.

structed of graphite-impregnated fiberglass strands that allow it to survive rough handling.

The ultimate sparkplug wire design for high-performance road use utilizes a spiral-core construction. The conductor is metallic, so it carries full voltage to the sparkplugs with a minimum resistance loss. Static is controlled by constructing the cable with the metal conductor wrapped in a spiral winding around a core of fiberglass and aramid fibers.

Here's how it works: Current flowing through the spiral-wound conductor creates a magnetic field around the wire and induces a reverse current flow in conductive fibers located in the wire's core. The reverse current flow acts as a filter, suppressing the higher frequency portions of RFI radiation without the losses that occur in carbon-core sparkplug cables. RFI suppression isn't as effective as in carbon-core plug cables, but it will be far lower than racing-type solid metal core wire. Computer-controlled engine management devices and radios are unaffected by the spiral-core wires. **PM**



Reverse current flow induced in fibers by spiral conductor (inset) cancels RFI from spark.

SOURCE LIST

- Accel Performance Products, Route 139, Branford, CT 06405
- Moroso Performance Products, Inc., 80 Carter Dr., Guilford, CT 06437
- Autotronics Controls Corp., 1480 Henry Brennan Dr., El Paso, TX 79936

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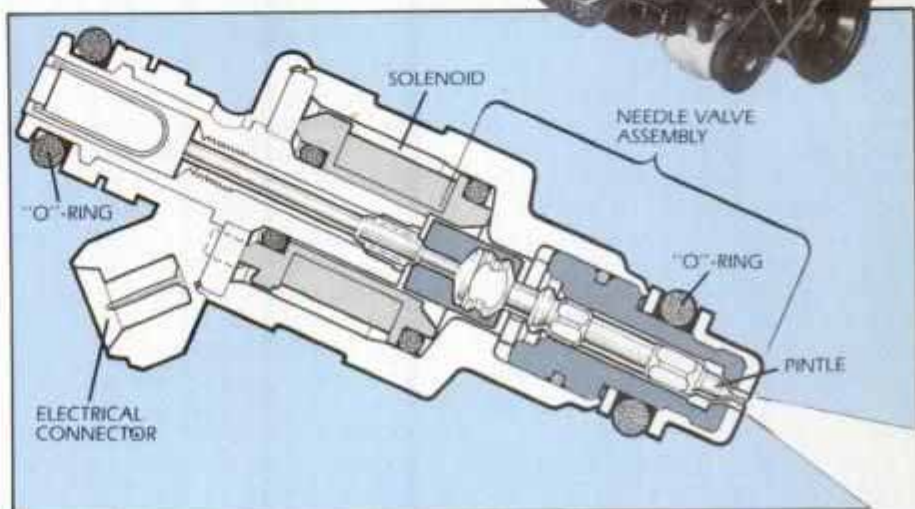
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PERFORMANCE Tuning Guide

FUEL INJECTION BASICS

This late-model Camaro engine is fitted with what may well be the industry's most advanced fuel-injection system. If gasoline without enough detergent is used, varnish will accumulate around the pintle, interfering with the injector's spray pattern and fuel-delivery capacity.



FUEL-INJECTION systems are almost maintenance free. But years of neglect could leave you in the lurch. On the other hand, a little bit of preventive maintenance can help keep you on the road.

Before we talk under-the-hood preventive care, we should mention in-the-tank precautions. The detergent additives in the gas you use can have a lot to do with how well your injection system works. Those commercials that say you can "fix" your fuel-injection system as you drive are actually telling it like it is. If you haven't been using gasoline with injector cleaner solvents and your engine runs rough at idle, add a can of fuel-injection cleaner for a tankful or two.

To start preventive care, clean the throttle plate linkage with carb cleaner and lubricate it with engine oil or light machine oil. Check to see that no parts are damaged or missing and that there is no possibility of binding. On throttle-body fuel-injection systems (those with the injectors in a unit that looks like a carburetor rather than in each intake port), check the mounting-bolt torque. On all systems check the gas cap gasket to make sure there is an even imprint all around, indicating a good seal.

Next, disconnect the negative terminal on your battery. Then, for cars with electronic fuel injection (most of those sold today), unplug each injector and make sure the terminals are free of corrosion. If not, scrape and spray with electrical contact cleaner. Severe corrosion of a connector is grounds for replacement. Check all sensor connectors and the control module connector. Never unplug or even wiggle a connector when the car's battery is connected.

If you do have to replace a connector, buy the original-equipment part from your dealer. If you have to replace a multiple-wire connector, replace the whole wiring loom that it's connected to. For single-wire connectors, you'll find replacement instructions in the service manual.

Replace the fuel filter according to the manufacturer's maintenance schedule. Because you never know how clean your gasoline is, it's best to follow the "severe usage" recommendations for fuel filter replacement. In-tank filters are replaced only if they fail. When replacing a filter on a fuel-injection system, relieve fuel pressure before you begin, as gasoline under high pressure stays in the lines for days after the engine is shut off. **PM**

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

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

Years of Testing and Use Have Proved it True!

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

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

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

TUV, a German testing laboratory with credentials every bit as prestigious as our Underwriters Laboratories, tested Slick 50 in 1986. They found substantial increases in both gas mileage and horsepower. Their tests showed that these gains were due to a reduction in friction.

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

The power technology laboratory at a leading southwestern university stated, "Slick 50 does increase horsepower and decrease fuel consumption in tests done at the university."

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

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



It's Easy to Treat Your Engine

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

Only One Treatment Necessary

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

Works with Most Oils

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

4 Ways Slick 50 Saves You Money

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

1. Increase mileage
2. Increase horsepower (small economy cars and large RV's really need this)
3. Reduce operating temperatures, thus increasing the lubrication and life of the oil and engine.
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POWERSHIFTING YOUR AUTOMATIC

SLUSH BUCKETS. That's how some folks describe automatic transmissions that make a leisurely slide from one gear to the next. But, because the commute is a long one and the old left leg can get awfully tired pumping a clutch, they drive 'em anyway.

Drive them we must, but suffer with sloppy shifting? It's unnecessary, because most automatic transmissions can be reprogrammed to shift with considerably more authority and at a higher speed. The treatment that produces this cure is called a shift kit. And in addition to sharpening those shifts, it'll give you true manual control of the transmission. That means if you start out in Low or First, the trans will start in Low and won't shift until you move the lever to Second. Furthermore, with a shift kit installed you can downshift to any gear at any speed and get immediate results. You'll still get fully automatic shifting in Drive, of course.

In most cases the kit also reduces transmission operating temperature and lessens wear. This fringe benefit comes from the added hydraulic line



Control-valve springs provided with kit are installed in the valve body.



Separator plate, dotted with holes to control hydraulic metering, is replaced.

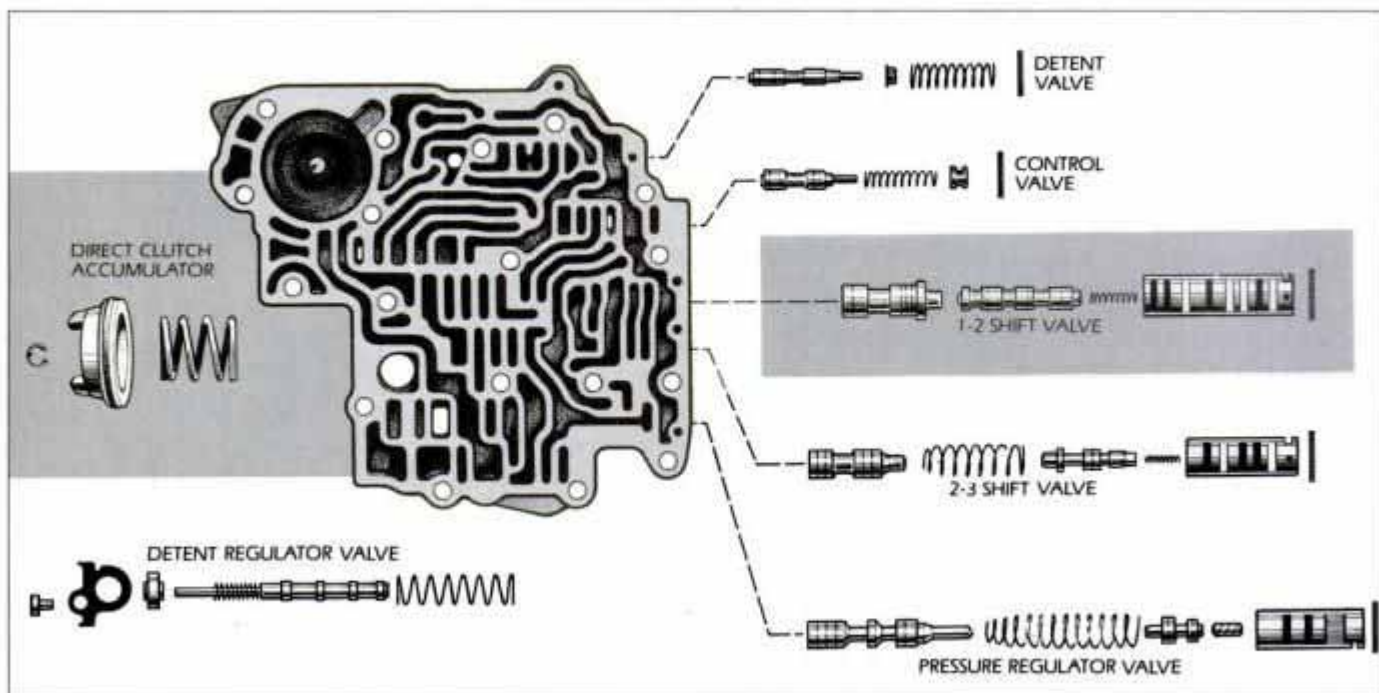
pressure, which applies the clutch packs with more authority and less slippage.

There's a trade-off, of course. If you inadvertently shift to First gear at high speed you could send the car into a skid and overrev the engine. The same is true of a full-synchro manual transmission and even some production automatics.

How does a shift kit work? Briefly, it alters the system hydraulics: Check

balls are changed, a separator plate between the valve body and trans case changes orifice sizes, pressure regulating, governor and modulator springs (where applicable) are swapped.

Shift kits are available through a number of high-performance aftermarket manufacturers and your local high-performance auto parts store probably has them on the shelf. We sampled one to make sure this modifi-



Transmission shift kit includes all springs. Disassembly is not necessary to install direct clutch accumulator and 1-2 shift valve.

cation was within the capability of our "Saturday Mechanic" readers. Our kit for a GM THM 350 transmission was provided by A-1 Automatic Transmissions and manufactured by Trans-Go.

Trans-Go kits are available in two variations. Those with a -2 suffix on the part number provide harsher shifts than those with a -1 suffix. We opted for the -2 kit because the trans on which it was to be installed was a high-mileage unit.

The folks at A-1 Automatic Transmissions told us that on an older trans with loose clutch packs, the -1 kit might not provide much improvement. On extremely high-mileage cars with lots of clutch-pack clearance, even the -2 kit won't do much in terms of making the trans really snap from one gear to the next.

You will get full manual control on any working transmission, though.

We found that the Trans-Go kit includes everything you need to do the job including gaskets. The instructions were very complete, fairly well illustrated and included cautions where appropriate.

Be careful, however, to follow the instructions exactly. It's important to note the color coding of the springs and pay scrupulous attention to what goes where.

Some tips included in the instructions, such as retaining those elusive little check balls on the separator plate with grease, were extremely helpful. This is *not* a job that you can do without reading the instructions.

When you install the kit you should change your automatic trans fluid and pickup filter while you're at it, so have these on hand. Trans-Go recommends that you not use "specialty" racing trans fluid or similar products. Use the type recommended by the vehicle manufacturer.

You can also have a professional mechanic do the job. In most cases it should take less than 4 hours, so you can figure on paying anywhere from about \$120 to \$200 labor, depending on the local rate.

After the kit has been installed and the fluid level renewed, drive the car nice and easy for a few miles, shifting up and down through the forward speeds. Then, at rest, shift in and out of Reverse a few times. Check the fluid level one more time before you go to wring it out.

SOURCE LIST

- A-1 Automatic Transmissions, 7359 Canoga Ave., Canoga Park, CA 91303
- B&M Automotive Products, 9152 Independence Ave., Chatsworth, CA 91311
- TCI, One TCI Dr., Ashland, MS 38603
- Trans-Go, 2621 Merced Ave., El Monte, CA 91733

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HOT WHEELS

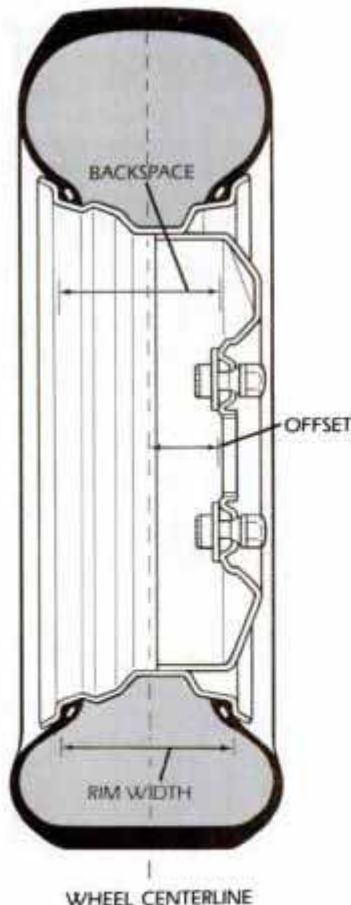
THE ENGINEERING concept of the wheel hasn't changed in the 5000 years since it first appeared in ancient Mesopotamia, but the styling certainly has. No longer are cars fitted with utilitarian steel discs concealed by decorative cover-ups. Now all but the most basic models are treated to attractive wheels. The only remaining problem is that they don't seem quite so special when just about everyone has the same equipment.

There's more to aftermarket wheels than a pretty face, though. They offer a number of possible advantages, depending on the model you choose. Rims wider than original-equipment wheels, with larger section width tires, help to maintain proper sidewall profile and quicken the steering response.

Lightweight aluminum alloy



Wheels like this can be disassembled to bolt on a replaceable inner or outer rim half.



Offset of a replacement wheel is dimension most critically important to handling.

wheels reduce unsprung weight, potentially aiding the suspension in both ride quality and roadholding. Many of the new smooth-faced designs will reduce aerodynamic drag, and at the same time, pump air over the brakes for additional cooling.

