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To Be The Best-Selling Truck, Than Tough.



Up front: Ranger and F-Series pickups offer the broadest range of multi-port fuel-injected engines. In back: wide, deep pickup boxes provide big maximum payloads and cargo-handling flexibility that are tough to beat.



Ford's exclusive Touch Drive System, standard on select 4x4 models, lets you switch from 2- to 4-wheel drive High and back, on the fly, with one push of a button.

RESALE
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An independent survey predicts: over the next 5 years, the full-size Ford pickup will cost less to operate than a comparable Chevy. And, will be worth more at trade-in time.**

OPERATING
COST

P R N D 2 1

Ford's full-size pickups offer an advanced-electronic automatic transmission designed for smoother shifting and 25% better highway mileage.*

**BEST
BUILT
BEST
SELLING**

Based on an average of consumer-reported problems in a series of surveys of all '81-'90 models designed and built in North America; and full-line sales by division.



*1991 EPA Highway estimate for E40D vs. '90 estimate for C-6 transmissions. ** IntelliChoice™ Inc., San Jose, CA, 1990. Base model F-150 with selected options vs. Base model C-1500 with selected options. Resale based on average for 5-yr. old models.

You've Got To Be A Lot More

If the truck you buy is going to last for years, it better be more than tough.

That's why Ford keeps making *its* trucks even more comfortable. The roomy interiors get better appointed, the choice of amenities, wider.



**Ford Trucks.
The Best Never Rest.**

The list of engineering advances grows longer.

It's no wonder the competition has found that catching up is considerably more than tough.



THE BEST-BUILT, BEST-SELLING AMERICAN TRUCKS
ARE BUILT FORD TOUGH.



Buckle up—together we can save lives.

This One



2XEN-TF9-Y3KF

ANGLER USES HIS IQ TO FIND GOLD AT THE END OF THE RAINBOW.

You won't let the big ones get away if you use your IQ—the super slim IQ Zoom 700.

This incredibly compact camera offers a full range of automatic features that are simple to operate. So you can reel in all the photos you want with just the push of a button.

The power zoom lens, first introduced by Pentax, lets you choose any focal length between 35mm and 70mm. And the macro setting lets you hook even the tiniest guppy.

The IQ Zoom 700 has many other special features that make picture-taking fun, and easy. Built-in auto-flash, backlight compensation, daylight sync and slow shutter-speed sync assure beautifully exposed photos from sunrise to sunset.

This user-friendly camera even has such unconventional creative features as a multi-exposure mode, and the self-timer lets you catch yourself with your catch, twice, with only one setting.

When you use your IQ you'll fall for picture-taking hook, line and sinker. And that's no fish story!

PENTAX
IQZoom700

© 1990 PENTAX CORP.



Caught with a Woolly Buggie, backlight compensation, and 70mm zoom lens.



Slow shutter speed sync.



Anchor your shot with focus lock.



All pictures taken with the IQ Zoom 700 and Kodak Ektar film.

Popular[®] Mechanics

OCTOBER 1990
VOLUME 167
NO. 10

PM PHOTO BY HUMPHREY SUTTON



25 COVER STORY

All that's new from Detroit for '91.
—PM cover photo by
Bruce Crabb/G Photo



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EDITOR'S NOTES

● It's hard to believe, but another year has passed and here we are with our annual new car issue. This year's new car issue is actually three issues. Our first report on the early release '91s appeared in April. On page 25, you'll find the second installment on Detroit's newest enticements. And we'll have a final report on what's new in imported cars in December. Gathering all the new model information we bring you each year is truly a staff-wide task. Our Auto Department editors—Tony Swan, Jim Dunne, Mike Allen, Rick Titus—traveled not only across the U.S. several times each, but to Europe and Japan as well. But the final piece of the picture was completed right in our backyard—at Raceway Park in Englishtown, New Jersey—where a bunch of us gathered to shoot the lead photo for our '91 new car coverage. The gleaming red Firebird Formula sparkled in the sun. Photographer Humphrey Sutton put the last roll of film through the camera and the story went to bed. . . . You walk




Keith Ferris and his "First Jet-Versus-Jet Victory."

into the Smithsonian's Air and Space Museum in Washington, D.C., and you're plunged into a time warp by a wall-size mural. Suddenly, it's Aug. 15, 1944. A Messerschmitt and several Focke-Wulf fighters roar through the blue sky 25,000 ft. over Germany, trying to shoot down four Boeing B-17 Flying Fortresses that have just bombed a Luftwaffe airfield in Wiesbaden. The 75 x 25-ft. mural, titled "Fortresses Under Fire," was painted in 1975 by aviation artist Keith Ferris, who, I am proud to say, has been contributing to PM for many years. The mural is accurate right down to the number of rivets on the nose of the B-17. Ferris didn't depict just any B-17, but a B-17G from the Eighth Air Force's 303rd Bomb Group on Aug. 15, 1944, on the plane's 72nd mission. When we asked Ferris to illustrate our tribute to the F-80 (page 48), America's first operational jet fighter, he asked which one on which day? Says Ferris, "I like to paint a specific moment in time." So after much research, he decided to depict 1000 hours, Nov. 8, 1950, in the skies over Sinuiju, Korea. At that instant, 1st Lt. Russell J. Brown downed a MiG-15 with his F-80 in the first jet-versus-jet combat in history. Nobody does it better than Keith Ferris. Till next time.



A typical shoot at Raceway Park (l. to r.): Deborah Frank, Suzanne McCreight, Barbara Novak.

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Joe Oldham

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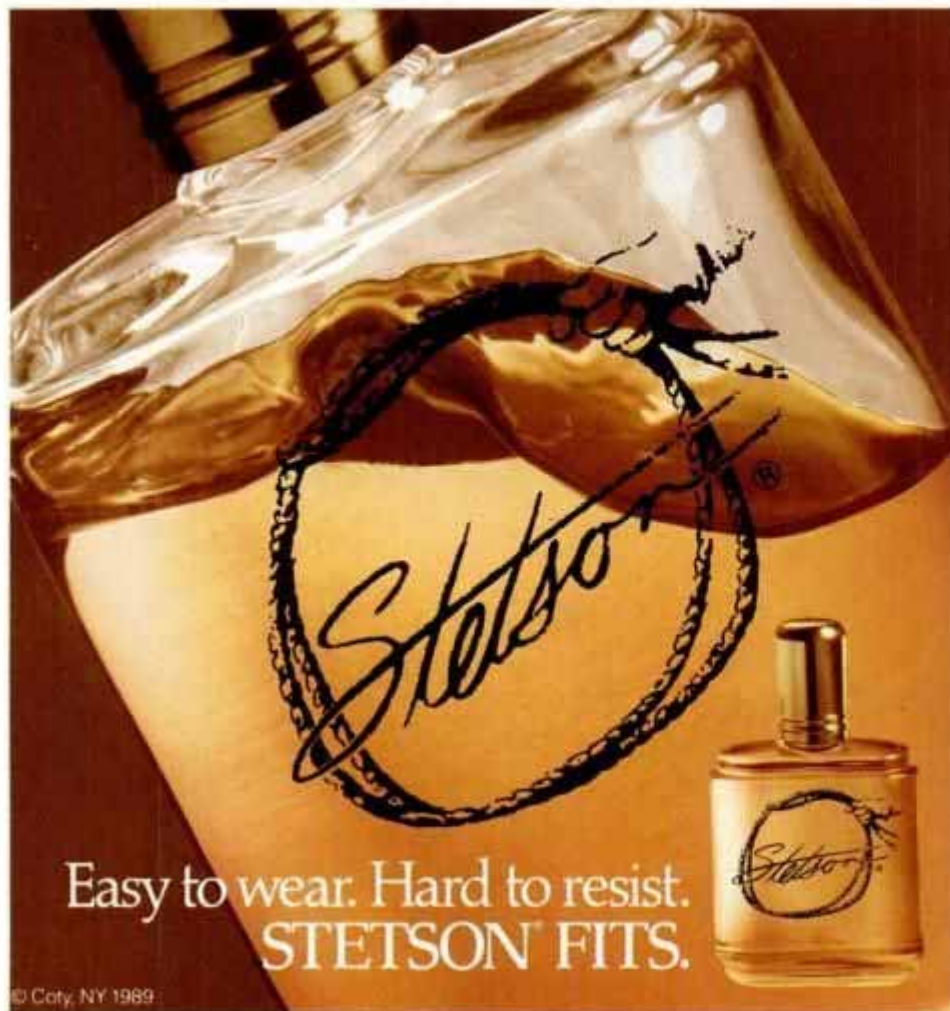
For more information on the Reliance In-Home Service program and Sta-Kleen self-cleaning gas water heaters, call 1-800-365-4054.



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know them.

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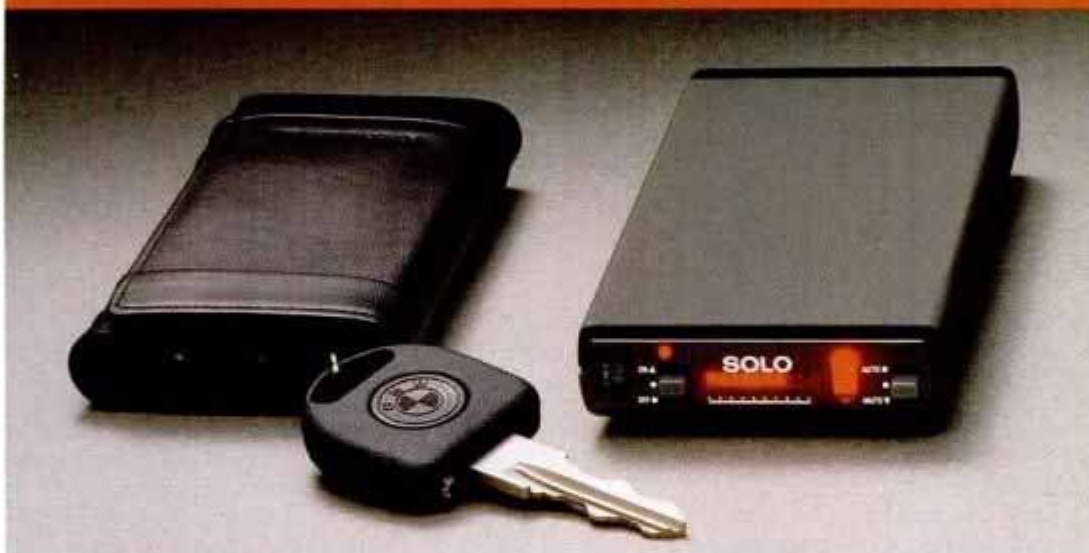
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NEW! From the maker of Passport and Escort



Finally, a radar detector so advanced,
you'll never be bothered with a power cord

Self-powered SOLO

Until now, high performance radar detection required a messy power cord. Plugged into your car's lighter. Dangling across your dashboard. And tangling in your pocket.

Finally, there is a better way.

No power cord

Solo is a totally new concept in long-range radar detection. All you do is clip Solo to your visor or windshield, and switch it on. It's that simple.



Solo comes complete with all accessories, including visor and windshield mounts that instantly conform to any car, but fold flat for convenient carrying. Both designs are patented.

You'll never need a power cord. Unlike any other radar detector, Solo has its own power source — inside its compact magnesium housing (Solo is 3/4" x 2 1/4" x 4 1/2" — just 5 1/2 ounces).

How it works

After years of research, our engineers (who also designed Escort and Passport) developed circuitry fifty times more efficient than conventional detectors. This design provides long-range radar warning for 200 hours on a single 9 volt battery.

If you drive one hour a day, you won't need to replace Solo's battery for over six months. (Even if you drive two hours a day, you'll get over three months.)

WHAT THE EXPERTS SAY

"No other detector manufacturer has anything even close...Solo moves the state of the art to a higher plane."

BMW Roundel

"The most user-friendly detector yet... we fell in love at first beep."

AutoWeek

No compromise performance

With Solo, you get long-range radar warning with no hassles. And you never have to worry about Solo's performance.

Solo maintains all of its radar warning capability over its entire battery life. Solo is even smart enough to turn itself off if you forget. When it's finally time to replace the battery, Solo will tell you five hours in advance.

Order today and try Solo
for 30 days at no risk

Call toll-free 1-800-543-1608



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Then just drop in another lithium battery for 200 more hours (or use a standard alkaline to power Solo for 80 hours). Solo costs less than three cents per hour of use.

Experience the freedom

You'll slip your Solo into its carrying case and carry it in your shirt pocket. In your car, just clip Solo to your visor and switch it on.

It's so easy, you'll never go without radar protection again. And now a special offer lets you try Solo for 30 days at no risk.



Solo's super efficient design never needs a power cord. A 9 volt battery provides 200 hours of power — several months of radar protection for most drivers (at a cost of only three cents an hour).

We GUARANTEE your satisfaction

Solo is available from us only, and comes complete with our Digital Key anti-theft system, all mounts and accessories, two batteries, and a one year limited warranty.

Here's our offer. Try Solo. If for any reason you're not completely satisfied, just return Solo within 30 days. We'll refund all your money and even pay your return shipping cost. You can't lose.

Once you try self-powered radar protection, nothing else will do. Order today.

LETTERS

Back To The Future

Say what you may, but the 1991 Chevy Caprice in your comparison test of the Caprice and the Ford Crown Victoria (page 56, July '90) still looks like a customized, chopped, channeled and sectioned '53 Buick. And the more I see the new Caprice, the better I like the '53 Buick. I miss the portholes in the fenders.

REV. JACK HENSLER
ANSON, TX

the way, I still own the pontoon boat I built from plans in your March '59 issue. A photo of the boat appeared in your April '61 issue. You might say that PM plans never die, they just get stored away.

JACK ENGLISH
BARNESVILLE, OH

Prewar Bird

Your June '90 issue has a very short article about the Douglas-built B-19 (Time

diesel is built by Cummins and is an industrial engine unlike the diesels produced by Ford and Chevrolet. In spite of its smaller size, it produces more torque, and it also provides amazing fuel mileage. My personal experience is that in the city, 18 miles per gallon is about average, while on the road, towing a 6000-pound trailer at 80 mph for 300 miles, I averaged 21.5 mpg. Maybe this is why Dodge is working overtime to produce them.

RICHARD R. ULRICH, M.D.
TYLER, TX

Kitchen Coupe

When we decided to redo our kitchen, my wife and I looked at dozens of magazine articles on what to do with our original cabinets. But it was to no avail.

Then we remembered your April '90 issue Kitchen Remodeling Guide (page 83). Presto! There was our kitchen. We took the Guide to our local builder and asked him to find the items listed.

We did all the work ourselves, including plumbing and electrical. And we saved hundreds of dollars. Thanks,

JIM AND LIL CRITCHFIELD
PLACERVILLE, CA

Family Tradition

I am a 61-year-old wife, mother, grandmother of 10 and a full-time secretary. I have been reading your publication for at least 50 years. My dad is 92 years of age now, and he still likes to read PM—it has always been in our home. I read it from cover to cover and have become interested in woodworking projects to the point where I am asking my husband for some woodworking equipment for Christmas. I have less than one year to retirement, and I want to try my hand at some of the projects I have seen in PM. Keep your magazine the same as it's always been. I wouldn't change a page of it.

MRS. ULMAN V. WHITE
CAMBRIDGE, MD

Decked Out

We frequently save project ideas from your magazine and want to thank you for your deck plans (page 90, June '85). This was our first building project, and with your detailed plans, we were able to complete it successfully. We take great pride in having built it ourselves.

KEVIN AND TERRY FULTON
ISSAQUAH, WA



The 1991 Chevrolet Caprice: A 1953 Buick in disguise?

It's Here Someplace

I've been a subscriber to POPULAR MECHANICS for several decades and have an extensive collection of back issues. The impending arrival of our first grandchild prompted a search for the issue that featured plans for a baby cradle, which I remember seeing years ago. I found it in the May '80 issue. While looking for the cradle, I came upon the Feb. '62 issue, which featured plans for a home fitness gym belt. With my wife and I constantly fighting the weight battle, I built this project also. I couldn't find a manufactured belt in my area, so my wife and I made our own from drapery header material. By

Machine, page 14). For many years I have wondered if the world knew about, or cared about, the B-19. I have a 12 x 18-in. colored photo of this behemoth. The photo is copyrighted by Douglas Aircraft in 1941.

The photo also has all the technical details of the B-19 printed on it.

It's amazing to me, looking back at this vintage photo, that the B-19 aircraft would have cost U.S. taxpayers only \$3.5 million per copy to build and manufacture.

JACK W. WILDER
PORT LUDLOW, WA

Dodge Tough

Regarding your "Diesels Are Back" story in your June '90 issue (page 62), the Dodge



As first-time deck builders, the Fultons are a PM success story.



Top hat, white tie¹ and trails.²

The Mitsubishi Montero is the ideal vehicle whether you're putting on the ritz for evenings in the city, or mapping out three weeks in the woods. But you don't have to take our word for it. Simply listen to some of the experts:

1 "As designer utility vehicles go, the Mitsubishi is my new favorite, more fun to drive than an Isuzu or a Cherokee and almost as comfortable as a Range Rover," wrote Michael Jordan in *Automobile* magazine. "It looks tough yet expensive."[†]

2 *Motor Trend* reports, "On a recent trip to Mt. Pacifico in the Angeles National Forest, we gave the Mitsubishi a thorough workout over dirt, rocks, sand, brush and gravel. On the twisting roads... the four-door's power-assist recirculating ball steering was quick and responsive, almost to the point where it felt like we were pilot-

ing a sports car around the corners."^{††}

"An uncommonly civilized vehicle," wrote *Car and Driver*, "the Montero takes you where you want to go in style, in comfort, and in the right price bracket." Their final judgment: "Best Buy, 1990" in sport utility vehicles under \$20,000.

When professional opinion of a vehicle runs this high, we don't need to add much more than a few specs: Montero's engine is a 3.0 liter, 143 horsepower V-6. Front suspension is independent torsion bar; rear is 3-link coil spring. Hubs lock automatically.

For the Mitsubishi Motors dealer nearest you, call 1-800-447-4700. He'll have a lot to tell you, too.

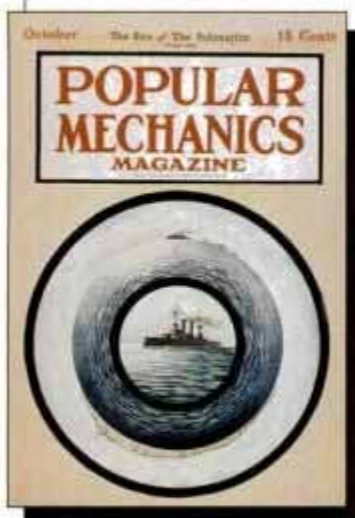
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MITSUBISHI
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TIME MACHINE

75 YEARS AGO: OCTOBER 1915



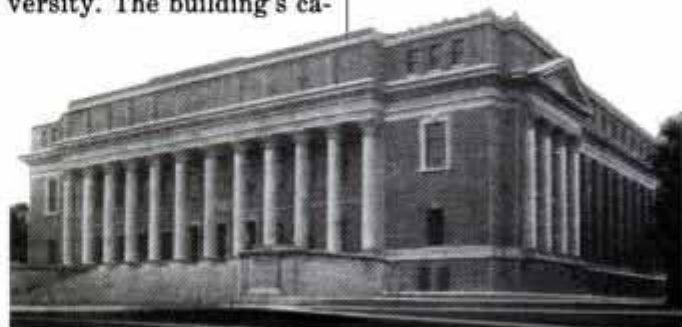
All-Seeing Eye

Not known as a submarine power, France nevertheless made key early technical contributions. Having invented the prismatic periscope in the 1870s, the French produced a panoramic version in 1915. World War I sub commanders had complained that they could scan only one horizon at a time. The French solution combined an annular lens and a straight-forward lens atop the scope. The panoramic image ringed the narrow-field image without interference.

Book Bonanza

A symbol of the nation's emerging intellectual confidence, the enormous Widener Memorial Library was completed at Harvard University. The building's ca-

capacity rivaled that of the New York Public Library and the British and French national libraries. Today, with underground addenda, it has over 3.5 million books.



50 YEARS AGO: OCTOBER 1940



Road Warriors

California was cultivating its car culture, and engineers were busy weaving a network of highways across the state. In our cover story, we detailed the roadbuilding hardware that was carving up the countryside. Back then, specialized vehicles such as caterpillar earth-movers were new on the scene. Where they weren't available, engineers often had to improvise—borrowing hydraulic equipment from nearby mines to scour tunnels through mountains.

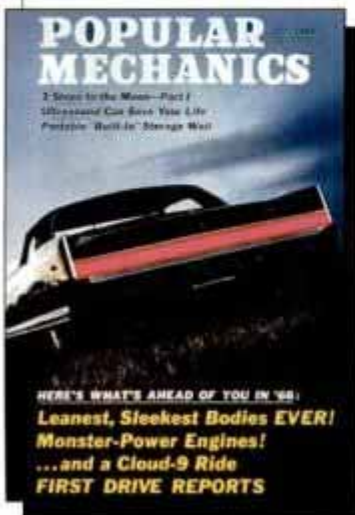
Lighter Than Air

Armchair strategists played guessing games about the role of the balloon in the new European war. Would the defensive balloon barrages over London hold up against the Luftwaffe? Would the British loft flocks of sounding balloons over Germany to distribute leaflets? Would aerial minefields be effective, or even sensible? The questions proved moot, since the golden age of the airship had ended with the *Hindenburg* disaster. Nevertheless, the U.S.

Navy continued testing its new helium-filled blimps.



25 YEARS AGO: OCTOBER 1965



Kicks In '66

Horsepower frenzy was at its peak as Detroit's 1966 models roared off the assembly lines. A Continental with a 462 cu. in. V8 led the charge, followed by Fairlanes, Comets and Chevilles, each harnessing well over 300 horses. Carmakers stayed with the styling of previous years, but peddled gimmicks, such as heated seats and back-seat TVs. Perhaps to lure regulators away from the monster powerplants, they also stressed new safety features such as shoulder straps.

Giant Steps

Moonwalking was four years off, but *Apollo* technology was already undergoing testing. A prototype lunar excursion module was on its way to NASA's huge new vacuum chamber in Houston. Astro-tailors were putting finishing touches on the Moonsuit, complete with aluminized skin, water-cooled underwear and a life-support backpack. Other hardware in the works included the then-miniature handheld TV camera that delivered the great moment in 1969.



On our way to the HDRA/SCORE Class 8 Championship we passed 57,942 cacti, 127,391 snakes and 47 Sunday Drivers.

There's no limit to what winners can achieve when they stick together. And when it's the winners that make up American Thunder, the off-road truck team sponsored by Mobil 1, BFGoodrich T/A Radials and Chevrolet, we proved you can really stick it to the competition.

During American Thunder's championship run, Mobil 1 proved time and again that it provides superior engine protection both on-road and off. BFGoodrich T/A radial truck tires were on a roll, too, providing control and performing exceptionally on some of the most unpredictable courses in the world. And Team Chevy's specially equipped C/K pickup did the rest. With Frank "Scoop" Vessels providing the finesse, guts and perseverance needed to take HDRA/SCORE's Class 8 championship.

So don't pass by your opportunity to ride with the winners, or they just might pass you in the process. Ride with Mobil 1, BFGoodrich T/A Radials and Chevrolet and feel the power of American Thunder.



HDRA / SCORE
INTERNATIONAL



CHEVY TRUCK

Mobil 1

BFGoodrich
Tires

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HOW NORELCO TOOK A RAZOR THAT WAS SEEMINGLY PERFECT AND MADE IT BETTER.

For the 1990's, Norelco® engineers have raised the standards of shaving excellence by creating a revolutionary new shaving system. A Norelco razor that shaves even closer without giving up any of its



Not to scale. More hair enters the chamber of the improved "Lift and Cut" system.

Improved system lifts and exposes additional hair.

Improved system cuts hair even closer.

legendary comfort.

This new standard of shaving excellence was achieved through major improve-

ments in virtually every area of the Norelco patented "Lift and Cut"™ system. The comb slots have been redesigned so hair growing at any angle can be quickly

directed to the blades. The cutting system has been engineered to shave even closer without the blades touching your skin. And an improved bearing mechanism delivers a more consistent, smoother cutting action.



Together, these engineering advances shave you closer than ever. Yet not one iota of comfort has been lost. Rather, you've gained a new level of closeness and comfort. The new Norelco. The seemingly perfect razor just got better.

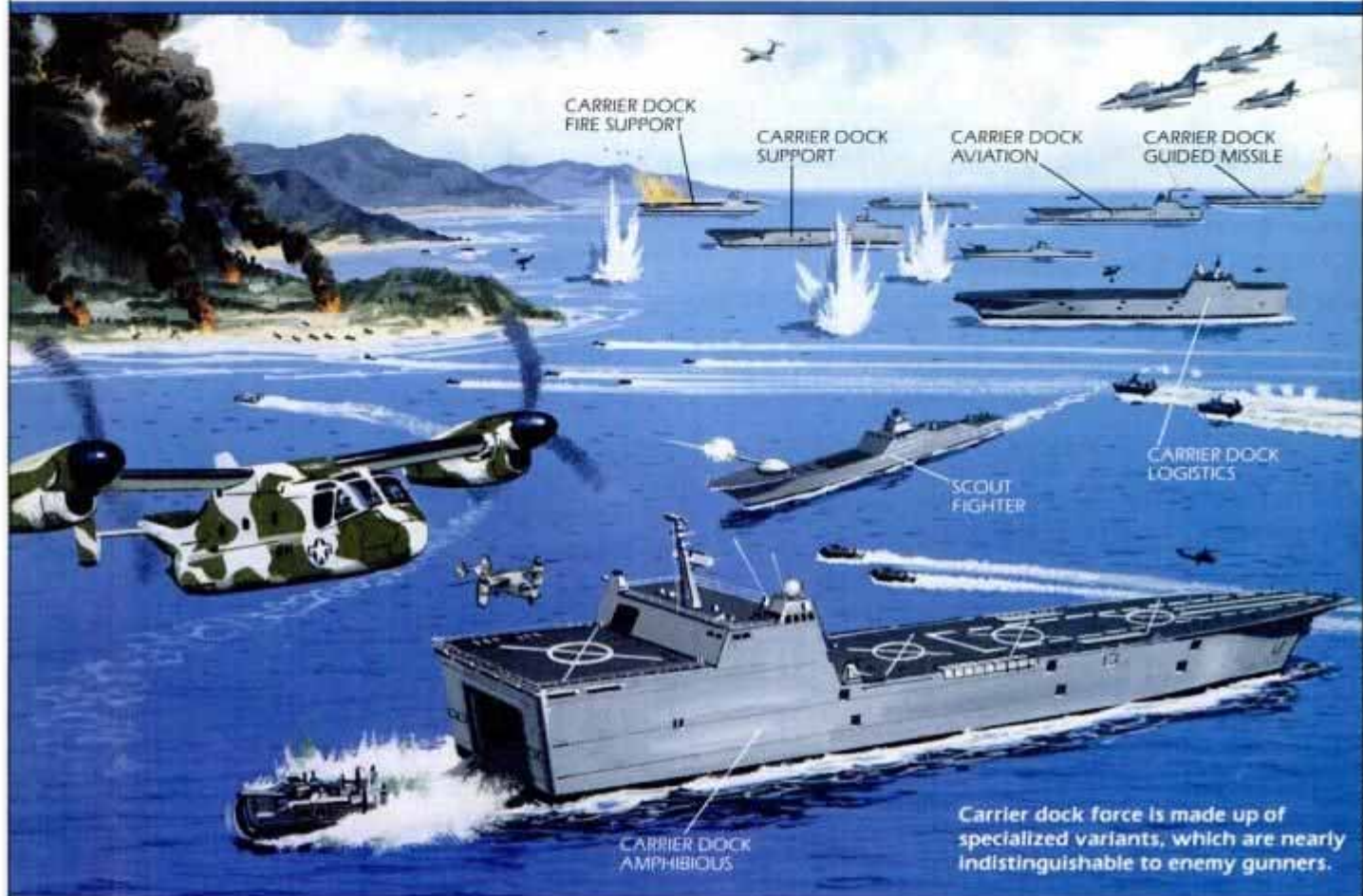


Norelco
A NEW LEVEL OF
CLOSENESS AND COMFORT.

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TECH UPDATE

News Of Tomorrow's Technology Today



PM ILLUSTRATION BY ED VALIGURSKY

Battleforce 2030: One Design, Many Missions

BETHESDA, MD—Forty years from now, the Navy may build its battle groups the same way Chrysler builds cars—with a diverse range of special-purpose vessels, all based on a single platform.

Researchers at the Navy's David Taylor Research Center envision a type of vessel called the Carrier Dock Multimission. Although each ship of the type could be customized for amphibious operations, logistics, fire support or other tasks, all variants would share a landing deck for short- and vertical-take-off aircraft, a well deck to release amphibious assault craft, and common combat and propulsion systems.

The advantages? In addition to reduced costs due to economies of scale, the ships' similar silhouettes would conceal their mission-specific roles from the enemy. And if a key ship is disabled, another can quickly be adapted to pinch hit for it.

The V-22 tilt-rotor figures heavily into the concept, as does an AEGIS-type anti-air warfare system, in which vessels cooperate in launching and targeting missiles. Gas turbine generators would provide electric propulsion and could feed power to directed-energy weapons and aircraft catapults.

Editor: Abe Dane
Assistant Editor: Greg Pope
Contributor: Oliver Fultz

Carrier dock ships would travel with conventional nuclear-powered carriers and a new class of minidestroyers

called scout fighters. Proponents hope the vessels can be phased in, starting around the year 2000.

Highlights This Month

- **Riding The Iron Highway**—Rail haulers pin hopes on ultralong freight car.
- **Electric Firepower**—High-watt weaponry for tomorrow's tanks.
- **Magnets Map The Mind**—Superconductors detail the brain's electric landscape.
- **Rush For Slush**—Semifrozen hydrogen could fuel and cool aerospace planes.
- **Sneaky Sea Drones**—Unmanned vehicles augment naval power.
- **Steel Gets Lean And Mean**—New technology strips costs from steelmaking.

Slush Fuel For Space Plane

CLEVELAND, OH—Engineers at NASA's Lewis Research Center are studying hydrogen slush in hopes that it may prove the ideal

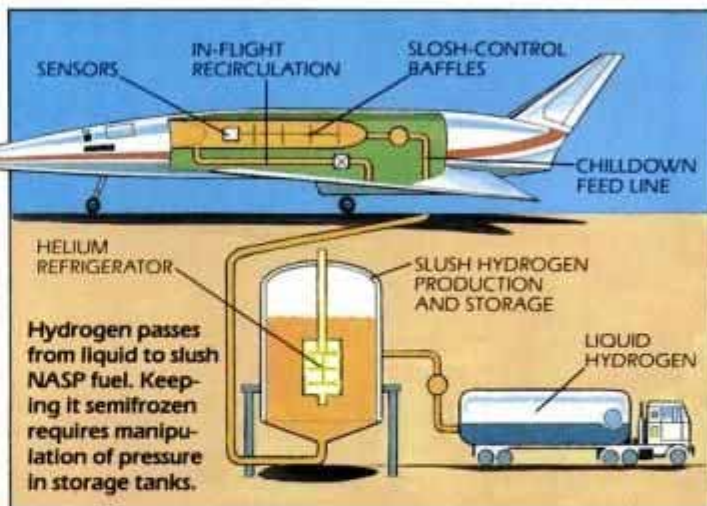


Slush test tank is mounted in a vacuum chamber.

fuel for the National Aerospace Plane (NASP).

Colder and denser than current liquid-hydrogen fuel, the semisolid slush would keep the plane's weight down by requiring smaller fuel tanks. In addition, slush can absorb more heat as it recirculates behind the plane's skin to cool surfaces baked by high speeds.

But the production and storage of slush hydrogen is complex. The best established manufacturing method is evaporative cooling, in which liquid hydrogen is subjected to lower and lower pressures, which force down its temperature. An alternative is to expose liquid hydrogen to an even colder liquid-



helium refrigerator and scrape off the hydrogen ice formed on the surface.

Large-scale testing of production and handling techniques first became possible earlier this year, when Lewis

put a new 800-gallon slush generator on-line. Meanwhile, other researchers are learning how to control the complex changes in pressure occurring inside a slush fuel tank during fueling or flight.

Flying-Donut Drone

STRATFORD, CT—A unique unmanned air vehicle developed by Sikorsky Air-



Aircraft tested Cypher concept.

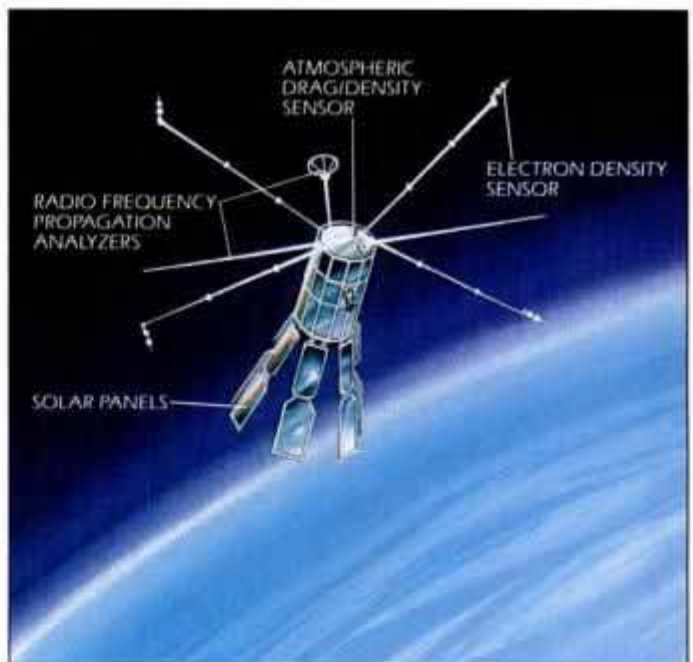
craft flies on a shrouded pair of independent coaxial rotors. Outfitted with camera and sensors, the drone could fly 3- to 4-hour reconnaissance missions.

Known as Cypher, the radio-controlled vehicle would be comparatively simple to launch and recover. Able to hover while its landing gear retracts or extends, it could launch from confined areas, such as decks of patrol boats or even from helicopters.

Sikorsky has already flown a small proof-of-concept craft and is now performing wind-tunnel tests before deciding whether to go to a full-scale prototype.



Vertical takeoff enables deployment from deck of a small vessel.



TRW's lightweight STEP satellite will fly on Pegasus.

Satellites Lose Weight

REDONDO BEACH, CA—A trend toward cheaper, lightweight satellites is materializing, thanks in large part to the success of the Pegasus-winged booster.

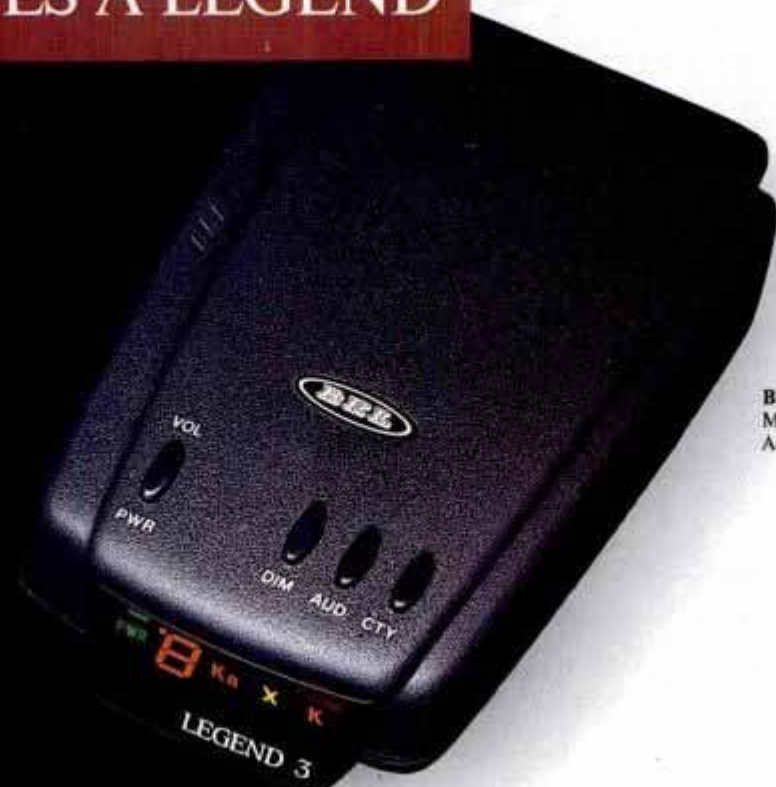
TRW is building a Space Test Experiments Platform (STEP) satellite for the Air Force and may deliver as many as 12 more over the

next six years. The first, which weighs less than 1000 pounds, will be lofted in 1992.