So it's obvious that buying wheels requires more than a simple review of the available styles to find one that agrees with your taste. For starters, you'll need to find wheels available in the proper diameter and bolt pattern. It must have the same number of attaching bolts as the original wheel and the same bolt circle diameter. Universal-fit wheels are available, too. In some cases these wheels are double drilled for two bolt circles. Others use reversible inserts to accommodate multiple bolt patterns. Many high-performance chassis shops shy away from multifit wheels, recommending a specific-fit, single-bolt-pattern wheel, particularly when hard driving and high cornering loads are in your program.

Whether a replacement wheel will fit properly is a function of how it's

constructed and where it locates the tire. Several dimensions are critical to proper fit, notably wheel offset and backspace (backside setting). Offset is defined as the measure of how far the mounting surface of the wheel at the hub deviates from the wheel centerline. Zero offset wheels have the mounting surface at the wheel centerline. You must compare the offset of the wheel you intend to purchase with the factory wheel to make certain they are close. If the difference is larger than the manufacturer's specs allow, the suspension geometry will be unfavorably altered to the detriment of handling and wheel-bearing wear.

The backspace dimension demonstrates how much of the wider wheel's width is moved toward the center of the car. Specifically, the backspace measurement is the distance from the hub mounting surface of the wheel to the inner side bead or tire-seating lip. You can easily measure this by laying a straightedge across the back edge of the wheel rim and sliding a ruler down into the wheel until it contacts the

mounting surface. Measure from the mounting face to the bead-seating surface of the rim, not the rim lip (see illustration).

A reputable tire shop should be familiar with what wheel and tire combinations fit your car. If they haven't had experience with your choice, a front wheel and tire should be mounted, the car lowered so that the full weight rests on the suspension, and the wheelwell area inspected. Most often the areas of interference will show up at the fender upper opening, fender front and rear opening, strut top and midsection, inner fenderwell or at some point on the suspension and brake components. Brake caliper interference is particularly common on ABS-equipped cars as the antilock system requires some components to be positioned outboard from the normal location.

Clearance problems may not appear until you've hurled the car into a corner hard and the tire sidewall deflects fully. In fact, even the spindle shaft and wheel may deflect enough to scrape things like the caliper under really hard cornering, so give the rim $\frac{1}{4}$ to $\frac{3}{8}$ -in. room, and the tire sidewall more like $\frac{3}{4}$ in.

Cars that use bolts to mount the wheels, rather than a wheel stud and

lug nut arrangement, should be fitted with wheels that retain the same type of hub center register as the original-equipment wheels. Lug nuts should be checked to ensure that the shank portion does not protrude through the wheel itself, which would cause them to tighten up when they run out of threads, instead of clamping the wheel in place.

If you've selected a wheel that's intended for the vehicle you're mounting it on, and you are fitting the tire intended for that size rim, then it should fit. If there is a clearance problem to the inside, you might consider using a spacer. Just be sure to use a proper spacer, one that's flat, or the wheel will wobble. It should support the rim 360° and the studs or bolts must be long enough for full thread engagement. A handful of flat washers will not make a safe spacer. Obviously, these lug bolts or studs must be adequately long to permit complete engagement of the threads. Just remember to remain close to the car manufacturer's recommendations for offset, or handling and wheel bearing life will suffer.

Clean the face of the hub or brake drum of all rust and dirt that may have collected behind the old rim—the new wheel must lie flat.

Lubricate the thread and chamfer surfaces of the lugs or nuts with motor oil or, better yet, an antiseize compound. Even with steel wheels, don't tighten the lugs down until they squeak. Lug nuts should be tightened with a torque wrench to a maximum of 65 ft.-lbs. on $\frac{7}{16}$ -in. studs and 85 ft.-lbs. on $\frac{1}{2}$ -in. studs.

Loosen and then retorque after 25 miles of driving. For extra assurance of a wheel's quality and safety compliance, check for a SEMA (Specialty Equipment Manufacturers Assn.) Foundation, Inc. specification label (SFI). **PM**

SOURCE LIST

- American Racing Equipment, 13705 Western Ave., Gardena, CA 90243
- Appliance/Keystone Product, P.O. Box 780, Ontario, CA 91761
- BBS of America, 33 Murray Hill Dr., Spring Valley, NY 10977
- Carroll Shelby Wheels, 19021 S. Figueroa Ave., Gardena, CA 90248
- Center Line Tool Corp., 13521 Freeway Dr., Santa Fe Springs, CA 90670
- Cragar Wheels, 19007 S. Reyes Ave., Compton, CA 90221
- Enkei/Golden Wheel Corp., 1250 Mahalo Pl., Compton, CA 90220
- Rocket Industries, 9935 Beverly Blvd., Pico Rivera, CA 90660
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BETTER BRAKES

MAKE a mistake tinkering with your engine and you could wind up losing a little performance. Do the same with your brake system and you might find yourself parked against a tree.

The typical passenger-car brake system is a lot more complex than it might seem. And its performance is governed to a great extent by the friction material—*asbestos organic*, *asbestos-free organic*, or *semimetallic*—used on pads or shoes.

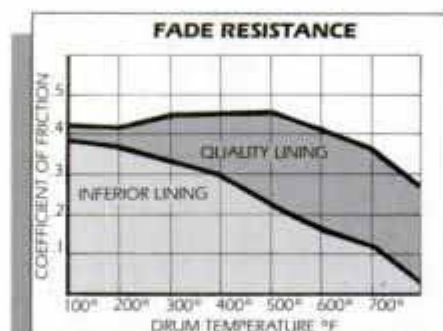
A particular brake's stopping power, resistance to fade and wear resistance depends greatly on friction-material efficiency.

The range for error in most of these areas is very small. The original-equipment linings provided by the manufacturer are usually a "best compromise" for the vehicle type. Replacing them with an inferior lining can be a tragic mistake. In some cases even the installation of a reputed "high-performance" lining can have a very negative affect on the braking performance of a car that was not engineered for such a lining.

For example, semimetallic friction material is more fade resistant than other types and, when operating at the right temperature, its high friction level can provide high-performance stopping power. But if you install this material in a car that was designed for asbestos lining you may lose stopping power if the semimetallic material doesn't get hot enough. And if it does get hot enough, it may boil the fluid in calipers that were engineered for asbestos or nonasbestos organic pads.

What's more, rotors or drums that were engineered for organic friction material can be damaged by semimetallic material. On the other hand, if you substitute either of the two non-metallic types for the semimets, you might use up a set of pads in less than 10,000 miles.

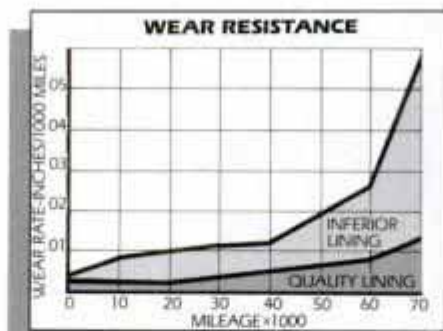
The key to high-performance braking is obtaining a premium lining that meets or exceeds original-equipment specs and is of the same composition. You can usually be sure you're getting the right stuff if you buy the top-line product from a name-brand manufacturer. But as always, it's a good idea to beware of bargains, as even some of the name producers market



Friction coefficient of an inferior lining can deteriorate fast as temperature rises.



Some products begin recovery from fade, then the coefficient of friction plunges again.



Inferior brake lining can wear up to five times faster than a high-quality product.

second-level products that may not meet all original-equipment requirements.

Of course, even the best friction material money can buy won't compensate for a brake job that has been botched. Follow all procedures in your service manual and make sure rotor and/or drum surfaces are true, round and free of deep grooves or heat damage. Check all hydraulic components for leakage or deterioration and replace or rebuild as necessary.

A clean hydraulic system can also

contribute to your braking system's capability. Bendix engineers recommend yearly flushing and rebleeding of the hydraulic system. To do this you simply bleed the brakes, pumping out about a quart of old fluid and replacing it with new DOT-4 fluid from a sealed container.

Some enthusiasts, particularly collectors of antique cars, replace the standard brake fluid with Dow Corning's silicone brake fluid. This fluid, which meets DOT-5 specifications, has a higher boiling point and can be superior to the conventional glycol DOT-4 brake fluid.

Collectors use it because it won't absorb water like glycol does. So, if you have to store your car, hydraulic system parts won't corrode.

Another plus for silicone fluid is that it doesn't dissolve a car's paint like the conventional fluid. The big *minus* is that silicone fluid costs three to five times as much as glycol.

If you'd like to convert a car to silicone fluid you have to thoroughly flush out *all* the old glycol fluid first. One way to do this is to pump at least a quart of the silicone through the system and then discard it.

FM



Don't forget to check and, if necessary, resurface rotors or drums. Proper surface finish is important to prevent brake squeal.

SOURCE LIST

- Abex Corp., 1827 Towers Ferry Rd., Marietta, GA 30067
- Allied Aftermarket Division (Bendix), 105 Pawtucket Ave., East Providence, RI 02916
- Parker Hannifin Corp. (EIS), 129 Worthington Ridge, P.O. Box 1315, Berlin, CT 06037
- H.K. Porter, Inc., 1301 W. Sandusky Ave., Bellefontaine, OH 43311
- Raymark Corp. (Raybestos), 100 Oakview Dr, Trumbull, CT 06611
- Wagner Division of Cooper Industries, 100 Misty Ln., Parsippany, NJ 07054

TIRE TALK

DOLLAR for dollar, there's still no better way to improve the cornering power of your car than by upgrading the tires. But jacking up the G-forces isn't done by simply dropping by the tire store and wagging a finger at the widest skins on the rack.

Though your original-equipment tires may look like the 98-pound weaklings of the tire world, they've actually been selected by the manufacturer after considerable research. Carmakers choose tires for each model based on a large number of factors, including wear resistance, impact resistance, ride quality, speed rating, fuel economy, noise level and wet and dry traction.

The trouble is, their priorities are different from yours. To boost cornering ability and sharpen the steering response you'll certainly have to live with some sacrifices, but if you make your choices intelligently the compromises will be insignificant.

The widely accepted "Plus 1" guideline to tire fitting is a proven plan to follow in choosing the proper tires.

Plus 1 (or Plus 2) refers to the larger rim diameters you'll need in order to physically fit the tires to the car. Stick with us, and you'll understand why.

In general, what's most important to look for in the construction of a

high-performance replacement tire is the widest possible contact patch and the shortest, most vertical sidewall. The reason for the wide contact patch is apparent—more rubber on the road means greater traction, assuming the rubber compounds and construction details are similar.

The shorter sidewall, a natural property of lower aspect ratio tires (a 50-series rather than a 70-series tire, for instance) is desirable because it will have less tendency to deflect and roll under during hard cornering maneuvers. When the vertical height of the sidewall is reduced so that it stands straight up, the car will respond quicker to steering input.

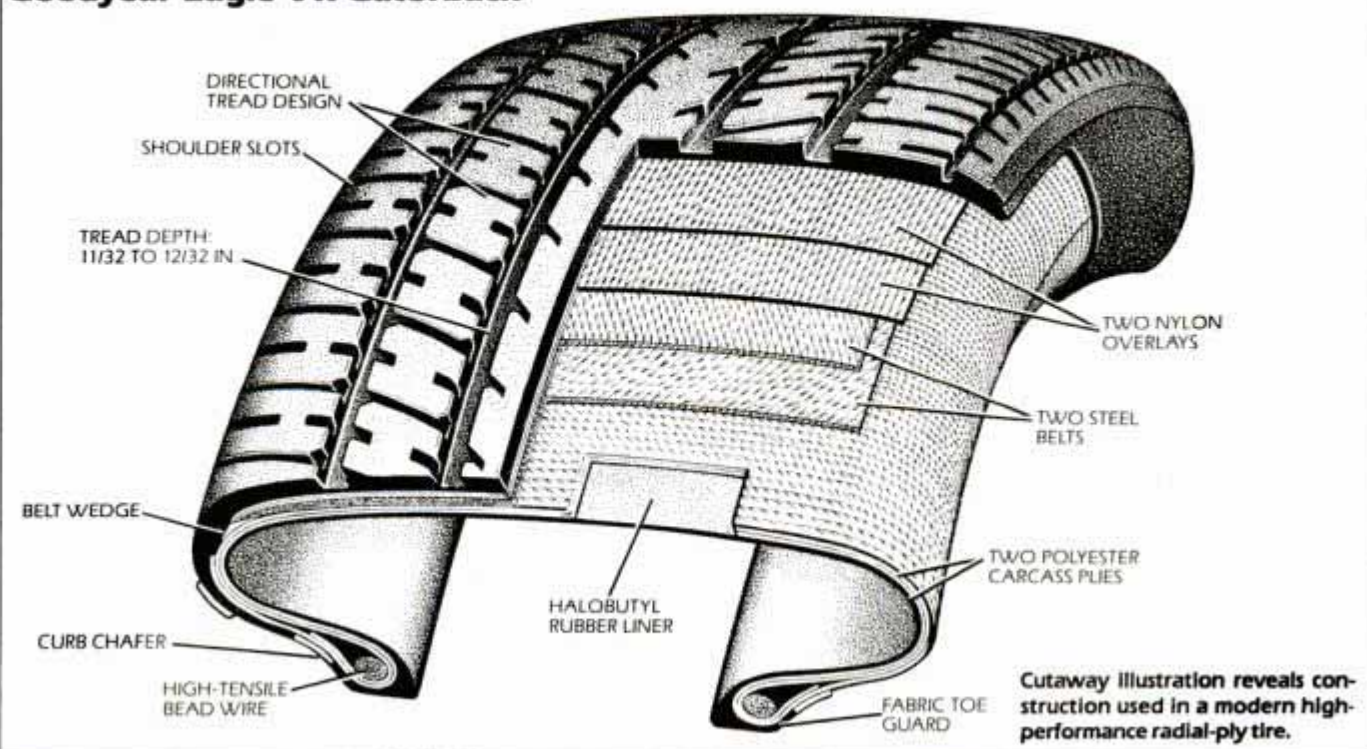
The choice of a replacement tire size must take three points into account: overall diameter, load-carrying capacity and wheel-width requirement. The tire diameter is critical for wheelwell fit, of course, and for its affect on the overall gearing and speedometer readings. New cars with electronic engine management systems are particularly sensitive in this area, requiring accurate road speed inputs



Goodyear's new 17-in. Corvette tire is rated for sustained speeds in excess of 149 mph.

HIGH-PERFORMANCE TIRE CONSTRUCTION

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WORTH WRITING FOR

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464 UNIQUE KNIVES LOOK SHARP

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TIRE TALK

to control a number of functions. To keep tire diameter constant when fitting a low-profile replacement, it will be necessary to change up to a larger wheel diameter.