On-board instruments will clock the propagation of radiowaves through the ionosphere and measure the density of electrons in the upper atmosphere. Although the spacecraft will last only one to three years, it will cost a mere \$5.5 million—a bargain compared to conventional satellites, often costing hundreds of millions of dollars.

(More Tech Update on page 16)

BEL CREATES A LEGEND



BEL LEGEND 3
Model 966
Actual Size

FMT®: Unequaled Sensitivity

To duplicate LEGEND 3's X, K, and Ka sensitivity levels, existing technology would require three separate radar detectors, each specifically designed to receive only one radar frequency.



Current radar detector designs use a harmonic of the fundamental mixer to detect K and Ka band radar. This significantly reduces sensitivity on these radar frequencies.



For maximum sensitivity, LEGEND 3 detects X, K, and Ka band radar using a fundamental mixer response for each of these radar frequencies.

Revolutionary New 3 Band Radar Detection




BEL-TRONICS, the pioneer of 3 band technology, introduces LEGEND 3: a new radar detector offering unsurpassed detection range for X, K, and Ka band radar.

LEGEND 3's revolutionary performance is achieved through a patented design called FMT® (Fundamental Mixer Technology). FMT® redefines how a detector processes X, K, and Ka band radar. With FMT®, LEGEND 3 provides a level of sensitivity never before achieved.

LEGEND 3 also breaks new ground in terms of selectivity. An advanced signal processing technique known as RSV® (Radar Signal Verification) automatically eliminates Intermediate Frequency (IF) interference—the most common source of false alerts. With RSV®, LEGEND 3 sets a new standard for selectivity.

Unmatched in sensitivity and selectivity, LEGEND 3 reflects a commitment to detail, quality and innovative thinking. And LEGEND 3's refined and convenient features make it unlike any radar detector ever designed.

Revolutionary 3 band performance is available today for \$339.95. And backed by a 3 year limited warranty. To order or for the name of a dealer near you, call toll-free:

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U.S. ARMY ILLUSTRATION

Gantry on pontoon platform snares cargo from container ship.

Floating Crane For High Seas

FORT BELVOIR, VA—In rough seas, getting materiel from cargo ships to fast hovercraft becomes one of the most exacting tasks for an amphibious assault force. To prevent snafus, Army engineers have developed a pontoon-mounted gantry crane called High Sea State Container Transfer System, or HISEACOTS.

An air-cushion vehicle first scoots onto a HISEACOTS

platform moored alongside a container ship. The platform itself stabilizes the wobble of the receiving vessel. Then, crewmen on the cargo ship begin lowering containers on slings. A truss at the top of the gantry catches the load and secures the sling cables. Hydraulic arms on the truss further dampen rocking motion. Gantry operators on the platform then maneuver the container onto the ACV.

SWATH Sub Hunter

AMELIA, LA—The small water-plane, twin-hull (SWATH) design has at last made its way from concept to reality. Having pioneered the concept 10 years ago, the Navy will send to sea its first mission-oriented SWATH vessel next year.

The 232-ft.-long USNS *Victorious* was built to glide

through the rough seas of the North Atlantic, towing passive acoustic sensors. The Navy's Military Sealift Command will operate the ship with a civilian crew. Three more SWATH surveillance ships are in the works.

USNS *Victorious* is launched by shear-leg crane during christening.

1000-Ft. Iron Highway

WATERTOWN, NY—A single 1000-ft. platform car with power cabs at each end could be the piggyback freight train of the future.

Now under study by the New York Air Brake Co., the "Iron Highway" concept consists of articulated 28-ft.

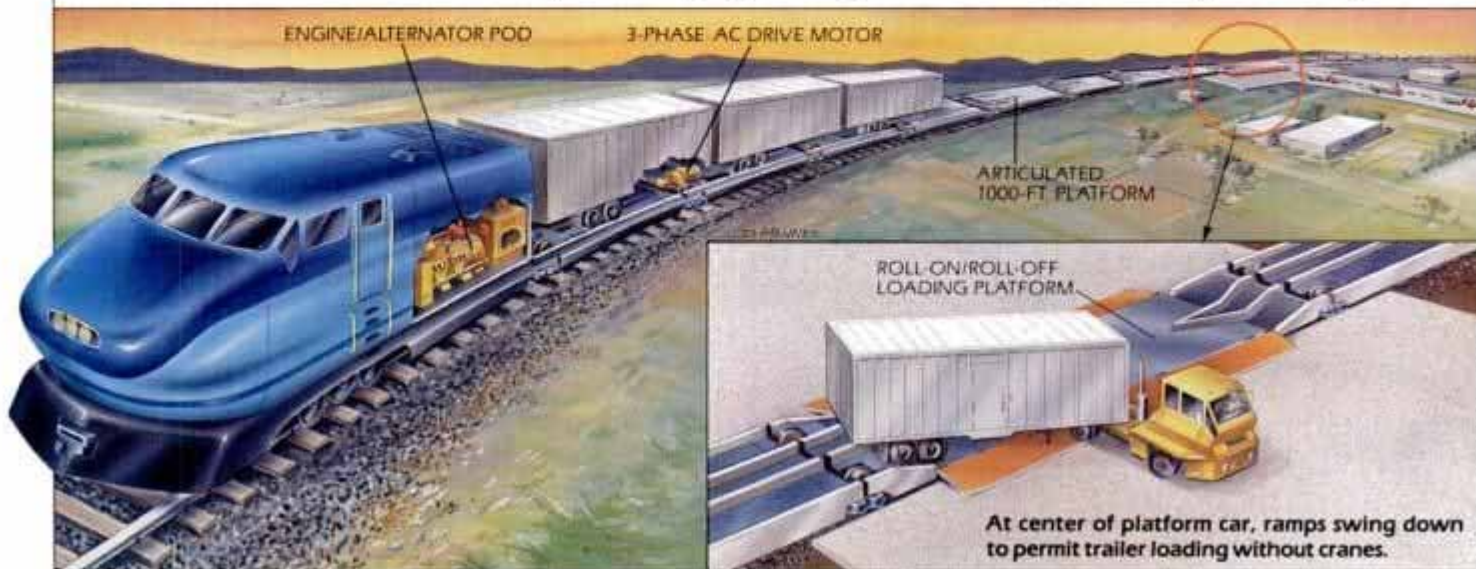
sections able to accept highway trailers of any length or design. Folding ramps in the center of the platform let tractors back trailers on at terminals. Trailers are held by sliding pull-up hitches that can be positioned anywhere along the car. Tightly

packed trailers mean efficient use of space and better aerodynamics.

Iron Highway power cabs feature removable engine-alternator pods for quick maintenance. These deliver AC power to induction motors on the first and last five axles of the platform car. Both powered and unpow-

ered wheels are steered independently, reducing friction.

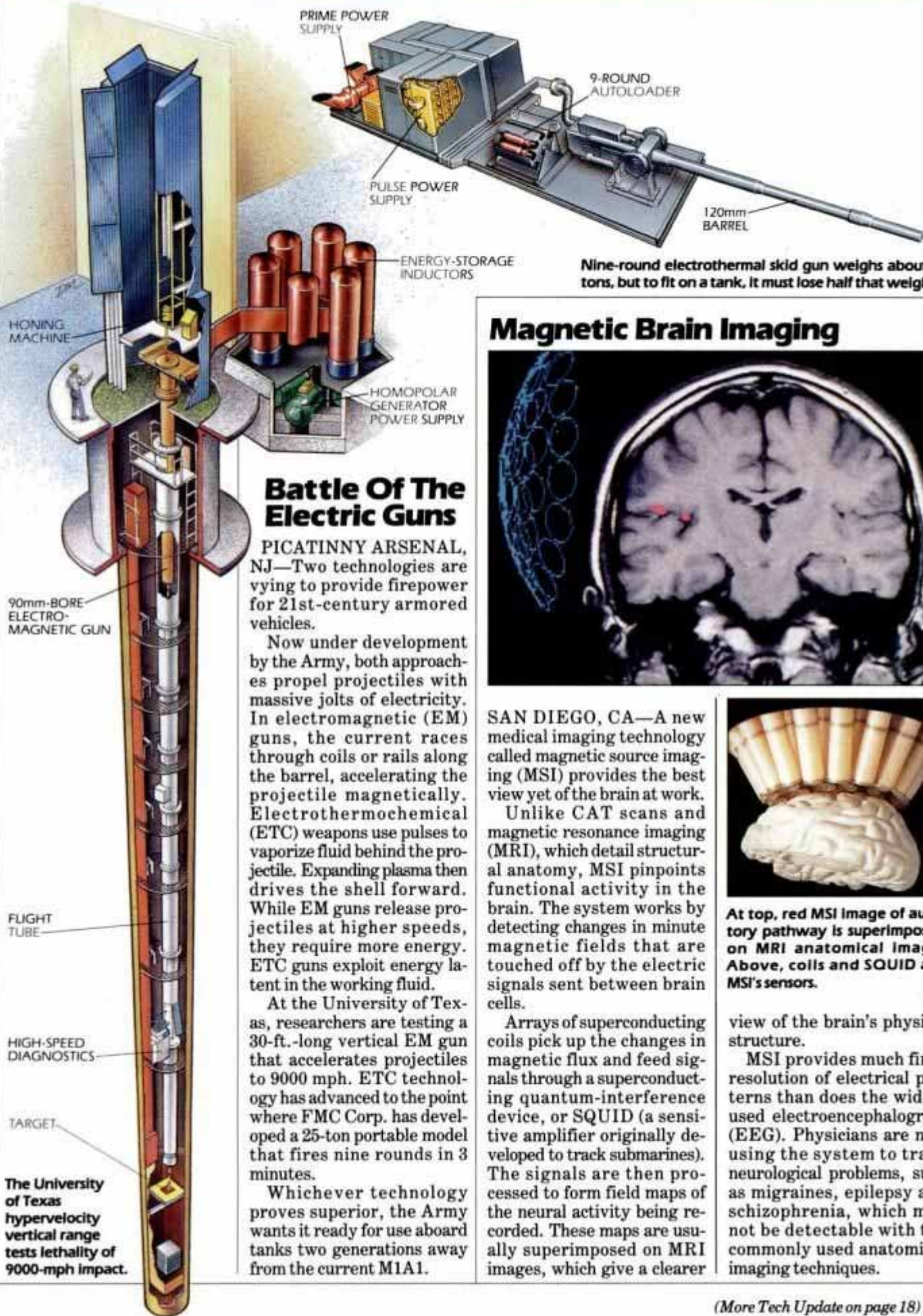
New York Air Brake is now testing parts of the concept and hopes to develop a prototype within a few years. It believes cost savings and convenience will let Iron Highway give road-going trucks a run for their money over the long haul.



At center of platform car, ramps swing down to permit trailer loading without cranes.

MACDERMOTT SHIPYARDS PHOTOS

PM ILLUSTRATIONS BY DON MANNING



Battle Of The Electric Guns

PICATINNY ARSENAL, NJ—Two technologies are vying to provide firepower for 21st-century armored vehicles.

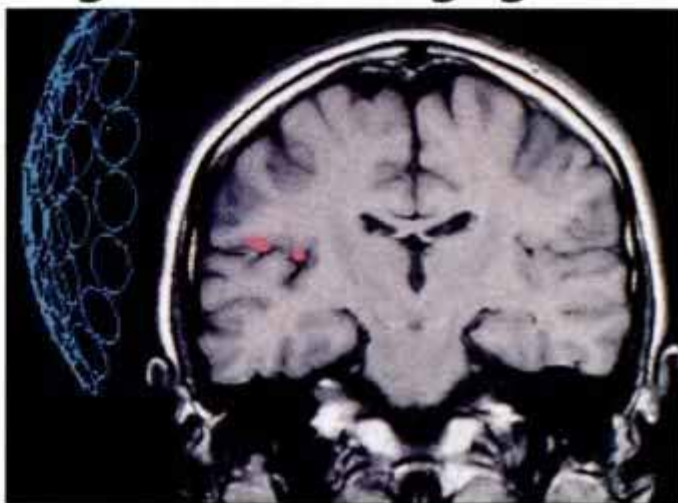
Now under development by the Army, both approaches propel projectiles with massive jolts of electricity. In electromagnetic (EM) guns, the current races through coils or rails along the barrel, accelerating the projectile magnetically. Electrothermochemical (ETC) weapons use pulses to vaporize fluid behind the projectile. Expanding plasma then drives the shell forward. While EM guns release projectiles at higher speeds, they require more energy. ETC guns exploit energy latent in the working fluid.

At the University of Texas, researchers are testing a 30-ft.-long vertical EM gun that accelerates projectiles to 9000 mph. ETC technology has advanced to the point where FMC Corp. has developed a 25-ton portable model that fires nine rounds in 3 minutes.

Whichever technology proves superior, the Army wants it ready for use aboard tanks two generations away from the current M1A1.

Nine-round electrothermal skid gun weighs about 25 tons, but to fit on a tank, it must lose half that weight.

Magnetic Brain Imaging



SAN DIEGO, CA—A new medical imaging technology called magnetic source imaging (MSI) provides the best view yet of the brain at work.

Unlike CAT scans and magnetic resonance imaging (MRI), which detail structural anatomy, MSI pinpoints functional activity in the brain. The system works by detecting changes in minute magnetic fields that are touched off by the electric signals sent between brain cells.

Arrays of superconducting coils pick up the changes in magnetic flux and feed signals through a superconducting quantum-interference device, or SQUID (a sensitive amplifier originally developed to track submarines). The signals are then processed to form field maps of the neural activity being recorded. These maps are usually superimposed on MRI images, which give a clearer



At top, red MSI image of auditory pathway is superimposed on MRI anatomical image. Above, coils and SQUID are MSI's sensors.

view of the brain's physical structure.

MSI provides much finer resolution of electrical patterns than does the widely used electroencephalogram (EEG). Physicians are now using the system to track neurological problems, such as migraines, epilepsy and schizophrenia, which may not be detectable with the commonly used anatomical imaging techniques.

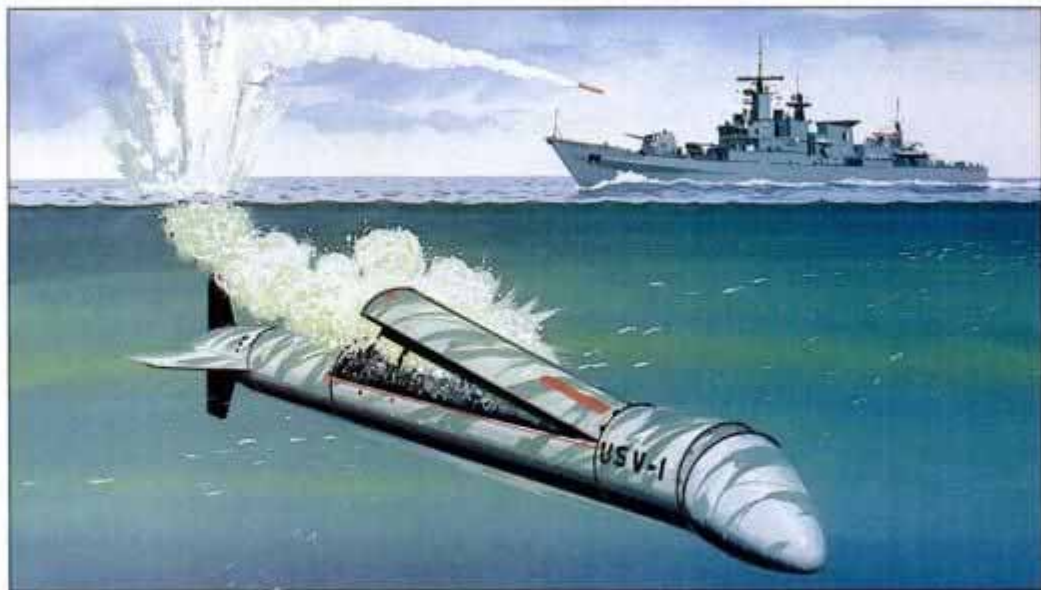
The University of Texas hypervelocity vertical range tests lethality of 9000-mph impact.

Robots To Prowl Seas



Surveillance UUV (above) is launched from chute. Future version (right) has deadlier designs.

CAMBRIDGE, MA—Unmanned underwater vehicles (UUVs), either autonomous or remotely controlled, are figuring increasingly in Navy planning. The Defense Ad-



vanced Research Projects Agency has tested the first of two UUVs designed for mine hunting and underwater surveillance. DARPA also plans to build a smaller vehicle that

can be launched through torpedo tubes.

Charles Stark Draper Laboratories, which built DARPA's UUVs, is investigating highly maneuverable

craft with articulating heads and tails. Such vehicles would stalk hostile ships and release cruise missiles or remora mines, which attach to enemy craft.

Quick-Quenching Steel May Help U.S. Mills

PITTSBURGH, PA—Hounded by fierce international competition, American mills are embracing new technologies aimed at making steel faster and cheaper.

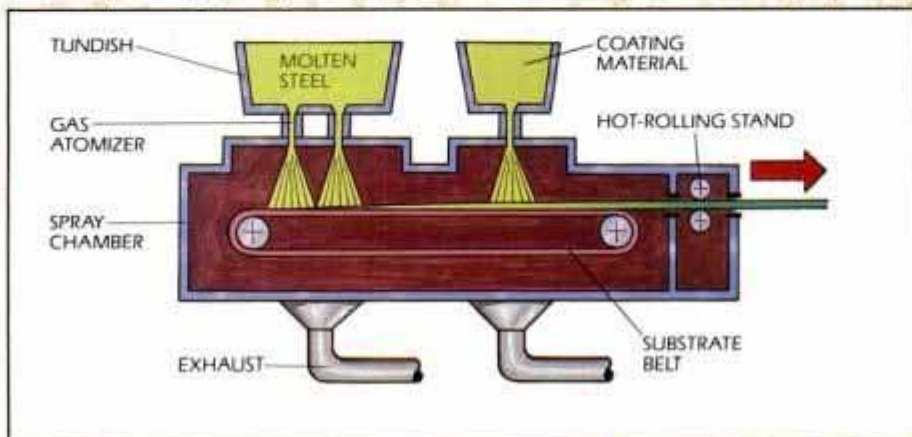
Producing steel in flat strips has always required sending the metal through a series of hot-rolling stands, steps that everyone is anxious to reduce. Minimills such as Nucor have already introduced thin-slab casting, but other steelmakers want to go even further.

Two emerging techniques—direct-strip casting and spray forming—show promise. Both rely on rapid solidification, the phenomenon that is behind revolutionary new aircraft alloys.

Allegheny Ludlum hopes to break ground soon on a commercial direct-strip casting plant. The new process releases liquid steel from a tundish onto a spinning water-cooled copper



In direct-strip casting (top), steel strips fly off cooling wheel. In spray forming (below), atomized steel cools on substrate belt.



wheel. The molten metal quenches almost instantly and sloughs off the wheel in a strip as thin as 0.12 in. Ludlum, currently operating a pilot plant, says the technique can shave weeks off the wait between smelting and delivery of finished steel products.

Meanwhile, spray forming is under investigation by researchers at Idaho National Engineering Laboratory, aided by other labs and steel and auto manufacturers. In the process, molten steel is sprayed onto a surface while it undergoes rapid solidification. Deposited on a conveyor belt, the steel hardens into a continuous strip, but tubes, billets and discs can also be produced.

Both techniques cut hot-rolling to a single followup step. In addition to saving time and money, they yield a steel with a fine-grained microstructure that lends strength.



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YOU CAN BE A WINNER IN THE POPULAR MECHANICS® SEARCH FOR THE MUST- KNOW MAN.

**THOUSANDS OF PRIZES —
VALUED AT OVER \$175,000**

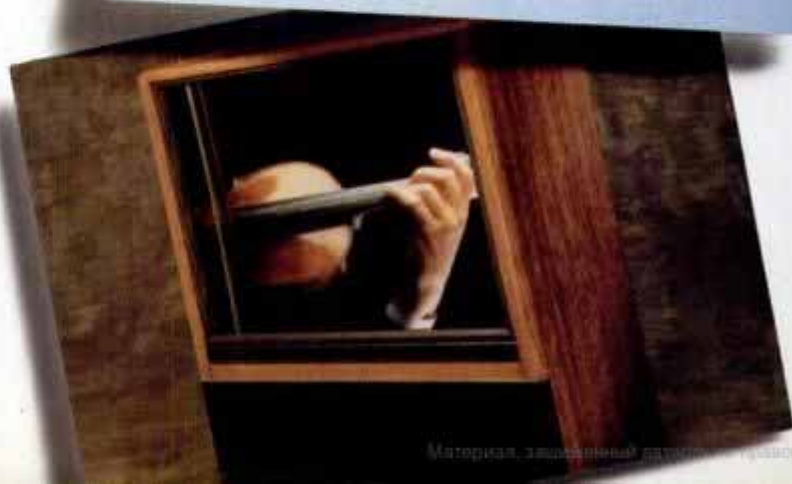
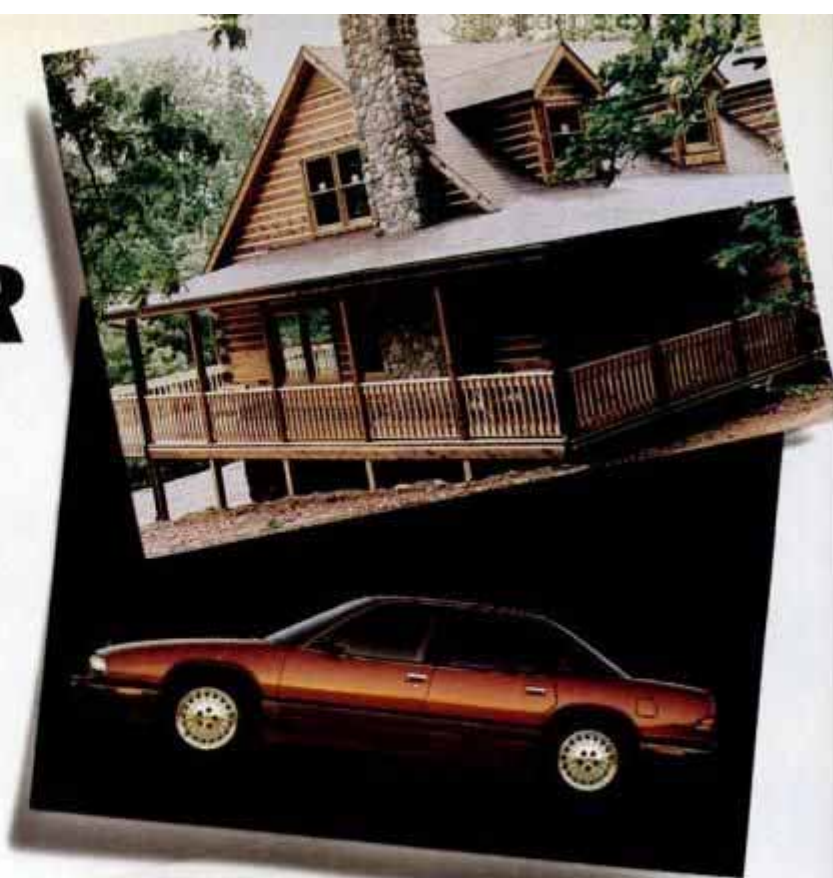
We're looking for must-know men. What's a Must-Know Man? Anyone with a passionate interest in knowing how and why things work. If that sounds like it might be you, simply identify the objects on the facing page, fill out the entry form, and if it's correct, you've already won the Tee Shirt pictured below.

EVERYONE CAN WIN

With the delivery of the Tee Shirt, you'll receive

"The Expert Skills Challenge." Answer twenty-five multiple-choice questions, then send along a photograph or drawing of a project, either conceived by and/or executed by you.

Make sure it's one that you think best expresses the Must-Know Man. If your project is selected, you win one of the five Grand Prizes, or one of a hundred consolation prizes pictured on the right.



THE FIVE GRAND PRIZES

AmerLink Walton Model Log Home weathertight shell package designed for 3 bedrooms, 2 1/2 baths... kit ready for assembly on your site. (Porch deck, railings, and fireplace not included.) ...valued at \$52,478.

The totally new 1991 Buick Regal Limited Sedan...valued at over \$17,000.

ProCraft's Procaster 190, designed for the serious water sportsman; powered by a Mariner 150 hp. outboard motor. Prize includes trailer...valued at \$5,000.

A trip for 4 people to Epcot Center at the Walt Disney World resort. Trip includes RT air fare, 5 days/4 nights at The Grand Floridian and \$1,000 in spending money... maximum value of \$5,500.

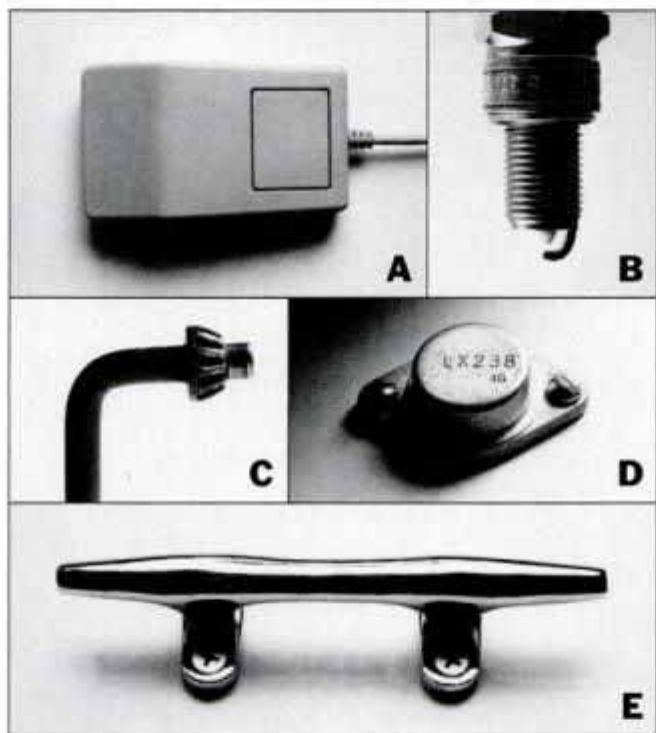
RCA 46" Color Trak 2000 Home Theatre Projection TV...valued at \$1,755.

100 CONSOLATION PRIZES



Schlage Keepsafer Security System including Emergency Dialer. The Keypafer is America's best selling, wireless electronic home security system. The Emergency Dialer provides contact with the Schlage National Monitoring Station to provide continuous protection... each set valued at \$314.

IDENTIFY THESE FIVE OBJECTS CORRECTLY AND YOU'RE ALREADY A WINNER.



CORRECT ENTRIES WIN A TEE SHIRT

The five objects above are each part of one of these five product categories:

1. Automobile;
 2. Boat;
 3. Stereo Receiver;
 4. Power Tool; or
 5. Computer.
- Match the objects A-E with the product name, and complete the Official Entry Form to enter The Search for the Must-Know Man.

All entries must be received by Dec. 31, 1990. If your issue of Popular Mechanics does not have an Official Entry Form, you may obtain one by sending a Self-Addressed Stamped Envelope to: Search Entries, P.O. Box 7324, Kankakee, IL 60902-7324. Requests for Official Entry Forms must be received by Dec. 1, 1990.

OFFICIAL ENTRY FORM

To enter THE SEARCH FOR THE MUST-KNOW MAN, complete this Official Entry Form. No purchase necessary. Only one entry per person. Incorrect entries will not be acknowledged.

Match the 5 objects pictured to the left of this Form with the 5 product categories listed below. Put the correct letter (A-E) inside each corresponding, numbered box (1-5).

1. Automobile
2. Boat
3. Stereo Receiver
4. Power Tool
5. Computer

Please enter me in THE SEARCH FOR THE MUST-KNOW MAN. If my entry is correct, I will receive the MUST-KNOW MAN Tee Shirt and be eligible for the Expert Skills Challenge. I will receive the Challenge Questions and Instructions with my Tee Shirt prize.

See Official Rules on back. All entries must be received by December 31, 1990.

NAME _____

ADDRESS _____

CITY _____

STATE _____

ZIP _____

MAIL TO:
THE SEARCH FOR THE MUSTKNOW MAN
P.O. Box 7325, Kankakee, IL 60902-7325

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3. No purchase is necessary. Just complete the Official First Level Entry Form to enter the Must-Know Man Search. Be sure to provide your complete name and mailing address in the space provided. Only Official Entry Forms will be accepted. If the Official Entry Form is missing from your issue of Popular Mechanics magazine, you may obtain one by sending a Self-Addressed Stamped Envelope to Search Entries, P.O. Box 7324, Kankakee, IL 60902-7324. Residents of VT and WA may omit postage. Requests for Official Entry Forms must be received by December 1, 1990.
4. Mail this First Level entry to Search for the Must-Know Man, P.O. Box 7325, Kankakee, IL 60902-7325. All First Level entries must be received by December 31, 1990. Sponsor is not responsible for late, lost, defaced, illegible or misdirected mail.
5. You may enter the Must-Know Man Search only once. Duplicate entries will be voided and neither acknowledged nor returned. Judging of First Level entries will be conducted as they are received by Promotional Services Center, an independent judging organization whose decisions are final. Incorrect entries will not be acknowledged or returned. All correct First Level entries win, therefore there are no odds of winning.
6. Within 4 weeks of receipt, all correct First Level entries will receive The Must-Know Man Tee-Shirt. All correct entries will also be eligible to enter the Expert Skills Challenge and will have an opportunity to win one of the 5 Grand Prizes or one of the other 100 Finalist Prizes. The Official Entry Form and rules for the Expert Skills Challenge will be mailed to eligible participants with their Must-Know Man Tee-Shirt.
7. Official Entries in the Expert Skills Challenge must be received by February 28, 1991. The Expert Skills entry form will include mailing instructions. Entrants into the Expert Skills Challenge will be required to answer 25 multiple choice questions or problems posed by the Editors of Popular Mechanics Magazine. Entrants will also be required to submit a photo or drawing of a project of which they are the author and which they believe is most representative of the Must-Know Man. Photos and drawings will not be returned.
8. To be eligible as a finalist or Grand Prize Winner in the Expert Skills Challenge, entrants must have the correct answers to the twenty-five questions. Judging of answers will be conducted by Promotional Services Center. All correct entries which also include the required photo or drawing will be judged by a panel of the 5 Popular Mechanics category Editors, who will make the final selection of the 100 finalists and 5 Grand Prize Winners. The decision of the Editors is final. Finalists will be selected on or about April 15, 1991.
9. Search for the Must-Know Man prizes and their approximate retail value are as follows: 5 Grand Prizes, AmeriLink Log Home valued at \$52,478; 1991 Buick Regal, \$17,426; Procaster 190 boat/motor/trailer, \$15,000; RCA 46" TV, \$1,755. Value of the travel prize to Epicot Center is dependent on point of departure but may not exceed \$5,500. 100 Finalist Prizes: Schiage Keeper & Emergency Diaper valued at \$314 per set. Entry Level Prize: Must-Know Man Tee-shirts, \$8 each. Total value of all prizes is estimated at \$175,000.
10. All prizes will be awarded. Winners will be notified by mail. Prizes are non-transferable and, with the exception of the log home, no substitutions or cash equivalents are allowed. The winner of the log home may elect to receive \$15,000 in place of the log home. Taxes, if any, are the responsibility of the individual winners. Winners will be required to execute an affidavit declaring eligibility, providing release and affirming project authorship, within 21 days after notification, in order to receive prizes.
11. The Search for the Must-Know Man is open to all residents of the United States and Puerto Rico who are 18 years of age or older. Employees and their families of The Hearst Corp., KLD Associates, AmeriLink Ltd., General Motors, Inc., Brunswick Marine, American Express Travel, RCA Inc., Schiage Inc., their affiliates, subsidiaries, advertising and promotion agencies are not eligible. Search for the Must-Know Man is void where prohibited or restricted by federal, state or local laws.
12. For a list of major prize winners, send a stamped, self-addressed envelope to Search Winners, P.O. Box 7328, Kankakee, IL 60902-7328. *Retail list price as of July 1990.

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8. To be eligible as a finalist or Grand Prize Winner in the Expert Skills Challenge, entrants must have the correct answers to the twenty-five questions. Judging of answers will be conducted by Promotional Services Center. All correct entries which also include the required photo or drawing will be judged by a panel of the 5 Popular Mechanics category Editors, who will make the final selection of the 100 finalists and 5 Grand Prize Winners. The decision of the Editors is final. Finalists will be selected on or about April 15, 1991.
9. Search for the Must-Know Man prizes and their approximate retail value are as follows: 5 Grand Prizes, AmeriLink Log Home valued at \$52,478; 1991 Buick Regal, \$17,426; Procaster 190 boat/motor/trailer, \$15,000; RCA 46" TV, \$1,755. Value of the travel prize to Epicot Center is dependent on point of departure but may not exceed \$5,500. 100 Finalist Prizes: Schiage Keeper & Emergency Diaper valued at \$314 per set. Entry Level Prize: Must-Know Man Tee-shirts, \$8 each. Total value of all prizes is estimated at \$175,000.
10. All prizes will be awarded. Winners will be notified by mail. Prizes are non-transferable and, with the exception of the log home, no substitutions or cash equivalents are allowed. The winner of the log home may elect to receive \$15,000 in place of the log home. Taxes, if any, are the responsibility of the individual winners. Winners will be required to execute an affidavit declaring eligibility, providing release and affirming project authorship, within 21 days after notification, in order to receive prizes.
11. The Search for the Must-Know Man is open to all residents of the United States and Puerto Rico who are 18 years of age or older. Employees and their families of The Hearst Corp., KLD Associates, AmeriLink Ltd., General Motors, Inc., Brunswick Marine, American Express Travel, RCA Inc., Schiage Inc., their affiliates, subsidiaries, advertising and promotion agencies are not eligible. Search for the Must-Know Man is void where prohibited or restricted by federal, state or local laws.
12. For a list of major prize winners, send a stamped, self-addressed envelope to Search Winners, P.O. Box 7328, Kankakee, IL 60902-7328. *Retail list price as of July 1990.

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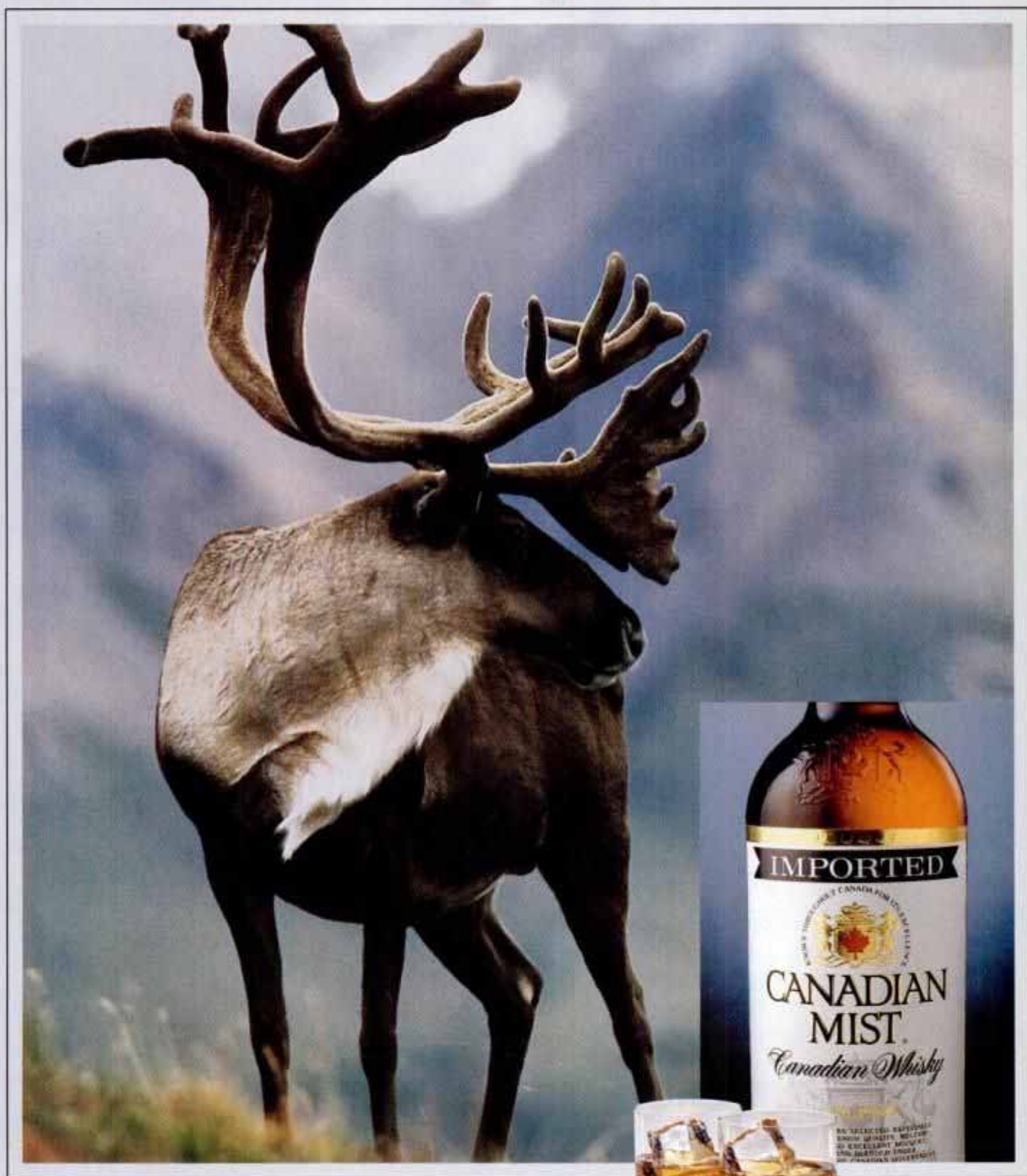
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CANADA AT ITS BEST



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LIGHT,
SMOOTH,
MELLOW

Quality is Job 1.