Load-carrying capacity of the new tire should never be less than the rating of the original equipment. It's not hard to run into trouble here, because a replacement tire with a lower profile and aspect ratio contains a smaller air volume. The way to increase the size of the air cavity—and the carrying capacity—is to move up to a wider section width tire. Not coincidentally, that puts a wider tread patch in contact with the road surface.

The down side is the poorer bad-weather performance of wider tires. Proper tread design helps, but—all else being equal—a wider tire tends to float over the top of rain, slush or snow. There are all-weather low-profile tires, but some climates still call for snow tires in winter months.

Rim-width recommendations listed by the tire manufacturer should be followed to get the best handling performance. Again, the idea is to keep the sidewall as vertical as possible when it's mounted on the car. Also, a rim that's too narrow could shorten the life of the new tires by causing a bead failure.

Looking at today's fastest-cornering sports cars clearly shows the latest trends in tire sizing and technology. The 1988 Corvette offers a 40-series, 17-in. Goodyear Eagle Gatorback. Ultrawide and very low in side profile, this tire is a vital component of the Z51 and Z52 suspension package options. And it has a directional tread pattern designed to route water out to the sides of the tire. The tire carries a Z rating, indicating its worthiness for sustained speeds over 149 mph. An increased number of cords per inch in the carcass design bolster shock absorption and high-speed stability. **PM**

SOURCE LIST

- Armstrong Rubber Co., P.O. Box 2001, New Haven, CT 06536
- Bridgestone U.S.A., Inc., 2000 W. 190th St., Torrance, CA 90504
- Firestone Tire & Rubber Co., 1200 Firestone Pkwy, Akron, OH 44317
- General Tire, One General St., Akron, OH 44329
- Goodyear Tire & Rubber Co., 1144 East Market St., Akron, OH 44316
- Kelly-Springfield Tire Co., Willowbrook Rd., Cumberland, MD 21502
- Michelin Tire Corp., P.O. Box 19001, Greenville, SC 29602
- Uniroyal Goodrich, 600 S. Main St., Akron, OH 44397

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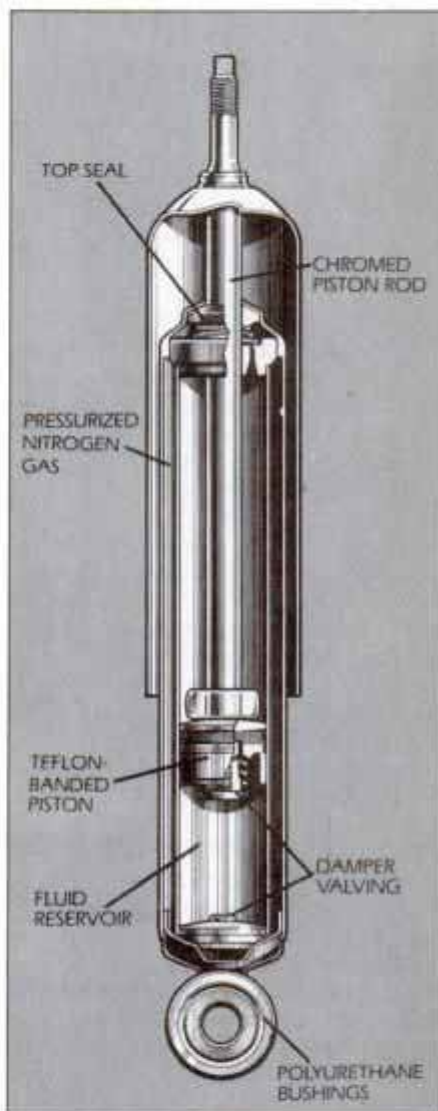
SHOCK TREATMENT FOR A SMOOTH RIDE

LET'S debunk one widely held misconception right from the start: A new set of high-performance shock absorbers will *not* turn your flaccid boulevard barge into a corner-carving sports sedan all by themselves. Shock absorbers are instruments of control, damping unwanted suspension motions by using the forces of hydraulics. They're important to good handling, but they're not a cure-all for inadequate suspension components like flabby springs and wimpy antiroll bars.

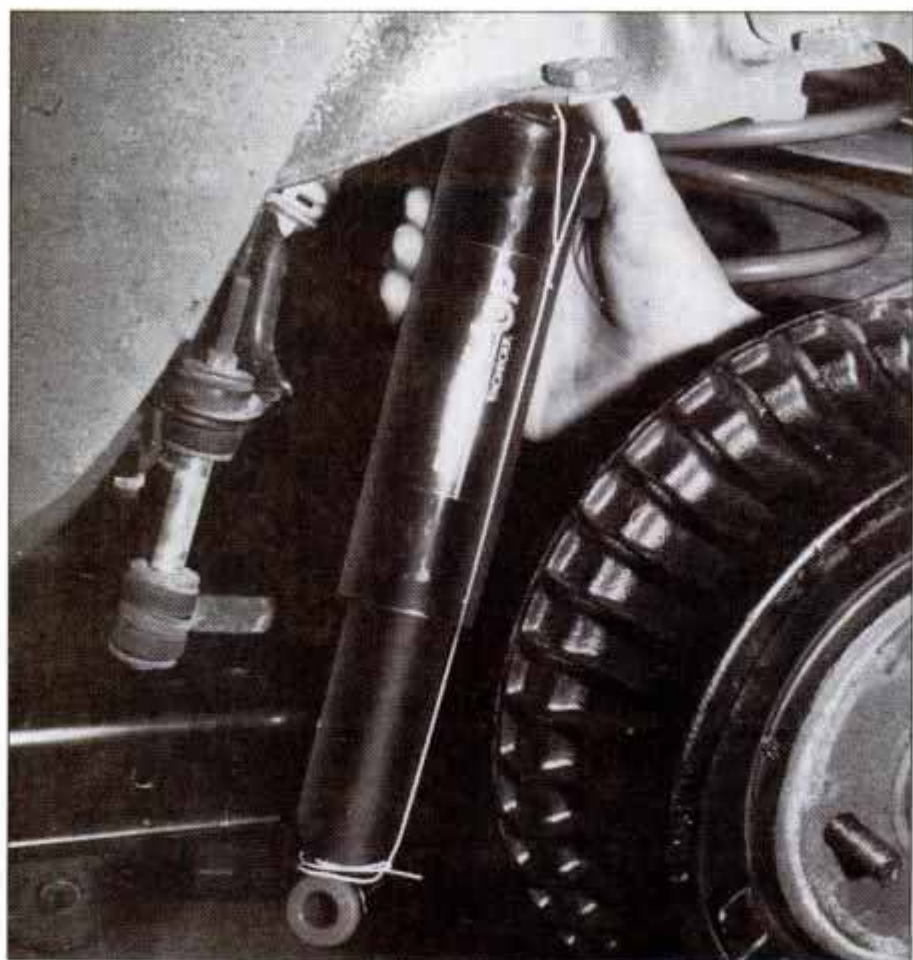
To understand how a shock absorber can affect the dynamics of your car you'll need to know a little about how it operates. One way or another, the shock forms a link between the suspension system and the chassis (the frame or unibody structure). On a

smooth, straight road the shocks do very little work, just keeping the wheel motions, such as those generated by imbalanced or out-of-round tires, in check.

When the suspension is deflected by a bump, though, the shock absorber is compressed, forcing the piston inside to displace hydraulic fluid in the chamber that houses the piston. By forcing this fluid to flow through a restrictive orifice, the rate at which the shock can be compressed (or extended) is regulated. In this way it can control how fast the spring is allowed to compress after hitting a bump (known as jounce) as well as damp the repetitive bouncing motion that would otherwise occur once the spring had extended itself again (the rebound action).



High-performance shock uses nitrogen gas at 200 psi to prevent aeration of the fluid. This retards cavitation and fade during hard use.



Wire loop controls pressure from nitrogen charge until you've finished installing shock.

It's that bouncing—the travel of the suspension past the point it would deflect normally—that makes a car hard to control on bad roads and in sharp corners. The car will lean in a corner, and proper shock damping will keep it from leaning too far.

Firm shocks, set up with stiff valving, make the ride generally harsher as they won't compress as easily for small bumps.

When the shocks are set *too* stiff they won't allow the tires to follow the road surface accurately, sacrificing

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PERFORMANCE

Tuning Guide

SHOCK TREATMENT

the tread contact needed for cornering traction.

In general, heavy-duty, high-performance shock absorbers (and MacPherson struts, which perform the same damping functions) have a larger hydraulic fluid capacity, a bigger body for increased cooling and perhaps an extra stage of valving operation which comes into play only in high-load situations. A large-diam-

eter piston rod also bolsters the strength of the unit, and its chrome-plated surface helps assure long life for the internal seals. Polyurethane bushings at the mounting points, rather than short-lived rubber bushings, also point to high-quality construction.

That's not all there is to know, though.

On very bumpy roads, air in the shock can aerate the fluid into foam—and foam doesn't give much damping. High-performance gas shock absorbers use a nitrogen charge to prevent this condition. By pressurizing

the reservoir chamber with nitrogen gas, typically at around 200 psi, fluid aeration and consequent shock fade are just about eliminated.

Don't confuse gas shocks with air shocks, the kind you can pump up with compressed air. Air shocks are intended for occasions when your springs need to be stiffer for carrying a heavy load. They *do not* have any more damping than conventional shocks, and should be bled off when the trunk is empty.

Installing high-performance shock absorbers is certainly within the reach of most driveway mechanics. Older model cars with A-arm front suspensions generally use a 2-bolt connection at the lower end of the shock and a long threaded stud at the top. No special tools are required.

Cars equipped with MacPherson struts require extra caution, as the front spring is often integral with the strut suspension unit. Compressing the spring far enough to remove the shock cartridge or strut from the center of the spring may call for a proper spring compressor, a certain amount of experience and plenty of caution. Once the spring is off, you'll either have to remove the cartridge shock from the strut, or on some vehicles simply replace the strut. The front end alignment must be checked after the job is completed, too.

In most cases, rear shock absorber replacement is a straightforward job. It may be necessary, though, to remove a number of interior carpet panels to gain access to the top-end mounting hardware, which was what we encountered when we installed Monroe's Formula GP shocks in the 1988 Camaro seen on the Performance Tuning Guide cover.

You'll notice a piece of wire wrapped around the shock in the installation photo. Any gas-pressure shock will extend itself to its greatest length, because the gas pressure inside it acts like a spring. It's not a very powerful spring, but it might be enough to make installation difficult. No problem—just leave the wire in place until at least one end of the shock is bolted in place. Line up the other end, and clip the wire. The shock will extend itself right into the mounting holes on the other end in a few seconds. **PM**

SOURCE LIST

- Bilstein Corp., 11760 Sorrento Valley Rd., San Diego, CA 92121
- Koni America, Inc., P.O. Box 40, Culpepper, VA 22701
- KYB Corp., 901 Oak Creek Dr., Lombard, IL 60148
- Maremont Corp., 250 E. Kehoe Blvd., Carol Stream, IL 60188
- Monroe Auto Equipment Co., International Dr., Monroe, MI 48161

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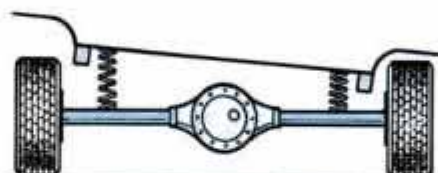
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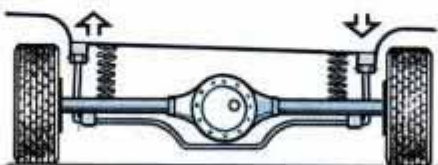
Any change in direction applied to a moving automobile brings a variety of forces into play that affect the way the tires contact the pavement. In a turn, the car's weight tends to lean and shift toward the outside. One effect of this weight transfer is an upsetting of the suspension geometry, skewing the tires from their normal vertical position, reducing tire traction and making the car harder to control. The more the car leans, the more pronounced this effect becomes.

To control body lean and weight transfer, suspension engineers specify installation of antiroll bars, also known as stabilizer bars or (incorrectly) as sway bars. There's no black magic to the operating principle. In simplest terms, the antiroll bar links the left and right sides of the suspension to the frame or unibody so that one side can't move up or down by itself without twisting the bar.

For example, in a left turn, when the left side of the car is moving up and the right side is moving down relative to the road, torsion (twisting) is applied to the spring steel bar.



WITHOUT ANTIROLL BAR



WITH ANTIROLL BAR

Antiroll bar attaches ahead of axle as well as above, must twist as car rolls in corner.

When an antiroll bar is designed for a mass-production passenger car, the engineers have to be conservative in determining how much body roll and lateral weight transfer they eliminate. For the sake of predictable handling in the hands of the average driver, cars normally are set up with a tendency toward understeer. That means the front tires will lose adhesion before the rears in a hard corner. Changing to upgraded factory units or quality aftermarket components can shift this balance to make the car handle with a more neutral attitude.

Bolting on a larger diameter front

antiroll bar will usually make the car understeer more. Replacement bars should be matched front and rear to work together, particularly if the car was not factory equipped this way. This allows the rear tires to assume more cornering load as well. Follow the recommendations of the supplier in this matter—too stiff a rear bar will give the car a tendency to oversteer and possibly spin out too easily.

In most cases, installation of a heavy-duty replacement for the original front antiroll bar requires nothing more than unbolting the old unit and sliding in the new one. Upgrading at the rear end is similarly clear cut, but if the car did not have an original-equipment rear bar you may have to drill holes to mount the brackets for the bar's end links. That was the case with the ADDCO antiroll bar we installed on a 1969 Camaro. The job required only basic tools and was easily completed in an afternoon.

Carefully consider how your car will be used before purchasing antiroll bars or any other high-performance suspension components, as you probably won't be pleased with the results of going too far. Fortunately, antiroll bars have little affect on ride quality.

Base your purchase decision of antiroll bars on the appropriateness of their offerings to your needs. Look for quality materials and clear instructions. If you're serious enough to consider some weekend slalom contests, you might look into the bars with adjustable end links that will allow you to fine tune the suspension to compensate for tire or weight variables. Harder urethane mounting bushings will transmit more road shock up to the passenger compartment, but will outlast rubber parts and also improve handling precision. Spherical rod end connectors at the link points indicate serious duty as well, which may be more than you need. **PM**



Adding aftermarket antiroll bar should take an hour or so with simple hand tools.

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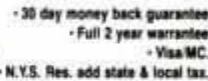
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FOUL BALL!

(Continued from page 85)

would if you pinched it—it has none of the fast rotation that a pitcher would usually want on a pitch. As a result, the ball meets air resistance and suddenly, very suddenly, loses velocity and drops straight down.