**Profile in quality #10:
Engineering.**

*Shown here is the 3.8 Liter Supercharged engine.
It represents sophisticated high performance engineering.
The Supercharged engine, available in the Ford
Thunderbird Super Coupe and Mercury Cougar XR-7,
is one example of Ford's constant exploration and
development of new technologies.
When quality is job 1—you don't do it any other way.*

**Ford, Mercury, Lincoln, Ford Trucks.
Our goal is to build the highest quality cars
and trucks in the world.**



Buckle up—together we can save lives.

MOTOWN FLEXES ITS MUSCLES

Powertrain improvements dominate domestic new car news for '91.

PONTIAC
FIREBIRD
FORMULA

● As the U.S. auto industry moves another year closer to the next century, we have some good news and some average news.

The average news is that we won't be seeing as much new sheetmetal this fall as in years past. Most of Detroit's really new '91s—Ford's Escort and Explorer, Mercury's Tracer and Chevy's Caprice sedan—are already in showrooms.

Outweighing this, in our view, is the good news. All three U.S. man-

ufacturers have added brand-new high-tech engines to their powertrain arsenals. With the closing of the quality gap, powertrains have ranked as the one conspicuous area where U.S. products still lagged.

We think 1991 will sharply reduce this disparity. Chrysler's 224-hp 2.2-liter dohc 16-valve turbo, Ford's 210-hp 4.6-liter sohc modular V8, and GM's 200-hp 3.4-liter dohc 24-valve V6 give the Big Three underhood firepower for the sales battles of '91 and beyond. The combination of new muscle and refinements to most vehicle lines adds up, by our reckoning, to one of Motown's more exciting autumnal shows.

—Tony Swan



DODGE SPIRIT R/T

Chrysler Corporation

The biggest news out of Highland Park this year is a major redesign of Chrysler's minivans. The corporation's perennial sales leaders—Dodge Caravan, Plymouth Voyager and Chrysler Town & Country—are new inside and out, the first overhaul in the series since its introduction in 1984.

On the performance side of the ledger, Dodge division has two new offerings: the long-awaited Stealth, known at Mitsubishi as the 3000GT, and a hot-rod version of the Spirit sedan, the R/T, powered by Chrysler's most advanced engine.

Stealth is the designated performance image leader at Chrysler, and rightly so. It's loaded with ad-

vanced features. Four models make up the line: the base Stealth, Stealth ES, Stealth R/T and the ultimate Stealth—the R/T Turbo, which has 4-wheel steering, all-wheel drive, anti-lock braking and a twin-turbo V6 engine that develops 300 horsepower.

Not as dramatic—but more important for Chrysler—are the refinements in the minivans. While Caravan, Voyager and Town & Country may look similar to the 1990 models, Chrysler claims that every scrap of sheetmetal on the body has a new form. Most noticeable styling changes are the lower hood and fenders that impart a more rounded look to the front. At the rear, a higher, wider and more curved tailgate continue the curved surface.

Chrysler did not want to change its most successful vehicles in any dramatic way. Dimensions and sizes of the new vans are exactly the same as past models.

Inside, many of the controls have been moved to handier positions, while the feel of switches is upgraded to a higher quality. A "Quad Command" seating arrangement has been added to the options list. It includes bucket seats for the second row.

Technical details of the vans include optional all-wheel drive and 4-wheel antilock braking. The 2.5-liter 4-cylinder continues as the base engine, while 3.0- and 3.3-liter V6s are available. In the all-wheel-drive setup, power is transferred to the rear wheels automatically through a viscous clutch that engages when slippage occurs in front-wheel drive.

Chrysler has also been busy on the powertrain front. The Spirit R/T's new 2.2-liter dohc 16-valve turbocharged 4-cylinder has the highest output of any engine ever produced

SPOTLIGHT



Dodge Spirit R/T

● Although Chrysler's sedan fleet tends to be on the vanilla side, here's one 4-door nobody's likely to confuse with your Aunt Martha's Monaco. The Spirit R/T will hustle you and your family from 0 to 60 mph in less than 7 seconds.

The heart of all this go-power is Chrysler's solidly established 2.2-liter 4-cylinder, with a new Lotus-designed 16-valve dohc cylinder head and Garrett turbocharger. Engineering details are spelled out in the technical highlights section, so

we'll confine ourselves here to the magic numbers: 225 hp at 6000 rpm, with 210 ft.-lb. of torque at 4800 rpm.

Chrysler has also refined the Spirit's 5-speed manual transaxle, improving shift precision considerably. The suspension is tuned to match the engine's output.

It all adds up to a car that will match the performance capabilities of any sedan in its price class—and many that aren't.

—Tony Swan



DODGE SHADOW CONVERTIBLE

by Chrysler—over 100 hp per liter. The new engine will hustle the Spirit R/T to 60 mph in 6.0 seconds, according to a Dodge brag sheet. This puts the R/T in with the three or four fastest 4-door sedans made in America, and it's the only one to sell for under \$20,000.

Chrysler's own 3.8-liter V6 is introduced in the Imperial and New Yorker Fifth Avenue. Although its peak hp rating is the same as the 3.3-liter on which it's based, the 3.8 makes about 15 percent more torque—204 ft.-lb. versus 185.

PLYMOUTH VOYAGER



SPOTLIGHT



Dodge Stealth R/T Turbo

● Built on the Mitsubishi Galant VR4 platform, the Stealth R/T Turbo sports every technogeek gadget known to mankind: 24 valves, twin turbos with air-to-water intercoolers, ABS, all-wheel drive, speed-dependent 4-wheel steering, viscous-coupled planetary center diff—you name it. There's even a dashboard adjustable muffler.

In spite of the hardware, Stealth is a solid performer, turning 13.7-second quarters with no difficulty. That's good enough to embarrass established leaders in the sports/GT segment like Cor-

vette and Nissan's 300ZX Twin Turbo.

For all its bulk—3800 pounds—brake performance is excellent. And with 245/45ZR-17 rubber, there's plenty of stick in the corners. Those who desire Stealthier levels of attention can also choose from normally aspirated and 2wd versions.

Pegged at around \$32,000, Stealth is sure to redefine the performance criterion in this segment the way the 300ZX Twin Turbo did two years ago. And eat Corvettes for lunch doing it.

—Mike Allen

The 2.5-liter turbo also gets a torque boost, from 180 ft.-lb. to 210, again with no increase in peak horsepower.

Technical changes in all of Chrysler's domestic front-wheel drives will result in less wander on the highway, less body roll in curves and better overall steering feel—all welcome improvements.

Dodge truck and Jeep vehicles also get their share of refinements.

In the compact pickup field, Dodge becomes the first to offer V8 power, with its 5.2-liter (318 cu. in.) now available in the Dakota.

Just for fun, the Jeep Wrangler Renegade has extra panels on its body that stress two of its most attractive qualities—it's fun to drive and rugged. The rollbar at the rear of the front seats is called a "sound bar" by Jeep, because it now houses two radio speakers that pipe audio right into the ears of both the driver and the passenger.

New for 1991 in the Wrangler engine lineup are a 2.5-liter higher output 4-cylinder engine and more power—190 hp versus 177—for the Cherokee's 4.0-liter inline Six.

—Jim Dunne



JEEP WRANGLER RENEGADE

PHOTOS BY JIM DUINNE

Ford Motor Company

Never forget the emphasis on Motor in this company's name. Clearly, the folks at Ford are remembering that. Ford's 1991 lineup puts the stress back on engines—V8s in this case: one new, one updated.

Lincoln's flagship Town Car, completely restyled last year, gets the most important change, a sohc 4.6-liter V8 that is smoother in operation, quieter, and more powerful than the 5.0-liter V6 it replaces. You can feel the added muscle—190 hp, versus the 150 of the 1989 model—the first time you step on the accelerator. With the 4.6-liter, acceleration is immediate. There is no lag while car speed catches up with engine revs.

Just as importantly in a 4035-pound car like the Lincoln flagship, engine torque is just about the same at 260 ft.-lb., as with last year's bigger V8. On the minus side, the 4.6-liter V8 reaches its peak at a much higher engine speed, 3200 rpm instead of 2000. However, the electronic 4-speed automatic transmission is calibrated to match up the engine's output with the driver's wishes, with the net effect of noticeably better performance at all driving speeds.

Ford officials will tell you that the 4.6-liter V8, called the "modular design" because other engine types can be made from its basic combustion chamber/cylinder layout, is the first of a family of V-arrangements that will be introduced in the 1990s. Later, higher performance V8s, using dohc valvetrains and V6s in a number of versions, will be added. Next year, for example, a dohc V8 will power a newly styled Mark VIII. Still later, a

V6, built from the same basic design, will be used in Ford's smaller cars.

While the 4.6-liter V8 has an aluminum head and iron block, future versions of the modular design may have other combinations of materials.

In the other engine shuffle that should be welcomed by most specialty coupe buyers, Ford has stuffed its slightly reworked 5.0-liter V8 back under the hoods of Thunderbird and Cougar. The engine runs smoother than its basic V6s, delivers strong torque over a wide range of

speed, and also seems to be quieter.

At the same time, the supercharged 3.8-liter V6 was dropped from the Cougar's lineup, but is still available in the Thunderbird Super Coupe. The 5.0-liter V8 is the HO version that is rated at 200 hp, versus the 210 of the supercharged V6.

An additional 15 hp—just what the Continental needed—have been coaxed from the 3.8-liter V6 engine for Lincoln's 1991 front-wheel-drive sedan. Dual exhaust pipes are

SPOTLIGHT



Dodge Dakota V8

● While there's nothing really new about the Dodge Dakota pickup truck, and there's certainly nothing new about Chrysler's 318-cu.-in. V8 engine, combining the two adds up to something that's new indeed: the first V8-powered compact truck.

This combination also adds up to a small but significant edge in horsepower and, more important, torque over the Dakota's V6-powered competition from

Ford and Chevrolet.

Besides additional muscle, the V8 makes the Dakota one of the smoothest compact trucks on the market. It's available with automatic transmission only, with 4wd available as an option.

Available with either a standard or a club cab body, the Dakota V8 also claims the highest standard payload and tow rating in its class.

—Tony Swan



FORD THUNDERBIRD V8

among the changes that produced the higher rating. Continental also gets Ford's new 4-speed electronically controlled transmission that plays a big part in bringing this powertrain up to luxury car snuff.

In the Taurus/Sable line, a similar 15-hp boost is found in the base 2.5-liter 4-cylinder engine, thanks to fuel-injection system refinements.

Earlier this year, Ford introduced the 1991 Escort, Tracer and Explorer. The completely redesigned vehicles apparently took up all of the effort of Ford designers for the year,

since there are no other styling changes this fall.

Explorer replaces the Bronco II sport/utility model in Ford's light truck line. Both 2- and 4-door body styles are offered, with significant differences between them. The 2-door has a tidy 102.1-in. wheelbase, which gets you over rough terrain with fewer hangups. The 4-door has a 111.9-in. wheelbase, to provide better ride and more room inside. The 4-door is almost 10 in. longer than the 2-door and correspondingly bigger inside. Both 2-wheel and 4-wheel drive can be or-

dered under both body styles.

The Escort/Tracer chassis is based on the latest Mazda 323 platform, giving the Ford a solid basis for its popular small-car line in the 1990s. Bigger in size, with more room inside for passengers, the small cars offer two engines—Ford's standard 1.9-liter 4-cylinder and Mazda's 1.6-liter dohc 16-valve 4-cylinder—as performance options.

Escort is offered in a 2-door and 4-door sedan and station wagon body styles, while Tracer has a 4-door sedan and wagon.

—Jim Dunne

SPOTLIGHT



Lincoln Town Car

● In addition to its role as the Ford Motor Company's flagship sedan, the Lincoln Town Car is also distinguished this year as the testbed for Ford's new 4.6-liter modular V8 engine. And our initial impression is that this test will grade out high indeed.

Sitting behind the wheel at idle, engine noise is virtually undetectable. During acceleration too, the engine is quieter than the pushrod V8 it replaces. In addition, Ford has mated the engine to the transmission more precisely, so over-

revving between downshifts is not the distraction it was with the older V8. Downshifts are quicker, and upshifts are smoother.

Performance is better at all driving speeds, and you can also get Ford's traction control system in the Town Car this year as an option.

Inside, the new analog instrument panel is a welcome change from the digital readouts that have been in previous Town Cars.

—Jim Dunne

General Motors

The General really doesn't have any all-new cars to introduce this year, but there are significant reskinning of several, as well as a plethora of welcome improvements. Add one new engine, and enhanced performance to several others to this mix, and GM buyers should feel like there's plenty to keep their allegiance.

Chevrolet

Big news, literally, in bow-tie land is the Caprice Classic Wagon, a return to the land-yacht, rear-wheel drive station wagons of yesteryear. Buyers who need acres of interior room and lots of seating can again drive something home from the showroom besides a mini- or full-size van. Replete with eight seats and a skylight, the wagon sits on the same old chassis as the past few generations of Caprice, but with a refreshing aero styling.

Corvette spotters will be able to pick out the '91s by new front and rear fascia treatments, with styling cues from the ZR-1. Camaro sees a new



CHEVROLET LUMINA Z-34

front-end treatment as well, unveiled in midseason as a '90½ model.

Biggest news on the performance front is the Lumina Z34, sporting the all-new Twin Dual Cam V6, a 24-valve 3.4-liter powerplant that makes 200 hp with a torque curve as flat as the parking lot at GM's Tech Center. (See page 32 for details about this motor.)

Performance of the 3374-pound coupe is brisk, rather than stunning, but it's the kind of performance you can live with. With a suspension that's capable, rather than punishing, optional 4-speed auto trans, 225/R60-16 Eagles, and seating for four, even a family man can add zing to his commuting.

Beretta GTZ gets the 180-hp HO

version of the Quad 4 2.3-liter 16-valver, while the entire Beretta/Corisca line gets new interior styling.

Pontiac

Grand Prix moves up from the more pedestrian pushrod 3.1-liter V6 to the Twin Dual Cam 3.4, at least as an option. Also available is the 2.3-liter 16-valve Quad 4. And the Grand Prix Turbo is replaced by the new 3.4-liter V6-powered GTP.

Like Camaro, Firebird sports a new front and rear fascia, introduced in midsummer as a '91 model.

Sunbird's 2.0-liter turbo option has been supplanted by the 3.1-liter V6, for smoother operation, more torque and better acceleration.

The 6000 S/E wagon and S/E AWD have been dropped from the lineup.

Buick

The Roadmaster nameplate returns to the Buick lineup for the first time since 1959 with the introduction of the Estate Wagon, and there are two sedan versions waiting in the wings for '92. With a full frame-and-body construction and rear-wheel drive, it's the answer to a lot of questions about why one of America's premium car builders had abandoned this market niche.

The Park Avenue and Park Avenue Ultra are powered by the 220 ft.-lb., port-injected version of the 3800 V6. Teamed with a new electronically controlled transaxle, they have shifting and driveability characteristics that are worthy of topflight luxury cars once again. Add 8 in. of length and 3.9

SPOTLIGHT



Buick Park Avenue Ultra

● If you liked the old Park Avenue, you'll love the new one. Under the designer body, you'll find GM's good-old C-body platform with a multitude of updates. More frame braces make it feel more solid. A new high-output version of the 3800 V6 engine is teamed with a new computer-controlled automatic transmission. The car boasts solar glass and 2-zone climate control, both industry firsts.

Our reaction to this long list of im-

provements is shorter: Oh yeah! Punch the throttle and you move out right now. It's a luxury car, yes, but the Park Avenue doesn't mind being driven hard over rough roads. The Ultra, especially, with its Grand Touring suspension, feels like a real roadburner.

Buick's new catchwords describe the new Park Avenue perfectly: substantial, distinctive, powerful, mature, smooth.

—Joe Oldham

SPOTLIGHT

Pontiac Grand Prix GTP

● The muscular-looking Grand Prix Turbo Coupe is replaced with the cosmetically identical GTP, dumping the cranky turbo motor for the Twin Dual Cam 3.4. This makes the GTP pleasant, although heavy, competition for the likes of Thunderbird and Taurus SHO. Although the performance of the turbo motor was adequate to the task, it was boy-racer performance, with boost coming up abruptly—just about in time to light up the tires coming out of a corner.

In contrast, the Twin Dual Cam V6 is a



great engine with a dreadful name. With 210 hp, a truly flat torque curve and a willingness to rev right up to the yellow wedge on the tachometer, it propels the Grand Prix GTP through traffic like a squirrel running from the family dog.

Coupled with its muscular (albeit

busy) good looks, soft ride and ample interior space, this is a mature driver's performance car. It'll run with most of the drive-in crowd's fat-tired hormone mobiles and still make a big impression on your in-laws with how responsible you've become.

—Mike Allen



CHEVROLET
CAPRICE
WAGON

cu. ft. of trunk room to last year's versions, too.

The Buick Regal gets a minor exterior freshening, as well as the TPI 3800 as standard equipment.

Oldsmobile

Completely reengineered for the '91 models, the front-drive 98s (Regency Elite and Euro-style Touring Sedan) get new exterior and interior styling to match.

Those who really feel the need for a 4x4 sport/utility vehicle, but who can't bear to put up with their more spartan accommodations can now have a Bravada. Based on the 4-door Blazer, Bravada has a unique, plush leather interior and softened ride to match. It's still plenty capable in light off-road driving, thanks to its full-time 4wd system. Using a planetary center diff and viscous coupling obviates the need to shift into 4wd or get out and lock the front hubs when the going gets rough. Bravada's 7.7 in. of ground clearance is adequate, but leave the serious stump-jumping to other trucks. The 4.3-liter V6 provides 160 hp to get up to speed on the expressway, and 4-wheel ABS is standard.

Olds also gets its version of the wagon, pegged as the Custom Cruiser and replacing the old wagon left over from the late '70s. With the 170-hp 305-cu.-in. V8, it's rated to tow a 5000-pound trailer.

Cadillac

The entire Caddy product lineup has received detail improvements, like standard ABS, the 200-hp 4.9-liter alloy V8 (up from 4.5 liters last year)

standard in all the fwd cars, except Allanté, and the wonderful new Hydramatic electronic trans.

Although there are no really new vehicles for '91, Eldorado and Seville are available in Touring versions, for a less traditional, performance-oriented buyer who wants a European-style luxury car with a more responsive suspension and leather interior.

Last year, the 5.7-liter engine was available in the rear-drive Brougham, as part of the trailer-towing package. Realizing not all of the 60 percent of Brougham buyers who ordered it were interested in towing, Cadillac now makes the 5.7-liter available as a stand-alone option.

PM

SPOTLIGHT



Pontiac Firebird Formula

● Can you still buy a real red-blooded American V8-powered musclecar at a reasonable price? A resounding yes.

The '91 Firebird Formula actually costs the same as the '90, but has added an AM/FM stereo cassette radio and driver's side air bag as standard equipment. Order a Formula version of the Firebird and you get a 5.0-liter V8 with throttle-body injection (two other more powerful versions are available), special

suspension, 245/50ZR-16 tires on alloy wheels, full instrumentation and more.

It's a bargain at \$14,610. And that's list. Any dealer in the country will give you a discount off that.

What you'll get is one of the fastest, and probably sexiest, cars in America. Make no mistake. The Firebird Formula is a traditional rear-drive musclecar, with all that implies—good and bad.

—Joe Oldham

G PHOTO

G PHOTO

PM PHOTO BY HUMPHREY SUTTON

INSIDE THE '91s

The big news is under the hood.

BY PAUL WEISSLER

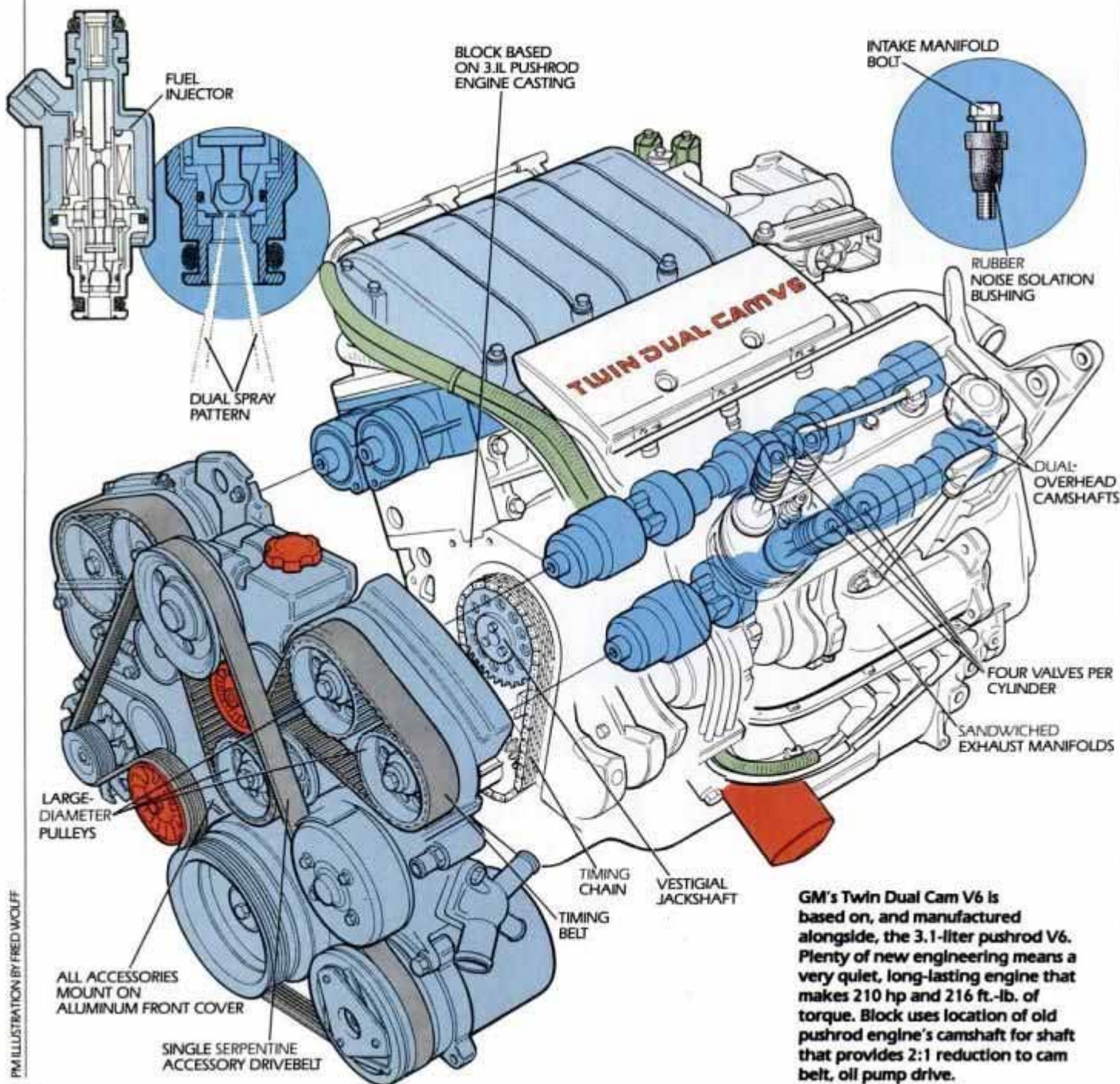
● Although there are precious few all-new vehicles rolling off the production lines in Detroit this model year, technical refinements abound. Hightech is in, with the Big Three each unveiling new engines and a myriad of engineering improvements sprinkled liberally throughout the new product lineups.

General Motors Engine Developments

The General's new star is a 60° 3.4-liter 24-valve V6 technical tour de force. For '91, there's also a new affordable antilock braking system (ABS), an innovative design that will sell for about \$300 now and far less when volume is cranked up. And GM's

transmission picture brightens considerably with the introduction of two electronically controlled designs.

GM now has its third multivalve engine, and it will come down the same assembly line as the 2-valve 3.1-liter V6, on which it's based. A larger bore accounts for the extra 0.3-liter of displacement. The 3.4 is the world's



GM's Twin Dual Cam V6 is based on, and manufactured alongside, the 3.1-liter pushrod V6. Plenty of new engineering means a very quiet, long-lasting engine that makes 210 hp and 216 ft.-lb. of torque. Block uses location of old pushrod engine's camshaft for shaft that provides 2:1 reduction to cam belt, oil pump drive.

PM ILLUSTRATION BY FRED WOLFF

largest displacement multi-valve V6. Horsepower is a hefty 210, over 60 per liter. The intake manifold and ports are tuned to put much of the 216 ft.-lb. of torque just off-idle. Result: The 3.4 has a lot of punch off the line. The engine is available on the Chevy Lumina, Pontiac Grand Prix and Olds Cutlass Supreme. A quiet-running camshaft belt is used instead of a more durable, but noisier, chain, as on GM's Quad 4. However, the 3.1's pushrod camshaft bore remains, and GM is keeping a "vestigial" shaft there, both to drive the oil pump and to accept a short chain drive from the crank. Result: The belt wraps around only large sprockets on the vestigial shaft and the camshafts, instead of also around the small crank pulley. This prevents tooth jump and cam timing shifts. Also helping to quiet the engine is a metal-fiber cover around each exhaust manifold. And the intake manifold is isolated from the head with a rubber-beaded gasket and rubber-sleeved bolts. The aluminum front cover is a single, robust casting to which all accessories are directly mounted. This not only cuts vibration, but also helps maintain belt alignment for a long, silent life. Other life extenders include valve guides made of sintered iron impregnated with the dry-lube moly. Cam lobes are notched, so they apply rotating force to crowned contact surfaces of the hydraulic lifters. Three main bearings have tapered oil grooves that improve flow to the connecting rod bearings.

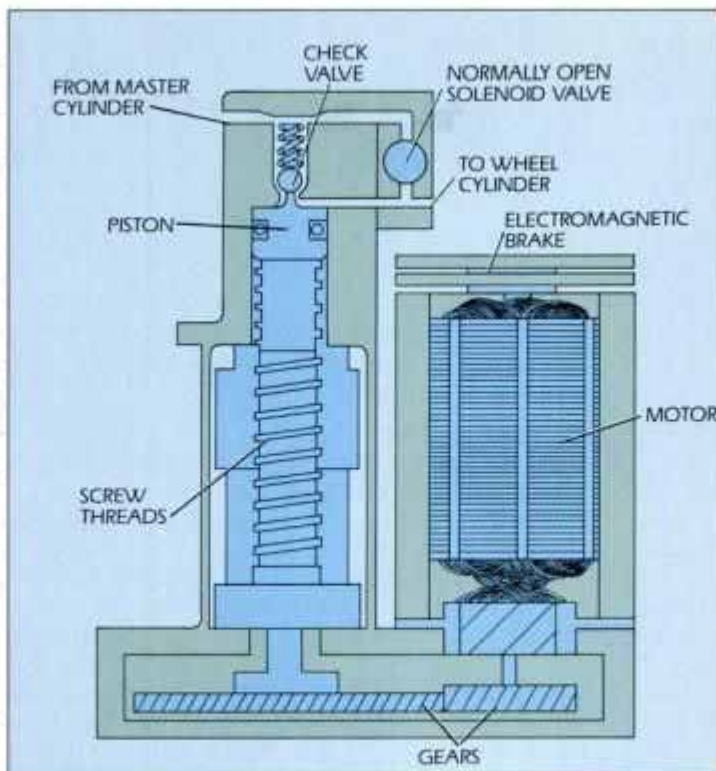
Each fuel injector has a dual spray, one into each intake port, for improved fuel distribution. Elsewhere under the hood at GM, Cadillac stroked its aluminum V8 to raise the displacement from 4.5 to 4.9 liters. The 4.9 V8 is standard on the De Ville, Fleetwood, Eldorado and Seville. With the addition of a lower-restriction exhaust, horsepower goes up from 180 to 200. Allanté, still packing a 200-hp version of the 4.5, has the first 100,000-mile spark plugs, thanks to a new 2-in-1 electrode design with primary platinum contacts.

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Antilock braking system

Everyman's ABS (Delco Moraine ABS VI) went from concept to production in three years. While other ABS systems use expensive multi-



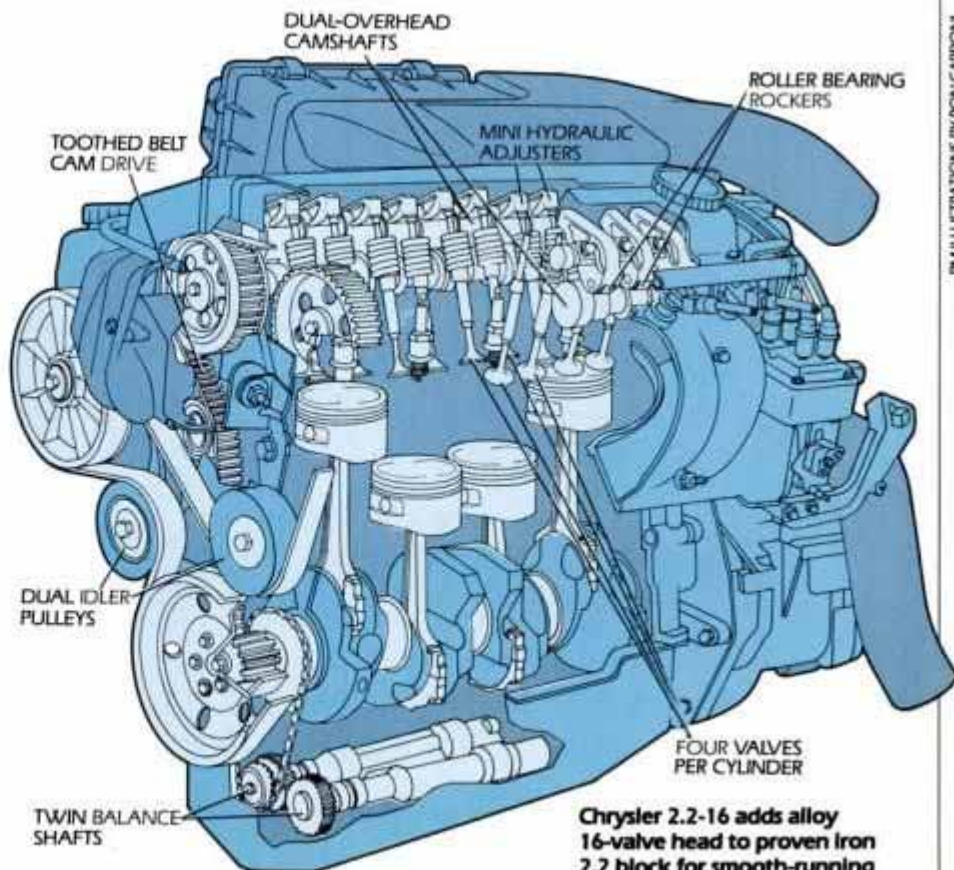
Delco Moraine ABS VI uses cheap electrical motors and screw-thread pistons rather than expensive hydraulic pumps and valves.

packs of pulsating solenoid valves and usually a motorized pump, GM's new ABS VI has just three low-cost electric motors to operate screw-jack plungers, plus three on/off solenoid valves and a conventional vacuum power-assist for the master cylinder.

second. There are slightly faster systems, but this one certainly does the job at the right price.

Computerized automatics

Electronic versions of two overdrive 4-speed automatics—a front-drive



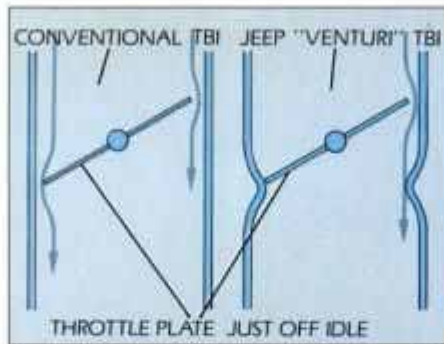
Chrysler 2.2-16 adds alloy 16-valve head to proven iron 2.2 block for smooth-running high-revving power.

PM ILLUSTRATION BY IRON CARBON

transaxle and a rear-drive transmission—see the light for '91. They make shifting and converter clutch lockup almost imperceptible. Instead of electric solenoids to move shift valves, GM takes the more conservative, indirect approach used by Ford and the Japanese. Solenoids move signal valves, which time the movement of shift valves, so shifts occur on schedule. Unlike many other transmissions, these have overrunning clutches (they lock one way and free-wheel the other, like a ratchet), which automatically release when a gear change occurs. The transmission has only to time the engagement of one band or clutch, not two. Combine that with an engine-transmission computer that can change engine timing and fuel delivery to reduce torque during shifts, and you've got *smoooothness*.

Add in a pulsing solenoid valve that gradually applies the torque converter clutch, and complaints about harsh engagement are eliminated. Program the electronics for a separate shift schedule when cruise control is on, and say goodbye to shift busyness.

The front-drive automatic first goes into the Buick Park Avenue, Riviera and Reatta; Chevy Lumina,



Venturi shape restricts off-idle airflow for smooth throttle progression.

Olds Cutlass and Pontiac Grand Prix with the 3.4 V6; Oldsmobile 98 and Toronado; and Cadillac De Ville/Fleetwood, Eldorado and Seville. Cadillac versions also continue the silicone-filled coupling that adds a bit of slippage for extra smoothness. The rear-drive automatic, which will be offered initially on Chevy full-size pickups and Suburbans, has twin stators rather than the usual one in the torque converter, to cope with heavy loads. A stator redirects oil flow to multiply torque when pulling away from a stop. Two stators provide more multiplication, a 3.5:1 gear ratio instead of 2:1 from a single stator.

Chrysler

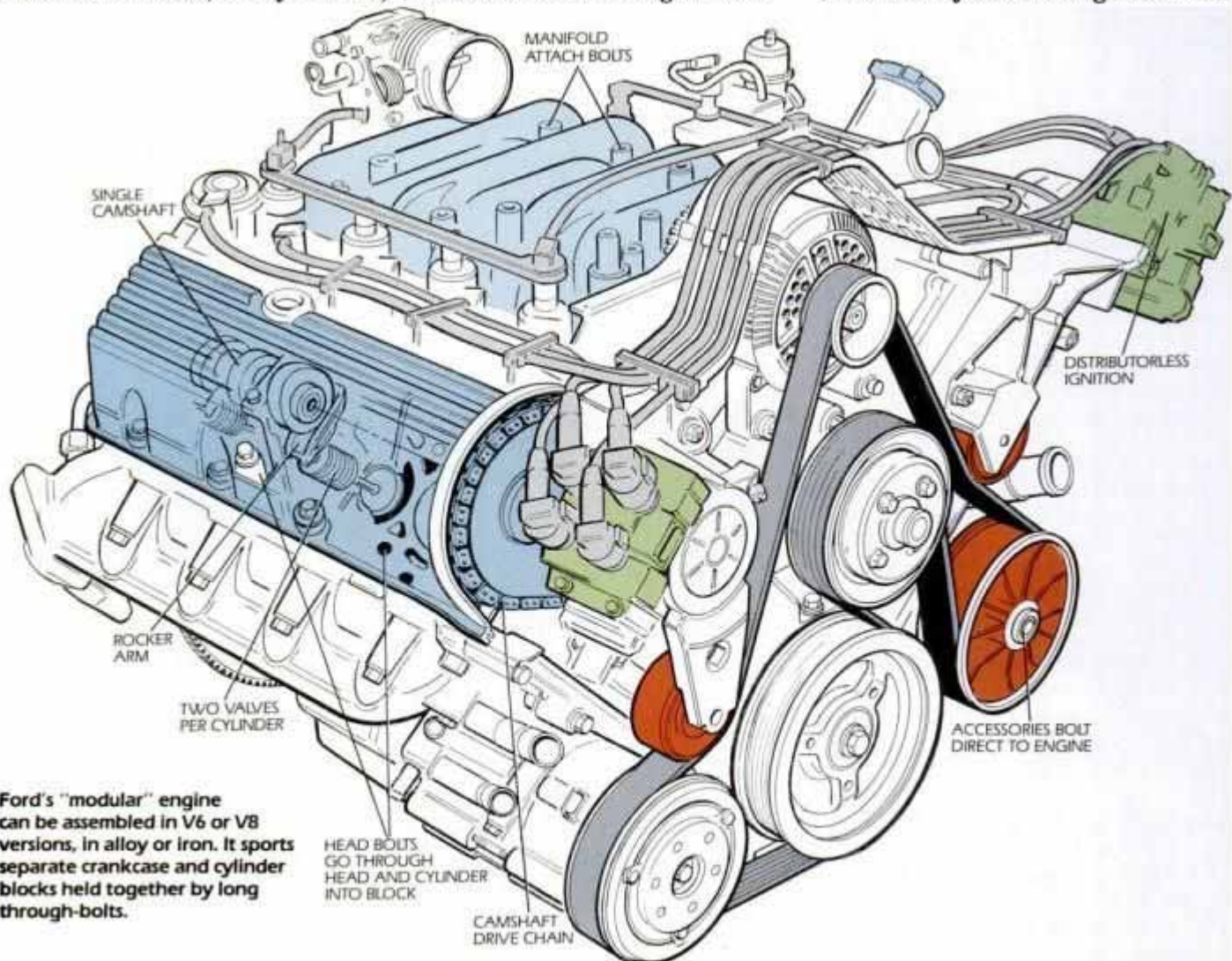
A 1991 Dodge Spirit sedan with a 2.2-liter 4-cylinder engine is a performance car? You bet.