With scuffballs and cut balls the break is usually sideways, left or right, though some pitchers say they can make it rise or drop. Either way, the break comes late—after the batter has judged where the ball will be. Here, you want to generate friction with the ball, and that's what the abrasion achieves.

The pitch is thrown with a fastball grip, fastball delivery, and usually at fastball speed. The way the pitcher grips his fastball determines where the ball gets scarified. But to break sideways, the scuff must remain in the same spot, perpendicular to the direction of the pitch as the ball spins bottom over top toward the plate.

Because the ball is rougher on one side, that spot creates turbulence in the air that flows over it on its way home. As Watts and others explain it, the turbulent air peels away from the rough spot, making the air's wake shift around toward the smoother side of the ball. This causes an imbalance that redirects the airflow and forces the ball to veer to the scuffed side.

If science has demystified what the scuff does to the ball, how it gets on the ball remains a total mystery to any pitcher who has ever been confronted by an umpire.

Of course, baseballs do get nicked and scratched in the normal course of duty. A foul off the backstop or a sharp grounder, especially on artificial turf, will leave scars. That's found money. The man-made variety takes more ingenuity.

In the days when most uniforms had belts, some pitchers might sharpen the buckle so they could cut shallow grooves in the ball while contemplating signs from the catcher. Congressman Jim Bunning was reputed to be a buckle-baller. Double-knits banished the buckle, but resourceful pitchers found ways to utilize the metal snaps at the waistband. Alternatively, a pitcher might conceal a needle, tack or other sharp object beneath a bandage on his glove hand, and give the ball a rough shave while he's rubbing it up.

As for scuffing, any abrasive substance will do. Whitey Ford has related how he wore a ring that was filigreed to the texture of a wood rasp. Sandpaper, emery cloth and emery boards have found their way to the mound from the hardware store and

manicure parlor. A roughened spot about the size of a quarter is all the scuff you need.

By the way, a ball needn't be cut or scuffed to have a sudden break. Even a splotch of mud will create the same aerodynamic irregularities. And it needn't be the pitcher who doctors the ball. Whitey Ford had his famous mudball prepared for him courtesy of catcher Elston Howard. Additionally, catchers have been known to scrape the ball against their shin-guards, and certain Dodger infielders of the 1960s were suspected of cutting the ball for certain Dodger pitchers as it was tossed around the bases.

With all these trick deliveries in the pitcher's arsenal, not to mention the legal stuff, you would think that the use of corked bats, as alleged, would be justifiable self-defense for batters.

Well, I don't think that corked bats are used as a conscious counterweight to the perception that a pitcher might be doctoring the ball. It's merely an attempt by the batter to improve his performance, satisfy his ambitions or solve his problems. For the guy with TP or track power—the ability to hit dramatic fly-ball outs to the warning track—a corked bat might mean several more home runs.

This is to the extent that corked bats are used at all—and I don't believe the practice is widespread. The only major leaguer I know of who was candid about the fact was the late Norm Cash, who said he used a corked bat when he played for the Tigers in 1961 and won the American League batting title with a .361 average and 41 home runs.

There's a lot of voodoo involved with freak bats, both regarding how to load one and what the loading is supposed to achieve. From the wood-working angle, the magical formulas vary but are basically as follows.

A hole anywhere from 1½ to 1 in. dia. is bored through the fat end of the bat, to a depth up to about 1 ft. The wood that's been removed is replaced by cork (a dowel, beads or rolled sheets) or bouncy superballs press-fit into the hollow barrel. Finally, the mouth of the hole is plugged with wood that matches the grain, and the top of the bat is stained and finished in a manner that camouflages the plug.

Why does anyone load a bat? One reason is to lighten it and thereby generate greater bat speed—the force with which the bat meets the ball. Another reason is bat control. If it takes less effort to bring the bat around, the hitter gains an extra fraction of a second to gauge the pitch before he commits to swing.

Another thing some players believe

(Please turn to page 145)

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For years, cars were painted with a thick layer of color over a coat of primer. Exposed to sun, salt, smog and other elements, the color oxidized and faded. Which is why car waxes contained harsh abrasives to renew the shine by removing the oxidized surface layer of paint. For years that worked fine. Then, suddenly, everything changed.

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Most car waxes leave scratches in clear coats, dulling the shine.



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painting process—a thin layer of color over the primer, covered by a layer of clear paint. While clear-coating prevents the color from fading, it can still get dull, hazy and yellowed. It can also be easily scratched by the harsh abrasives still found in many car waxes. The car owner's old friend has become an enemy.

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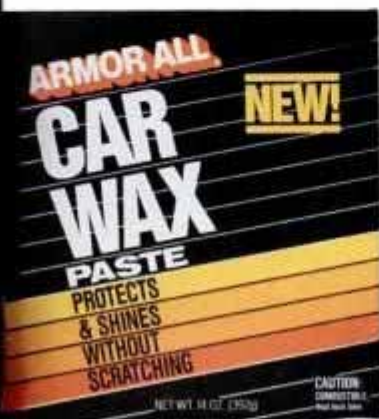
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FOUL BALL!

(Continued from page 142)

is that the cork or rubber filling endows the bat with greater resiliency, making the ball jump off the bat with more pop. But science says it isn't so.

Lighter weight, not resiliency, is what makes the freak bat drive the ball farther. As Brancazio and others explain it, the bat hardly deforms at all when it collides with the ball—or only hundredths of an inch if at all. But upon collision, the ball deforms by an inch or two, squishing down almost to a hemisphere. So whatever you fill the bat with doesn't matter, as long as it's lighter than wood. And cork, according to Brancazio, has about one-third the density of wood. Superballs give almost no weight-savings at all. But something stiff and light like styrofoam would work well, too. Actually, a hollow bat would work best—if the hitter could be confident that the bat would hold up and not sound too hollow to the nearby catcher and umpire. In fact, Brancazio says that the newer style of cupped bats, the ones with an inch-deep scoop of wood removed from the business end, achieve the same effect in bat speed as boring out several cubic inches of wood farther down the barrel. That's because the mass, or weight, is removed farther away from the bat's pivot point at the handle. The net result is a lower polar moment of inertia when the hitter begins to swing.

What's the net result on the scoreboard? In his Tulane University lab, Watts has calculated that a hitter using a 32-ounce bat generates a bat-speed of about 70 mph. If termites or other activity shed 6 ounces from this weight, bat speed rises about 2.5 percent, to about 72 mph. The extra velocity, Watts says, translates into 15 to 20 ft. more mileage for the ball if it collides with the bat.

Meanwhile, another revelation from Watts' lab almost makes the point of corking bats irrelevant. It has to do with the role of backspin in making a ball travel farther.

When a ball is propelled so that the seams turn into the airflow, or against it, from the bottom of the ball to the top, it's said to have backspin. This orientation creates the force known in aerodynamics as lift. The more rpm in the spin, the greater the lifting force.

The way to give backspin to a batted ball is to undercut it with the swing. And here lies the rub. If you undercut the pitch too much, you pop up. Watts tells us that the optimal launch point is an area from $\frac{5}{8}$ to 1 in. below the equator of the ball. The difference between this uppercut and hitting the ball dead-center (so that it

hardly spins) could, depending on the angle of swing, put as much as several thousand rpm of backspin on the ball good for about 250 ft. more travel. With just a small increase in backspin, the ball would travel another 30 ft.

Smart hitters have always sensed this, and Watts believes that more batters are becoming savvy to it. He points out that the amount of backspin is affected by the amount of friction generated when the bat strikes the ball. Applying a substance such as pine tar to the hitting surface of the bat would increase friction, but this is illegal, as George Brett can testify. Something players used to do years ago was scrape out the dark-grained areas of the wood—in effect scoring the bat's surface in a manner resembling the face of a golf club—where the grooves are intended to impart backspin to the ball.

Although scuffing and corking are called cheating, I really don't agree with the term. Professional baseball players are more or less evenly matched. Everyone knows what's at stake, so I don't believe that taking an edge is cheating in the moral sense. Ballplayers call it gamesmanship.

All things being equal, I really think the trick pitches and freak bats ought to be legal. After all, let's look at some practices that are never questioned, or just winked at, but which nonetheless give someone an edge.

Home teams routinely groom the field to give themselves an advantage, or put the visitors at a disadvantage. The baselines get beveled to make bunts go fair or foul. The area in front of the plate can be watered down to favor a sinkerball pitcher, or hardened to cause Baltimore chop-type infield hits. Teams regularly soak the basepaths or dump sand around first base to slow down base stealers. There are no strictures against any of this in the rulebook. At the time when I played for the Twins, the Chicago White Sox used to store the baseballs in a freezer to deaden the ball. When our power hitters made contact, it was like hitting a rock and the ball didn't go anywhere. While we're at it, let's not forget about stealing the signs, or the way hitters stand behind the boundary of the batter's box to get a longer look at the pitch, or how first basemen plant a foot in foul territory when setting up for a pickoff throw. And most recently, a New York team that plays in the Bronx moved its fences closer to its batters.

All of these things fall into the category of getting an edge. It's not as though they're criminal acts. And no matter whether the book says they're legal or not, I don't think we'll see any less of them in 1988 or beyond. **PM**

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BMX BIKES

(Continued from page 81)

1988. Immediately, other companies jumped on the Formula One bandwagon, including General, Hutch, Cyclecraft and Titan.

A national schedule of Formula One races—run on twisting parking-lot courses—has already taken shape.

Unlike BMX or Freestyle bikes, which are relatively simple machines, Formula One bikes are multigear, high-tech street racers. One of the most interesting is the Shimano 6-speed indexed shifting system, which allows the rider to thumbshift flawlessly. Unlike familiar 10-speed shifting systems, indexed shifting clicks solidly into gear every time without any search for exact cog centering.

Brakes, as on Freestyle bikes, come on the front and rear. Rear brakes on some models, like the Haro Dart (\$400-\$440), are the new Shimano Hub Roller, which locks up on a dime and gives you 9 cents change.

Wheel discs, as on the Diamond Back Formula One (\$350-\$400), are used for aerodynamics as well as looks. Molded-plastic fairings, as on the Hutch HPV Superbike (\$300-\$400), are new to the market, and since the bike has been clocked at 38 mph, about 8 mph faster than a BMX bike, it's a design likely to be copied.

Formula One bikes are designed for serious racers. Prices now range from \$300 to \$450, but bikes in the \$250 range should soon appear.

Safety gear


After choosing a bike, the next important decision is gear. Safety bike gear, especially for BMX racing, includes pads for the crossbar, stem and top tube of the frame.

Protective clothing, includes helmet, gloves, good sneakers and a full set of leathers (a name borrowed from motorcycling, but in BMX racing, refers to padded pants and shirts made of lightweight synthetic fabrics).

Smart BMX and Freestyle riders wear open-faced helmets with goggles and mouth guard, which run from \$50 to \$100. Well-padded leather gloves, heavy socks and sturdy sneakers are also important. Full leathers, run \$60 to \$100, and have built-in padding—in shoulders, elbows, hips, knees and shins. They can save a rider pain in a BMX or "stylin" crash.

Finally, determine exactly what type of riding your son plans to do—either elbow-bumping BMX action, cool freestyle contortions or space-age, Formula One street racing—and then pick a bike that looks as good as it feels. The choice is up to you... and, of course, your son. **PM**

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— Mary Hickman

had drilled down into the earth and found sparkling, clear, delicious water! It was such fun, the kids are eager to drill some more wells.

It must be contagious; my friends are getting caught up in it, too. When we started, they thought it was a pie-in-the-sky idea. Now they've got the well-drilling bug and I could sell my Hydra-Drill in a minute.

But, seeing is believing. Thank you, DeepRock.

MY FRIENDS THOUGHT I had lost my mind. The idea that the children and I could drill a water well by ourselves sounded like an impossible dream. However, we had to have more water for our large garden and lawn.

AN EASY WAY

Then I saw an advertisement that claims that you can drill your own well with a Hydra-Drill and save a lot of money. I had never even watched a well being drilled, much less drilled one myself, so I assumed it would be difficult. But they offered a free brochure, so I sent for it.

When the information came, I was delighted to find it contained a wealth of material. In addition to pictures and descriptions of the equipment, there is a very informative booklet about drilling your own water well.

I was impressed with the information package, but I wondered what we would do if we ran into a problem while we were drilling. Then I thought—well, they have a free consulting service with a toll-free telephone. Any company that is willing to go out on a limb like that, knowing they'll get calls from all over must have a lot of confidence in their product. So I took a deep breath, crossed my fingers, and ordered a Hydra-Drill.

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Much to my amazement, the Hydra-Drill arrived from the factory in Alabama in just 7 days. That was my first surprise.

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SPARKLING, CLEAR WATER

The biggest thrill came when we hit water. It was such an exhilarating experience, I can hardly describe it. We

IF YOU ASK ME

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CAR OF THE FUTURE

(Continued from page 74)

you'll see a mixture of analog, digital and hybrid digital analog gauges. Information like the car's speed, which is generally displayed on road signs numerically, such as "55," is probably best shown in the same form on a digital speedometer. Engine rpm, however, is rarely recognized as a specific number, but as something understood relative to the engine's redline.

An analog tach with the redline pointed straight up would address this function more squarely, and also show rate of change more graphically.

All this will vary with the purpose of the vehicle. In the future, owners in some market segments might get all digitals because they equate the techno look and bright lights of those displays with luxury. Cost might keep digitals from the inexpensive entry-level models. On the other hand, even though Ferrari uses digital readouts in its Formula One cars, don't expect them to displace the lovely traditional analog instrument panel from future Ferrari road cars. It just wouldn't fit the image.

Heads-up displays

One of the hottest bits of new hardware in instrument panels takes the gauges off the dashboard and projects them on the windshield. Heads-up displays (HUDs) are used in many aircraft already, and some designers would like to see them in automobiles soon. Oldsmobile, for one, already has experimental HUD-equipped cars.

Cost and packaging problems will keep HUDs in the future for the time being, while some critics of the systems aren't certain they'll be appropriate even then. Even in aircraft, there can be problems with the pilot shifting attention from up ahead to the display and back again. Can you concentrate on a speedometer readout glimmering on your windshield while you're trying to sort your way through rush-hour traffic?

On the other hand, flashing a warning light or other emergency information on the windshield to get your immediate attention makes sense. So do turn signal repeaters. And new advances in heads-up focusing make it possible for the driver to look well down the road and still be able to see the information projected on the windshield without having to strain to refocus out and back—a critical point for drivers over 40 who need bifocals.

Look inside many show cars these days and you'll find a small television screen. These CRTs are already being used in production cars like Buick's Riviera and Reatta, plus a

number of upscale models in Japan. But how these readouts will be used in the future is open to question.

TV screens look very advanced in cars, and at first glance seem to be an obvious direction automakers should take. CRTs, however, present the same basic problem as the multi-use instrument pods that have too many functions and take so much of the driver's attention.

Buick's system is fascinating, particularly for the passenger, who has the time to work through all the various computer menus, from heating/air conditioning controls to use of the radio. But what about the driver? Opinions vary on this question.

Nevertheless, there doesn't seem to be much doubt among designers that CRTs have a definite place in future cars.

There is the obvious use as entertainment devices, particularly for rear-seat passengers. Video games are a given, and television programs could be shown, as they are in Toyota's home-market Soarer, though only when the car is stopped, with the transmission locked securely in Park, to prevent the driver from becoming one of the viewers.

These screen readouts are also a natural for satellite navigational systems, which are probably less than 10 years away from widespread use. And the multilayer menu format of a computer system allows a screen to provide a driver with very detailed information about the condition of his car's various systems, tied into the same diagnostic system used by dealer service departments.

There are societal changes taking place that will increase the acceptability of CRTs in future cars. One involves the increasing use of computers by children, beginning with their prekindergarten days. As the current generation of computer-savvy teenagers grows to be a part of the upscale car market—which is where many advanced systems will first appear—computer monitors will seem to be as much at home on the dashboard as steering wheels.

Another development

Flat-screen LCD monitors, like those used in today's handheld TVs and laptop computers, will solve some of the packaging problems that go with the relatively bulky CRTs.

Still another use for these screens could be for rear view, with a small TV camera monitoring activity behind the car. Besides the prospect of an unimpeded, panoramic view, rear-view TVs offer other advantages. Aerodynamics will improve, thanks to the removal of wind-snagging side

mirrors and the opportunity to raise rear deck-lid height. And this in turn will give designers the opportunity to provide more cargo space.

Finally, display screens inside the car could be used to relay infrared pictures to the driver, allowing safer navigation in bad weather.

All these displays and controls are tantalizing, but even they may become dated when voice recognition systems (VRS) come of age. We're not talking about those irritating talking cars of a few years ago. These are interactive control systems in which you say, for example, "windshield wipers," and they activate.

And as you'd expect, the car's VRS would only react to voices programmed into the system.

Such systems hold great promise for luxury cars, at first, and would wipe still more gauges and controls from the dashboard, saving space and reducing complexity. It will be a long time, however, before such systems become practical enough to be used in inexpensive vehicles.

Nor would they make much sense in rental cars, which have different drivers every few days. And who would ever want to have only verbal dealings with a driver's car—a Ferrari, Lotus or Corvette—where the fundamental objective of possession is the interrelationship between automobile and owner.

Some problems

There's a more immediate challenge ahead for today's automotive designers, though, and that's the problem of responding to the upcoming passive-restraint regulations. What do you do with steering wheel-mounted controls, which are becoming quite popular, when you have to put an airbag in the wheel hub? How do you fit knee bolsters, door-mounted pelvic impact pads or motorized seatbelts into an interior that has to be friendly and non-claustrophobic, with easy-to-use controls?

It could well be that VRS will prove to be the only viable answer to the overlapping design constraints of passive safety and advanced controls. According to Tom Matano, who runs Mazda's design department in the U.S., VRS could allow designers to create completely clean dashboards. No dials, no switches, no multicontrol stalks projecting from the steering column. Nothing.

According to Matano, there would be only one problem left for the designer to confront.

"All we'd have to do," he says with a grin, "is decide where to put the input microphone and where to put the speaker."

PM

DRILL BITS

(Continued from page 94)

(\$14.85). Contact Vermont-American, Box 340, Lincolnton, NC 28093.

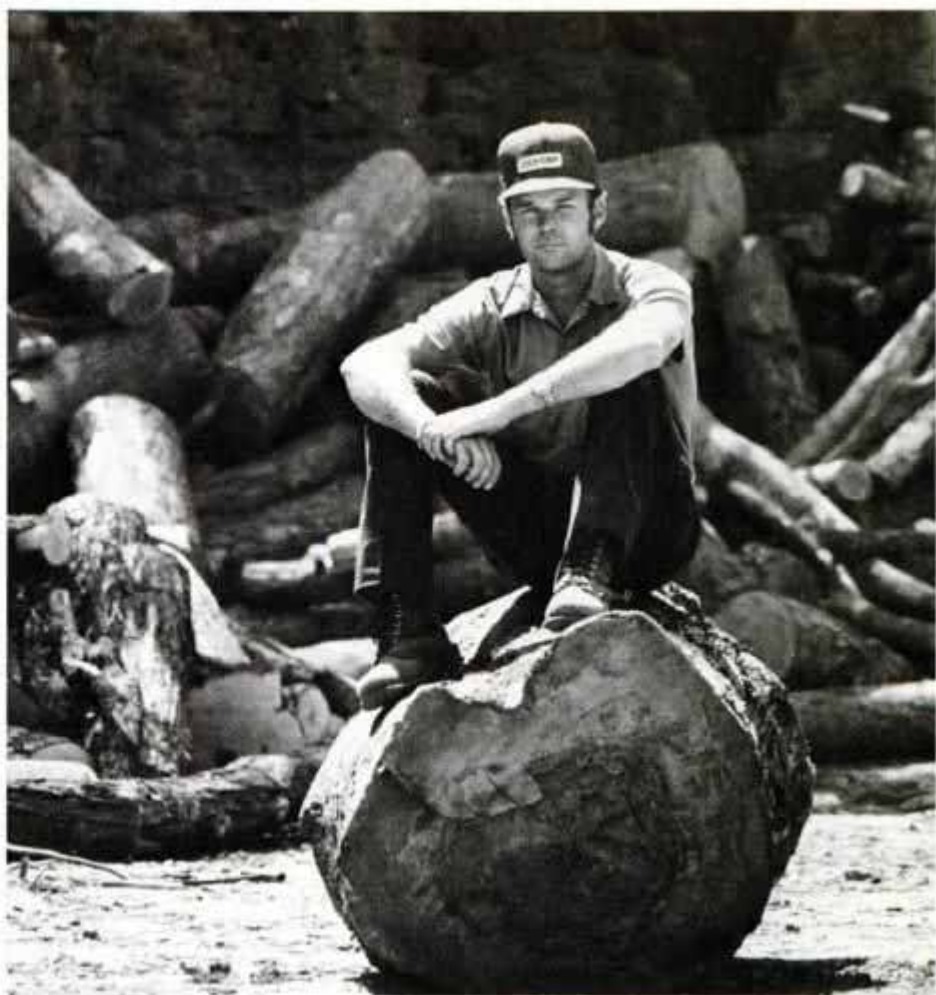
17. Cobalt bit—This rather ordinary looking $\frac{3}{8}$ -in.-dia. twist drill bit is made of supertough cobalt. It's designed specifically for drilling in extremely hard, abrasive metals such as stainless steel, chrome, armor plate and titanium. The bit shown costs about \$10.50. Other sizes: from $\frac{1}{16}$ in. to $\frac{1}{2}$ in. dia. Contact Vermont-American, Box 340, Lincolnton, NC 28093.

18. Compass cutter—This unique device allows you to cut holes up to 18 in. dia. using a portable electric drill. It consists of an adjustable trammel stud and a side-cutting twist drill bit. Insert the trammel stud in the center of the work and tighten the drill chuck onto the bit. Then, drill into the work and apply pressure with your free hand to the horizontal rod. It cuts rings and discs, too. The tool adjusts from $1\frac{1}{2}$ in. to 18 in. dia. For use on wood, fiberglass, plastic laminate and light-gauge sheetmetal. It's \$15.10, plus shipping, from Connecticut Valley Manufacturing, Box 3200, New Britain, CT 06050. For details, call toll-free (800) 336-0076.

19. Expansive bit—Here's a versatile, adjustable wood-boring bit (\$17.35) that can bore holes from $\frac{1}{8}$ in. to 3 in. dia. To adjust the bit, simply loosen the screw and slide the cutter to the desired position. A convenient direct-read inch scale is stamped on the cutter. The $\frac{3}{8}$ -in.-dia. shank can be used in a drill press, hand brace or portable electric drill. Contact Connecticut Valley Manufacturing, Box 3200, New Britain, CT 06050. Call toll-free (800) 336-0076.

20. Glass bit—Believe it or not, this very simple bit can drill through glass, china and ceramic tile. It consists of a diamond-ground piece of tungsten-carbide steel welded to a steel rod. Operate the bit at slow speed, either in a drill press or portable electric drill, and use a lubricant such as kerosene. A 7-piece set— $\frac{1}{8}$ in. to $\frac{3}{8}$ in. dia.—costs \$15.75 post-paid from Constantine's, 2050 Eastchester Rd., Bronx, NY 10461.

21. Double-ended bit—Designed primarily for metalworking, this bit is actually two drill bits in one. Only $2\frac{1}{2}$ in. long, it's known as a screw-machine length bit, and is ideal for drilling thin stock such as sheetmetal and aluminum. A 135° split point on each end ensures quick starts and fast cutting. Double-ended bits come in various fractional and wire gauge sizes. The $\frac{1}{4}$ -in.-dia. bit shown costs about \$3. Contact Vermont-American, Box 340, Lincolnton, NC 28093. **PM**



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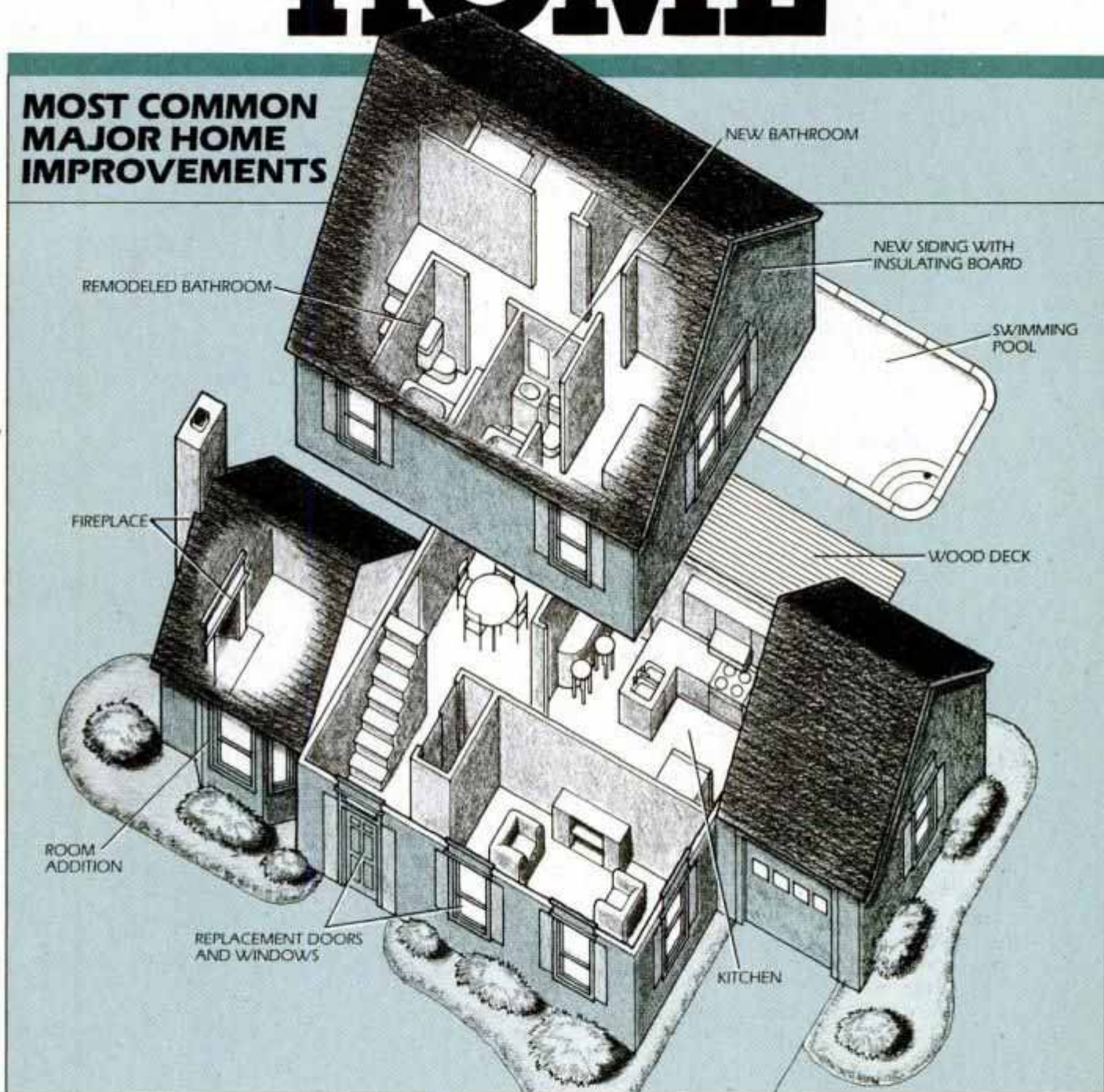


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THE BETTER HOME

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Investing In YOUR HOME

BY WALTER L. UPDEGRAVE; PM Illustrations by George Retseck

IF A WHITE-KNUCKLE roller coaster ride in the stock market isn't your idea of sane investing, maybe you should consider putting

your money into a solid, familiar investment you can keep track of every day—your home.

Whether you're remodeling a dingy

kitchen or bath, adding an extra bedroom or boosting the "curb appeal" of your house by installing attractive new siding and replacement doors and

THE BETTER HOME

windows, you can often increase the market value of your home by the full amount or more than you spend on a home improvement.

And, unlike stocks or bonds, renovating your home pays a valuable extra dividend—the sheer pleasure you and your family get from living in a comfortable house whose decor reflects your personal style.

While last year's stock-market meltdown may have increased home remodeling's appeal as an investment, the crash should also caution you to give long serious thought before embarking on a major improvement today.

More often than not, stock market turmoil of that magnitude signals a coming period of economic stagnation or recession—which means you could be affected by Wall Street even if you live on Main Street and don't own a single share of stock.

During a recession, for example, housing prices may fall or not climb as quickly, making it harder for you to recoup the cost of a home improvement on resale. And unemployment usually rises, meaning homeowners who've had to take out loans to finance improvements could face a financial squeeze.

Does this mean you should postpone or even cancel an improvement? Probably not.