A new 16-valve turbo version of the Spirit produces 225 horsepower—more than 100 horses per liter. It's very hot and less than \$20,000. Ask for the R/T.

The Chrysler 4-cylinder block is robust, so the 2.2 16-valver's is basically the same as the 93-horsepower base engine. More horsepower comes from an intercooled Garrett turbocharger and a 16-valve aluminum head designed by Lotus.

Dual-overhead cams move rocker arms with mini hydraulic lifters. Chrysler chose to use a cam timing belt instead of a chain drive for quieter operation. The 2.2-16 engine is a freewheeler, so a belt snap won't send valves crashing into pistons. Two idler pulleys provide maximum belt wrap around the sprockets to prevent belt jump.

Pistons are Lotus forgings, but rods, crank and twin balance shafts are off-the-shelf Chrysler items from the '90 variable-nozzle turbo (VNT) motor. Computer-controlled sequential fuel injection and ignition with



Ford's "modular" engine can be assembled in V6 or V8 versions, in alloy or iron. It sports separate crankcase and cylinder blocks held together by long through-bolts.

PM ILLUSTRATION BY FRED WOLFF

plenty of timing built-in also help make the power.

Despite the turbo and 16-valve setup, which are higher-rpm power boosters, the engine has a nearly flat torque curve from 2800 to 4800 rpm, where the 210 ft.-lb. of torque peak is reached. Launch feels good, and 0-to-60 is under 7 seconds.

The 2.2-16 is available only with a 5-speed manual transmission packing a Getrag gearset and a performance-tuned suspension. Production capacity for the engine is about 4000 rpm for the first year.

The 2.2 variable nozzle intercooled turbo is dead, a victim of its \$600 premium over a standard turbocharged engine. Instead, Chrysler is offering as a step-up in most of its car lines a well-tweaked 2.5-liter Turbo I, which produces 210 ft.-lb. of torque at 2000 rpm. Top end is clearly weaker because horsepower is only 152, compared with 174 for last year's VNT. Major change was recalibrating the Turbo I wastegate to raise boost, which ranged from 7-11 psi, to a uniform 11 psi. Although the torque numbers seem comparable, Turbo I isn't quite a match for the VNT at the low end (primary advantage of the variable nozzle), but should be responsive enough for many drivers.

Chrysler has another 100-hp-per-liter engine in the Stealth R/T sports car from Mitsubishi. It's a 300-hp 3.0-liter V6, a 24-valver with twin air-to-water intercooled turbos.

Chrysler has also stroked its 3.3-liter pushrod V6 to 3.8 liters. Horsepower is 150, same as the 3.3, but torque is up from 187 to 203 ft.-lb.

More important for Chrysler's corporate bottom line is a 13-hp upgrade of the Jeep 4.0-liter inline Six from 177 to 190. There's a reworked intake manifold, dual-exhaust system and sequential fuel injection. The 2.5-liter Four also is up from 117 to 126 hp.

There's a smoother gas pedal feel in new Jeeps. A neat throttle-body fuel-injection unit with a venturi design eliminates the throttle linkage levers and bell cranks that increase friction. Before, it was necessary to use the linkages to change the mechanical advantage of the throttle linkage just off-idle, so a small motion of your foot wouldn't make the car shoot forward.

Now, the linkage is simplified, and the airflow of the system is relatively small until the throttle blade is opened farther.

Ford

Ford has a clean-sheet-of-paper 4.6-liter V8 on the '91 Lincoln Town Car, and that's just the beginning. The engine is modular, thus it can be made with aluminum or iron castings in V6 and V8 versions ranging in displacement from under 3.0 to over 5.0 liters.

The chain-driven single-overhead cam engine has two valves per cylinder, and a 4-valve version is on the horizon. Horsepower is a respectable 210. But with this engine, Ford proves there's more to high-tech than simply making more horsepower.

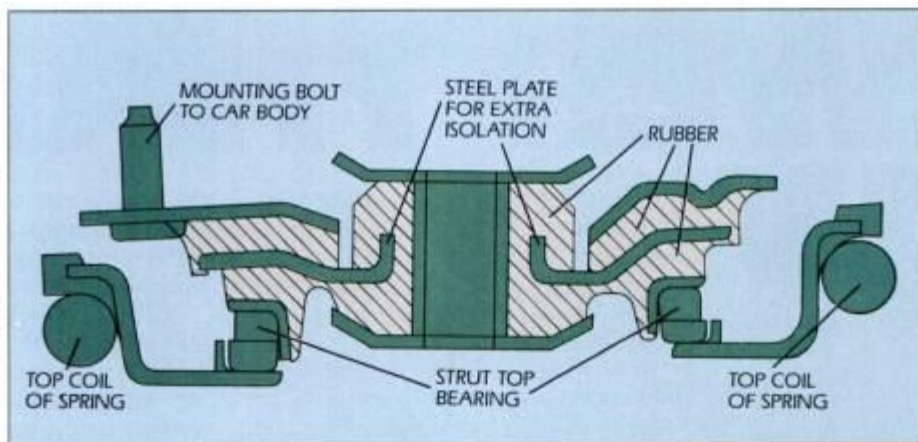
- Connecting rods are cracked apart at the bearing end, but it's no accident. Cracking instead of cutting means they fit back together precisely. The bearing insert is a round shell, rather than the usual half-moon shells

yield, a design almost everyone uses to evenly clamp head bolts. Gaskets are used on all seal-flat surfaces, and they're the premium silicone O-ring type. However, they're not just round or oval, but have a computer-generated shape to prevent cracking.

- Extraordinary steps were taken to prevent sludge buildup. Sequential fuel injection, distributorless ignition and an efficient clamshell combustion chamber limit unburned exhaust. Precise piston and bore sizing plus good ventilation should minimize combustion gas blowby into the crankcase. A cooling system pressurized from a remote container should mean less air entrapment and more uniform cooling. Is Ford confident? Check the tiny oil pickup, which prevents the oil pump from sucking air on hard cornering. If sludge was a worry, it would have to be much larger.

The engine is also quiet. An oil reservoir in a rocker shaft bracket retains oil fed to the hydraulic lifters so

they don't bleed down overnight and become noisy on cold startup the next day. All accessories bolt directly to the engine, not to brackets or covers. Vibration is reduced and the single belt should stay in squeal-free alignment indefinitely. The crank's internal balance is much more precise than on earlier designs,



Taurus front-strut mount uses extra rubber for added isolation without degrading steering.

crunched together for an approximation of a circle.

- Valve guides are sintered iron with built-in moly lube, so they'll live even with minimum oil feed. Main bearing caps are bolted both underneath and through the sides, in racing fashion. A threaded adjuster takes up free play between cap and block to prevent block distortion. The bottom of the block has ribs and other strengthening to maintain alignment. The precision machining and low distortion means that the more-durable, but less-compliant (than the usual lead), aluminum crankshaft bearings can be used.

- The heads and manifold have horizontal, rather than angled, mating surfaces. This helps prevent the manifold from pulling the heads and the banks of the block toward each other. Block distortion is greatly reduced.

- The engine is designed to be leak-free off the line and to stay that way. All critical fasteners are torque-to-

signs, eliminating the need for a separate damper at the front. The huge single intake manifold casting reduces performance-robbing air leaks, but could have amplified combustion noise. To counter this, Ford has employed thick rubber beads on the gasket and rubber sleeves on the bolts to isolate the manifold from the heads.

The 5.0-liter V8 isn't dead. Ford trimmed it and shoved a 200-horsepower version into the '91 Thunderbird/Cougar, giving buyers a step-up over the 140-horsepower 3.8-liter V6 without the expense of the supercharger used on last year's SC.

Under the car, rather than under the hood, Ford also installed double-isolated strut upper mounts on the Taurus and Sable. Each mount looks as if the rubber layer is thickened to sandwich an additional steel plate. It provides the ride of an isolated subframe suspension without the expense or complexity.

PHOTO BY BRUCE CRABBIG PHOTO



NEWER THAN NEW

A quick look beyond 1991.

BY TONY SWAN,
Automotive Editor

● Dream cars have always been more appealing than their production counterparts. But the game is changing. With the steady escalation of new-product development, concept cars

now do more than merely seduce auto show crowds. They also showcase new vehicle systems and can even become working development prototypes. The Cadillac Aurora is a good example of the latter.

In any case, Detroit's current concept car crop suggests shapes and systems we'll see in real passenger cars as early as the 1995 model year.

Ford Shoccc Wave

Here's a shape that's easy for enthusiasts to love. The Shoccc Wave was conceived to surround

the 3.0-liter 24-valve Yamaha V6 engine and an all-wheel-drive system riding on composite wheels with 255/35R-18 tires.

Nifty touches inside include a modular instrument panel, allowing the driver to fine-tune control positioning, an articulated knee bolster and cantilevered seats that eliminate the need for traditional seat rails.

Mercury Cyclone

The 4-door, 4-seat Cyclone has room under its low snoot for Ford's new 4.6-liter V8, and high-



MERCURY CYCLONE

GPHOTO

GPHOTO

are carbon-fiber body panels, a voice-activated cellular phone and composite high-intensity headlamps that pop up at the base of the windshield.

Eagle Optima

Optima isn't destined for production as-is, but you can expect to see the airy cockpit, cab-forward layout and wind-cheating shape embodied in several future Chrysler Corporation car lines.

Chrysler Voyager III

Car-pool special or urbo errand-runner, the Voyager III makes versatility as easy as hitching up a trailer. There are details to be resolved, but the modular minivan is an idea whose time can't be far away.

Cadillac Aurora

Aurora's drivetrain—all-wheel drive and V8 engine—is definitely on the horizon. As for the shape, we wouldn't be at all surprised to see something very similar in Cadillac showrooms by 1996. **PM**



FORD SHOCCC WAVE



BUICK BOLERO



PONTIAC SUNFIRE



EAGLE OPTIMA



CHRYSLER VOYAGER III

intensity fiberoptic miniheadlights show the way at night. The liquid-crystal translucent roof allows variable opacity at the flip of a switch, and vision to the rear is augmented by a pair of video monitors.

Buick Bolero

The Bolero is one dream that's close to near-term production reality. Technical highlights include an extensive use of fiberoptics and a 206-horsepower supercharged version of GM's 3300-rpm V6 engine.

Pontiac Sunfire

Pontiac's vision of future 2+2 coupes, with a rear-opening demi-door for rear-seat passengers, is real dream stuff, but the Sunfire's techno touches aren't. Included under this heading



CADILLAC AURORA

SATURN STORY

Hands-on with GM's billion-dollar gamble.

BY TONY SWAN, Automotive Editor

● "A new car. A new way of doing business."

That's the theme for the advertising that will herald the arrival of GM's long-awaited Saturn line of subcompacts, due to hit showrooms in late October. While the new way of business remains to be seen—after all, at

some point the buyer signs a contract and drives away, just like always—the issue of new is incontestable. New engine, new car, new factory—this is as new as new gets in the car business.

But will new be enough to seduce buyers who might otherwise choose a Honda Civic, Toyota Corolla, Nissan Sentra or Mazda 323? Will Saturn be better than the host of excellent Japanese sedans arrayed against it in the small end of the market?

Our Saturn experiences to date are drawn from prototypes that were well short of production status, so we can't comment on build quality. But we have some solid impressions of what this car is and how it will stack up against the cars it must displace.

Top ride quality

From a driver's point of view, Saturn's strongest suit appears to be ride quality. Like its competitors, the new car will roll on an all-independent suspension system. Suspension tuning varies from one manufacturer to another, of course, but the Saturn will have a distinct edge in wheelbase—



HIDDEN IMAGE PHOTOS



WATER



HYDRODYNE 20 DYNE COMP

Olympics. The folks who build Malibu ski boats, in Merced, California, were so impressed that they bought the company. Now, Flightcraft is American-made and drawing rave reviews, including this one from the PM test team. We crowned it our comparison test champ.

The sleek Flightcraft received top marks in handling,

ski ability, and fit and finish. With a small, well-defined wake and little turbulence in the middle, the 20XLOB is an ideal boat for 3-event (slalom/jump/trick) and 1-event (barefoot) skiers. Overall handling is smooth as silk. Even pulling the beefiest skier through a slalom run, the boat maintains level turns and steady tracking.

SHREDDING WATER



FLIGHTCRAFT 20XLOB

Performance is also exceptional. It combines a quick hole shot with impressive top-end speed (58 mph).

Craftsmanlike detailing is superior inside and out. Among the standout features are: molded-in gel colors, an integrated swim platform with molded deck steps, meticulous upholstery, a driver's bucket seat with armrest and twin speedos on a padded dash.

The Flightcraft falls a bit short in stowage because the fuel tank is located under the forward deck. But this isn't a problem. In fact, it may account for the rock-steady handling. Skiers going for the gold will like the interior

tweaking done by Malibu to an already winning hull.

Hydrodyne 20 Dyne Comp

Calling the 20 Dyne Comp's hull the elder statesman of the fleet is hardly an insult. It's based on record-setting skiboats and continues to dazzle a majority of show and club skiers. Top marks in hole shot and cockpit design, combined with solid figures across the board, make the Dyne Comp a close second-place finisher.

Using end-grain balsa-core construction, Hydrodynes are among the

most durable boats in the business. Quality workmanship is equally evident in the interior. Dash panel edges are rolled and smooth. A rear bench seat reverses for tournament judges. Teak molding adds a touch of class. Stowage space is generous.

The Dyne Comp was a jackrabbit out of the hole. A look at the bottom reveals why: a smooth, resistance-free surface minus strakes and hard chines. But lack of hard chines makes for steep body roll in turns and requires a seasoned hand at the helm.

Veteran skiers point out two minor flaws that contribute to the boat's

TEST PARAMETERS

Boats were propped and tuned by Yamaha. Top-end and acceleration data are averages of multiple runs with two riders and matched fuel loads. Skiability rankings are result of observations by PM test team and veteran skiers. It includes analysis of wake, table, turbulence and spray. Bold numbers indicate ranking in fleet.



OVERALL RANKING/MAKE/MODEL	1. FLIGHTCRAFT 20XLOB	2. HYDRODYNE 20 DYNE COMP
LOA/Beam/Weight/Fuel Capacity	20'/80"/2262 lb./30 gal.	20'/84"/1996 lb./24 gal.
Top End	2. 58.0 mph, swift and smooth	4. 53.0 mph, off pace, but fast enough for skiing
Acceleration 0-35 mph	2. 4.6 sec., leaps out of the hole	1. 4.5 sec., instant response, fleet leader
Handling	1. level cornering, rock steady	3. disconcerting body roll in turns
Skiability	1. none better in overall versatility	3. faint double wake, turbulence in close
Ski Stowage	3. 18.1 cu. ft., forward fuel tank eats space	2. 30.1 cu. ft., copious lighted areas under deck
General Stowage	4. 12.2 cu. ft., unique stern trims here	1. 17.9 cu. ft., immense, ideal use of space
Deck Space	3. 17.6 sq. ft., close, but not cramped	2. 21.9 sq. ft., large by any standard
Fit and Finish	1. voted best dressed	2. quality materials, rock-solid construction
Price As Tested	\$22,688	\$20,276
Address	Flightcraft by Malibu, 1861 Grogan Ave., Merced, CA 95340, (209) 383-7469	Three Rivers Ind., Inc., 5621 County Rd. #68, P.O. Box 220, Spencerville, IN 46788
Boats equipped with 90° V6, 200-hp Yamaha outboards. Oil injection, loop charging, three dual-throat carbs and trim and tilt are standard. Price is about \$10,200.	Exceptional tournament instrumentation, custom shifter, driver's armrest, beautiful detailing.	Matched tournament speedos, custom shifter with separate trim/tilt switch, great leg- and kneeroom.





HYDROSTREAM VOYAGER XT

third-place ranking in skiability: 1. a faint double wake and, 2. a turbulent table, especially in close. On the upside, the boat gets high marks for tracking, lack of spray and good control when pulling multiple skiers.

Barefoot Sanger

Given Sanger's performance-boat heritage, it's not surprising that the California builder's tournament skiboat takes a lean, all-business approach. The goal here is to make skiers happy, and the Barefoot Sanger succeeds. It led the fleet in dedicated ski stowage space and finished a

close second in overall skiability.

As the name implies, it's a bare-footer's dream: no spray, good definition to the wakes, soft bubbly turbulence and an easy-to-handle stern wave at acceleration. Wake and table were also excellent for slalom skiing. At slower, trick speeds there was a hint of a double wake.

Hole shot and top-end speed were off the pace, but not much. Handling was characterized by level turns, arrow-straight tracking and a welcomed ability to smooth out chop.

Nits to pick include tight access to helm bucket seat and a narrow driv-

er's footwell. Fit and finish is sound, but more utilitarian than plush.

Features we especially like are: spacious cockpit, copious stowage, removable aft bench seat, twin speedos and tilt steering wheel.

HydroStream Voyager XT

If your idea of a good time involves white-knuckle thrills, then the HydroStream Voyager XT is the skiboat for you. This screamer was the top-end champ at 61 mph. Although we tested an open-bow model, the hull is the same one used on HydroStream's Vulture XT, a closed-deck version the company hopes to have tournament-certified.

As mentioned, the mod-V hull sets it apart. On the upside, it has a soft wake that works well for trick skiing and kneeboarding. On the downside, the centerline wash may be too turbulent for barefoot and slalom skiers.

Its greatest strength is hot-boat looks and speed, but this may not be for everyone. At WOT and fully trimmed out, this boat does a fair bit of chine walking. To an experienced driver, it doesn't get any better than this. To others, it's hair-raising.

The open bow cuts into ski stowage (a drawback alleviated in the Vulture model), but general stowage is adequate. Handy teak and stainless-steel grab rails enable passengers to hold on at speed. Mooring cleats, a rarity in this fleet, are a welcome feature.

Fit and finish is sound throughout, if not plush. There's lots of legroom at the forward seats. The helm, overall, has a functional layout and a comfortable feel. But instead of yelling, "Hit it!" HydroStream skiers might want to whoop, "Ride 'em cowboy!"

Whether you're a gung-ho Wally Weekender, like us, or dedicated club or show skier, like our expert testers, the boats and engines in our fleet are ready to hit it when you are. **PM**



3. BAREFOOT SANGER

20' 2 7/8" / 1662 lb. / 30 gal.

3. 56.5 mph, fast for a skiboat

4. 4.8 sec., within a fraction of leaders

2. level turns, stable

2. superb wake and turbulence for barefooting

1. 41.9 cu. ft., enormous, no opportunity missed

3. 13.1 cu. ft., sufficient for most gear

1. 22.0 sq. ft., wide-open spaces for seating comfort

3. (tied) utilitarian, as opposed to plush

\$20,950

Sanger Boats, 3316 E. Annadale, Fresno, CA 93725, (415) 651-8400

4. HYDROSTREAM VOYAGER XT

20' / 89" / 1362 lb. / 24 gal.

1. 61.0 mph, racing hull flies

3. 4.7 sec., quick all around

4. not for the inexperienced

4. best for weekend recreational skiers

4. 15.7 cu. ft., open bow eliminates prime area

2. 13.3 cu. ft., adequate for family use

4. 13.5 sq. ft., loses out to large bow area

3. (tied) lean performance heritage is evident

\$23,000

Hydrostream, 2059 White Bear Ave., Maplewood, MN 55109, (612) 777-4802

Twin tournament speedos and tilt steering wheel a plus, but driver's footwell and entry/egress to seat are tight.



Loads of leg- and kneeroom. Integral trim button on throttle a plus. Dash needs more nonglare.



HIGHWAY PATROL

New radar detectors are smaller, sleeker, and most importantly, more sensitive.

BY MICHAEL J. McDERMOTT; PM Photos by Michel Tcherevkoff

● The sun is out. It's 70° F and there's nary a cloud in the sky. It's a great day to be alive and to be driving along the coast highway. You round a curve and the car responds beautifully. You punch open the throttle and you feel that big engine unwind. The torque presses you back into the seat. You're into it, until you look down at the speedometer. Holy cow! You're going much faster than you intended—80 miles per hour. You get on the brakes and slow down. No flashing lights in sight. No wail of a siren. Whew! You got away with it.

Or did you?

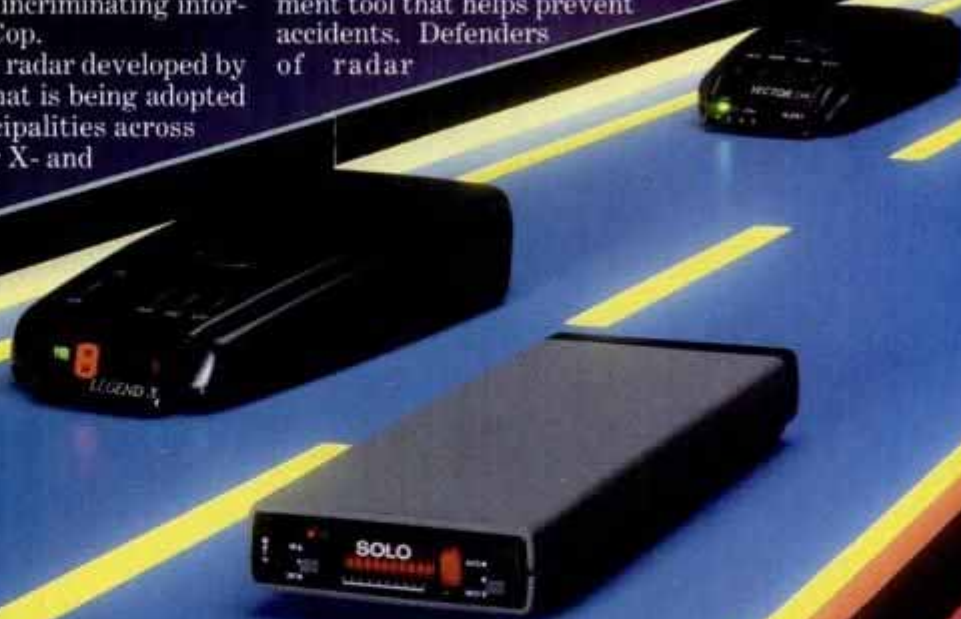
A few days later, in your mail is a photograph of your car and a citation for speeding. There you are behind the wheel, and the photo is imprinted with the time, the date, your speed and lots of other incriminating information. You were nailed by PhotoCop.

PhotoCop is a new kind of traffic radar developed by Traffic Monitoring Technologies that is being adopted by an increasing number of municipalities across the country. Along with the older X- and K-band radar, PhotoCop is a new tool operating on the Ka band that gives

police another way to enforce traffic laws.

Now, let's flip the coin. You're driving along at or under the speed limit, but you get a citation anyway. Speeder or victim, you may then become one of the estimated 2 million people who buy radar detectors annually. If radar is tracking your car—for better or for worse—a radar detector will let you know about it. New models even let you know when PhotoCop is on the job, and almost all are small enough to do it discreetly.

The whole subject of traffic radar and radar detectors is a sensitive one. Emotions run high on both sides in this years-long heated debate. Some law enforcement and highway safety officials argue that traffic radar is an effective speed-enforcement tool that helps prevent accidents. Defenders of radar



JOURNAL



SHOP TECHNIQUES

WOOD CARVING

How to shape wood by hand using the simplest of tools.

TEXT AND PHOTOS
BY ROSARIO CAPOTOSTO,
Contributing Editor

● If your carving experience is limited to things like shaping the legs of Queen Anne furniture or adding simple carved details to a chair back—or if you haven't even tried carving yet, then you're missing out on one of the most enjoyable, relaxing and rewarding areas of woodworking.

The three types of carving presented here are chip carving, relief carving and carving in the round. We've chosen a duck motif to illustrate the techniques because its graceful contours and simple details are not too difficult to reproduce. If you've never carved before, practice the carving

techniques in the order they are presented, so that each exercise acts as a foundation for the next.

Carving tools are available in a wide variety of shapes and sizes, but you'll only need a few basic tools for the projects described here (Photo 1). Our toolkit consisted of straight and bent gouges, straight and skew chisels, a veiner, a V-tool, chip carving knives and a mallet. A standard carpenter's chisel is also handy and can be used in place of the straight carving chisel, if necessary. For smoothing, we used a round file, half-round file, 4-in-hand rasp/file and a set of rif-



1 A simple carving kit includes straight and bent gouges, straight and skew chisels, a veiner, a V-tool and a mallet. Chip carving knives (bottom left) are used for decorative surface carving. Files and rasps smooth carved surfaces, and rifflers shape and smooth details.

Chip Carving

In chip carving, small knives are used to make shallow incisions on the surface of the wood. The designs produced are traditionally decorative patterns made up of repetitive geometric elements. Basic chip carving cuts include 3-cut and 6-cut triangles and the sweeping curved cut.

To chip carve the 3-cut triangle motif, first lay out a row of triangles along the grain. Then, make stop cuts on the two sides of each triangle that go across the grain. These cuts meet at the apex, where they should be about $\frac{1}{8}$ in. deep. The cuts taper to zero depth at the triangle baseline. Then, remove the chip by holding the knife at a low angle and cutting in at the baseline to meet the stop cuts (Photo 2).

To make the 6-cut triangle, basically an inverted-pyramid shape, lay out another row of triangles and draw three lines from the center to the cor-

ners of each triangle. Make three vertical stop cuts along these centerlines, inclining each cut so it's deepest at the center, and at zero depth at the corners. Then, make a slanting cut from each triangle side to remove the three chips (Photo 3).

To produce a sweeping cut, first draw the outline on the wood and then make a vertical stop cut along the center of the line. Then, hold the knife at 45° to the surface at the far end of the line and draw the knife toward you while making a slicing cut. Make a similar cut on the other side of the line to complete the V-cut (Photo 4).

When you feel comfortable using the chip carving knife, you can tackle the duck panel. Begin by making a paper pattern of the duck shape as shown in the drawing (page 55) and then transferring the outline to the stock. In order to emphasize the outline, create deeper shadow areas and increase contrast, we used a cut that

isn't a true V, but has one slanted side while the other is vertical.

The most important requisite for carving is a razor-sharp cutting edge. If a tool bevel needs to be reshaped, do this on a coarse bench stone. Then shift to a medium stone to smooth the bevel until a wire edge or burr is formed. Remove the wire edge on a fine stone. Use a fine slipstone of the proper shape to hone the inside of a gouge or V-tool. Polish the bevel on an extra-fine stone and then strop on a strip of leather charged with jeweler's rouge.

Although there are many woods suitable for carving, we chose basswood because it's one of the easiest to work with and it has a tight, straight-grained structure that holds detail well. White or sugar pine will also work for these projects. Carving tools, equipment and the 8mm glass eye we used for the duck decoy are available from Constantine, 2050 Eastchester Rd., Bronx, NY 10461.

isn't a true V, but has one slanted side while the other is vertical.

Make a vertical stop cut along the entire outline (Photo 5). Using a French curve, draw a parallel line about $\frac{1}{8}$ in. outside the original outline, except at the beak, where the spacing should be about $\frac{1}{16}$ in. Also, add parallel lines on the lower side of the wings, and a water line at the bottom of the duck (Photo 6). Vertical stop cuts must be made where lines intersect to prevent the wood from splitting beyond that point.

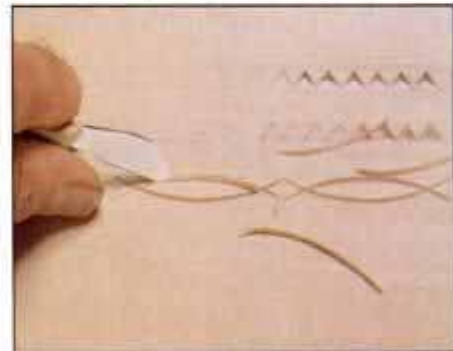
To form the grooves, hold the knife at a 45° angle and make slow slicing cuts on the secondary lines (Photo 7). Cut with the grain. Where the grain direction changes in the middle of a cut, it may be necessary to stop the cut and finish it from the opposite direction. To finish the panel, lightly sand with 220-grit sandpaper. Then bore the hole for the glass eye and attach it with glue.



2 Begin the 3-cut triangle by making two cuts from the triangle apex. Then, make a low-angle cut from the triangle base.



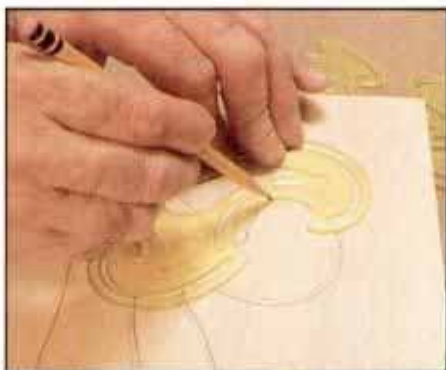
3 Six-cut triangle begins with three stop cuts made from the center of the triangle. Remove waste by cutting in from sides.



4 Make a sweeping chip cut by holding the knife blade at 45° . Then, steadily and slowly pull the blade across the surface.



5 After laying out the duck profile, begin carving by holding the knife at 90° to make stop cuts that follow the outline.



6 Use a French curve to lay out lines parallel to and about 1/8 in. from the original lines. Use 1/16-in. spacing around the beak.



7 Hold the knife at 45° to the surface and cut along the second set of lines to remove wood and delineate the shape.

Relief Carving

A relief carving is a carved design that projects from a recessed background. The background may be level and smooth or trench-carved, as in our example. To begin, select a block of wood at least 1 in. thick and transfer the duck outline from a pattern. Screw a 2 × 4 block to the back of the work so that it can be held in a vise. Position the screws under the thickest part of the carving.

Use a small V-tool to make an outlining cut around the figure. Keep the cut about 1/8 in. outside the line, and change the direction of the cut when necessary to avoid working against the grain (Photo 8).



8 Begin relief carving by using the V-tool to outline the duck profile. Keep the cut in the waste area—about 1/8 in. from the line.

Setting-in is the next step. Using the V-groove as a guide, make shallow vertical cuts along the outline using the chisels and gouges that most closely match the curves. Use a mallet to drive the tools, but avoid deep cuts which crush the wood fibers. Next, use a gouge to make short passes up to the vertical cuts to create walls around the outline. Repeat the process to gradually deepen the walls (Photos 9 and 10).

In order to deepen the background to its finished depth of about 3/8 in., use a bent gouge and make scalloped cuts radiating from the outline.

Next, begin modeling the duck shape by drawing a pencil guideline



9 After making vertical cuts around the outline using straight gouges and chisels, remove waste with a gouge.

about a 1/2 in. in from the body perimeter. Use gouges to roughly contour the body, taking off small chips around the head and chest areas. Use wide chisels to make the long sweeping cuts that define the wing and tail sections (Photo 11). Shape the wing indents with the V-tool (Photo 12) and then make paring cuts to fine trim the contours.

Bore the 5/16-in. eye socket before the final head rounding. Pare down the beak with a shallow gouge and use the V-tool to incise the lower jaw. Use a razor knife to form the nostril. Smooth the beak details with rifflers, sand all but the background with 220 paper (Photo 13), and glue in the eye.



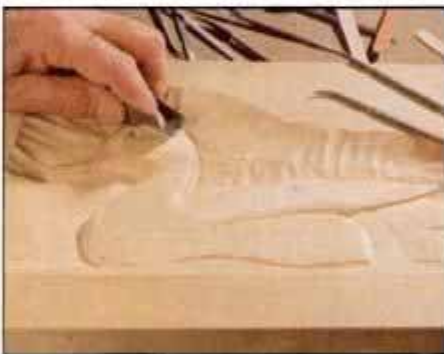
10 As work progresses, continue alternating between grounding cuts made with bent gouge and cuts that follow outline.



11 Shape convex curves of duck with a straight carving chisel. Change cut direction when necessary to follow grain.



12 Use the V-tool to incise the separation between the wings. To clearly see contours of carving, light the work from a low angle.



13 Sand the figure—not the background. Start with 150-grit and work through to 220-grit paper for a smooth finish.

Carving In The Round

Carving a decorative decoy duck in three dimensions is a little more challenging than the relief-carved version. Not only is there more carving involved, but the work must be symmetrical and sensitively done in order to appear realistic. The tools and techniques are similar to those used in relief carving.

If you can't find a large enough block of basswood for this project, you can make the block by gluing together smaller pieces. We used two pieces of $1\frac{3}{4} \times 5\frac{1}{4} \times 12$ -in. basswood. Be sure to orient the grain direction of the pieces in the same way to avoid grain reversal problems when carving across glue joints. The head is carved

from a separate block for ease of handling and better control.

Use paper patterns to transfer the top and side profiles to the block (Photo 14). Band saw the side profile, and tack the waste back on to the block to replace the top profile outline (Photo 15). Then, band saw the top profile. Before sawing the head roughly to shape, bore a $\frac{1}{16}$ -in.-dia. hole through the head at the eye location. This will serve as a pilot for the final eye socket hole to be bored later. Then, cut the side and top profiles of the head in the same way as the body.

Bore and counterbore the holes for the lagscrew that holds the head to the body as shown in the drawing. Make the head-holding jig, also shown

in the drawing, and secure the head blank to it with a lagscrew. Use four brads with the heads nipped off to keep the head from rotating on the holding jig.

Begin shaping the head by whittling with a knife (Photo 16). For more careful shaping and detailing, secure the holding jig in a vise. Use a knife, V-tool and skew chisel to finish detailing the bill (Photo 17), and use a fine razor knife to form the nostrils. After the head is roughed out, use a gouge to shape the characteristic eye trough along each side of the head (Photo 18).

Next, remove the head-holding jig and temporarily secure the head to the body. Check the mating surfaces for a good fit. Trace the neck outline



14 Mark top and side view of decoy body on the stock. Make sure both views are accurately aligned. Repeat for head blank.



15 Band saw the side profile first. Replace the waste to reinstall the top view layout. Then, band saw to the top outline.



16 Fit the head blank to the head-holding jig and shape head by whittling. Note how thumbs are placed to help control cut.



17 After preliminary shaping, install head-holding jig in vise and begin shaping the bill details with a small skew chisel.