"Most peoples' remodeling plans won't be affected by what happened in the stock market," says Bryan Patchan, executive director of the National Association of Home Builders Remodelers Council. "But whenever you make major expenditures, it always behooves you to look a few years down the road and re-evaluate your family's income and financial position."

If you're financing an improvement, make sure the monthly payments don't put too much of a strain on your budget.

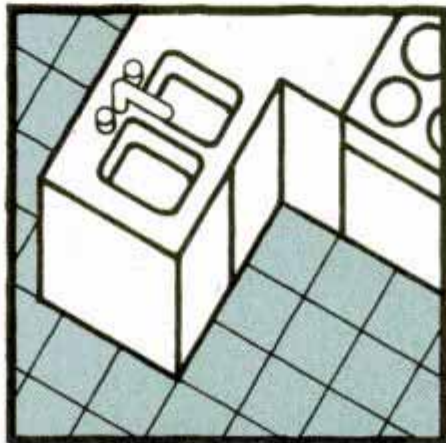
And if you're improving your home, but counting on getting that money back in a year or two through a higher sales price, keep an eye on resale prices in your neighborhood. If they're flat or, worse yet, heading South, you might consider scaling down a planned improvement.

Instead of refurbishing your kitchen from ceiling to floorboards, you might settle for less costly touches such as new surfaces on cabinets and countertops, inexpensive flooring and

a fresh coat of paint.

In short, now more than ever it pays to examine the financial side of home remodeling. Otherwise, the rules and guidelines which can help you balance the aesthetic considerations in home remodeling with the economic ones remain pretty much the same. Most important: Don't overimprove.

"If you're remodeling for your own comfort and enjoyment, you don't have to worry about what you spend," says Jacelyn Swenson of the National Association of the Remodeling Industry. "But if you're doing it as an investment, you want to make sure you



"The kitchen can have more impact on the market value of your house than any other single room. If a remodeled kitchen is new and well-done, you can almost hear a sigh of relief from potential buyers."

don't outprice other houses in your neighborhood."

For example, if you own a house worth \$90,000 in a neighborhood where the top houses sell for \$100,000 and you sink \$50,000 into an elaborate renovation, your chances of getting \$140,000 at resale are remote at best. People looking for \$140,000 houses don't buy in \$100,000 neighborhoods. A good rule of thumb: Make sure the current market value of your house plus planned improvements doesn't exceed the value of the better houses in your area by 20 percent. That would mean limiting the renovation on the \$90,000 house above to about \$30,000 tops.

Timing plays an important role, too. "People think they'll get their money back immediately," says Michael Zaccaria, a vice president for Remodeling Consultants, Inc. in Westchester County, New York. "That's not always true. Sometimes it takes a few years."

In general, the longer you stay in your home after remodeling, the better your chances of recovering an improvement's cost.

Unless real estate prices in your town are booming or you've picked up your house at a bargain price, you should be wary of doing a major renovation if you plan to move within two years. You'll have little time to enjoy the remodeling yourself and you run the risk that the next buyer won't value the improvement enough to increase his or her bid for the house.

If you think you'll sell your house within two years, stick to cosmetic fixups, such as fresh paint inside and out, replacing floor coverings with new but inexpensive ones and repairing cracked siding and crumbling window sash putty.

Improvements that bring your house up to par with the rest of the neighborhood should earn better returns than those that put you above the crowd. Adding a second bath to a 1-bath house almost always returns 100 percent or more of its cost—as does expanding a 2-bedroom house to three bedrooms if that's the norm for the neighborhood. But add a third bath or a fourth bedroom and you might recoup only 70 percent or less of your investment.

A local real estate agent should be able to tell you whether your planned improvement is too ritzy for your neighborhood. An agent can also tell you which remodeling projects excite today's home buyers enough to raise their bids and which provoke an ambivalent or even negative reaction to a house.

There's also a new emphasis on architectural design in home renovation. "Aesthetics and good design are more important to today's 35- and 40-year-old homebuyers," says Patchan. "Not only must the individual project be well thought out and executed, but it has to fit in with the rest of the house."

This is especially important in exterior renovations of post-World War II suburban houses.

Many such houses were erected

THE BETTER HOME

quickly without much regard for architectural appeal and now they are being given a contemporary look with new siding, roofs, higher-impact entries and better landscaping. Thus, if you're a bit weak on design skill, it may pay to hire an architect or designer to help plan a major addition.

The *quality* of work also determines how much value the next buyer places on any improvement—or, in the case of a shoddily done job, how much the buyer actually detracts from his or her bid for the house.

If you don't have the skills of a professional craftsman, hire one.

Keeping these guidelines in mind, here's a look at some new trends in the most popular remodeling projects and a rundown on the kinds of returns you can expect to get.

Replacement Doors And Windows

Replacing weather-beaten doors and windows remains the most popular residential remodeling project. And today's emphasis on high-quality wood or steel doors, unique window designs—such as round-tops, box, bays and clerestories—and technological innovations such as low-emissivity window coatings that increase energy-efficiency seem to be paying off in higher returns. You can expect to recoup as much as 75 percent of this investment now, versus just 40 percent five years ago. But the higher quality comes with a heftier price tag: Replacing all exterior doors and windows for a modest house can run from \$7000 to \$18,000.

New Siding

Installing new siding with insulating board is far less expensive—just over \$6000 on average—and can boost your home's resale price by 75 percent to 100 percent of the project's cost. Higher energy efficiency accounts for some of this project's value, but more important is the enhanced curb appeal it gives your home. This makes your house easier to sell and helps it fetch a better price than less attractive houses on the block.

Vinyl and vinyl-coated aluminum siding remain most popular because they require little maintenance, but owners of more expensive houses may be better off going with natural wood. It's more expensive and, if painted, more difficult to maintain, but is generally preferred by home buyers at

the upper end of the market. When renovating your house's exterior, pay special attention to creating a dramatic entry—for example, a landscaped brick path leading to a carved door flanked by fluted pilasters and topped by a classical pediment. This feature alone can help swing sales negotiations to your favor.

Room Addition

Building a 15 × 25-ft. room addition is costly—close to \$30,000 on average—and has a relatively modest recovery rate—about 70 percent if you sell within two years. But if you like your present location and simply need



“With a 1-bath house being very hard to sell in today's market, adding a second full bathroom to a house that has just one is one of the best remodeling investments you can make.”

more space, you're often better off adding a room or even an entire second floor than buying a larger house. To get the best return on resale, make sure the addition blends in with the layout and architectural character of the house. Also, a multipurpose room addition that can be used as a family room, den or guest bedroom, for instance, will do better than one whose use is restricted to a single purpose such as a gym or workshop.

Says Patchan, “You must try to anticipate not just your own needs, but those of a typical buyer.” Popular features now being found in room additions include fireplaces, skylights, cathedral ceilings with exposed

beams, and built-in cabinetry for video and audio equipment.

Remodeled Kitchen

The kitchen can have more impact on the market value of your house than any other single room.

“If the kitchen is new and well done you almost hear a sigh of relief from buyers,” says remodeler Zaccaria. “If it's in bad shape or been remodeled on the cheap, you can practically hear them subtracting the cost of redoing it from their bid.”

The trend today is toward opening up the kitchen to the living areas and bringing in natural light via skylights, greenhouse or clerestory windows. Sleek, Eurostyle cabinetry—made of either natural wood or high-quality laminates—are still all the rage, as are countertops of granite, marble or durable man-made marble look-alikes such as Corian and Avonite.

Many renovators are also going to the top of the line in appliances like Sub-Zero refrigerators whose doors accommodate panels to match your cabinets and Jenn-Air ovens that feature range-top broiling with down-draft exhaust.

All this has raised the cost of kitchen renovation to \$19,500 on average, while some contractors report doing kitchen make overs for what a complete house sells for—\$100,000 and up. While the returns on this investment are high—75 percent to 90 percent of the project's cost—you're better off from an investing standpoint opting for a medium-cost renovation than an ultra-expensive one. But if a state-of-the-art kitchen is your goal and you're planning to stay in your home for quite a few years, this is definitely the room to enjoy a splurge.

Remodeled Bath

With a 1-bath house a hard-sell in today's housing market, adding a second full bathroom to a house that has just one is one of the best remodeling investments you can make. Getting all your money back at resale is almost guaranteed and you can often recoup as much as 130 percent of the cost—typically between \$5600 and \$12,900. Remodeling an existing bathroom is comparable in cost—\$4500 to \$11,500—but doesn't pay off quite as well, recouping about 80 percent of your investment.

Opulence is the catchword in bath

THE BETTER HOME

remodeling today. Whirlpool tubs, separate tubs and shower stalls, skylights and huge windows, imported ceramic tile on walls and floor, color-coordinated fixtures—all have become practically commonplace in the American bath during the past five years and, as a consequence, have driven up the cost of the average remodeled bath 80 percent.

If your bathroom is small or you think you'll sell your house within the next two years, opt for good-quality standard items instead of expensive whirlpools and Italian marble tiles.

If, however, you plan on remaining in your house or enjoy indulging yourself, then feel free to turn your '50s bathroom into an '80s sybaritic pleasure chamber.

Wood Deck

While lumber-price increases as high as 30 percent have boosted the cost of a 320-sq.-ft. pressure-treated pine deck to \$5300 on average, the entertainment and leisure value of wood decks makes them favorites all over the country. Even in cold climates you can expect to recover 75 percent to 80 percent of your costs on resale and in warmer climates—where the absence of a deck is a minus—decks get even higher returns. New trends include decks with several levels, planks arranged in patterns, privacy walls on one or two sides and use of decks in place of concrete porches. If you want a redwood or cedar deck, you can expect the project's cost to jump 15 percent to 20 percent.

Fireplace

Its low cost—\$2600 to \$4000—and high recovery—as much as 140 percent—make a fireplace the best home remodeling investment you can make. "The returns on fireplaces are even high in the South and Southwest," says NARI's Swenson. "People like the notion of warmth and of coziness fireplaces evoke." Many homeowners now put fireplaces in corners to conserve space, while oth-



"While you may recoup more money in warmer climates and in neighborhoods where having a swimming pool is considered almost essential, as an investment pools don't hold much water."

ers still prefer a free-standing fireplace in the center of a room.

To allow more flexibility in choosing a place for yours, stick to a "zero clearance" model. The top, sides and bottom remain cool while a fire burns inside, allowing you to install it against any surface.

To avoid air leaks and to insure your fireplace meets all building and safety codes, proper installation is key. You may want to turn this project over to an experienced building contractor.

Energy Savers

Unlike most remodeling projects, energy improvements can begin paying off from the day of installation by lowering fuel bills. Start with the simplest, and cheapest, tasks such as weatherstripping around doors and windows, replacing any broken window panes and caulking around window frames.

Next, make sure you have adequate insulation in the attic and in crawl spaces. The cost: About \$500 to \$700, depending on how many square feet you must cover and the necessary R-value, which is a measure of resistance to heat loss in winter and heat gain in summer. Generally, you'll need anywhere from R-22 to R-38. Installing insulation in your home's walls is relatively expensive and may not lower your energy bills enough to justify the cost. Recovery on energy improvements, however, is very difficult to gauge. Home buyers don't get as excited about less visible and non-glamorous projects such as new insulation. But keeping receipts showing lower fuel bills might help boost the return on this improvement.

Swimming Pool

New automatic maintenance equipment has eliminated some of the hassles in owning a pool, but returns are still notoriously low on this investment—30 percent to 35 percent in cooler climates. Meanwhile, the costs remain high—\$19,500 on average, and elaborate pools can cost over \$30,000. You might recoup more in warmer climates and in posh neighborhoods where a pool may almost be a necessity for resale. If you enjoy lolling around poolside on sunny days, then a swimming pool may be a worthy personal indulgence. But viewed as an investment, this project doesn't really hold much water.

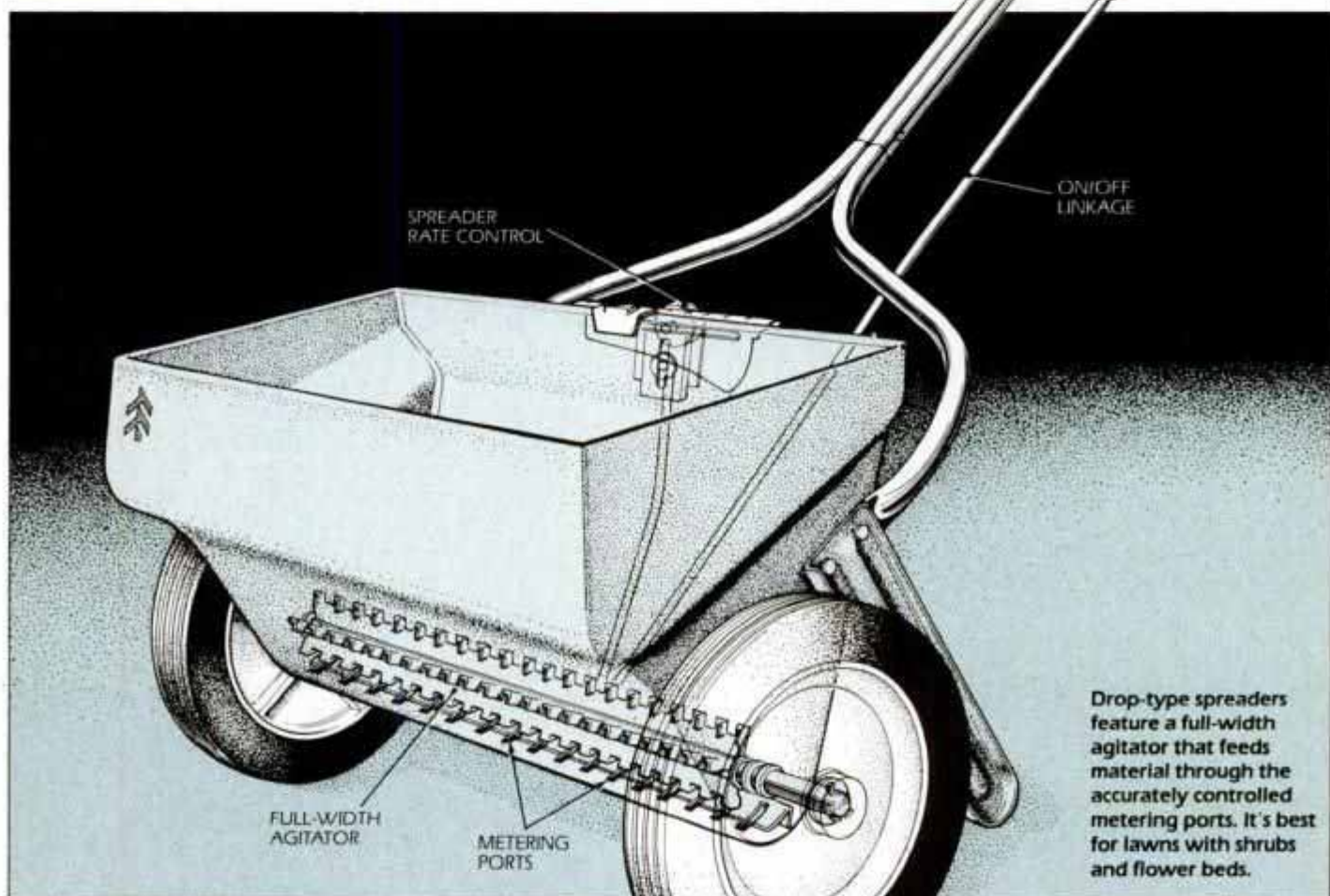
Dollars And Sense Of Home Improvements

PROJECT	COST (\$)	RETURN (%)
Replacement doors, windows	7000-18,000	70-75
New siding with insulating board	4400-6800	75-100
Room addition	23,000-35,000	70-72
Major kitchen renovation	10,000-30,000	75-90
Minor kitchen remodeling	4800-9600	90-95
Adding a full bathroom	5600-12,900	120-130
Remodeled bath	4550-11,500	70-80
Wood deck	3300-7700	75-80
Fireplace	2600-4000	140
Swimming pool	14,000-31,000	30-35 in cold climates 65-80 in Sun Belt

Source: Remodeling Contractor Magazine

How To Choose A LAWN SPREADER

BY PATRICIA AND RICHARD L. PARISH
PM Illustrations by George Retseck



IF THERE'S one thing common to just about every home in America, it's that carefully maintained patch of green that highlights the property. Homeowners who take pride in their lawns know that maintaining it in top-notch condition demands an investment in time and equipment.

On the top of the list of basic tools for a lush, healthy lawn, is the lawn spreader. This machine is designed for spreading granular fertilizers, insecticides, herbicides and grass seed uniformly and quickly. It can also be used for spreading ice-melting materials in the winter.

You have a choice between two distinct spreader designs, each having certain benefits and each suited to your specific requirements.

Spreader models

Lawn spreaders are distinguished by the way they disperse the fertilizer or insecticide. Drop-type spreaders feature a hopper to hold the product being applied and a full-width agitator for uniform dispersal rate. The material flows out through a row of small slots below the agitator. These slots, also called metering ports, can be adjusted to provide the optimum feed rate for the specific product you're applying. A properly maintained and operated drop spreader will provide a very uniform dispersal pattern over the entire width of the swath.

Rotary-type spreaders are comprised of a drum to contain the product and an impeller that spins as the

spreader is being pushed. The spinning impeller broadcasts the material over the lawn as you walk. Rotary spreaders also feature adjustable metering ports, but disperse the product over a much wider swath than a drop spreader. While they don't offer the precise control that a drop spreader does, they're faster and easier to operate.

Making a choice

Before you shop for a spreader, take some time to determine the specific requirements of your lawn and the amount of use the machine will get. If your lawn contains numerous ornamental shrubs or flowerbeds, you'll want a spreader that offers the greatest control over application of chemicals. Some chemicals designed for

lawn treatment can damage or kill other plants in the yard. You must make sure the application is confined to the grass only. Because drop spreaders treat only the area directly under the metering ports they are a good choice for this type of lawn. They do, however, require a short lawn. Taller grass, especially if it's wet, can be a problem due to the low ground clearance of this design. Also, some fertilizers are produced in granules that are too large for the port size of drop spreaders.

On the other hand, if your lawn is large and fairly free of obstructions, a carefully operated rotary spreader will get the job done in far less time. Depending on the manufacturer, rotary spreaders will apply fertilizer in a 2½ to 8-ft. swath. The wider swaths tend to provide a less uniform application and you'll probably find it best to adjust the swath and sacrifice some speed for a uniform pattern. Because the broadcast pattern of rotary spreaders tends to feather out at the edges of the swath, it's easier to get an even dispersal over the entire lawn than with a drop spreader. However, chemical particles are also more likely to fall on areas where you don't want them. A rotary spreader should not be used to apply pesticides unless it throws a narrow swath or the lawn area is open and free from bordering ornamentals or vegetables.

After you've decided which type spreader best fulfills your particular needs, take a close look at the actual construction of the model of your choice. The precision metering components of drop spreaders demand steel construction which is prone to corrosion. Some models offer an epoxy coating on these parts. This feature will at least double the life of your drop spreader regardless of your maintenance schedule. Although

drop spreaders with corrosion-resistant plastic components are offered, they don't achieve the metering accuracy of those with steel or coated steel parts. Rotary spreaders, however, can make effective use of plastic metering components without sacrificing precision because of their large port openings.

Spreader use and care

Each lawn-treatment product is designed to be spread at a specific rate. Too heavy a coverage can injure the lawn and too light a coverage reduces the product effectiveness and may have no effect at all. Make sure you observe the coverage requirements specified for the product you're using and set the spreader rate accordingly. Unfortunately, spreader settings vary from one manufacturer to the next and can vary from one model to the next of the same make.

If you have questions about the rate setting for a particular application and spreader, ask your dealer.

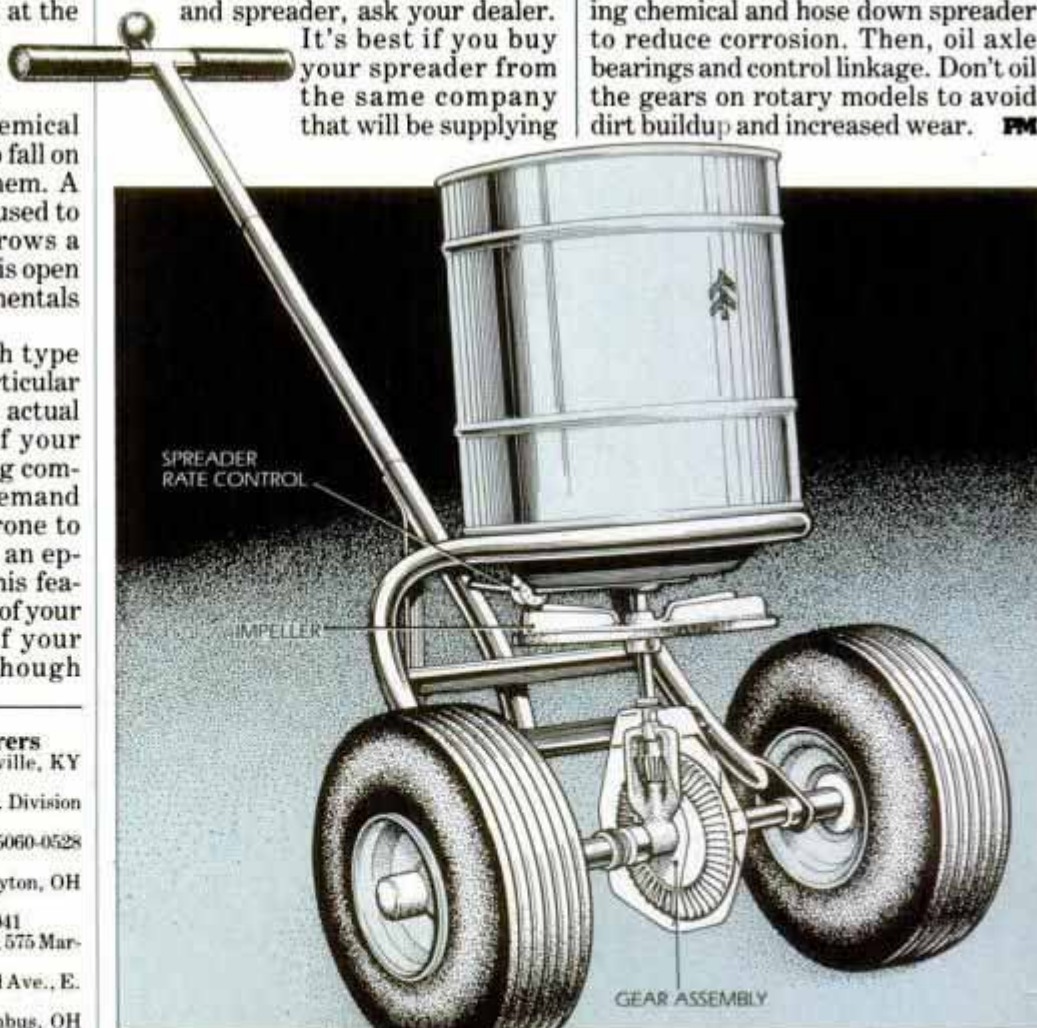
It's best if you buy your spreader from the same company that will be supplying

your chemical applications. This assures you that the coverage specified with the chemical is compatible with the rate settings on your machine.

Before filling the spreader, turn off the spreader control and adjust the rate setting appropriately. Fill the spreader on the driveway or sidewalk, clean up any spills and roll the machine to the lawn. Always have the machine moving when you turn on or stop the spreading control and turn off spreading when you make turns. This helps avoid dropping excessive chemical that may burn the lawn at the beginning and end of a pass.

Pay close attention to aligning consecutive swaths. Each swath of a drop-type spreader must line up with the edge of the last swath. When using a rotary spreader, it's useful to set up stakes at opposite ends of the lawn that indicate the centerline of the pass. After each pass, reposition the stakes to center the next pass.

When finished, empty any remaining chemical and hose down spreader to reduce corrosion. Then, oil axle bearings and control linkage. Don't oil the gears on rotary models to avoid dirt buildup and increased wear. **PM**



The rotary spreader drops the material through adjustable metering ports onto a spinning impeller that's driven by the wheels. An agitator inside the drum keeps the granules moving. Swaths can be as wide as 8 ft., but narrower passes give more control.

Lawn Spreader Manufacturers

- Brinly-Hardy Co., Box 1116, Louisville, KY 40201 (rotary only)
- Central Quality Industries, Inc., 900 S. Division St., Polo, IL 61064
- Gandy Co., Box 528, Owatonna, MN 55060-0528 (drop only)
- Lambert Corp., 519 Hunter Ave., Dayton, OH 45404
- O.M. Scott & Sons, Marysville, OH 43041
- Ortho Division, Chevron Chemical Co., 575 Market St., San Francisco, CA 94105
- Precision Products, Inc., 2415 S. Grand Ave., E. Springfield, IL 62708
- PSB Co., 555 W. Goodale St., Columbus, OH 43215-1171
- Spyker Spreader Works, Box 210, N. Manchester, IN 46062 (rotary only)
- True Temper (Cyclone), Box 3500, Shiremanston, PA 17011

Homeowners' Clinic

BY NORMAN BECKER, P.E.

Shallow Well Pumps Air

I use a shallow-well jet-pump for watering my garden. The problem is that it pumps too much air. The point is located 20 ft. below the surface and there's always about 8 ft. of water standing in the pipe. I attached a 30-gallon tank to the pump to hold reserve water for priming the pump. Every week I must release 10 pounds of air from the tank. Why am I getting all the air?

ROBERT MICHAELS
FREEHOLD, NJ

Since you mention that there's a point at the end of the well piping, I assume you have a driven well and not a drilled or dug well. The pipe that's driven is the pipe through which the water flows. The problem with removing the pump and measuring the water level is that it's being measured under static conditions. When the water is being drawn up the pipe, the level will drop.

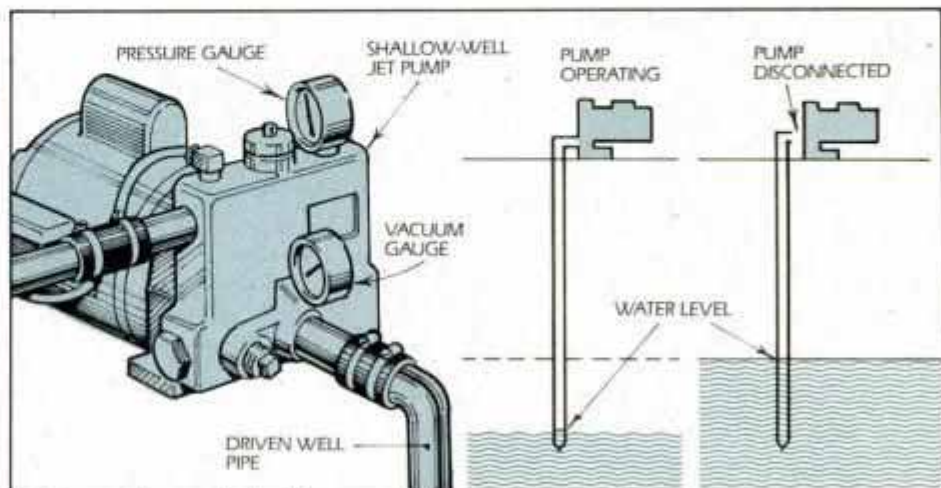
You can check the level of water in the pipe when it's being pumped by connecting a vacuum gauge to the suction line after the check valve. The gauge is calibrated in inches of mercury. One inch of vacuum will pull up water 1.13 ft. If the gauge reads 20 in., the pump is lifting the water 22.6 ft. This includes the effort needed to overcome the friction of the water against the inside wall of the pipe.

If all the joints are tight, then your problem appears to be caused by a low level of water when the pump is running. As the water is pumped, the level descends to the strainer at the end of the point and sucks air from around the pipe. Although there's no guarantee that it will work, you might try driving the point down another 5 to 10 ft.

You should not have to prime the pump each time it's used. If priming is necessary, then there's either a leak in the suction line, a faulty check valve or, possibly, both.

Condensation Between Glass

My 12-year-old double-pane windows have moisture between the glass. Can



Shallow-well water level with pump disconnected can be different than when pump is running. Connect vacuum gauge to suction line to check dynamic level.

they be taken apart, cleaned and resealed?

GEORGE KOSTELNIK
BROWNSVILLE, PA

Repairing a faulty seal in this type of window is not a do-it-yourself project. The process involves removing the existing seal, cleaning out the edge joints and cleaning the panes. Most insulated windows have a spacer around the edges between the panes that contains a dessicant to absorb residual moisture. If the seal fails, the dessicant becomes ineffective and must be replaced. Finally, the window must be reassembled and the edge joints sealed.

The only way for a homeowner to remedy this problem is to buy new double-pane units. Quality manufacturers warrant double-glazed windows against faults that develop as a result of a manufacturing defect, if the problem occurs within the first five years.

Removing Linoleum

We'd like to refinish the hardwood floor that's under the linoleum in our kitchen. Is there an easy way to remove the linoleum?