18 Use a gouge to shape the eye trough recess, as shown in drawing. This is an important feature of a duck's head.



19 Begin rounding the body by making a series of chamfer cuts around the bottom. Use the mallet for heavy work only.



20 Use chisel with bevel up on convex curve. Pressure is applied with hand on handle. Hand on blade controls the cut.



21 Use gouge in pivoting motion to form the concave shoulder curvature. Always follow grain direction of block.

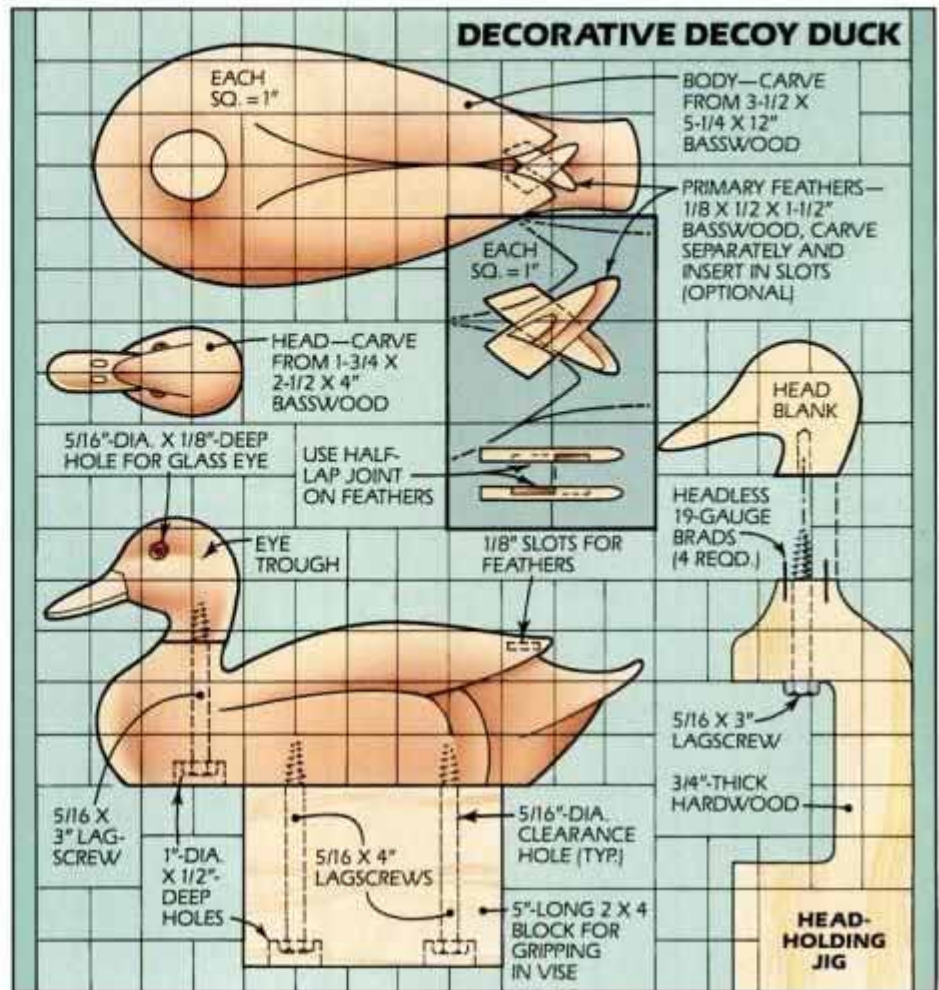


22 Use a skew chisel for cleaning out tight areas. Work is firmly secured in vise by a 2×4 block screwed to the work.

on the body block and remove the head. Then, screw a 2 x 4 block to the bottom of the body blank for securing the blank in a vise.

Begin carving the duck body to rough shape with a large straight chisel and gouge. Use a mallet to drive the tools for initial heavy stock removal, and resort to hand power only for final shaping. Generally, use the hand that you have on the tool handle to apply the cutting power and allow the hand on the blade to guide the cut. For sweeping, modeling cuts, allow both hands to guide and power the tool (Photos 19 through 25).

After the body is carved, attach the head permanently with glue and the lagscrew. Then, blend the neck to the body with a gouge (Photo 26). Use a combination of rasps and files to remove the carving marks and smooth the work (Photos 27 and 28). Some ducks, such as the Mallard that our carving is modeled after, have primary feathers that project well out of the body. Because it's difficult to carve them out of the solid block, they're carved separately and inserted in slots cut below the large feathers carved at the rear. Sand the entire carving, finishing off with 220-grit sandpaper. Then use a $\frac{5}{16}$ -in. drill bit to bore the eye sockets, and secure the glass eyes with glue. **PM**



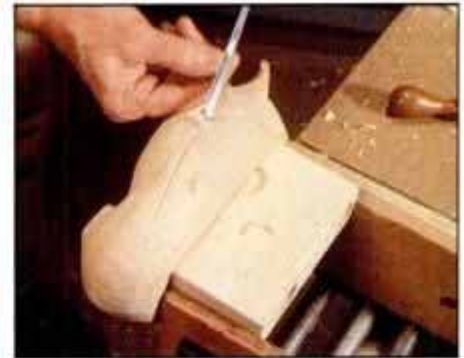
PM ILLUSTRATION BY EUGENE THOMPSON



23 Use a straight gouge to shape the depression on decoy back. Note that neck joint has been shaped to match head.



24 After preliminary body shaping, use a paper pattern to lay out wing-pocket shape symmetrically on sides of decoy.



25 Use the V-tool to cut the wing-pocket divisions on the decoy sides. Screwed-on block permits gripping work in vise.



26 Install decoy head with glue and lagscrew. Use a gouge to blend the head with the body so the surfaces are continuous.



27 After shaping nostrils with razor knife, smooth and refine the beak details with riffler rasps or files before sanding.



28 Use a flat file for smoothing convex areas, a half-round file for large concave surfaces and a round file for small curves.

HOMEOWNERS CLINIC

BY NORMAN BECKER, P.E., Contributing Editor

Illuminated Light Switch

I recently bought an illuminated light switch to control the overhead light in my hallway. The illuminated switch lever is very effective in that I can now find the switch in the dark. However, I don't understand how it works. Could you explain it?

LISA RAPPOLD
GARNERVILLE, NY

To understand the inner workings of the switch, I called the Leviton Manufacturing Co., a company that makes these switches and other electrical devices. Inside the switch is a parallel circuit (see diagram at right). One leg of the circuit is the switch that controls the ceiling light. The other leg contains a neon glow bulb in series with a resistor.

When the switch is open, current flows through the bulb path. The resistor in this path is sized so the current is only about 1 to 2 milliamps. This is enough to light the bulb, but not the ceiling light. It is also small enough so that if a short occurs in that leg of the circuit, it won't trip a ground-fault circuit interrupter. A GFCI trips when there is an imbalance in the circuit of 5 milliamps or more.

When the switch is closed (the ceiling light is turned on), that leg of the

parallel circuit has little or no resistance compared to the high resistance of the neon bulb leg. Electricity, seeking the path of least resistance, flows through that leg of the switch and lights the ceiling bulb, while the neon bulb dims considerably.

Vapor Barrier Paint

I have a ranch-style house that has no vapor barrier in the walls or ceiling. I recently added more insulation to the ceiling and have blown insulation into the walls. Now the paint outside the house is blistering. What should I do? I have heard of a special paint to seal the inside walls, but can't find it locally. Can you help?

RALPH STETTENBENZ
WELLSVILLE, NY

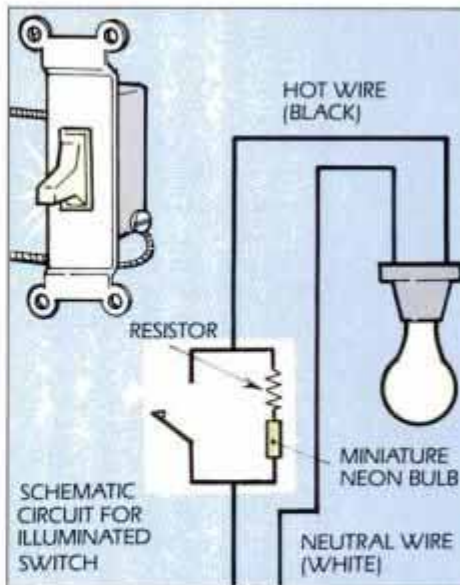
By blowing insulation into the walls, you've restricted the airflow inside the wall cavity. Consequently, the moisture-laden air that migrates from the interior of the house to the wall cavity cannot pass harmlessly outside. Instead, the moisture is absorbed by the wood siding, causing the paint to lose adhesion and peel.

A vapor barrier paint should correct this problem. Glidden Coatings & Resins manufactures a coating called Insul-Aid, which is applied like a paint and can be used on a previously painted surface. It can also be used as a general-purpose primer for wallboard or plaster. According to the manufacturer, Insul-Aid, applied at the rate of 400 sq. ft. per gallon, has a .6 perm (permeability) rating. A material with a perm rating of less than 1 is generally accepted in the construction industry as an effective vapor barrier.

Insul-Aid costs about \$20 per gallon, and is sold at paint stores and home centers. For information, write to Manager, Public Relations, Glidden Coatings & Resins, 925 Euclid Ave., Cleveland, OH 44115.

Faulty Relief Valve

I have two relief valves in the plumbing system of my house that discharge 1 to 2 pints of water per day. Both are set to discharge at 150 psi or 210° F. One valve is on my water heater, and the other is attached to the hose bib at the rear of the house. The water pressure entering my house is 160 psi, and a pressure reducer by the water inlet



Illuminated light switch relies on miniature neon glow bulb and parallel circuit.

reduces it to 58 psi. The thermostat on my water heater is set for 140° F. Do you have any suggestions?

HAIG HAYDOSTIAN
NORTHRIDGE, CA

There are three conditions that cause relief valves to discharge. The pressure is too high, the temperature is too high or the valve is faulty.

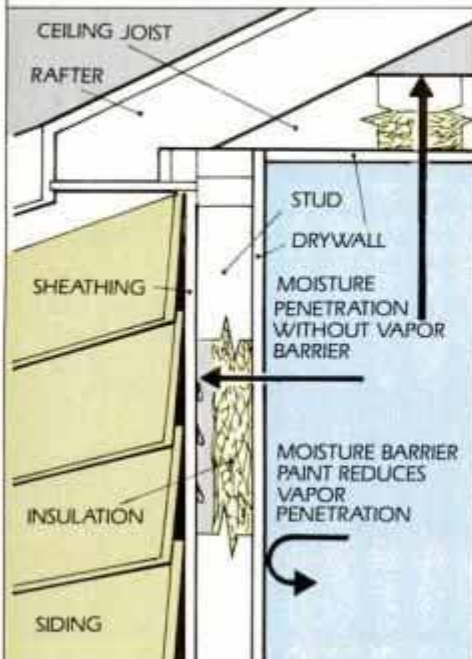
Assuming the temperature and pressure measurements you indicated are correct, I suspect that the relief valve on your water heater is faulty and should be replaced.

Normally, a hose bib doesn't need a relief valve, although it should have a vacuum breaker to prevent water from the hose from back siphoning into the house's water system, in the event of a pressure drop. The fact that there is a relief valve indicates that the piping to the hose bib probably bypasses the reducing valve.

In that case, the relief valve is working properly by discharging at pressures above 150 psi. The street pressure of 160 psi will vary and drop according to the demand from other houses. This variation in pressure causes the relief valve to discharge intermittently. To correct this problem, redirect the piping so it does not bypass the reducing valve, or install a separate reducing valve. **PM**

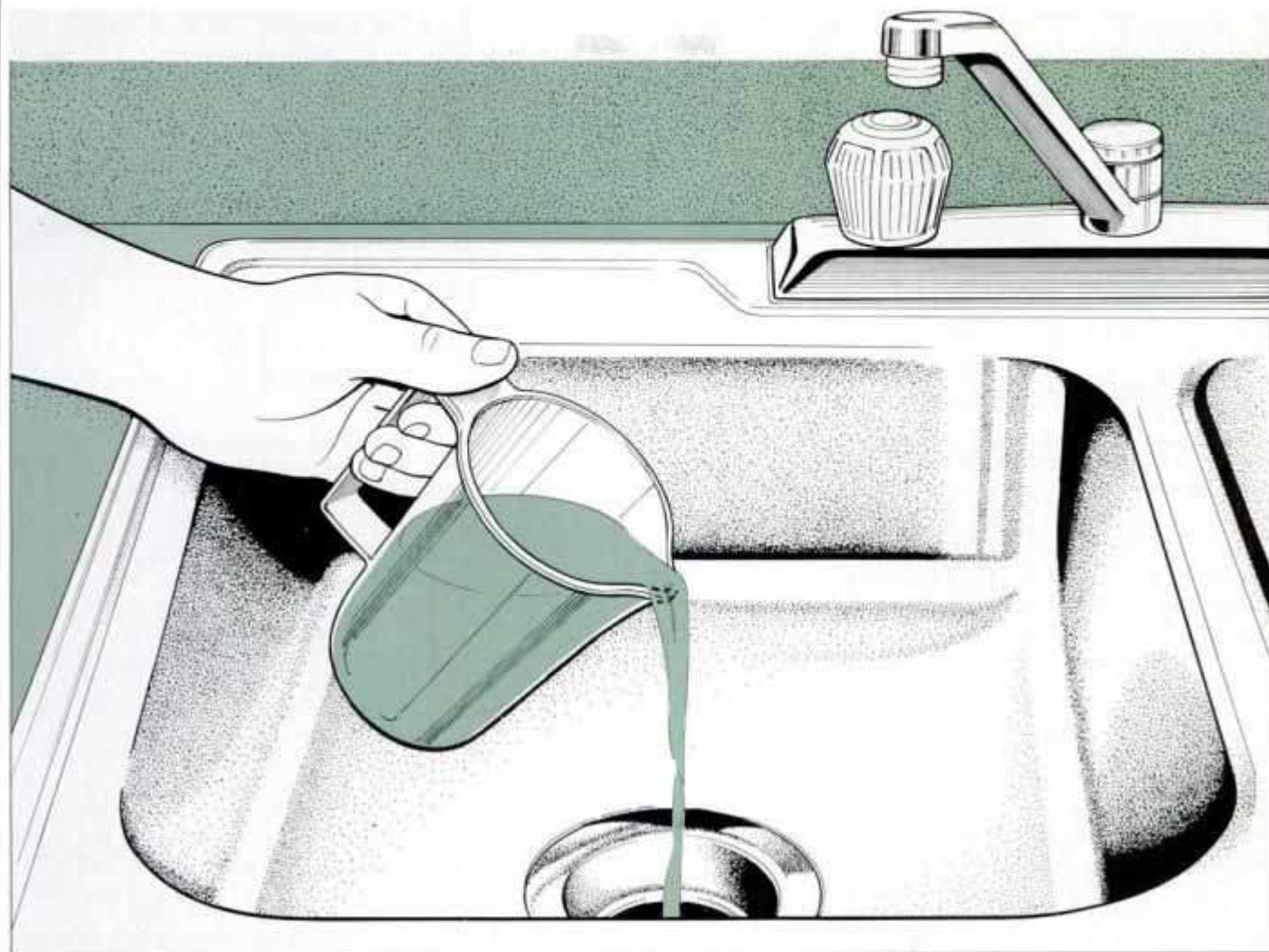
DO YOU HAVE A HOME-MAINTENANCE OR REPAIR PROBLEM?

Just ask Norman about it. Send your question to Homeowners Clinic, Popular Mechanics, 224 West 57th St., New York, NY 10019. While letters cannot be answered individually, problems of general interest will be discussed in the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$5.95 postpaid. Send your order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, NY 10101.



Vapor barrier paint reduces moisture transmission through house wall.

PM ILLUSTRATIONS BY ED LIPINSKI



CLOSING DOWN A SUMMER HOME

BY MERLE HENKENIUS
PM Illustrations by
George Retseck

● If you own a summer home or head south with the first cold snap, you know the difficulties involved in shutting down a house for winter. The problem, of course, is that without heat, every pipe and appliance containing water will freeze if not drained or protected. For years, the only solutions were to drain all water appliances and supply piping, and replace all trapped waste water with automotive antifreeze. Because conventional antifreeze is highly poisonous, many homeowners stuffed rags in fixture traps instead.

While these methods work reason-

ably well, they don't solve every problem, and may produce a few of their own. The basic problem is that plumbing systems and their appliances are meant to be used, not left idle. A garbage disposer, for example, will rust tight when left unused. When dry, the rubber seals of a dishwasher pump can shrink and cause the pump to seize or leak when restarted. Galvanized pipes that are drained undergo increased oxidation, and existing rust that would remain relatively stable when wet will crust over and flake off when dry. When the system is recharged, loosened flakes of rust will clog aerators, hose screens and toilet ballcocks.

As for protecting fixture traps, both alternatives present problems. Rags stuffed into toilet bowls and fixture traps do a moderately good job of blocking sewer gas, but are less effective in holding back roaches, water beetles and other insects common to public sewers. As for automotive antifreeze, it should not be flushed into public sewer systems and can kill the nitrifying bacteria needed to maintain

One crucial step in protecting your plumbing system from freezing is to pour specially formulated antifreeze into all waste traps.

an effective septic system.

If by now you crave some good news, here it is. Nearly every problem associated with a winter shut-down can be circumvented with careful planning and the right materials. Furthermore, the toxicity problems associated with antifreeze have been greatly reduced with the introduction of a new product. The product is Dowfrost RV, developed by Dow Chemical and marketed under a number of private labels. (Recreational Antifreeze is one brand name.) Dowfrost is an antifreeze, but when used properly, leaves no toxic residue. Its intended use is for the fresh water systems of campers and motorhomes, but it also works well in house plumbing systems.

Unlike automotive antifreeze, which contains ethylene glycol, Dowfrost contains propylene glycol with toxin inhibitors. Not only is it much less toxic, recreational antifreeze



1 If you have a gas water heater, turn off the gas at the meter. Use a wrench to turn the valve ridge perpendicular to the pipe.

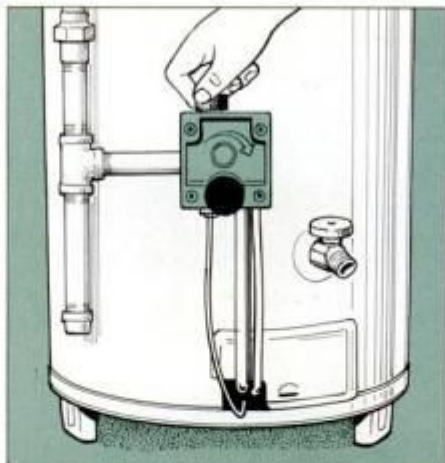
serves as a pump lubricant, retards corrosion and greatly reduces evaporation. Instead of preventing a freeze, propylene glycol provides burst protection. Its molecules shrink with a freeze and thereby keep pipes and appliances from rupturing.

Partial shutdown

If you'll be away from your home for only a month or so, I suggest a partial shutdown. The reasons are simple. A total shutdown involves much more work and is more problematic. By turning your thermostat down to 45° or 50° F, and by shutting off the water supply, you can greatly reduce maintenance expense and still be assured of minimal damage in the event of a power failure.

Protecting appliances

Begin by clearing out your refrigerator and unplugging it. Then prop the door open to prevent the molds and mildews associated with closed, dark spaces. Next, shut off your water heater. If it's an electric model, inter-



2 You can also turn off the gas at the water heater to eliminate possible trouble with thermocouple. Pilot light will stay on.

rupt the current at the disconnect panel or main service panel. If it's a gas model, you'll have two choices. You can either shut the gas off entirely (Fig. 1), or shut off only the burner and leave the pilot on (Fig. 2). While a pilot light will consume a few dollars in gas (approximately \$30 through the winter), shutting the gas off completely may cause your heater's thermocouple to fail.

Your dishwasher will also need attention, not because it's likely to freeze, but because evaporation of the water held in its base may cause the seals to shrink. If you will be gone only a short while, pour a coating of vegetable oil onto the standing water. The oil will seal the water surface and slow evaporation.

Clothes washers and water softeners will not likely be a problem, but your garbage disposer may rust. Soak a rag with sewing machine oil or gun oil and lay it in the disposer so that it covers the bottom of the drum (Fig. 3). Apply a little oil directly to the cutter blades. When you return, remove



3 To keep garbage disposer from rusting and possibly seizing, moisten rag with light oil and push rag into disposer drum.

the rag and pour a liberal dose of grease-cutting dish detergent into the disposer, then rinse.

Protecting piping

As you'll be providing enough heat to keep water lines from freezing, you won't need to drain your fresh water piping. To keep bacteria down, shut off the water supply with the piping fully charged. If you have city water, shut off the valves on both sides of the meter (Fig. 4). Then loosen the meter unions and drain the meter (Fig. 5). Wrap insulation around the exposed portion of the service pipe.

If your home is supplied by a private water well, shut off the valve located on the house side of the pressure tank, and shut off the power to the pump. Then drain a few gallons of water from the tank (Fig. 6).

Preserving water traps

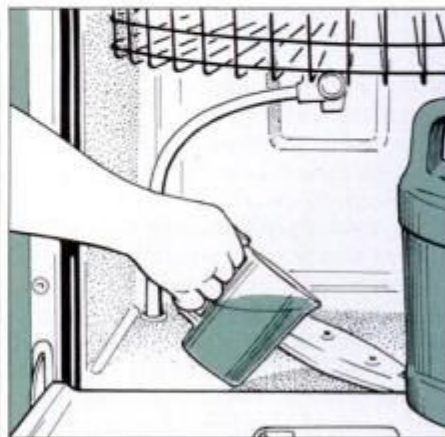
The water held in your fixture traps is all that prevents sewer gas infiltration. Even with a partial shutdown, you need to protect these traps from



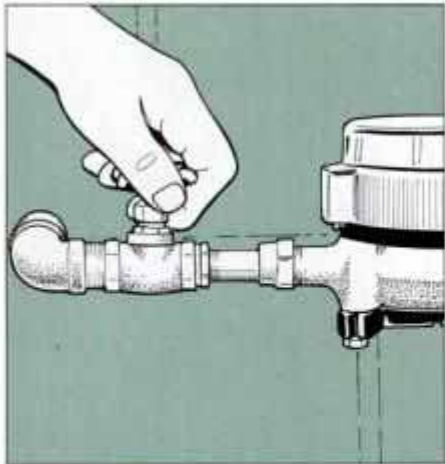
7 Remove all water from toilet tank and bowl using small paper cup and rags. Then fill bowl to normal water level with Dowfrost.



8 To protect clothes washer, pump all water from machine, then pour 2 cups of Dowfrost down waste trap stand pipe.



9 To protect dishwasher, pour 2 cups of Dowfrost into bottom well. This keeps water from freezing and protects pump seals.



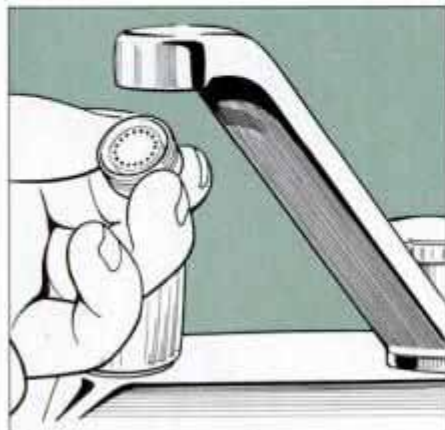
4 To cut off your water supply, shut off the valves on both sides of your water meter. If stiff, loosen valve nut with wrench.

evaporation. The best solution is Dowfrost RV.

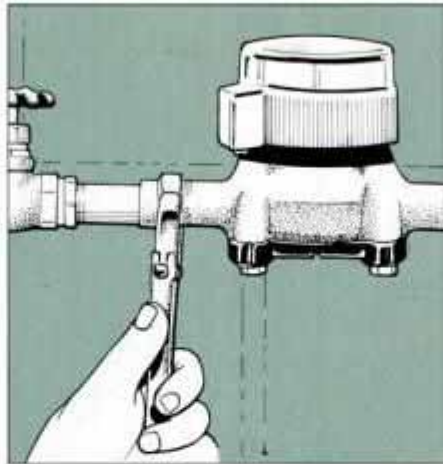
Start by flushing your toilet with the water supply shut off below the tank. Sponge the tank dry and replace the bowl water with Dowfrost up to the normal water level (Fig. 7). Then pour a cup of Dowfrost into each sink and tub drain and 2 cups into any floor drains, shower traps and your clothes washer stand pipe to protect its trap (Fig. 8). This will give you burst protection in a power failure, but will also provide the evaporation inhibitors needed to maintain trap seals.

A total shutdown

If you will be gone for the entire winter and would rather not pay even a reduced heating bill, then a total shutdown is your only alternative. In this case, fortify the water in your dishwasher (Fig. 9) and washing machine with Dowfrost. Also, undo the supply hoses from your washing machine and drain them. Treat all fixture traps with Dowfrost, just as you would in a



10 To remove trapped water from supply system, first close all faucets. Then remove aerator from sink farthest from service line.



5 To keep the meter from freezing and breaking, loosen the unions on both sides of the meter and drain water from base plate.

partial shutdown. Treat your disposer with the oil. If you have a water softener, loosen the unions on either side of the head and drain it. Any filter reservoirs should also be drained.

Shut off the power to the water heater. Then, using a garden hose, drain the heater and the pressure tank. In each case, close the hose bibs when the tanks are completely drained.

Draining the water supply system

Because plumbing codes prohibit unnecessary fresh water piping traps, you should be able to drain your system by draining your water heater and opening the meter unions or pressure tank hose bib. Open all upper-level faucets and fixtures. You can expect gravity to do most of the work for you, especially if you also have basement fixtures.

But even well-plumbed homes sometimes have one or two small piping traps, so you should also force the system with compressed air. This can



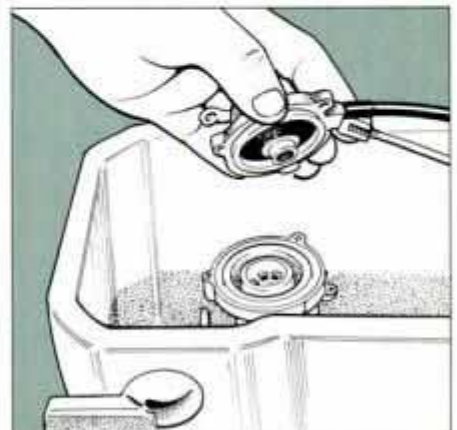
11 Open cold side and insert gun tip from air tank into spout. Seal with rag and shoot air, then repeat for hot side.



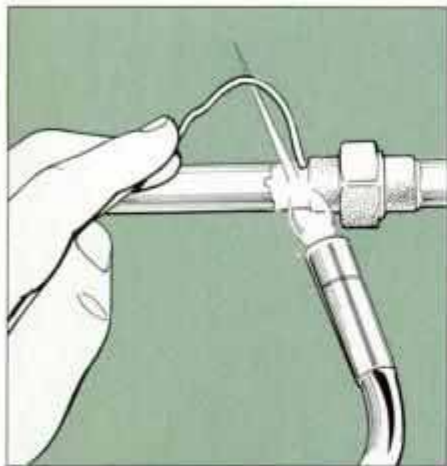
6 If you have a water well, first open all faucets and flush all toilets to drain most of water, then drain pressure tank with hose.

be done with an air tank, a blow gun attachment—both are rental items—and a damp rag. Begin by closing all faucets and valves, except the lowermost drain points. Then proceed to the faucet farthest away from the drain point and open just the cold side of the faucet. Then remove the spout aerator (Fig. 10) and insert the blow gun attachment into the faucet spout and wrap the damp rag tightly around the joint. Release several short bursts of air (Fig. 11). Then, shut off the cold side and repeat the procedure on the hot side. When you've finished, close all faucets, valves and unions.

If your fresh water supply piping is made of copper or plastic, sediment will not be a problem. If it's made of galvanized iron, flakes of rust will float free when the system is recharged. When recharging a galvanized system, simply remove the aerators from all faucets and purge the system through those and other unrestricted outlets, such as tub spouts and sillcocks. When the water runs clear, replace the aerators and



12 To clean rust and sediment particles from toilet ballcock, remove diaphragm cover and lift out particles with tweezers.



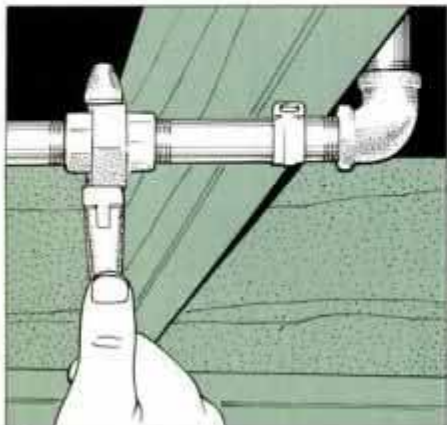
13 To install draining union in copper tubing, cut out ½ in. of tubing and solder union in place. Be sure to clean parts and use flux.

flush the toilet several times. If you find the toilet does not shut off completely, stop the water at the shutoff valve and remove the diaphragm cover from the ballcock. Pick out any rust particles with tweezers (Fig. 12).

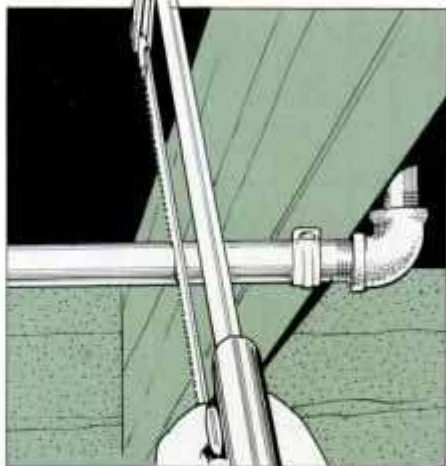
Cutting in drain points

If your plumbing system steps down and then up again, forming a long length of trapped water, you won't be able to blow enough water from it to prevent a freeze from splitting the pipe. In most cases, cutting in a union at the lowest point in the trap will be your best alternative.

Unions for copper piping are the easiest to install. All you'll need to do is cut about ½ in. from the line and solder the two halves of the union in place (Fig. 13). Steel piping (usually called iron piping) will require you to first cut the pipe with a hacksaw near the closest fitting (Fig. 14). Then remove the short length that goes into the fitting and thread the end of the longer pipe (Fig. 15). Now install a new threaded nipple (Fig. 16). If your



16 Turn threaded nipple into fitting, then install union fitting and tighten together. Use pipe joint compound on threads.



14 To install a draining union in iron pipe, first cut pipe with hacksaw. Make cut within a few inches of an accessible fitting.

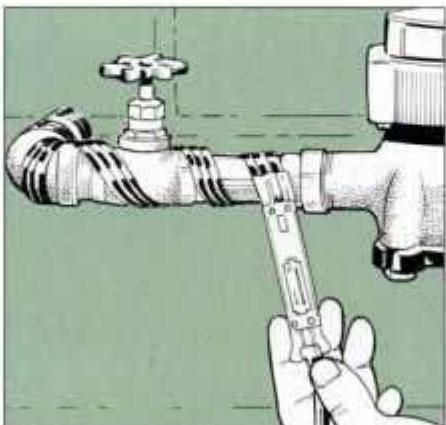
piping is made of plastic, cut out a section of pipe and glue a tee and male adapter into the trapped line. Then thread a cap onto the adapter.

Draining water service lines

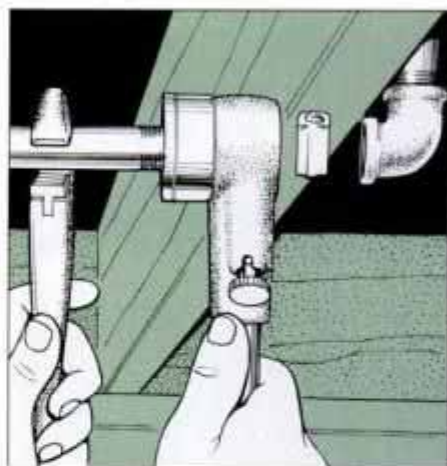
The buried portion of the service line between your public water main (or private well), and your home will be protected by the soil that covers it. Any piping extending from your basement wall to your meter or pressure tank will need protection, however.

In the case of a service line connected to a public main, you'll have two choices. The first and best solution is to have your service shut off near the street. If the valve between your sidewalk and street is accessible and in good shape, a city worker or plumber will be able to turn it off in a few minutes with a long street key. If your meter is buried in an outdoor meter pit, the job is even easier. In either case, you can then drain the service line from inside your home.

If your service line and street valve



17 If your service line and street valve are very old, it's a better idea to leave water turned on and install heat tape around line.

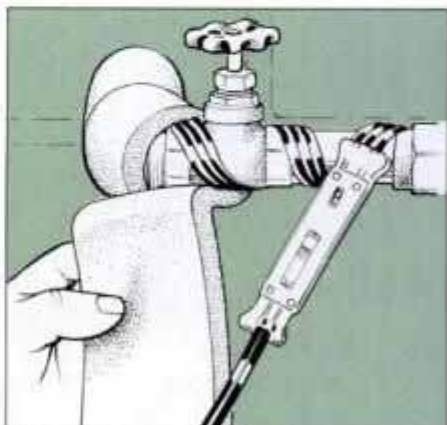


15 Remove short pipe stub. Then, using a die, cut threads on end of remaining pipe. Hold pipe securely with pipe wrench.

are very old and if the access pipe above the valve is cracked or full of dirt, you'd best let it be. In this case, I suggest wrapping the exposed section of service pipe inside the house with thermostatically controlled heat tape (Fig. 17) and covering the pipe and tape with faceless fiberglass insulation (Fig. 18).

If your service line is part of a private well system, you may be able to drain the line. Most wells will include a check valve in a pit or just inside your home, depending on the location of the pressure tank. If the tank and check valve are located in your basement, remove the valve and drain the line. If the check valve and tank are in a well pit, you'll automatically drain the line when you drain your pressure tank.

If all else fails, use heat tape and insulation to keep the exposed piping warm. One advantage of heat tape is that you won't have to prime your pump in the spring. The disadvantage is that you'll have to provide electricity throughout the season. **PM**



18 Once heat tape is installed, cover tape with fiberglass insulation that has no vapor barrier. Hold it in place with duct tape.



SHOP PROJECT

COUNTRY PINE MIRROR

A charming hall mirror that can be built in a weekend.

BY ROSARIO CAPOTOSTO, Contributing Editor

● Build this hall mirror and add a touch of charm to your home's decor. An experienced woodworker can build this piece in a weekend, and an inexperienced woodworker will find it an ideal project from which to gain experience.

To reduce the materials cost, you can use No. 2 pine instead of C-select (clear). To get the necessary clear stock, simply rip and crosscut between the knots. If you have to use a piece with a knot in it, face the knot toward the mirror's back.

We used a $\frac{1}{16}$ -in.-thick \times 16-in.-wide \times 24-in.-long mirror for this project. You can buy the mirror at your local glass shop or, as I did, buy an inexpensive one at the local home center and remove the frame. Check the mirror's actual size before you begin this project.

Adjust the project dimensions to suit the mirror, if necessary. When assembled, there should be a $\frac{1}{16}$ -in. space around the mirror ($\frac{1}{8}$ -in. total clearance).

Color photo: J.R. Rost
Black-and-white photos: Rosario Capotosto
Technical art: Eugene Thompson
Photo stylist: Gabe Herrick

Rails And Stiles

Rip and crosscut the stock for the rails and stiles. To mark the ends for the half-lap joints, lay a rail across a stile and scribe a line along the rail using a razor knife or a sharp pencil (Photo 1). Install a dado head in the table saw and adjust the blade so $\frac{3}{8}$ in., or half the stock thickness, is above the saw table. Cut the notches by making multiple crosscut passes pushing the workpiece over the blade using a miter gauge (Photo 2).

Next, install a 3-bead molding cutter on the table saw, and position the fence $\frac{1}{4}$ in. away from the edge of the blade.

Note that the bead cuts in the stiles are stopped $3\frac{1}{2}$ in. from the end of each board. This operation is easily controlled with a long auxiliary fence, simply a board temporarily attached to the rip fence. A pair of stopblocks are clamped in place on the board to limit the length of the bead cuts.

To locate the stopblocks, raise the molding head cutter so it just clears the saw table (about the height of one bead). Turning the molding head by hand, make cross marks on the saw table where the molding head emerges and where it descends. If necessary, stick some tape on the saw table and mark on the tape. Marking is easier if you butt a piece of scrap

wood against the fence and the cutter head and draw a line against its edge (Photo 3). Lower the beading cutter head after you've made the two marks on the saw table.

Mark $3\frac{1}{2}$ in. in from each end, on the edge of each stile. Lay a stile on the saw table so the mark on its edge farthest from you aligns with the mark on the saw table farthest from you (the stile should extend back from the aligned marks toward you). Butt a block against the stile's end closest to you and clamp the block to the auxiliary fence. Or make a mark on the auxiliary fence and clamp a block on the mark.

Slide the stile forward until the mark on the stile closest to you aligns with the mark on the saw table closest to you. The stile should extend from the aligned marks away from you. Butt a block against the end of the stile farthest from you and clamp it to the auxiliary fence.

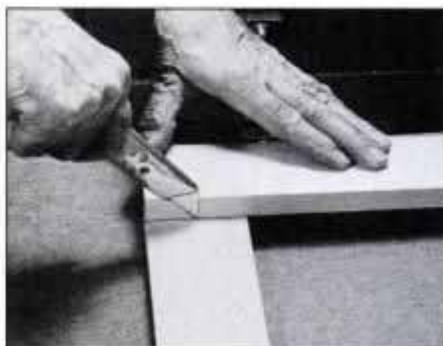
To make the stopped-bead cuts on the stiles, simply butt the stile against the block closest to you and lower it onto the blade (Photo 4). Push the stile forward until it hits the second block. Shut off the saw, and when the blade has stopped spinning, pivot up the workpiece.

To make the beading cut on the rails, simply push them over the bead-

ing cutter. There's no need to use stopblocks. With both rails and stiles, make one pass over the beading cutter, swap the workpiece end for end and make a second pass to cut the other three beads.

Use folded pieces of fine grit sandpaper to sand the grooves and beads (Photo 5).

Sand the rails and stiles, and apply glue to the lap joints sparingly. Use four $\frac{1}{8}$ -in. nails driven in from the back at each joint. Align the parts for nailing with a framing square butted into the inside corner (Photo 6). These nails only keep the parts from sliding. Use clamps to close the joints, and protect the surface of the joints with scrap blocks (Photo 7).



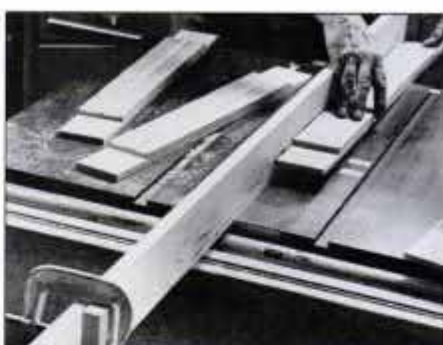
1 Rip and crosscut the stiles and rails. Lay the pieces on one another, then mark for the half-lap joint with a razor knife.



2 Cut the half-laps using a miter gauge and a dado head on the table saw. The blade height equals half the stock thickness.



3 Apply tape to table saw bed to set up for beading cuts. Marks on tape indicate where beading cutter engages workpiece.



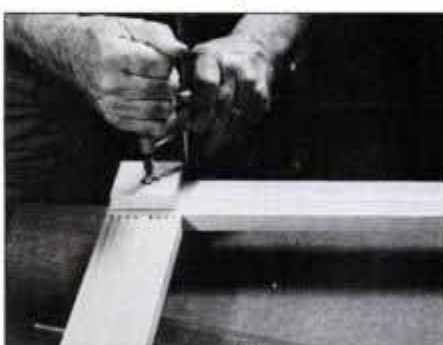
4 To start beading, butt stile against stopblock clamped to auxiliary fence. Lower stile into blade and push forward.



5 Lightly hand sand the beading with folded fine-grit sandpaper. Avoid rounding over the beading's crisp corners.



6 Butt a framing square into the frame corners. Apply glue to the joints, and drive in $\frac{1}{8}$ -in. nails from back of joints.



7 After the nails are driven, clamp corners tight and let glue set. Use scrap blocks under the clamp heads to avoid marring.

Making Trim Strips

Rip the rail and stile trim and the outside trim strips. Set up a feather board on the table saw to cut the rabbets on the rail and stile trim. The feather board keeps the strips secure against the fence. Make a cut along one edge. Readjust the feather board, tip the strip 90°, and make the second cut to complete the rabbet (Photo 8).

Cut the end notches on the rail trim strips with the dado head on the table saw.

Test fit the trim pieces. Measure from the edge of one rabbet to the edge of the other rabbet to determine if the mirror will fit with clearance. Apply a thin bead of glue, and nail in the rail trim strips with 3/4-in. brads (Photo 9).

Crosscut the stile trim strips to fit, check for mirror clearance, and glue and nail them in place (Photo 10). Glue and nail the small trim pieces in place.

Crosscut the outside trim pieces to fit, glue and nail them in place. Crosscut the bottom trim piece. Attach it with glue and nails. Then, fill any exposed nailheads with wood filler, and sand the filler flush.

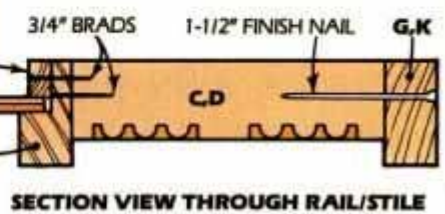
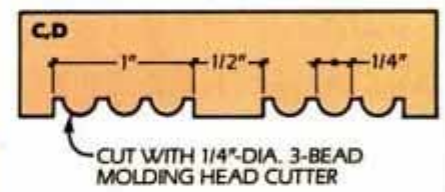
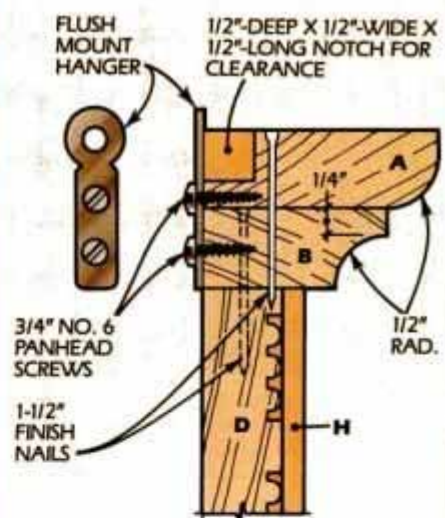
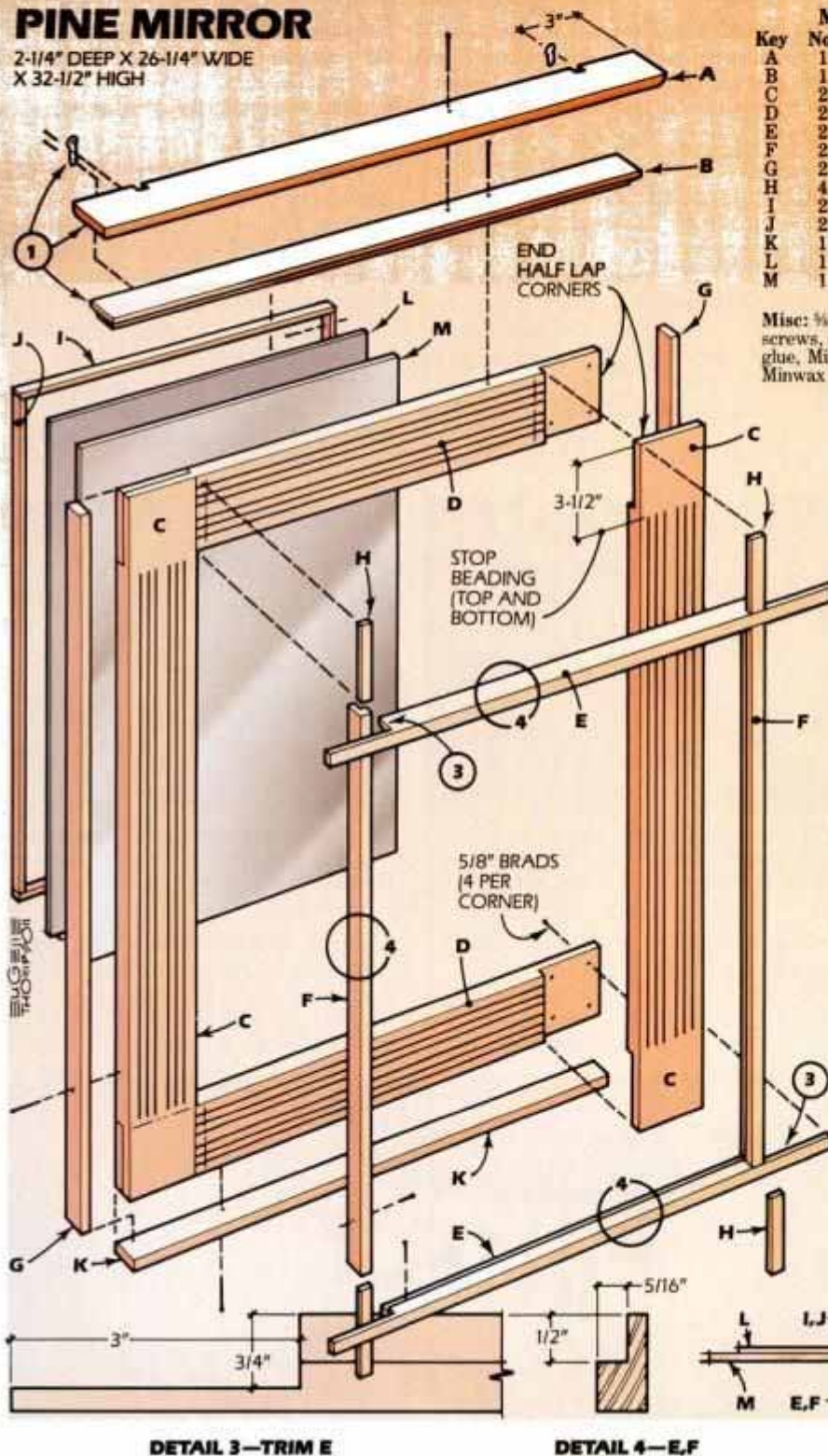
PINE MIRROR

2-1/4" DEEP X 26-1/4" WIDE
X 32-1/2" HIGH

MATERIALS LIST—PINE MIRROR

Key	No.	Size and description (use)
A	1	3/4 x 2 1/4 x 26 1/4" pine (cornice top)
B	1	3/4 x 1 1/4 x 24 1/2" pine (cornice bottom)
C	2	3/4 x 3 x 30 1/2" pine (stile)
D	2	3/4 x 3 x 22 1/2" pine (rail)
E	2	1/2 x 1 x 22 1/2" pine (rail trim)
F	2	1/2 x 2 x 23 1/2" pine (stile trim)
G	2	1/2 x 1 x 31" pine (outside trim)
H	4	1/4 x 1/2 x 15 1/4" pine (trim)
I	2	3/16 x 3/4 x 15 1/4" pine (trim)
J	2	3/16 x 3/4 x 23 1/4" pine (stile cleat)
K	1	1/2 x 1 x 22 1/2" pine (bottom trim)
L	1	16 x 24" cardboard (mirror backing)
M	1	1/16 x 16 x 24" (mirror)

Misc: 3/4" brads, 3/4" brads, 4d finish nails, 3/4" No. 6 panhead screws, one pair flush-mount hangers, yellow or white wood glue, Minwax Golden Oak Stain, Minwax Wood Conditioner, Minwax Semi-Gloss Polyurethane Finish, sandpaper.





8 Cut rabbet in rail and stile trim with two cuts on table saw. Use a feather board to keep workpiece against the saw fence.



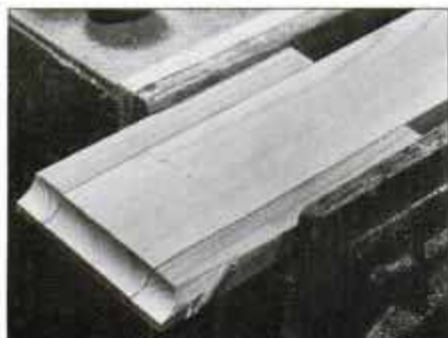
9 First attach the upper and lower rail trim with glue and nails. Apply glue sparingly to the notched end of trim pieces.



10 The stile trim pieces go on next. Hold the frame upright in a vise. Glue and nail the trim. Set and fill the nailheads.

Cornice And Finish

The cornice is made in two parts, each edge molded separately with the router, using a 1/2-in.-rad. corner round bit for the top cornice piece and a 1/2-in.-rad. cove bit for the bottom piece. To avoid tearout when cutting the shape on the ends of each cornice piece, simply clamp scrap backup strips on the edges of the workpiece when cutting the molding on the end grain (Photo 11). To assemble, glue and nail the



11 Clamp scrap strips to edges of cornice moldings when routing the end grain. Scrap edge splinters, workpiece doesn't.

lower section to the frame first, then add the second (Photo 12).

When the glue is dry, cut the mortises for the hanger screws or nails and attach the flush-mount hangers.

Finish is optional. Here's how we obtained a warm-toned finish. First, we finish sanded the piece with 220-grit sandpaper and then wiped down the piece with a tack cloth to remove dust.

We applied a coat of Minwax Wood

Conditioner to prevent uneven stain absorption, often a problem with softwoods. This was followed with Minwax Golden Oak Stain and two coats of Minwax Semi-Gloss Polyurethane Finish. Sand lightly between the coats of polyurethane, and remove sanding dust with a tack cloth.

Install the mirror. Back it with cardboard, then nail in the cleats, sliding the hammer along the cardboard (Photo 13).

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12 Glue and nail lower cornice molding to rail, then glue and nail on upper molding. Divide the cornice overhang equally.



13 Place cardboard behind mirror. Nail cleats to rails and stiles. Lay hammer on cardboard and swing into the brads.

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Insecta is available at hardware stores, home centers and drug stores. For more information and details, write to Insecta, Inc., 12127B Galena Rd., Plano, IL 60545.

PM





REPAIRING DAMAGED FINISHES

BY ROSARIO CAPOTOSTO,
Contributing Editor
PM Illustrations
by George Retseck

• Ordinary use, abuse and the ravages of time can damage a furniture finish, but fortunately most of this damage is easily repaired. All that's required is some time and a minimum of materials and expense. In most cases, it's better to preserve and repair a finish than it is to replace it (strip it off and refinish it). It's amazing what a difference a thorough cleaning and repair job can make. Also, repairing instead of replacing a damaged finish preserves the charac-

ter of a piece of furniture.

Most of the tools and materials to make these repairs are available at your local paint store or home center. For specialized materials, see the source list at the end of this article.

The first step is to identify the finish used on the furniture being repaired. Ideally, you'll overcoat the repaired area with the same finish. Shellac, lacquer and varnish are common finishes. To identify them, apply a solvent to an inconspicuous area on



1 First identify the finish on furniture being repaired. Test it with solvent.



2 Hide minor scratches by rubbing over them with a furniture touchup pencil.



3 Stain and overcoat small blemishes in one step with a touchup solution.



4 Apply solvent to an alligatored finish. Softened finish flows into the cracks.

your piece of furniture (Fig. 1).

Start by applying denatured alcohol. Alcohol will readily dissolve shellac, and it will slowly soften lacquer. Lacquer thinner will readily dissolve lacquer, and will soften shellac. It will cause varnish to start to swell, crinkle and lift.

Cleaning, minor repair

Next, clean the surface using a soft cloth dampened with mineral spirits (also known as paint thinner) or commercial furniture cleaner. This removes built-up dirt and wax and gives you a clearer idea of what the finish actually looks like. After cleaning, you may discover the damage is really just a light scuff. If so, you may be able to hide the scuff by applying paste wax or polish.

You can also hide a minor scratch by rubbing over it with a furniture-wax pencil or by applying some liquid touchup solution (Figs. 2 and 3). Both are available in a variety of wood colors. Touchup solution stains and overcoats in one step.

Crazing/alligatoring

Crazing and alligatoring describe a pattern of fine, irregular cracks in



7 Draw graining on patch with a fine-tip pen. Soften sharp lines with a cotton swab.



5 Firmly pack wood filler into gouges using a putty knife. Strike off the excess.

the finish usually caused by excessive heat or long exposure to sunlight.

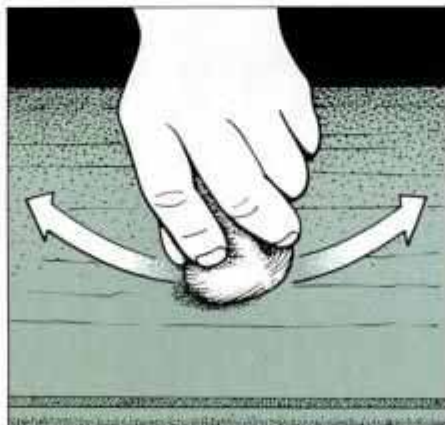
Alligatored shellac or lacquer usually responds nicely to amalgamation (applying a solvent to partially dissolve the finish). Stroke with a fine artist's brush until the finish softens and fills the cracks (Fig. 4). Let the finish reharden overnight, then buff over the repair with some paste wax. Amalgamation doesn't work on varnish, however. The condition can be lessened slightly by varnishing over the affected area.

Gouges

Fill a gouge with wood filler, either premixed or a powder which is mixed with water. Most are buff-colored, while others are wood-toned. Colored compounds rarely match the wood so you need to stain them.

First, scrape away loose finish around the gouge. Next, press the compound firmly into the gouge with a putty knife (Fig. 5). Shave off the excess, then sand the filler flush with a sanding block and 320- or 400-grit sandpaper.

Stain the patch with a cotton swab, and draw grain lines on the patch with a felt-tip pen when the stain is dry



8 Apply padding lacquer in quick, pendulum-like strokes, without stopping.



6 Once filler is dry and sanded level, apply wood stain with a cotton swab.

(Figs. 6 and 7). Marking pens are sold in a variety of colors at art supply stores. Seal the stained patch with a coat of dilute shellac (refer to the thinning instructions on the can), then apply the same finish on the patch as was used on the rest of the piece. Blend in the patch by rubbing it with 4/0 steel wool dampened with mineral spirits.

If you don't know what the original finish is, use padding lacquer, available from most mail-order woodworking supply houses. This lacquer is compatible with any finish.

To do this, wrap a soft lint-free cloth into a tight pad over a ball of cotton. Moisten the pad in the lacquer and tap this on your palm to disperse the lacquer throughout the pad.

Stroke the pad briskly in a pendulum motion (Fig. 8). If you stop on the patch, the cloth will stick to the fast-drying lacquer. Build up the lacquer in several coats until the patch is level with its surroundings. For a satin sheen, rub the spot lightly with 4/0 steel wool.

Shellac sticks

Fill small gouges and holes with melted shellac. Special burn-in shellac sticks, in a variety of colors, are sold



9 Heat burn-in knife or grapefruit knife over a soot-free alcohol lamp.

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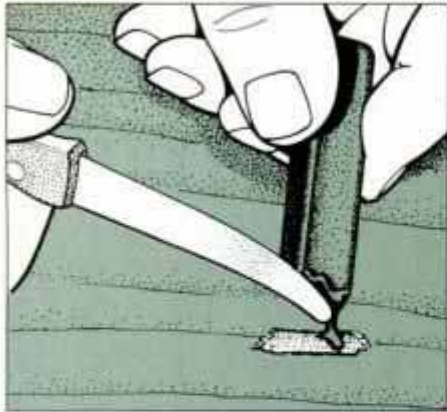
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10 Press burn-in knife on shellac stick and let shellac melt into damaged area.

through woodworking supply houses. In order to do this, you'll need a burn-in knife (or substitute a grapefruit knife), an alcohol lamp, a shellac stick of appropriate color, 400-grit waterproof abrasive paper, a felt block and leveling solvent (usually alcohol). These materials are also available through woodworking supply houses. This technique is somewhat difficult, so you should practice before you try a real repair.

Heat the tip of the knife over an alcohol lamp (Fig. 9). Hold the hot knife over the gouge, and press the stick



11 Reheat knife, wipe it clean with 4/0 steel wool and smooth the shellac patch.

against the blade until the shellac melts into the gouge (Fig. 10). Reheat the blade, wipe it clean with fine steel wool, and spread the shellac level (Fig. 11).

Avoid touching the surrounding finish. If some melted shellac does get on the surrounding surface let it get firm, but not hard, then gently scrape it off. Remove any residue with a piece of cloth moistened with alcohol.

Moisten the felt block with leveling solvent and rub it briskly over the hardened shellac. Dry sand the area with 400-grit paper, and use a felt-tip



12 Gently rub on some toothpaste to remove white ring from shellacked surface.

marker to draw in grain lines. Seal the patch with shellac and apply finish.

White spots

To remove the white spots or rings on a shellacked surface left from a wet glass, simply rub a little toothpaste over the spot with the tip of your finger (Fig. 12). If this doesn't remove the problem, rub the surface with a soft cloth lightly moistened with denatured alcohol or lacquer thinner, depending on the finish. Now apply paste wax and buff (Fig. 13). The white spot or ring should disappear.

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13 Apply a thin coat of paste wax over area polished with toothpaste, then buff.

Burns

A cigarette burn—or any other deep localized burn—is repaired by patching with wood filler. Scrape away charred wood using a razor knife with a curved blade (Fig. 14). Clean the depression with a cloth dampened with paint thinner, then pack it with a filler that's colored to match the wood, or stain the filler to match. When the patch is dry, sand it smooth and level to the surrounding surface (Fig. 15). Use a felt marker to draw in grain lines, seal the spot and apply the top finish.

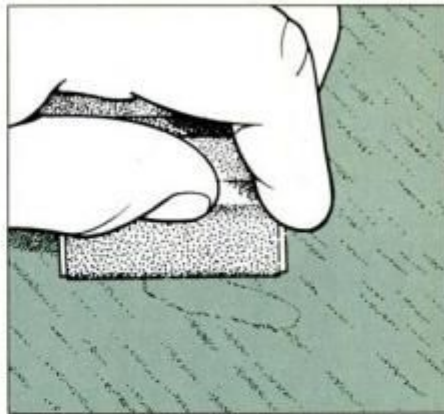


14 Use a curved razor knife to scrape away material charred by a cigarette.

Blistered/peeled veneer

A veneer blister may be flattened by heating it and pressing it down. The finish on and around the blister may have been damaged as the blister formed. Gently scrape off any flaking or cracked finish before repairing.

Cut into the center of the blister, along the grain, with a razor knife to let the air escape (Fig. 16). Heat the blister with a hair dryer to soften the adhesive (Fig. 17). Then roll the blister flat with a veneer roller (Fig. 18), weight it down, or clamp a small block of wood over it.



15 After filling a scraped area, sand it level to surroundings with fine sandpaper.

A blister that formed at the edge of a surface is easily repaired. Gently slide a little glue under the peeled section, and clamp a block over it.

On large veneer blisters, make an X-shaped slit to permit access for re-cementing. Regardless of whether the veneer was originally applied with glue or contact cement, use contact cement to make the repair.

Gently bend back each flap of the X, and apply cement to the veneer and the substrate with a small brush (Fig. 19). Allow the cement to air dry, then press the veneer back in place. Apply

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16 Slit the center of veneer blister with a razor knife. Make the slit along the grain.

pressure with a roller or by placing a wood block on the repair and tapping it with a hammer.

Veneer patch

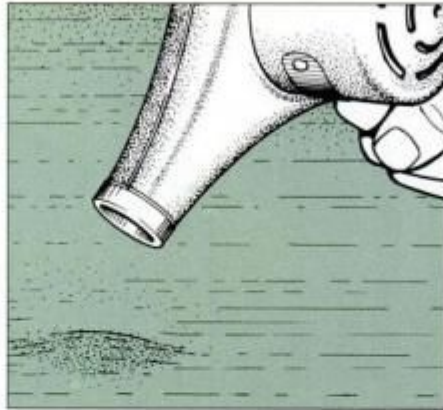
Seriously damaged veneer can be repaired with a patch of closely matched veneer. Start by using a knife and straightedge to make a diamond-shaped cut around the damage (Fig. 20). Use a sharp chisel and a knife to remove the veneer inside the cut-lines, and scrape the recess clean (Fig. 21). If the substrate is gouged,



19 Make X-shaped slit on a large blister. Peel back the flaps and brush on cement.



22 Next, lay tracing paper over cutout and rub over paper with a sharp pencil.



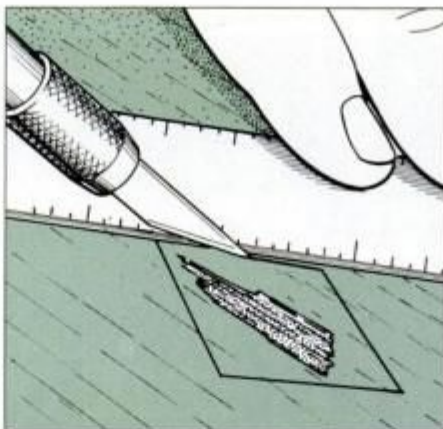
17 Soften the glue under the veneer blister by blowing on it with a hair dryer.

fill it with compound and sand it level.

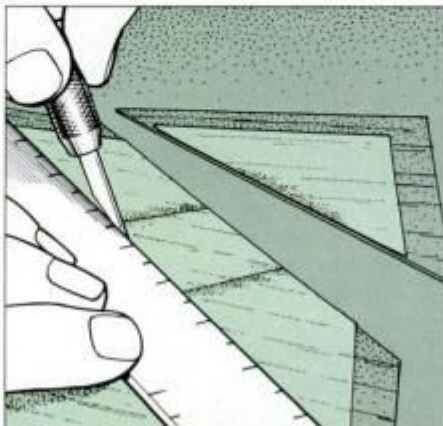
Hold a sheet of tracing paper over the recess and rub over the recess with a pencil to obtain a pattern of it (Fig. 22). Select a piece of veneer to match the original and attach the pattern to it with rubber cement.

Cut out the patch (Fig. 23). Peel off the paper and test fit the patch. Pare the patch to fit and apply contact cement to the veneer and the substrate.

Insert the patch in the recess when the cement has set. Apply pressure by rolling or tapping, then sand the



20 Use a razor knife and straightedge to cut diamond shape around damage.



23 Cement paper to a veneer sheet. Cut out the diamond tracing with a razor knife.

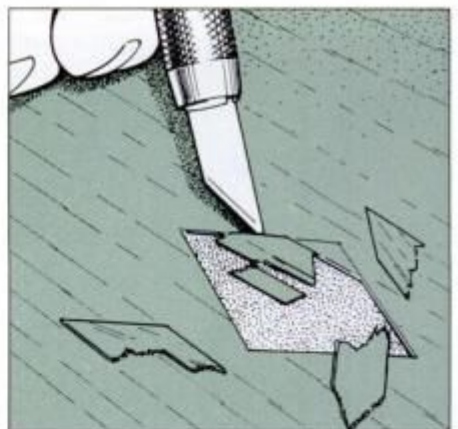


18 Press veneer down with roller and leave a weight on it until glue resets.

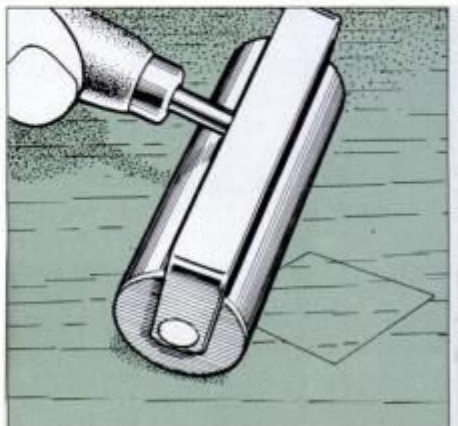
patch level to the surrounding veneer (Fig. 24). Stain the patch, if necessary, and apply several coats of finish, until level with the surrounding area.

Supply sources

Materials not at your local hardware or paint store may be available from: Constantine's, 2050 Eastchester Rd., Bronx, NY 10461; Garrett Wade, 161 Avenue of the Americas, New York, NY 10013; The Woodworkers' Store, 21801 Industrial Blvd., Rogers, MN 55374-9514. **PM**



21 Pry up the damaged veneer from inside diamond cutout using a razor knife.



24 Apply the patch with contact cement. When cement is dry, roll over the patch.

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 Enclosed is my check for \$249 plus \$7.50 shipping/handling, a total of \$256.50*.

*Any applicable sales tax will be billed with shipment.

Leather Flying Jackets.
 Regular Long

to my credit card.
 Amer. Express

Exp. Date _____

606-231

NEW PRODUCTS

FALL FINALE

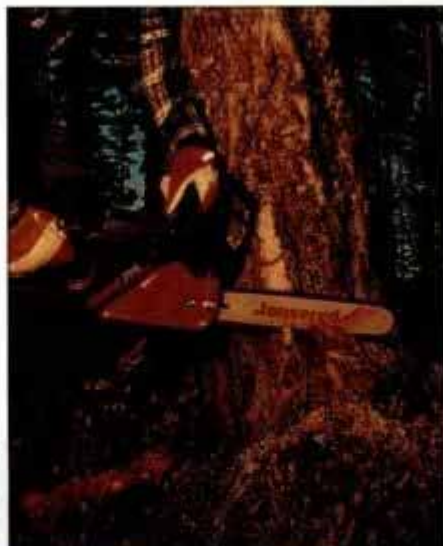
Get ready for winter with versatile new outdoor power products.

BY ROY BERENDSOHN, Assistant Home Improvement Editor



Brush Buster

This chipper/shredder uses an improved shredding mechanism. Its eight triangular, free-swinging hammers can be rotated six times to extend their life, and they deliver three times the energy of conventional shredding hammers, says the manufacturer. It's powered by a 6-hp industrial/commercial engine and costs about \$1220 at outdoor power equipment dealers. Write to Tornado Products, Inc., N114 W18605 Clinton Dr., Germantown, WI 53022.



Part-Time Help



Clear A Path

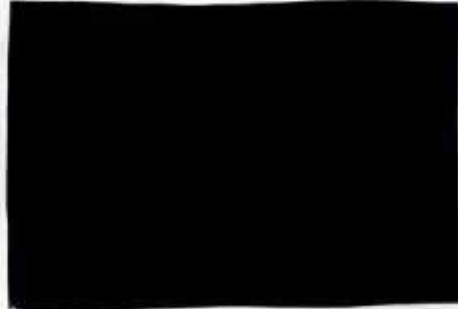


Long-Lived

This consumer chain saw incorporates professional-quality features, according to its manufacturer. To ensure the component's longevity, its 34-cc engine has steel-lined cylinders, its crankshaft is ball-bearing mounted to reduce friction, and its bar/chain lubrication is supplied by a gear-driven oiler. Also, its handle is isolated from the saw body with rubber mounts to reduce the vibration. Equipped with a 16-in. bar (shown), it costs about \$180 at Solo dealers. For more information, write to Solo, Inc., P.O. Box 5030, Newport News, VA 23605.



Snow Go



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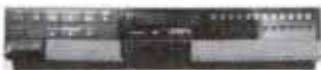
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FREE VCR!



See other side for details.

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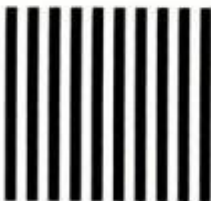
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Niche Filler

Designed to fill the niche between hand tools and gas-powered equipment, this cultivator/tiller churns a 6-in.-wide swath. Its gear-driven steel tines are replaceable, and you can reverse tine direction at the flip of a switch. The 11.5-pound machine is powered by a 1/2-hp motor and stands about 54 in. high. It costs about \$150 at hardware stores and home centers. Write to Black & Decker, Customer Service, U.S. Power Tools Group, 10 N. Park Dr., Hunt Valley, MD 21030.



Light Pump

Light enough to carry with one hand, this 9-pound pump can move 1860 gallons of water per hour. It's powered by a 2-stroke, 25-cc engine and comes with 10 ft. of 1-in.-dia. suction hose, couplings and a strainer. A garden hose fits on its outlet port so you can use it for power washing your car or the exterior of your home. It runs about 45 minutes on a tank of gas and costs about \$170 at home centers and hardware stores. For more information, write to Homelite, 14401 Carowinds Blvd., Charlotte, NC 28217.

Hole Punch

Bore holes for posts or bulb planting with this 20-pound auger powered by a 41-cc engine. It accepts 2-, 4-, 6- and 8-in.-dia. auger bits, which bore to a depth of 30 in. (a 12-in. depth extender is also available). Its diaphragm carburetor allows horizontal drilling. It comes with a toolkit and costs about \$600 at outdoor power equipment dealers (bits cost \$40 to \$60 extra). Write to RedMax, Komatsu Zenoah America, Inc., P.O. Box 1545, Norcross, GA 30091-1545.

Leaf Blaster

Blast leaves into a pile with a 180-mph airstream, then vacuum them up and shred them with the Toro 850. Its airstream is adjustable down to 90 mph for delicate work. It's powered by a 12-amp motor, weighs 7 pounds, and costs about \$90 at outdoor power equipment dealers. Write to Toro, 5300 Shoreline Blvd., Mound, MN 55364. Ringer Thermal Composter Bin (background) costs \$160 from Ringer Corp., 9959 Valley View Rd., Eden Prairie, MN 55344.



Double Clip

Equipped with two blades stacked over each other and offset 90°, this push mower recuts clippings and leaves, turning them into a fine mulch. Its 20-in.-dia. die-cast aluminum deck has no outlet port to improve mulching action. It weighs 60 pounds and is powered by a 4-stroke, 4-hp Briggs and Stratton engine with a 2-year warranty. It costs about \$340 at Simplicity dealers. Contact Simplicity, 500 N. Spring St., Port Washington, WI 53074.



Power Compost

Turn over the vegetable patch this fall with this rear-tine tiller. It's equipped with removable bolo-type tines that chop vegetable matter into small pieces. It's powered by a 5-hp, 4-stroke engine, with a 3-year warranty, and a cast-iron gear-driven transmission. It tills a 16-in. path up to 8 in. deep and has hand controls that let you steer it from behind or as you walk next to it. It costs about \$919 direct from Garden Way/Troy-Bilt, 102nd St., Ninth Ave., Troy, NY 12180. **PM**



NEW PRODUCT

FROSTED FINISH

TEXT AND PHOTOS
BY ROSARIO CAPOTOSTO,
Contributing Editor

● Woodworkers looking for an easy-to-use, low-sheen finish might be interested in this new product from Minwax. Called WoodSheen Frosted Stain & Finish, it combines a low-sheen rubbing oil with pastel-colored stains.

Gel-like in consistency, it's suitable for interior applications and cleans up with mineral spirits.

I tried the finish on a pine clock case and found it necessary to apply three coats to build up a depth of color to suit my taste. If you prefer a lighter finish, just use fewer coats.

To use the finish, squeeze a glob on a piece of scrap wood or a nonabsorbent surface. Dip a brush or rag in the finish and spread it on the workpiece. Allow it to penetrate for 10 to 15 minutes, then wipe the surface gently with a soft cloth. In 2 hours, it dries to a soft sheen.

Packaged in 12-ounce plastic squeeze bottles, it costs about \$6 at hardware stores and home centers.

For further information, contact Minwax Co., Inc., 102 Chestnut Ridge Plaza, Montvale, NJ 07645. **PM**



WoodSheen Frosted Stain & Finish comes in a range of colors, including peach, jade, rose, white, slate and pale gray (above). It combines a pastel-colored stain with a low-sheen oil finish and comes in a 12-ounce plastic squeeze bottle. Convenient to apply and use, it's well-suited for small woodworking projects, such as the pine clock case shown at right. WoodSheen does require multiple coats, however, to build up a depth of color that will suit you.



The consistency of mayonnaise, the finish is easy to use without runs or drips. Squeeze it out and spread it on the workpiece.



Apply the finish liberally with a rag or brush. Let it set for 10 to 15 minutes, then wipe the surface with a soft cloth.

REVIEW

WOOD SIDING INFORMATION

BY ROY BERENDSOHN, Assistant Home Improvement Editor

● Unlike some technical guides, this one from Western Wood Products Association provides a good introduction to its subject with a minimum of promotional hype. The language extolling wood siding is limited to a few introductory sentences, and then after that, it's all solid, technical information.

Well, but briefly, covered here are the basics on how to apply plank-type softwood siding. This includes properties of the material (grading, moisture content), the types of nails to use, and how to finish it with stain, paint or clear water repellents. Its de-

tailed chart on estimating siding coverage is especially handy. With it, you can determine the total cost of your project's siding if the lumberyard gave you the siding cost in board feet or in linear feet. In all, the booklet provides more than enough information to get you started.

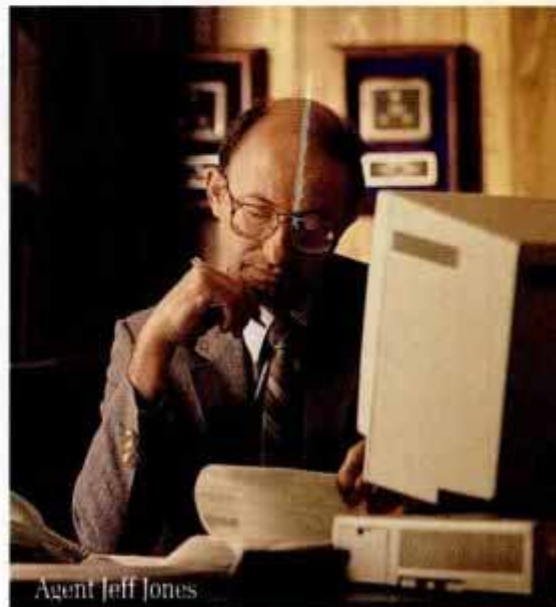
The booklet's title, however, is a little misleading. It does not cover all natural wood siding—cedar shakes and shingles are omitted. But it does discuss beveled clapboard, rabbeted clapboard, tongue and groove, board and batten, log cabin and similar plank siding styles.



For your copy of the guide, just send 75 cents to Western Wood Products Association, Dept. PM, Yeon Building, 522 Fifth Ave. S.W., Portland, OR 97204. If you'd like a video version packed with more details, send \$20 to the same address. **PM**

Paoli, Indiana since 1972:
3,650 people,
1,260 babies,
2 floods,
2,647 auto claims

...and 1 State Farm agent.



Agent Jeff Jones

Paoli's not a big city by any stretch. But even in a small town like this, things keep changing. They put up a new church not far from the courthouse last year. Families are building houses. Babies are being born. And every time something changes, someone's insurance coverage needs reviewing. That's where Jeff Jones, Paoli's State Farm agent for the last 18 years, comes in.

Like State Farm agents across the country, Jeff offers all his policyholders a free State Farm Family Insurance Checkup. That helps them make sure that no matter what's changed, their insurance coverage won't be out-of-date. Whether it's auto, home, life or health insurance.

In 18 years, about the only thing in Paoli that hasn't changed is Jeff. And that's the way folks in Paoli like it.



Like a good neighbor,
State Farm is there.