M.J. DIETCH
PEORIA, IL

Unfortunately, there is no easy way. If the hardwood floor consists of oak strips, and was originally smooth, then the linoleum was probably glued directly to the floor. Begin by cutting the linoleum into 12-in.

strips with a utility knife. Be careful to set the blade depth so that you don't cut into the wood. Use a long-edged trowel to pry up the linoleum strips. A heat gun will help to soften the adhesive as you go. Eventually, you'll remove all the linoleum and some of the adhesive. Portions of the linoleum's felt backing, however, will stick to the adhesive that remains.

If your hardwood floor had open joints or crevices, it was probably leveled with a quick-setting, plaster-like compound before the linoleum was applied. In this case, prior to lifting the strips, pound on the linoleum with a flat object to crumble the leveling compound and facilitate lifting.

After removing the linoleum, you'll have to sand the floor. Be aware that up until about five years ago, the felt backing of linoleum contained asbestos. You can check this by having a sample analyzed or contacting the manufacturer. If it does contain asbestos, and the floor is sanded, then asbestos fibers will become airborne creating a health hazard. In this case, you'd be better off simply covering your floor with a new layer of linoleum.

PM

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

Appliance Clinic

BY STEVE TOTH

Hot-Water Problem

We have an unusual problem with our 9-year-old Kenmore washer model No. 110.72884810, serial No. C80906154. When filling with warm water on any water level, only the cold water shuts off when the level is reached. We have to shut the hot water off at the faucet. The water-level selector switch has been replaced to no avail. Can you help?

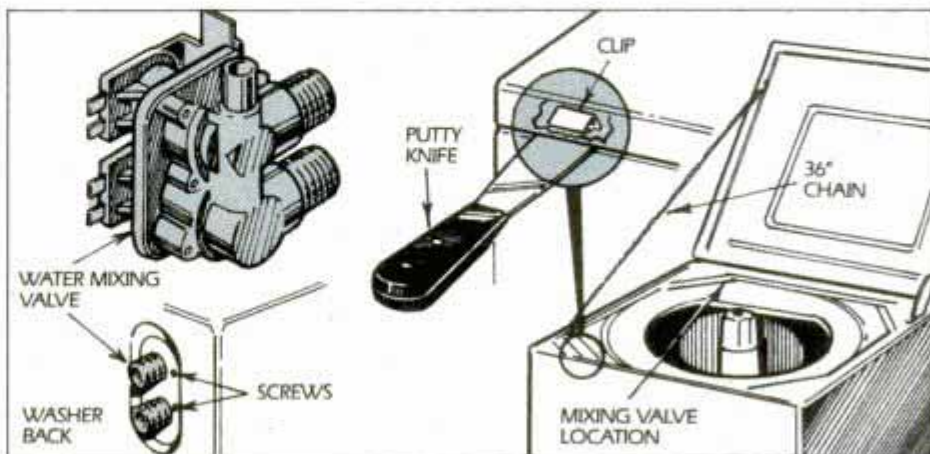
JOHN HANSEN
CURTICE, OH

The water mixing valve may be sticking open or possibly not seating properly. To test this valve, first set the water-level selector switch at a low setting. Then set the machine to fill with warm water. When you get to the point where the cold water shuts off and the hot doesn't, unplug the washer from the wall outlet. If the hot water keeps coming in, your problem is with the water mixing valve. You can get a replacement at any Sears parts or service center in your area. The water mixing valve is part No. 358277 and costs about \$12.

To replace the valve, first unplug the washer and shut off both the hot and cold faucets. Wrap a piece of tape around the hot-water hose so you can identify it later. Then, use a pair of pliers to remove each of the water-fill hoses from the valve. Have a small pail on hand to catch any water that might drain from the hoses. Close the washer lid and tape it shut with masking tape.

Next, insert a putty knife between the cabinet top and front about 2½ in. in from the corner. Push in on the knife to release one top locking clip. Then, move to the other corner, release the other clip and slowly lift the hinged top. To keep the cabinet top open and prevent it from pivoting too far back, use a 36-in. length of chain with S hooks at both ends. Hook one end of the chain to the corner brace of the cabinet front and the other end to the corner brace on the top.

You'll see the water mixing valve at the rear between the left side of the cabinet and the tub. Remove the wires from the valve and label each as to the terminal it was on. Remove



A faulty mixing valve is removed by first disconnecting both water hoses. Then, open the top and disconnect the wires and fill hose. Free the valve by removing screws at rear of unit.

the hose clamp and fill hose from the top of the valve. Now, go to the back of the machine and remove the valve mounting screws with one hand while holding the valve with the other. Carefully remove the valve from the cabinet. Reverse this procedure to install the new valve. The hot-water hose that you marked earlier attaches to the bottom connection on the valve.

Dryer Trips Breaker

Our Kenmore electric dryer model No. 110.77455700, serial No. M42213976 is wired to a 20-amp, double-pole circuit breaker. While the dryer sometimes completes the cycle, more often the circuit breaker trips and we have to reset it—often three or four times—to finish the load. The breaker has been replaced with no improvement. The dryer functions perfectly otherwise.

C. E. DICKENS
LAMESA, CA

According to the manufacturer, a 20-amp circuit is inadequate for your dryer. It's recommended that your unit be attached to a separate, grounded, 240-volt circuit protected by two 30-amp circuit breakers or equivalent.

Minimum wiring for a 30-amp circuit requires No. 10 copper wire. I recommend you have a licensed electrician check that your dryer circuit wire is heavy enough for handling 30 amps and, if so, install the correct circuit breakers.

Oven Still Works

While checking the indicating lights in the control panel of our Sears Double Oven gas range model No. 103.7857001, serial No. 0090483, I noticed that a 10,000-ohm resistor in the lower oven door locking circuit was burned in two. I don't know how long it has been this way, but the oven seems to work normally. Do you know what purpose that resistor serves and is it safe to continue operating the oven?

ORVILLE KERSEY
CROWN POINT, IN

It's not safe to use your oven without this resistor. Its purpose is to prevent a direct short during the cleaning cycle through the selector switch and prevent the unlock solenoid from drawing enough current to unlock the door. This condition would not effect the bake or broil circuit, but would prevent the indicator light from coming on during the clean cycle.

If this resistor fails, as it has in your case, it's recommended that it be replaced with an 18,000-ohm, 2-watt resistor and that adequate insulation be used to prevent shorts between the resistor leads and either the range or other wires. The replacement resistor can be purchased from any Sears parts distributor. It's part No. 68-18321 and costs about \$1.

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

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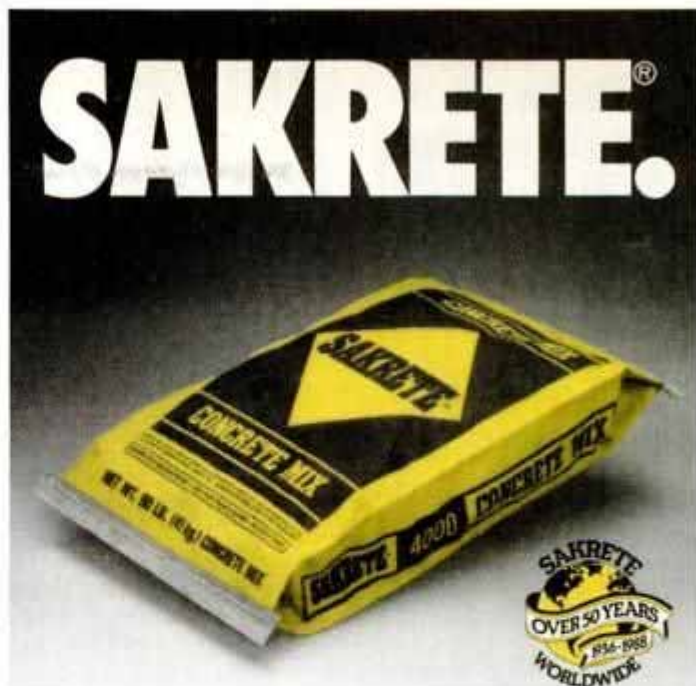
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THE WRITE STUFF

(Continued from page 77)

$\frac{5}{1000}$ of an inch. Nibs are traditionally constructed of steel or gold, the only metals impervious to the corrosive elements in ink and yet flexible enough for writing. The best fountain pens have nibs crafted of 14- or 18-karat gold. Because gold is softer than steel, nibs made of the precious metal flex more, and therefore need less force to move them along a surface. For cosmetic purposes, the steel nibs in less expensive pens are sometimes electroplated with gold but this does nothing to change their writing characteristics. Solid-gold nibs are invariably engraved with 14- or 18-karat designations, their numerical equivalents (585 or 750) or both.

Fused to the very tip of the nib is the pellet, which makes direct contact with the paper. It's made from a supertough metal, usually an iridium alloy. The pellet's shape determines the nib style.

Nibs come in a variety of configurations: Some typical widths include extra-fine, fine, medium and broad. The size of your handwriting should play a part in choosing a particular nib. As a rule of thumb, people who fashion small letters incline toward fine nibs while those who write in larger than average strokes are more likely to prefer broad.

Some makers, such as Parker, offer a choice that goes beyond simple line width. Oblique nibs, for example, employ angled pellets that can be used to combine broad and fine strokes for a more stylish script. Southpaws may prefer left oblique nibs, more appropriately angled for those who must literally push the pen across the paper rather than letting the nib follow the hand from left to right.

According to Marilyn Brown, who manages The International Pen Shop at Art Brown & Bro. in New York, heavy-handed writers should choose pens with an inlaid-nib design, found in some Sheaffer models.

Writing with a fountain pen is like driving a car in that people prefer different handling characteristics. A pen may be slim or, in the case of the classic Mont Blanc Diplomat, fat and cigar shaped. Some pens are extremely light while others are heavy. Marilyn Brown suggests that neither your sex nor the size of your hand should determine what you buy. The key, she says, is comfort. Whenever possible, "test-drive" a pen before you purchase it.

Care and where

It is best to fill a pen with fresh ink since the passage of time might cause crystallization and consequent clogging. Experts differ as to what constitutes "fresh" but agree that if crystallization

is evident in the bottle, the ink is no good. And although plastic is not a perfect vapor barrier, sealed ink cartridges should stay fresh longer than ink stored in bottles, which is exposed to air each time you go to the well. Every major fountain pen manufacturer markets ink and, since each is optimized for that maker's pens, matching pen and ink brands is the recommended procedure.

You should always carry and store your pen vertically, nib upward, to keep ink from clogging the nib. The nib-up carrying position is especially important in airplanes, where pressure outside the pen may suddenly fall below that inside the reservoir and force ink outward. Some experts recommend either completely emptying or filling a pen before flights. Makers of piston-fill pens advise bleeding off two or three drops of ink once the pen is full. Holding a fountain pen nib-upward when opening it after a flight is also a good idea—in case it does leak.

As far as cosmetics go, the best pens are jewelry and should be treated as such. Sheaffer recommends periodic polishing of gold and silver pens with a jeweler's rouge cloth or with a small amount of jewelry polish. The company suggests you clean lacquer finishes by wiping with a soft, moist cloth to remove surface dirt, then polishing with a cloth made for the purpose. Matte and other finishes can be wiped clean with a soft cloth dampened in a mild solution of liquid detergent and water. Abrasive cleaners should never be used.

You'll find the broadest assortment of fountain pens in stationery and art-supply shops, though department stores, jewelers and even tobacconists carry a selection, too. You can also buy by mail. Comprehensive catalogs are available for free from Art Brown & Bro. (2 W. 46th St., New York, NY 10036, (212) 575-5555) and from Fahrney's Pens (1430 G St. N.W., Washington, D.C. 20005, (202) 628-9525). These retail shops also perform repairs. According to Nunzio De Pietro, parts are difficult to find for pens more than 40 years old, especially from defunct manufacturers. For this reason, he says, collectors often hunt for old pens and cannibalize them for parts.

If you have an old pen, or if you're interested in collecting, you'll find a friendly welcome in The Pen Fancier's Club (1169 Overcash Dr., Dunedin, FL 33528). The club's various publications, including a monthly magazine, provide details on pen history, values and repair. In addition, the club sells replacement parts and repair tools for fans who want to fix their own, and also serves as a trading post for selling and swapping among members—giving new meaning to the term "pen pals." **PM**

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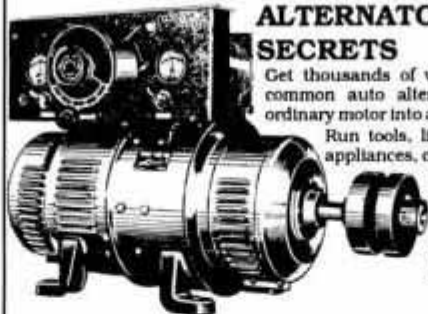
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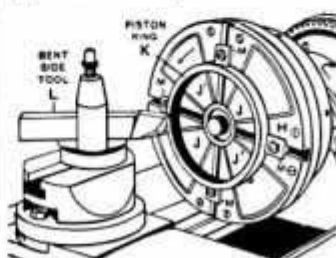
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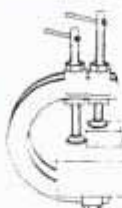
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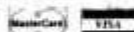
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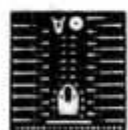
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(Continued from preceding page)

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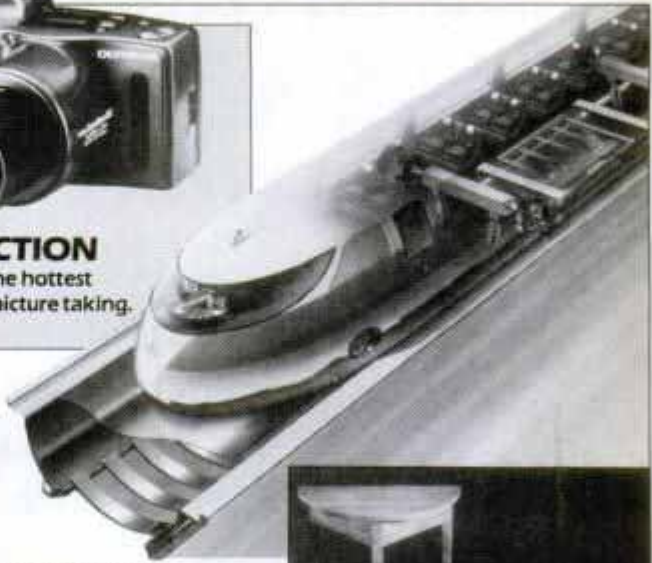
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