State Farm Insurance Companies
Home Offices: Bloomington, Illinois

APPLIANCE CLINIC

BY STEVE TOTH,
Contributing Editor

No Gas

I have an RCA Whirlpool gas dryer, automatic model No. LM14641W0, serial No. N0002259M517. When turned on, everything works perfectly for about 20 seconds, then the gas turns off and the machine blows cold air only. What's the problem?

PATRICK JOYCE
YONKERS, NY

Your 1965 gas dryer may either have a bad master control on the burner assembly or there may not be enough air flowing through the dryer.

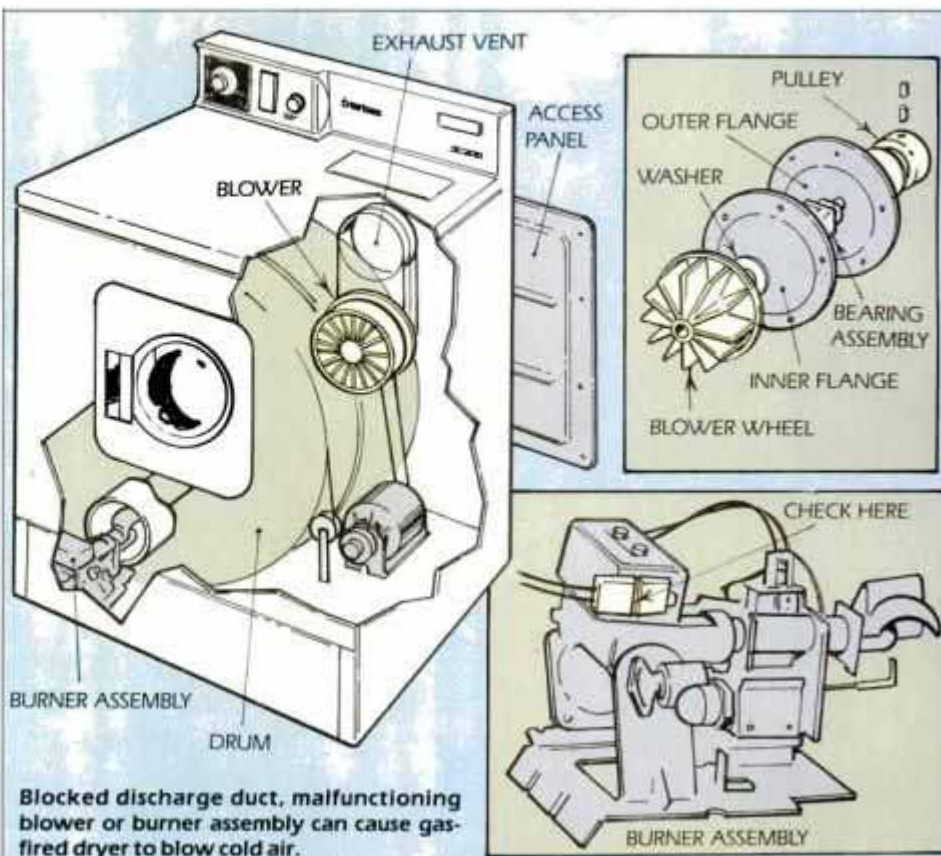
To check the airflow, disconnect the 4-in.-dia. exhaust duct at the dryer's back. Turn on the dryer and check for a large volume of air being forced out the exhaust. If you notice little or no airflow, you may have a broken blower belt, or the bearings inside the blower assembly may be worn, causing the blower to run slower than normal.

To check the blower, disconnect the power to the dryer and remove the back service panel. With the panel removed, you can see the blower assembly and belt at the left side near the top. If the belt is broken, slowly spin the blower pulley. It should turn without binding. If it binds, remove the blower assembly by backing out the hexhead screws around the housing and pulling out the assembly.

Check if a lint buildup or worn bearings are causing the binding. The blower bearing assembly is Whirlpool part No. 238881. Also get a tube of turbine oil, part No. 10943. This is added to the bearing's wick when assembling the blower. The combined cost of these parts should be about \$22. The blower belt is part No. 691371, and it costs about \$8.

Next, vacuum inside the exhaust duct to remove lint. If the blower assembly and belt are okay, check the master control on the burner assembly. Before testing, reassemble the dryer and reconnect the exhaust duct vent, then recheck airflow.

Checking the master control requires a live voltage test, and unless you are experienced at working with electrical components, leave this to a trained Whirlpool technician. Remove the spring clips holding the ac-



Blocked discharge duct, malfunctioning blower or burner assembly can cause gas-fired dryer to blow cold air.

cess panel at the dryer's bottom front. Press a volt-ohm meter's probes to the two wires that feed power to the burner. Set the meter to the 125-volt AC scale and plug the dryer back in. Turn on the dryer to a heat setting, and watch the meter and the flame. If the flame goes out after a short time and you still have voltage going to the control, then there is a good chance a bad master control is the problem.

Another remote possibility is that the burner assembly may have a bad coil on the gas valve. If the coil is malfunctioning, gas flow to the burner will be shut off. The master control with igniter assembly is Whirlpool part No. 688229, and costs about \$85. The entire burner assembly with controls and coils is part No. 239387 and costs about \$140.

Fry Pan Needs Control

I have a Hoover stainless-steel fry pan model 8668, which is no longer made. I need a JPR1104 uniprobe control for the pan, but I cannot find one.

G.W. LAWTON
LOUISVILLE, KY

A new control is no longer available, but you can send your old control to Noffsinger & Bashor Appliances, 728 E. Main St., Trotwood, OH 45426, along with a check for \$20. The company will rebuild your old

control, if possible, and send it back. The repair should take a week and is guaranteed for 30 days.

Needs Thermostat

We have a 1947 Sears Kenmore electric range that needs a new oven thermostat (type B thermostat 25483-30). It was made by the Wilcolator Co., Elizabeth, New Jersey. Is it possible to find a new one?

C.W. FITZ
RICHMOND, VA

The Wilcolator Co. went out of business many years ago, and it's almost impossible to find a new thermostat for a 1947 range. I suggest you turn off the power to the range and remove the old thermostat, being sure to label each wire as it is removed. Pack the thermostat with a note with your name, address and phone number, and that you would like to have your control rebuilt and sent back to you.

Send the package to Control Service Co., 1545 North Western Ave., Chicago, IL 60622. The cost to repair and return your Wilcolator control is about \$50.

FM

DO YOU HAVE AN APPLIANCE PROBLEM?

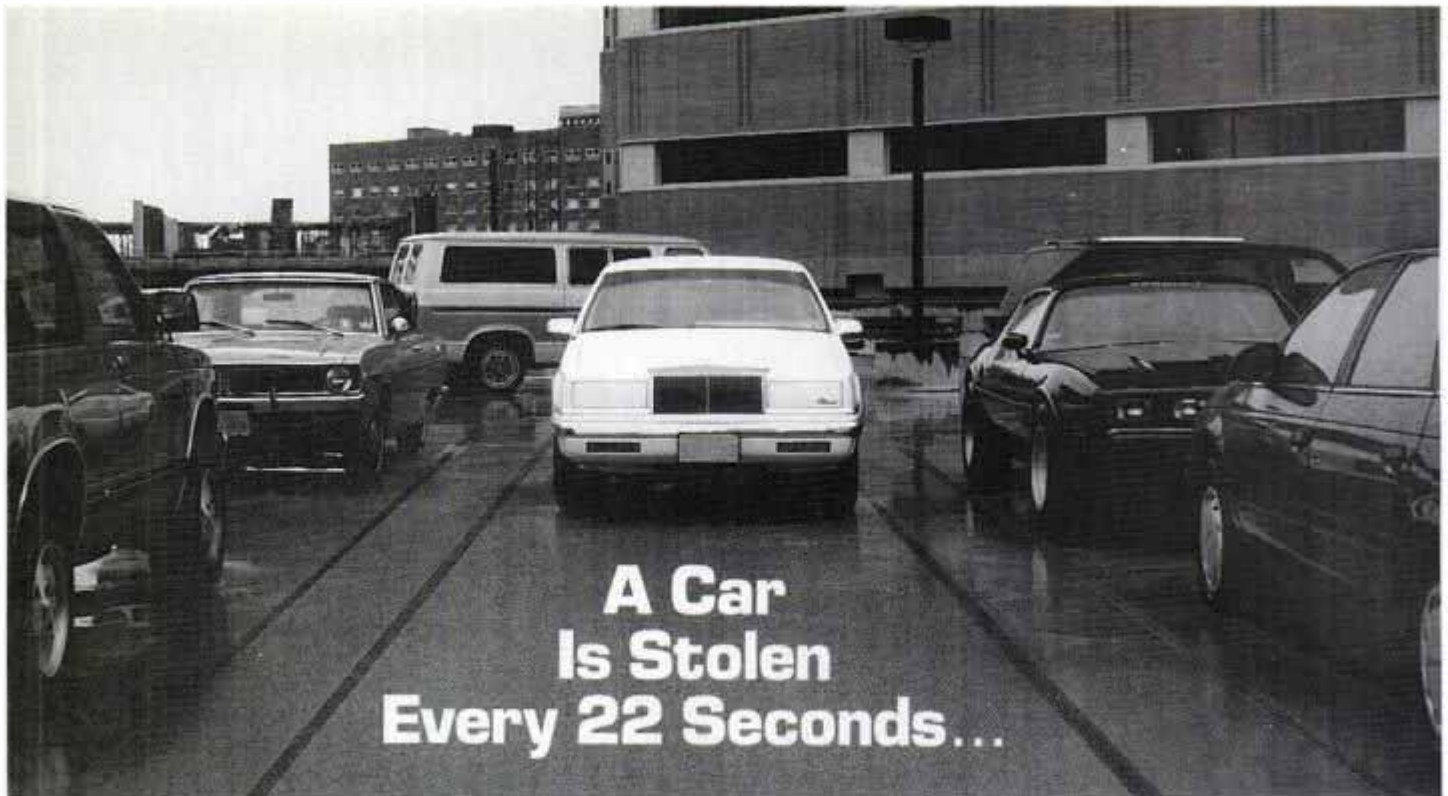
Just ask Steve about it. Send your question, along with the model and serial numbers, to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, NY 10019. While letters cannot be answered individually, problems of general interest will be discussed in the column.

PM ILLUSTRATIONS BY ED LIPINSKI



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Custom VW Hood

Bolt-on, 1940 Ford-style hoods for all VW bugs come with a 3-piece chrome-



plated aluminum grille that utilizes all existing hardware for mounting. 1932- and 1937-style hoods are other conversions that are also available. *Contact: Burly Industries, P.O. Box 10, 221 N. First West St., Mendon, UT 84325; (801) 752-4359.*

Dash Cover

Dash and rear deck covers protect against fading and cracking from the hot sun. They also reduce windshield glare and add to the interior appearance of the vehicle. *Contact: Covercraft Industries, Inc., 19731*



Nordhoff St., Northridge, CA 91324; (818) 407-6660.

TOOLS AND EQUIPMENT

Speedwrench

Sidewinder Speedwrench is a standard reversing ratchet wrench that combines the ratchet capabilities with a 90° speedwrench. One 360° turn of the T-handle is equal to at least eight normal motions of the standard ratchet wrench. The slim 1/4-in.-drive model is ideal where space limits ratchet travel and where excessive repeti-



tions are required to install or remove long bolts. *Contact: Sidewinder Products Corp., 2066 Old Rocky Ridge Rd., Birmingham, AL 35216; (205) 823-3405.*

Wrench

Gorilla Wrench uses 2-piece construction for lug wrench and 1/2-in. sock drive applications. The wrench works as a breaker bar to loosen tight lugnuts and as a speed star wrench, depending on handle setting. *Contact:*



Gorilla Automotive Products, 2141 E. 51st St., Los Angeles, CA 90058; (213) 585-2852.

Antifreeze Changer

EZ Changer is a handheld valve that flushes old coolant and corrosion from



the entire cooling system and overflow bottle through the radiator cap opening. The system uses a garden hose and a bucket so there's no need to open a drain cock. Old coolant is fully contained. The unit will even refill your cooling system with fresh antifreeze. *Contact: Auto-Saver Corp., P.O. Box 75, Glenview, IL 60025-0075; (800) CHANGEX.*

Tight-Fit Drill

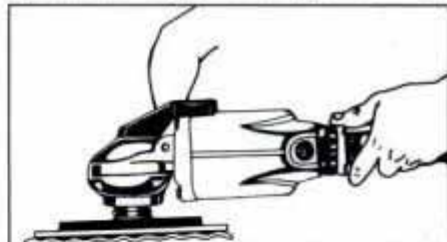


The Tight-Fit Drill Kit makes it possible to work in areas with as little as 2 in. of clearance. You can also drill

around corners or over obstructions. The kit comes with a right-angle attachment, a threaded 6-in. extension, a chucking spud (to allow the bits to be used in conventional situations) and a 6-piece drill bit set. *Contact: Omni Manufacturing Co., 12961 Sunnyside Place, Santa Fe Springs, CA 90670; (213) 946-8444.*

Body Shaper

The Amazing Disc straightens sheetmetal without the need for body filler by using serrations, like corrugated sheetmetal, around its 9-in. perimeter. The serrations hit only one high spot at a time, generating centralized



heat. Cooling the spot with a wet rag then shrinks the metal. *Contact: Sun-chaser Tools, 3202 E. Foothill Blvd., Pasadena, CA 91107; (818) 795-1588.*

Oil Filter Wrench

Steen's heavy-duty oil filter wrench will remove even the most stubborn filters. Turning the tool's outer nut causes the three fingers to tighten down on the filter. Turning the inner nut then removes the oil filter. *Con-*

(Please turn to page 90)



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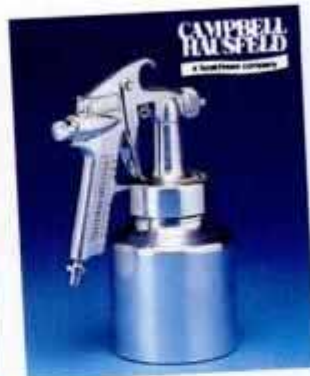
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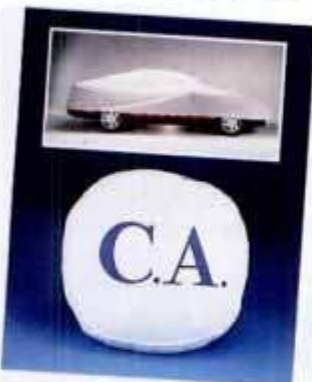


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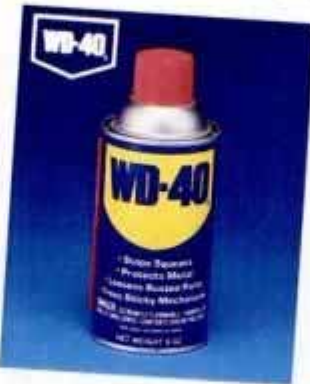
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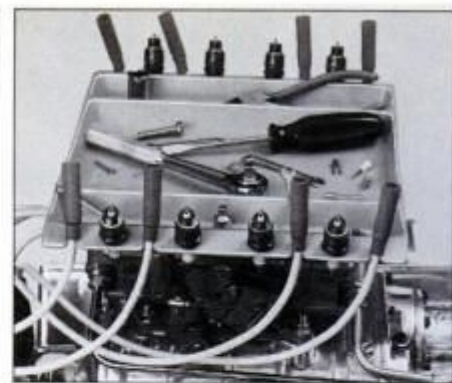
Because participating stores vary in size and merchandising policies, some may not stock all items shown and prices may vary. Prices are subject to change without notice and may be higher in Alaska and Hawaii. Prices expire October 14, 1990



tact: *Steen Products*, 402 Tillman Rd., Fort Mill, SC 29715; (803) 548-7205.

Tool Tray

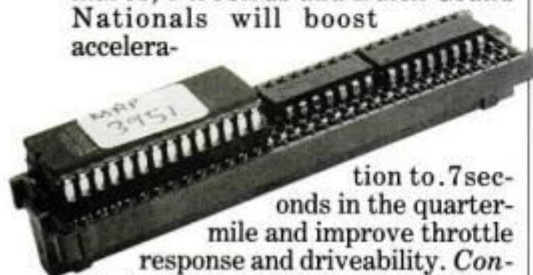
Tool Maid engine-tool tray fits over the carburetor stud of standard 2- and 4-barrel carburetors. The tray holds spark-plug wires in position, and tools and parts for easy retrieval. Contact: *Maid For You Products*, 787 Phelan Rd., Unit #9, Pinon Hills, CA 92372; (619) 868-6962.



REPLACEMENT PARTS

E-Prom

MRP's replacement E-Prom (computer chip) for TPI Corvettes, Camaros, Firebirds and Buick Grand Nationals will boost accelera-



tion to .7 seconds in the quarter-mile and improve throttle response and driveability. Contact: *MRP*, 12 Barbara Dr., Fairfield, NJ 07004. (201) 343-0680.

Screen Antenna

Autotenna's microscreen pattern antenna is equal in performance to a factory 31-in. external antenna on AM/FM bands, and exceeds an external through-glass antenna for cellular



phones. Signal is unaffected by the direction in which the car is traveling. Installation time is about 5 minutes. Contact: *Autotenna*, 2575 El Presidio St., Long Beach, CA 90810-1112; (213) 632-5555.

Lift Supports

The Lift Saver brace is a permanent, inexpensive and easy replacement for worn-out hydraulic lift supports on trunk lids, hatchbacks and hoods. Designed to support more than 360



pounds, the brace installs in minutes. Contact: *Lifetime Automotive Products*, 2811 McKinney Ave., Suite 300, Dallas, TX 75204; (214) 855-5455.

Heated Wipers

Thermo-Blade's electrically heated windshield wiper quickly melts ice



and snow from the blade and frame with heaters at each end of the frame and throughout the length of the blade. Contact: *Thermo-Blade, Inc.*, Expressway 95 Business Center, 3580 Progress Dr., Bensalem, PA 19020; (800) 523-3499.

Automatic Mirrors

Gentex's inside and outside rearview mirrors dim automatically to reduce the glare from headlights of following cars. An electric current varied by the



amount of light reflected in the mirror controls the darkness of the glass. Contact: *Gentex Corp.*, 600 N. Centennial St., Zeeland, MI 49464; (616) 772-1800.

Timing Controls

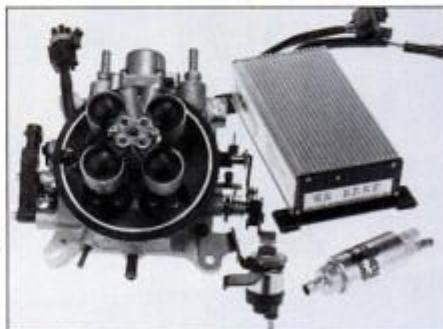
MSD's adjustable ignition timing controls for domestic and import vehicles



with computer-controlled engines allow you to manually adjust the ignition timing via a dash-mounted dial. Timing can be continuously adjusted for best economy, maximum performance and to prevent engine detonation (spark knock, pinging) when the engine is under heavy load, such as towing uphill or when using low-octane fuel. Contact: *Autotronic Controls Corp.*, 1490 Henry Brennan Dr., El Paso, TX 79936; (915) 857-5200.

Fuel Injection

Pro-Jection 4 4-barrel fuel-injection system for noncomputerized carbu-



reted V8-powered vehicles is capable of sustaining between 300 and 600 hp (Please turn to page 92)

WINTER COLD STARTS CAN REALLY GRIND YOU DOWN

Because at start-up, your oil's in the pan, not in the engine. So when you turn the key, mechanical parts grind together until sluggish motor oil can begin to flow. And in those first critical seconds, 70% to 80% of all mechanical engine wear takes place.

Slick 50 Engine Treatment does what no other lubricant can

It protects engines at start-up. So even during cold starts when oil and additives aren't there, Slick 50 protects and lubricates your engine to help reduce wear.

In fact, Slick 50 was recently tested by a major EPA-recognized independent laboratory. And when the results were in, the Slick 50 treated engine had 50% less wear compared to the test engine run with reference oil alone.

And additional tests have also shown a dramatic reduction in fuel consumption.

It's not an oil, not an additive

Slick 50 treats the engine, not the oil. It bonds PTFE to working metal engine parts to create a full time coating so slippery and tough, it lubricates and protects for more than 50,000 miles. No need to add at each oil change.

In fact, just one quart one time gives you protection that lasts winter after winter, cold start after cold start. Plus protection that lasts longer than your car payments.

Slick 50 also works with synthetic oils. And delivers maximum lubrication benefits even in turbo charged engines.

So before winter cold starts can grind you down, add Slick 50 Engine Treatment.

SLICK®
The Engine Wear
Protector. 50



Available at auto parts stores nationwide.

AUTO PARTS GUIDE (Continued from page 90)

on engines with 350 or greater cubic-inch displacement. The system bolts onto most manifolds originally mounted with a carburetor. The unit's low profile allows it to be used on limited hood clearance applications. **Contact:** *Holley Replacement Parts Div., 11955 E. Nine Mile Rd., Warren, MI 48090; (313) 497-4000.*

Clutches

Two clutches for late-model 5-liter Mustangs offer 30 percent and 60 percent more holding power, respectively, than the stock unit. Centrifugal force works to increase plate pressure, but pedal pressure remains relatively light and smooth. **Contact:** *Midway Industries, Inc., 15114 Adams St., Midway City, CA 92655.*



All-Season Tire



Goodyear's Eagle GT+4 is an all-season version of its Eagle GT, offering improved winter performance and wet traction, and equal dry handling capabilities. The tread pattern forces a larger footprint area. **Contact:** *Goodyear Tire & Rubber Co., Marketing Dept., 1144 E. Market St., Akron, OH 44316; (216) 796-8130.*

Replacement Boot

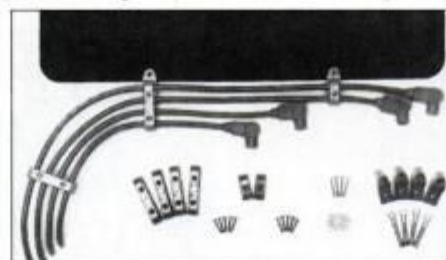
Quick Boot CV joint replacement boot kit uses a 2-piece design to quickly replace damaged solid boots without the need to disassemble the axle. Once installed, the boot sections are fused, or



welded, together through a chemical reaction using aerospace industry technology. No special tools are needed. The kits cover applications for over 200 vehicles. **Contact:** *Dorman Products, 1 Dorman Dr., Warsaw, KY 41095; (606) 567-7000.*

Wiring Loom

Smoothie Loom system neatly routes ignition wires and is constructed of aircraft nylon, so it will not melt, mar,



distort or crack. The nonconductive loom comes in five high-gloss colors to match plug wires. Stainless-steel installation hardware is included. **Contact:** *Maid For You Products, 787 Phelan Rd., Unit #9, Pinon Hills, CA 92372; (619) 868-6962.*

Engine Buildup Kits

High-performance engine buildup kits for 305-350 Chevy, 351W Ford



and 360 Chrysler engines come with hypereutectic or forged-aluminum

pistons, Perfect Circle piston rings, MPG power camshaft (with a profile to increase low-end and midrange torque, while maintaining stock idle and vacuum levels), precision hydraulic lifters and a complete Victor gasket set. Also included in the kits are a high-performance roller timing chain set and Tri-Metal engine bearings. **Contact:** *Dana Corp., Automotive Distribution Sales Div., P.O. Box 455, Toledo, OH 43692-0455; (419) 891-1900.*

Dropped Spindles

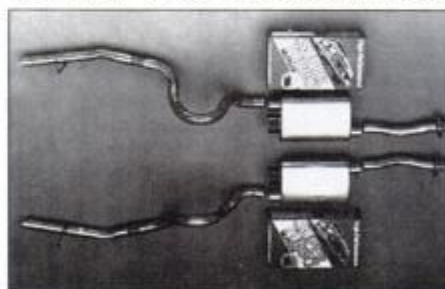
Bell Super Tech dropped spindles are designed to lower 1982-88 Chevy Camaros and Pontiac Firebirds by 2 in., and still maintain OEM wheel travel, an caster, camber and toe-in settings. Cast from high-strength ductile iron two grades higher than OEM, the



spindles are a bolt-in replacement, and do not affect stock springs, steering, brakes and shocks. Other applications are also available. **Contact:** *Bell Super Tech, 152 M St., Fresno, CA 93721; (209) 445-1602.*

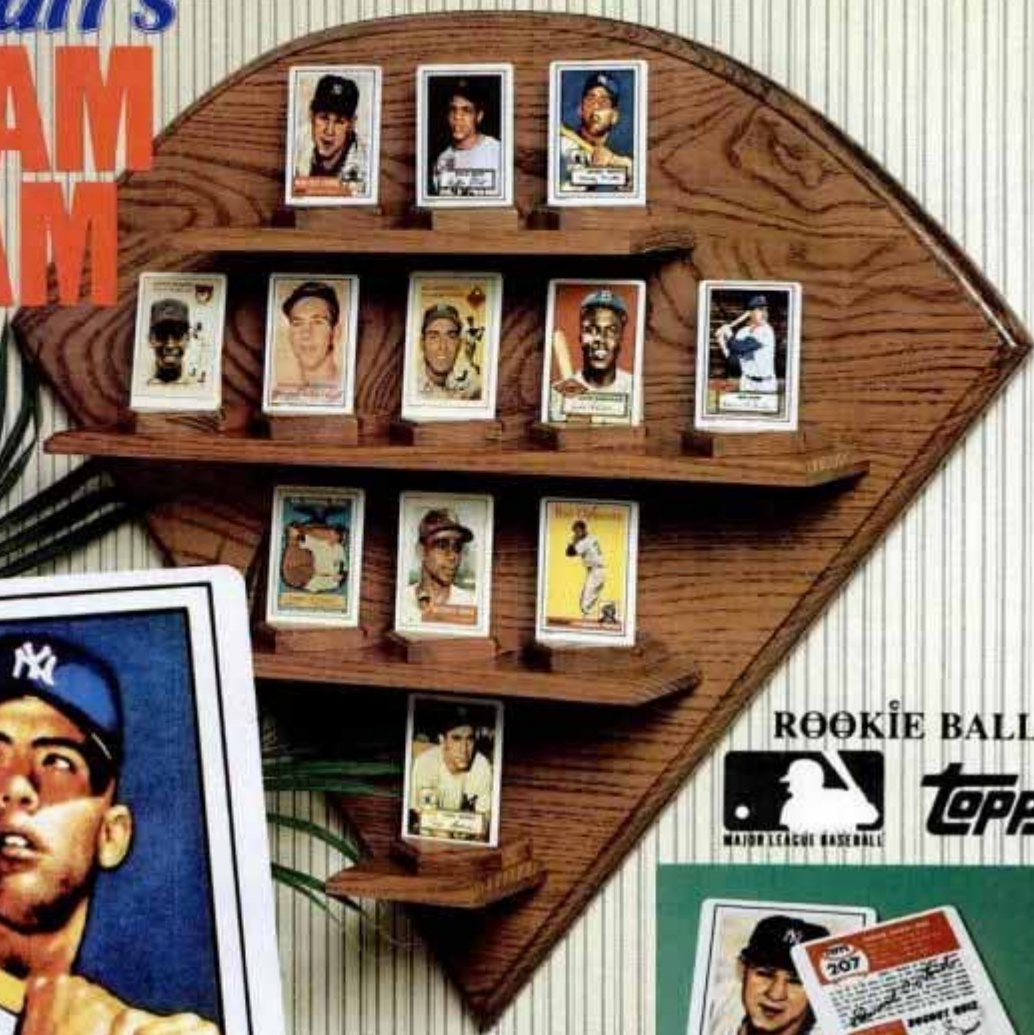
Exhaust Systems

Complete bolt-on exhaust systems can convert a stock exhaust system to a high-performance DynoMax system without the need for any pipe modifications. The heart of the new exhaust system is Walker's DynoMax very



low-restriction Super Turbo muffler. **Contact:** *Walker Manufacturing Div., Tenneco Automotive, 1201 Michigan Blvd., Racine, WI 53402; (414) 632-8871.*

Baseball's DREAM TEAM



ROOKIE BALL
MAJOR LEAGUE BASEBALL
TOPPS®



Wall display included at no additional charge
Display shown smaller than actual size (27" x 24")

Authentic Baseball Cards reproduced on porcelain

Card shown actual size

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lain, cut to the exact size of the original card. A handsome ash wood base, crafted in the shape of home plate, accompanies each card. And the entire collection can be displayed in the custom designed wooden rack, included with your collection.

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City _____

State _____ Zip _____

Telephone No. (_____) _____

Signature _____

*CA, FL, and IL residents will be charged appropriate state sales tax. All reservations must be signed and are subject to acceptance.

The Hamilton Collection
9550 Regency Square Blvd., P.O. Box 44051, Jacksonville, FL 32231

TRUCK ENHANCEMENTS

Ride Control System

The Gabriel Ryder Command Variable Ride Control System for light trucks and 4wd vehicles is programmable for touring or a higher damping "sport" setting at the push of a button. The system consists of four foam-cell technology, electronically controlled shock absorbers; a dash-



mounted switching module; an underhood control unit; and electrical wiring and connectors. Instructions and hardware are included. *Contact: Gabriel Ryder Command, 250 E. Kehoe Blvd., Carol Stream, IL 60188.*

Ramp

The Deck Ramp is a 5-in.-high telescopic unit that becomes a second floor in your pickup. Designed with a third plane to eliminate the hangup



point on other ramps where the ramp and vehicle meet, the ramp slides into and out of loading position in 30 seconds. The unit, designed for full-size, long-bed pickups, installs and removes in 5 minutes and requires no special tools. *Contact: Deck Slider, Rt. 1, P.O. Box 1000, Stewartville, MN 55976; (800) 533-3123.*

Rolltop Cover

Rolltop Cover instantly rolls out of its 9½-in. storage canister to cover the bed and keep contents dry and secure. Interlocking aluminum panels under the fabric provide security from break-in, and the full-length handle allows 1-hand operation. It fits most domestic and import pickups, and installs in 30 minutes with a drill and screwdriver. *Contact: Pace-Ed-*



wards Co., 100 Commercial St., Centuria, WA 98531; (800) 338-3697.

Tailgate System

Aero Gate and Aero Duct systems improve pickup truck aerodynamics. The Aero Duct is a targalike wing that wraps over the top and sides of the pickup truck's cab to direct airflow into the vacuum area behind the cab. The Aero Gate system consists of multiwings made of reinforced plastic, adjusted from inside the cab from near-parallel to the ground to a closed position, to further control airflow for



handling, performance and fuel economy. *Contact: Mantex Corp., Plastics Div., P.O. Box 15, 1800 Metamora Rd., Oxford, MI 48051. (800) 66-MANTX.*

Camper Top

Kwikie Kamper is easily installed in 15 minutes, using a 3M Scotchmate hook and loop tape to fasten the tubu-



lar steel framework to the truck for access through the cab's sliding rear window. When parked, the 40-pound unit's side covers and back are designed to be folded to create a sunshade. *Contact: SC Manufacturing Div., Adbrook, Inc., 11879 Woodbury Ave., Garden Grove, CA 92643; (800) 323-8922.*

Fastener

Stayput Fasteners' shock cord cover clip for pickup truck tonneau covers remains under tension to keep cover taut and trim. The clip, which is made from nylon, can be used with its own knob or with any other nylon or stainless-steel hook. Installing the shock cord cover clip requires punching a ¼-in. hole in the cover and snapping the fitting into the fabric with a special setting tool. *Contact: Stayput Fasteners, 125 Via Yella, Newport Beach, CA 92663; (714) 673-2967.*



Cargo Carrier

The Wheelless Trailer adds 14 cu. ft. of dry, secured storage by attaching



the unit to any Class III receiver hitch. The unit is made of high-impact ABS plastic, weighs 61 pounds and *(Please turn to page 96)*

For better performance, fill up with premium.



If you're looking for a way to improve your vehicle's performance, install a set of Bosch Platinum spark plugs. And step on it.

The minute you do, you'll get smoother acceleration, improved fuel efficiency, and, of course, quicker starts. As you can see in the cut-away, Bosch Platinum has a 99.9% pure platinum center



electrode engineered into a revolutionary extended insulator design. It's the only plug in the world with this feature.

Next time you change your plugs, try a set of Bosch Platinum, the premium spark plug. You'll be better off in the long run. To locate the Bosch dealer nearest you, call **1-800-882-8101**.



BOSCH

The Ultimate Spark Plug.

AUTO PARTS GUIDE (Continued from page 94)

will carry up to 240 pounds. **Contact:** Carefree of Colorado, 2145 W. Sixth Ave., P.O. Box 664, Broomfield, CO 80020; (303) 469-3324.

Light Bar

NightLighter light bars are made of solid-steel construction to eliminate any possible torsional flex or bouncing. All bars are custom-fit and predrilled for easy, no-cutting installation. Optional pedestal allows mounting up to seven lights. Choice of



roof mounts, rollbar and windshield mounts. **Contact:** SC Manufacturing Div., 11879 Woodbury Ave., Garden Grove, CA 92643; (714) 530-5754.

Bed Box

The Delta Commander is constructed

of high-density polymer formed over a specially designed full-length lid and bonded floor. The unit is strong enough to earn the industry's first



guarantee against sagging. The box resists rust, chemicals, salt spray and extreme cold. **Contact:** Delta, Inc., of Arkansas, P.O. Box 1846, Jonesboro, AR 72403-1846; (800) 643-0084.

Tilt Cap

Tilt-A-Topper kit installs onto any new or existing pickup cap, allowing the entire cap to be easily lifted up sideways. Cargo can be loaded and unloaded from the side of the truck, with no need to crawl around inside. It can be installed on aluminum, fiberglass or plastic caps with no drilling required. **Contact:** Cosmos Enter-



prises, Inc., Hwy. 79 E., Elbow Lake, MN 56531; (218) 685-4403.

Tailgate Net

Covercraft's Tech-Flo tailgate net for full-size and minipickups uses an anodized aluminum I-beam construction and is guaranteed not to sag. **Contact:** Covercraft Industries, Inc., 19731 Nordhoff St., Northridge, CA 91324; (818) 407-6600.



ACCESSORIES

Cassette Alarm

This key-operated cassette alarm locks into the cassette player and features an alarm powered by a 9-volt battery. Forcibly removing the alarm will destroy the cassette mechanism.



Contact: Anes Electronics, 4112 Del Rey Ave., Marina Del Rey, CA 90292.

Digital Thermometer

Battery-powered digital thermometer gives inside/outside temperature at the flick of a changeover switch. Easily installed with Velcro tape. **Contact:** Car Mate, Inc., 306 S. Lem-



on Ave., Walnut, CA 91789; (714) 595-2959.

Portable Garage

Carcoon portable garage provides storage for any car under 17 ft. long. Waterproof vinyl/polyester fabric over 1-in. galvanized tubing sets up in minutes with no tools. Interior space is 144 sq. ft. **Contact:** Autonetworks, P.O. Box 728, Rancho Cucamonga, CA 91730.



Wheel Locks

Exten wheel locks screw onto one stud on each wheel and feature a free-spinning sleeve. Unlike "puzzle locks," the Exten design makes them resistant to removal with tools that friction-wedge on the outside rim of the lock. The Exten unit uses a key



which has two pins mounted in the proper combination to fit the two holes in the locknut. **Contact:** Exten, Inc., 50 Stradtman St., P.O. Box 1508, Buffalo, NY 14240-1508; (716) 895-2216.

Tire Cradle

Quickwheel flat-tire cradle assumes the rolling function of a disabled tire to avoid the hassle involved with a roadside repair. Lightweight and easy to use, the unit's loading ramp is unfolded and positioned in front of the



flat tire. Driving onto the unit automatically locks the tire and car wheel in place. The unit's three heavy-duty riding wheels operate as the car's fourth wheel with no noticeable change in braking or steering performance. Quickwheel will carry up to 1320 pounds, weighs 19 pounds and measures 13 x 11 in. folded. **Contact:** Quickwheel, Inc., 52 Mason St., Greenwich, CT 06830.

Oil Spout

Spillsaver oil spout features a built-in twist shutoff valve that stops drips and leaks. The spout screws onto most 1-quart plastic bottles of oil. **Contact:** FloTool International, 135 E. Alton Ave., Santa Ana, CA 92707; (714) 850-9212.

PART NO. 10100

NO SPILL... NO MESS!

OIL SPOUT

NO MORE SPILLS BEFORE ENTERING FILLER HOLE
ON/OFF TWIST STOPS SPILLS AND DRIPS

FOR A CAR'S...
- MOTOR OIL
- TRANSMISSION FLUID
- POWER STEERING FLUID
- AND MUCH MORE.

NO MORE SPILLS
NO MORE MESS!

MADE IN AMERICA

EASY-TO-USE...
Twist ON...Oil Flows.
Twist OFF...Flow Stops.

SPILLSAVER "The No-Mess, No-Spill Pouring Spout"

Memory Saver

This computer memory saver eliminates the need to reprogram computer functions, such as digital radios, clocks and keyless entry systems, when the vehicle battery has been disconnected. The unit maintains power by plugging into the cigarette lighter and clamping the cable ends to a 12-volt "slave" battery. **Contact:** East

Penn Manufacturing Co., Lyon Station, PA 19536; (215) 682-6361.

Engine Degreaser

Berryman BioGrade Engine Degreaser is formulated to accelerate biodegradation, while emulsifying grease compounds into environmentally safe particles. The degreaser removes heavy grease, dirt and road grime from engines, machinery, tools



and driveways. The environmentally friendly degreaser sprays on and washes off. **Contact:** Berryman Products, 3800 E. Randol Mill Rd., Arlington, TX 76001; (800) 433-1704.

Remote Starter

AutoCommand allows you to start your car by remote control from over 400 ft. away with a touch of a keychain transmitter. It can also turn on the heater or air conditioner before you

(Please turn to page 100)

Where is Rislone needed most?

From new car or truck to one that's older, from classic to exotic... whatever your answer, you're right. With a quart of Rislone® Engine Treatment replacing a quart of oil in any car or truck engine, you can count on performance like this:

In new vehicles, Rislone prevents engine deposits; prolongs smooth, powerful engine operation. In older vehicles, it removes power-robbing varnish, gum and sludge; quiets noisy valves and lifters; and assures a quieter, smoother running engine.

So, whether new or old, 4-, 6- or 8-cylinder, reach for a quart of Rislone... **now with a bold, new look.**

FREE Lube Tips booklet. Write or call 414-324-2211.

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- *Biggest standard payload. Two-tier loading.*
- *Shift-on-the-fly Insta-Trac.™ America's favorite 4x4 system.*
- *More leg and shoulder room than Ford.*



See your Chevrolet dealer for terms of this limited warranty



Chevy Half-Ton. America's favorite pickup. Ever wonder why so many people work with Chevy trucks? Just check out these benefits: Power. Payload. Two-tier loading. Leg and shoulder room. The hardworking Chevy Half-Ton. No wonder it's America's favorite pickup.

More People Are Winning With ***The Heartbeat***  of America. **TODAY'S TRUCK IS CHEVROLET.™**

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enter. A security feature prevents the car from being driven until you insert the key in the ignition. **Contact:** Design Tech International, 7401 Fullerton Rd., Springfield, VA 22153; (703) 866-2000.

Warning Scanner

Colt CHiPS Detector alerts drivers to the presence of state police within a 3-mile distance. Not a radar detector, the unit monitors the special radio channels used by state police and visually and audibly alerts the driver



when it detects transmissions being made on these channels. The scanner also picks up traffic and road reports and emergency weather information.

Contact: Chips/Comtron, 313 Main St., S. Fork, PA 15956; (800) 344-5188.

Tire Pressure Controller

EntireControl automatically monitors and adjusts tire pressure. The system uses a dash display, which houses a main computer, programming buttons and warning signals. Detector/drive modules monitor tire pressure changes and work with actuators that inflate or deflate the tires. **Contact:** Techni Guidance, Inc., 3000 Co-



ronado Dr., Santa Clara, CA 95054; (408) 970-8841.

Cuddly Animals

Buckle Up Buddies promote seatbelt use by children, as these furry animals fit over the belt, allowing the



kids to snuggle when they buckle. Available in various designs. **Contact:** ABC Auto Beauty Care, 3450 Wible Rd., Bakersfield, CA 93309; (805) 836-0677.

Windshield Repair Kit

The Clear Star Windshield Saver re-



pair system fixes a multitude of break types, including bull's-eyes, flowers, BB chips and stars. The system fills glass breaks with transparent resin, which protects the formerly broken areas, and substantially restores visibility to the repaired area. **Contact:** Clear Star Products, Inc., P.O. Box 737, E. Moriches, NY 11940; (516) 878-8346.

ID Kit

Auto-Etch glass-etching kit enables you to permanently etch your car's

PROTECT YOUR CAR BY THE NUMBERS

AUTO-ETCH
ANTI-THEFT

Vehicle Identification System



VIN number on all the car's windows. This discourages car thieves who would have to replace all the windows to resell the car. **Contact:** Armour Products, Godwin Ave., P.O. Box 56, Midland Park, NJ 07432. **PM**

How to build a high-paying career, even a business of your own, in computer programming.



**RICK BRUSH,
NRI PROGRAMMER/ANALYST**

Start with training that gives you hands-on programming experience—at home and at your own pace. Training that begins with BASIC, then continues with Pascal, C, and COBOL—today's hottest computer languages. Training that even includes a powerful IBM-compatible computer, modem, and programming software you keep.

Start with real-world training. The kind of training only NRI provides.

Now with NRI's new at-home training in Computer Programming, you can be one of today's highly paid, creative team of computer wizards who give computers the power to carry out an astonishing range of business, professional, and personal applications. Now, with NRI, you can be a computer programmer, ready to build a high-paying career—even a business of your own—making computers do anything you want them to do.

The only programming course that includes a powerful computer system and software you keep.

Unlike any other school, NRI gives you hands-on programming experience with a powerful IBM compatible West Coast computer system, including 2400



Only NRI gives you an IBM-compatible computer with modem, 640K RAM, disk drive, monitor, and software—BASIC, Pascal, C, and COBOL—all yours to keep!

baud internal modem, 640K RAM, disk drive, monitor, and invaluable programming software—BASIC, Pascal, C, and COBOL—all yours to keep.

You get the experience and the know-how, the computer and the software to get to the heart of every programming problem, design imaginative solutions, then use your choice of four key computer languages to build original, working programs.

No matter what your background, NRI gives you everything you need to succeed in programming, today's top-growth computer career field.

You need no previous experience to build a successful programming career with NRI training. Indeed, your NRI lessons start by walking you step by step through the fundamentals, giving you an expert understanding of the programming design techniques used every day by successful micro and mainframe programmers. And then the fun really begins.

C, and COBOL. Then, rounding out your training, you use your modem to "talk" to your instructor, meet other NRI students, even download programs through NRI's exclusive programmers network, PRONET.

Your career in computer programming begins with your FREE catalog from NRI.

For all the details about NRI's at-home training in Computer Programming, send the coupon today. Soon you'll receive NRI's fascinating, information-packed, full color catalog.

Open it up and you'll find vivid descriptions of every aspect of your NRI training. You'll see the computer system included in your course up close in a special, poster-sized foldout section. Best of all, you'll find out how you can use NRI training will make it easy for you to build that high-paying career—even a business of your own—in computer programming.



You master today's hottest computer languages, gaining the skills you need to build programs for a wide variety of real-world applications.

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YES! Please rush me my FREE catalog describing NRI's at-home training in Computer Programming.

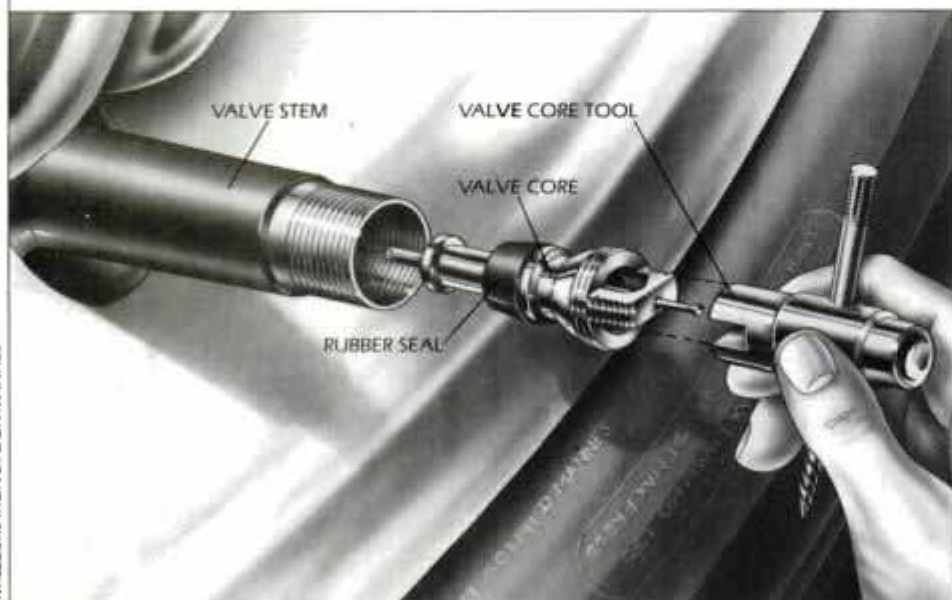
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CAR CLINIC

BY MIKE ALLEN, Assistant Auto Editor



PM ILLUSTRATION BY DON MANNES

An Airtight Solution?

Here's a tip for all the Car Clinic readers. One of my tires had a slow leak—just fast enough to need air every day. And the air was leaking out of the valve core. So I just removed the core from the stem and used penetrating oil to blow the dirt out of the valve stem. I reinstalled the core, and good-bye leak!

JOHN FINAGLE
PORTLAND, OR

Thanks for the tip, John. It's good to be able to repair an annoying leak without being at the mercy of the local service station. Removing the core is easy enough with an inexpensive valve core tool—something that's part of my trunk toolbox, along with a couple of new cores. Dirt or corrosion can easily keep the small valve hidden in the middle of the valve core from sealing, and often it's not possible to blast it out of the way by just adding and bleeding air. It sticks to the rubber valve seat inside the core.

However, don't ever use penetrating oil or any other petroleum product on rubber parts, like the rubber valve seat or seal, or the rubber valve stem. It will break down the rubber. If you must use a lubricant, use silicone lube or something water-based, like Armor-All or Son of a Gun.

I also heartily recommend using the slightly more expensive steel

truck-type valve stems, rather than the rubber kind. Or at least replace the rubber ones whenever the tire mounted on that rim is replaced. The rubber stems do deteriorate, and centrifugal force can make them fail at high speeds.

Also be aware of the fact that there are long and short valve stems, and long and short valve cores, and they shouldn't be interchanged. And use the screw-on caps to keep dirt out, and air in.

The Meaning Of Truth

Could you clear up a discussion I was having with some other mechanics? If the manual calls for, say, 50 ft.-lb. of torque on a bolt, what happens if I use a 1/2-in.-drive torque wrench, and then a reducer and a 3/8-in.-drive socket? Will the torque reading be true? Or is there a correction that should be added to the 50 ft.-lb. number?

SHELDON WERTHEIM
FLUSHING, NY

You can use any combination of straight adapters, extensions or reducers on a torque wrench without a correction factor. You can even use a universal, if the angle is shallow.

The only time you'd need to add any correction is when the adapter is horizontal. That is, it's parallel to the

beam of the wrench. These adapters are specifically made to extend to the capacity of a torque wrench—although I haven't seen one in years, not since I purchased a good micrometer-dial torque wrench.

Basically, these adapters make the distance between the bolt and your hand longer. With the same force applied to the handle of the wrench, the torque is proportional to the distance between your hand and the bolt.

If there's 18 in. between the handle of your wrench and the drive, then adding an 18-in. adapter would give you twice the torque that the wrench indicates. A 6-in. adapter would give you 1 1/3, making your 50 ft.-lb. indication actually represent 67 ft.-lb.

Doin' The Laredo Crunch

My Jeep Laredo, once in every 50 shifts or so, will crunch First gear when I try to get away from a traffic light. I always sit at a light in Neutral, rather than holding the clutch down.

It all happens so fast that I don't have a chance to react. The hydraulic transmission fluid is full. What is the problem, and will it reduce the life of my transmission? SSGJ. CARRIERE
FORT HOOD, TX

It's not necessarily a problem. When the car is idling in Neutral and your foot is off the clutch, the clutch disc and trans-input shaft are turning at the same rpm as the engine. When you press the clutch pedal down, the clutch disc must decelerate to 0 rpm before first gear can engage without grinding. There's a synchronizer to help this.

But if the engine isn't at idle, or your foot is a little behind your gear-changing hand, you'll get an occasional crunch, as the teeth of first gear skip over each other's tops before they mesh.

Give the parts a second or three to spin down on their own before you shift to First. Check for a dragging clutch disc or bad pilot bushing this way: At idle, in Neutral, push down the clutch pedal all the way to the carpet. (Check that the clutch adjustment is correct, first.) Count to five,

(Please turn to page 106)

Acura Integra GS.....	\$16,685	Ford Escort GT.....	\$10,588	Oldsmobile 98 Regency Brougham.....	\$21,595
Acura Legend Coupe LS.....	30,690	Ford Tempo LX.....	11,422	Peugeot 405 Mi16.....	21,990
Alfa Romeo Veloce.....	20,950	Ford Mustang GT.....	14,803	Plymouth Laser RS.....	12,675
Audi 80 Quattro.....	22,800	Ford Taurus LX.....	16,180	Pontiac Sunbird GT.....	12,444
Audi 100.....	26,900	Ford Probe GT.....	15,543	Pontiac Grand Am SE.....	15,194
Audi Quattro V-8.....	47,450	Ford Thunderbird Super Coupe.....	20,390	Pontiac Firebird Trans Am GTA.....	23,320
Bentley Mulsanne S.....	133,200	Ford LTD Country Squire.....	17,921	Pontiac 6000 S/E.....	16,909
BMW 325is.....	28,950	Honda Accord EX.....	16,595	Pontiac Bonneville SSE.....	23,994
BMW 535i.....	43,600	Honda Civic.....	10,920	Pontiac Grand Prix SE.....	17,684
BMW 750iL.....	70,000	Jaguar XJ-6 Vanden Plas.....	48,000	Porsche 944.....	41,900
Buick Skylark Custom LE.....	13,145	Lamborghini Countach.....	145,000	Porsche 911 Targa.....	59,900
Buick Regal Limited.....	15,860	Lexus LS 400.....	35,000	Porsche 928.....	74,545
Buick LeSabre Estate Wagon.....	17,940	Lincoln Town Car.....	27,986	Rolls-Royce Corniche II.....	215,800
Buick Electra Park Avenue.....	21,750	Lincoln Mark VII LSC.....	29,468	Saab 900.....	17,515
Buick Reatta.....	28,335	Lotus Esprit.....	71,500	Saab 9000 CD.....	32,995
Cadillac DeVille.....	27,540	Mercedes-Benz 190E.....	31,600	Sterling 827SL.....	29,975
Cadillac Allante.....	50,900	Mercedes-Benz 300CE.....	55,700	Subaru Legacy LS.....	14,699
Chevrolet Beretta GT.....	12,500	Mercedes-Benz 500SL.....	83,500	Subaru XT-6.....	17,111
Chevrolet Camaro IROC-Z.....	15,360	Mercury Topaz LS.....	12,360	Suzuki Swift GS.....	9,264
Chevrolet Lumina.....	14,240	Mercury Sable LS.....	16,067	Toyota Camry LE.....	14,658
Chevrolet Caprice Brougham.....	16,325	Mercury Cougar XR-7.....	20,213	Toyota Cressida.....	21,498
Chevrolet Corvette ZR-1.....	58,995	Mitsubishi Galant GSX.....	17,171	Toyota Corolla LE.....	11,703
Chevrolet Geo Metro.....	8,465	Mitsubishi Eclipse GSX.....	17,260	Toyota Celica GT-S.....	17,258
Chrysler LeBaron.....	15,995	Nissan Stanza GXE.....	14,775	Toyota Supra Turbo.....	25,200
Chrysler Fifth Avenue.....	20,860	Nissan Axxess SE.....	16,749	Volkswagen GTI.....	10,800
Dodge Daytona ES Turbo.....	13,700	Nissan Maxima SE.....	18,749	Volkswagen Jetta GLI.....	14,555
Dodge Colt Vista.....	13,906	Nissan 300ZX Turbo.....	33,000	Volkswagen Corrado.....	17,990
Eagle Premier ES.....	17,845	Oldsmobile Cutlass Calais SL.....	14,015	Volkswagen Passat GL.....	14,770
Eagle Talon TSi Turbo.....	15,613	Oldsmobile Cutlass Supreme Intl.....	17,995	Volvo 240-DL.....	18,450
Ferrari Testarossa.....	150,600	Oldsmobile 88 Royale.....	15,995	Volvo 780.....	38,735

Source: Automotive News 12/18/89, "Pricing the '90 Models"



Isn't your car worth the extra protection?

FINALLY. A NEW MOIST SNUFF GOOD

WARNING:

THIS PRODUCT IS NOT A SAFE ALTERNATIVE TO CIGARETTES

STRAIGHT FINE CUT



EXTRA WINTERGREEN FINE CUT



© 1990 The Pinkerton Tobacco Company

CAR CLINIC (Continued from page 104)

and put the trans into Reverse. If there's grinding, investigate further. If not, there's nothing wrong. Use Reverse because the reverse gear has no synchronizer. It's the most susceptible to dragging clutches.

Blowin' More Than Smoke

I have a 1986 Chevy with the 2.0-liter 4-cylinder engine. When I try to pour oil into the filler when the motor is running, it just blows back out. I had two 6-cylinder Oldsmobiles that sucked the oil in when I did this, but this Chevy just blows it all over. Will this make my valve covers leak?

There's no smoke from the exhaust, and the oil consumption is low, but there must be something wrong.

CHARLES ULANCH
GRAND RAPIDS, MI

Those 6-cylinder engines had push-rods. There wasn't much under the valve cover except rocker arms slowly rocking back and forth. Your Chevy has a camshaft whirling around at a pretty good clip, about an inch from the oil filler cap. And that oil isn't blowing out, it's being thrown out as

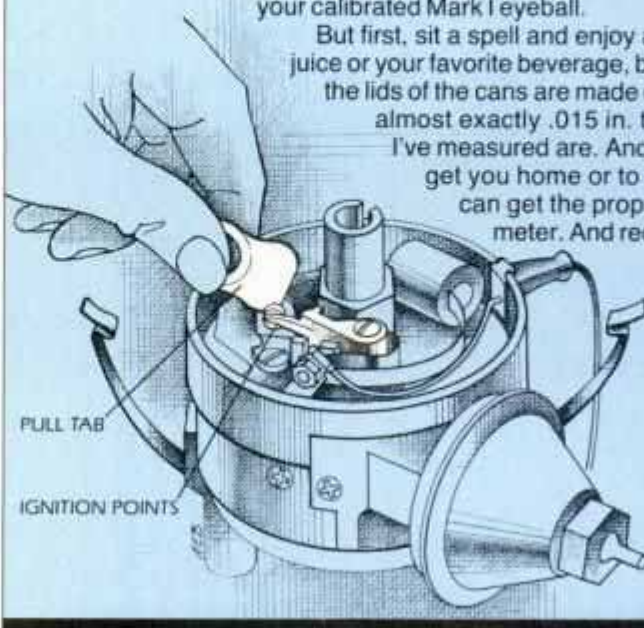
The Pause That Refreshes

So you've finally gotten around to putting in those new ignition points. Or you're miles from nowhere in your 4x4 and the old points just melted. Whatever.

All you really need is a screwdriver to install the new ones and a set of feeler gauges. . . Uh-oh. No feeler gauges.

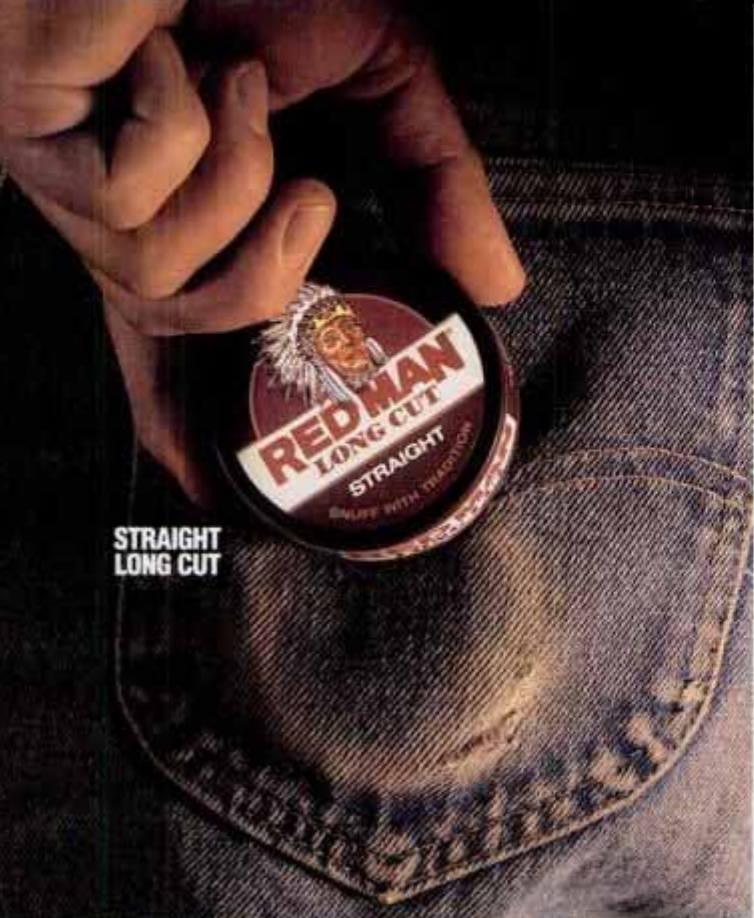
Kicking yourself for owning anything so ancient that it still even has points, you're now going to have to guess at .016 of an inch with your calibrated Mark I eyeball.

But first, sit a spell and enjoy a can of some cold fruit juice or your favorite beverage, because the pull tabs on the lids of the cans are made out of sheetmetal that's almost exactly .015 in. thick, at least the ones I've measured are. And that's close enough to get you home or to someplace where you can get the proper gauge or tach/dwell meter. And recycle that can.

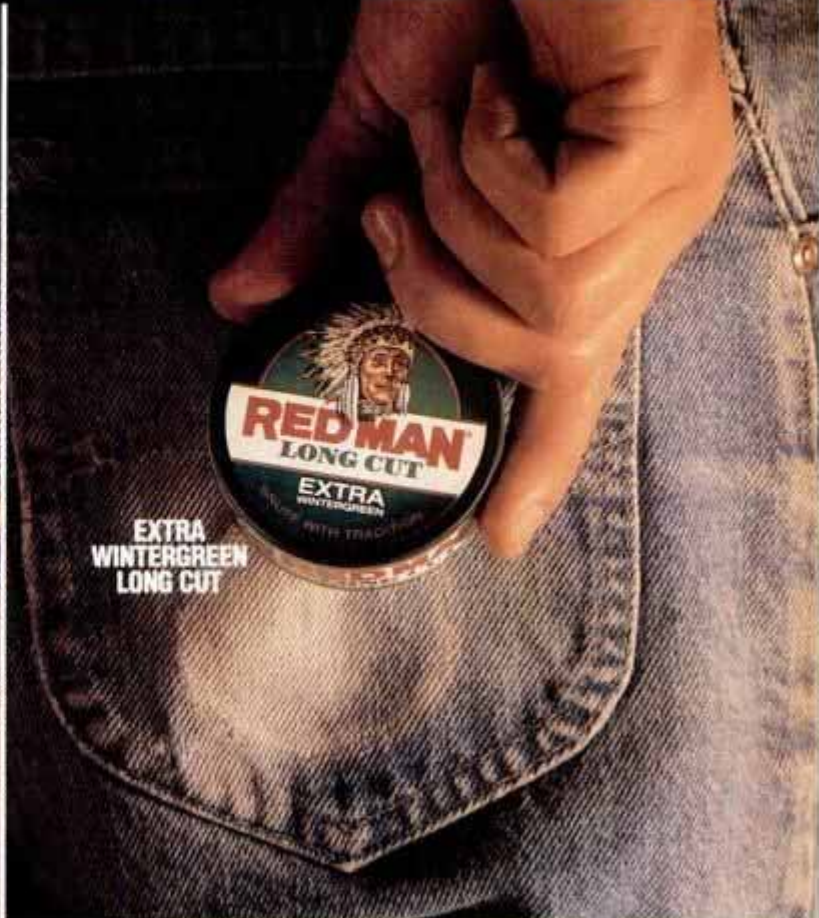


PM ILLUSTRATION BY ADOLPHE BROTMAN

ENOUGH TO BE CALLED RED MAN.[®]



STRAIGHT
LONG CUT



EXTRA
WINTERGREEN
LONG CUT

the camshaft flings it back out.

Everything is normal. Just shut off the engine before removing the cap.

White Magic

Help! My mechanic recommended that I put ½ pint of motor oil into the replacement radiator of my '84 Blazer to prevent white deposits from forming. He says he does this in all his trucks and cars, and his father-in-law says he uses the same trick.

The auto shop teacher in the local high school says I did a bad thing. Conventional wisdom seems to be on his side. But my radiator is free of white deposits. Who's right?

T. MCQUAY
MINDANOGA, ONTARIO, CANADA

Assuming that you're using a proper 50/50 mix of a brand-name coolant, there is no need to add anything else to your radiator. There are plenty of anticorrosives in modern glycol-based coolants. Adding motor oil, however, is really hard on the rubber hoses and O-ring seals in your engine. Don't do it.

Heavy Metal Thunder

I have an '88 Lincoln and an '89 Mustang, both with 302 V8s. Any advan-

tage to using the new platinum-tipped spark plugs?

VERNON OSBORNE
LAKE HAVASU CITY, AZ

I'm a big fan of precious-metal tipped spark plugs. They last longer and burn cleaner, with a wider heat range than conventional plugs. I especially like them in cramped engine compartments which make plug changes about as much fun as assembling a model airplane inside a pizza oven—blindfolded.

There are a number of manufacturers of precious-metal plugs besides the one you mentioned in your letter. The plug tips might be constructed of platinum, a gold-palladium alloy or a silver alloy. The prices are often quite unpredictable. I've seen the same plug sell for as little as \$1.89 or as much as \$12.50, so it pays to shop around.

Incidentally, these plugs aren't new. They've been around in automotive applications for at least 25 years, and in aircraft before that. **PM**

DO YOU HAVE A CAR PROBLEM?

Just ask Mike about it. Mail your question to Car Clinic, Popular Mechanics, 224 W. 57th St., New York, NY 10019. While letters, faxes or phone calls cannot be answered individually, problems of general interest will be discussed in the column.

SERVICE TIPS

■ Jeep/Eagle owners with the 4.2-liter engine should be aware that there are two different oil filters.

1986 and prior engines used an oil filter without an internal bypass valve and ¾-in. threads.

1987 and later vehicles used an oil filter with an internal bypass valve and 20mm threads.

The two filters are not interchangeable, although the later filter will probably screw onto the smaller threads for the earlier one, so beware. TSB 09-57-88

■ Pontiac TSB 89-6-10 says that slight weepage and tracks of residue from the weep hole on the bottom of your water pump are normal, and not necessarily indicative of a leaky pump. Dripping from the hole when the cooling system is pressurized does indicate a leak.

■ Clicking noises during braking from the front end of 1984-88 Escorts, Topazes and Lynxes may be the result of excess clearance between the pads and caliper housing.

TSB 88-20-6 details peening the end of the pad backing plate to obtain the proper .006-in. to .012-in. clearance.

■ Ford TSB 89-16-7 shows how to cure a/c evaporator condensation water leaks into the passenger compartment of '89 Probes by trimming approximately 1¼ in. from the rubber drain tube in front of the dash panel.



There's an all too common notion that owning a 4-wheel drive vehicle means sacrificing a smooth ride and comfortable interior environment. But the 4-wheel drive Ford Aerostar is changing that notion—combining improved traction with ride and handling so exceptional, you may not even realize you're driving a 4-wheel drive vehicle.

Advanced electronic 4-wheel drive and anti-lock brakes.

To help you stay calm (even when the weather doesn't), we gave this Aerostar the most advanced 4-wheel drive available in a minivan: a full-time system that electronically senses road conditions and accordingly adjusts the power given to each set of wheels. In addition, we included standard rear anti-lock brakes, designed to inhibit rear-wheel lockup and help you make straight stops.



Smooth handling. Comfortable ride.

But since a minivan should be as comfortable as it is comforting, we also gave Aerostar smooth ride and handling, along with a well-appointed, roomy interior. In fact, Aerostar has greater rear cargo capacity than Caravan or Voyager.*

Standard 4.0L V-6 power.

As for Aerostar's 4.0L V-6 engine, it, too, is capable of handling practically anything, whether you're towing up to a 4500-pound** trailer or just looking for a little extra power. It's one more reason Aerostar 4WD is ideal for families on the go. And for families who



refuse to let Mother Nature rule the roost.

Ford Aerostar 4WD is Motor Trend's award-winning minivan.

*With rear seats removed.
**Maximum available towing reduced by weight of passengers and optional equipment.

Ford Aerostar 4WD

Have you driven a Ford...lately?



It handles the road as easily as it handles Mother Nature.



Buckle up—together we can save lives.

OLD HOUSE RESTORATION

BY BOB VILA, Contributing Editor



BERRIDGE MANUFACTURING PHOTOS

Metal Roofing

● Topping off your turn-of-the-century house with an authentic metal roof may be the finishing touch your restoration needs. Fortunately, there are still a few manufacturers who supply metal shingles, along with standing and batten seamed sheetmetal roofing, to the restoration market.

Popular metal shingle designs include stamped diamond and fish-scale patterns. You'll also find shingles that look like Spanish clay tiles and those that resemble classic slate shingles.

Some of the materials used years ago, like copper and tin plate (terne), are still used in manufacturing today. The advances made in the industry over the years have seen the addition of *self-healing* or corrosion-resistant metals, along with those that are factory finished (painted).

If you've been considering reroofing your old house with metal, knowing more about the products available, as well as tips on proper installation and maintenance (in most cases, this means painting), will guide you along.

One of the major advantages of a

metal roof is its longevity. Although the guarantee on many materials today is 20 years, when properly installed and maintained, you can expect some metals, like copper and terne, to last much longer. For example, history has shown that a properly installed and maintained terne lead roof should last at least 50 years and in some cases more.

Of course, the length of time any metal roof will last depends on lots of factors. One of the main ones is the effect of climatic conditions in the area. Like many other materials, environmental factors like salt air, acid rain and smog all play a part in speeding the metal's aging process.

Metal roofing also has a high degree of wind resistance. Because of the way they lock together, metal shingles are more resistant to wind than composition shingles. So it's rare to lose them in a wind storm. Metal roofing is also considered fire resistant, in that the material resists ignition from sparks and flames.

When installed properly, these lightweight roofs are watertight and, aside from the periodic painting of some metals, virtually maintenance-free. Another advantage of metal roofing is its natural ability to shed

Today's metal roofing products are a far cry from the simple tin roofs of yesterday. Here is a sampling of the types available.

snow. When the sun heats the surface, it facilitates the natural melting of snow and ice.

Although the initial case outlay may be more than that for other types of roofing, when you consider its durability, a metal roof is often a wise investment. It's possible to find metal roofing in a variety of materials, including copper, terne, galvanized steel, terne-coated stainless steel (TCS) and aluminized steel or Galvalume.

Traditional roofing metals

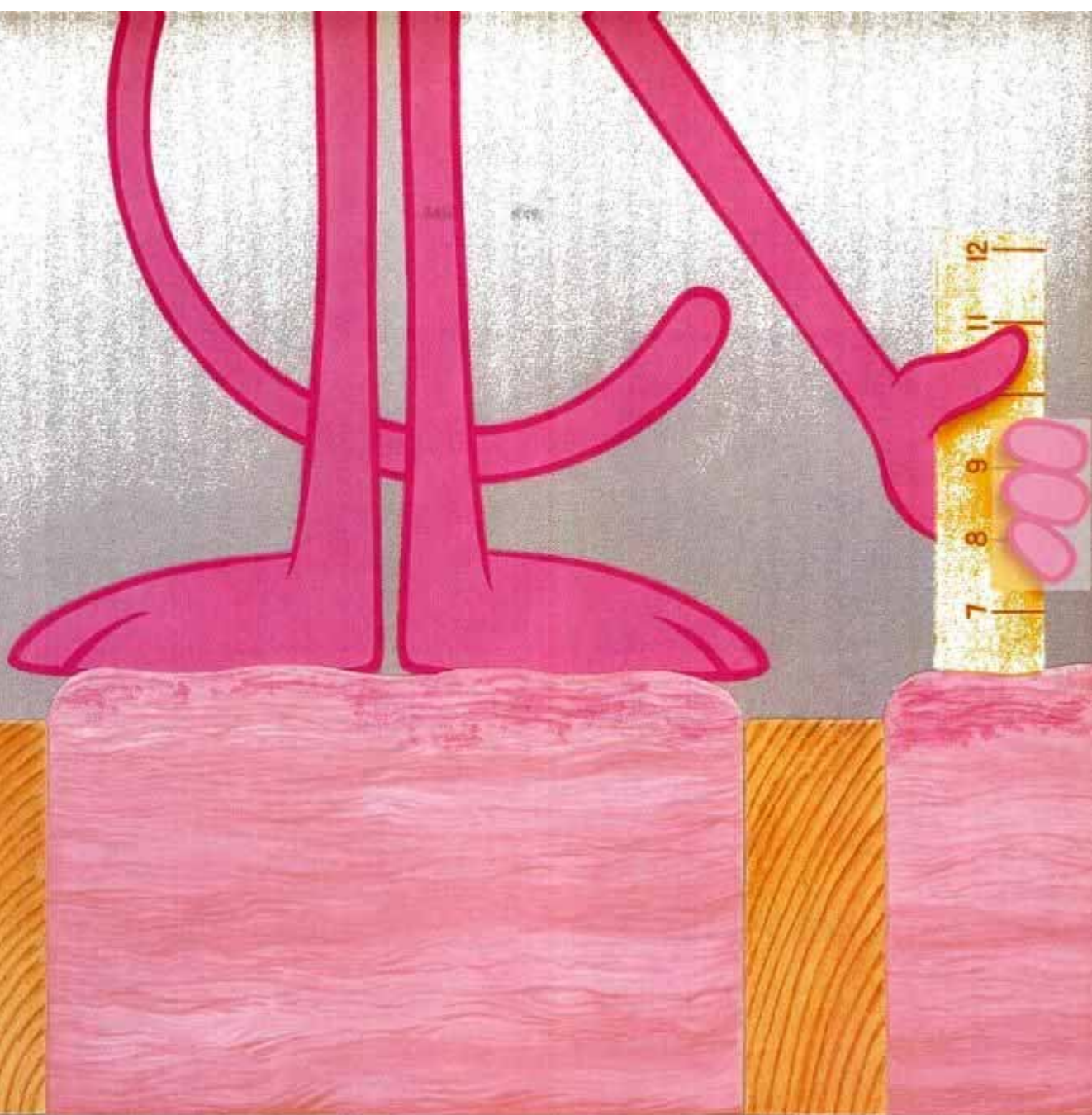
Considered the *top-of-the-line* metal roofing material, copper shingles and sheets need no painting. Naturally resistant to corrosion, a copper roof changes color slowly when it's exposed to the weather. Its initial bright, shiny appearance will likely pass through various warm tones of brown and sometimes green (depending on climate), eventually progressing to a uniform dark patina. Expect to pay more for copper than other materials. One manufacturer charges 2½ to 3 times more for copper shingles than for galvanized.

Terne, which consists of a mixture of lead (about 80 percent) and tin (about 20 percent) on steel plates, has been used for roofing since Colonial times, when it was produced and imported from Wales. It's often called *roofing tin*. Historically, this coated metal was imported into the States in rectangular pieces, often 20 in. × 28 in. Craftsmen would then solder these rectangular pieces together, creating cross joints on the roof.

Thanks to today's technology, it's now possible to coat the metal from coils, then recoil it. The resultant long, seamless sheets have nearly eliminated the need for soldered cross joints, and create a smooth, seamless standing or batten seamed metal roof. When today's restoration jobs demand the recreation of yesterday's soldered cross joints, some manufacturers can simulate this look with a die cast.

(Please turn to page 113)

Contributing Editor Bob Vila hosted public television's "This Old House" for 10 years.



If you don't have 12 inches of attic insulation, you don't have enough.



According to the Department of Energy, most attics should be insulated to an R-value of 38. That's 12 inches of Owens-Corning Pink[®] Fiberglas[®] blanket insulation. Unfortunately, too many homes don't have enough. They waste heat in the winter; air conditioning in the summer. And money year round.

What about your house? To find out if you're properly insulated, take a ruler up to the attic. If you don't have 12 inches of Pink Fiberglas blanket insulation, visit your Owens-Corning retailer and get some more. It's easy to install. And cheaper than years of high fuel bills.**

To find out more about insulation recommen-

dations in your area, call 1-800-GET-PINK (Ext. 80) or send in this coupon for a free 32-page color booklet. After all, who wants to live in a house that doesn't measure up?

Mail to: Owens-Corning Fiberglas Corp., Attn. C.J.I. Meeks, P.O. Box 44179, Jacksonville, FL 32231-4179. Please send me a free copy of "A Homeowner's Guide to Insulation." I am interested in this for: building a home, remodeling, adding insulation.

Name _____

Address _____

City _____ State _____ Zip _____

**Savings may vary. Higher R-values mean greater insulating power. Find out why in the seller's fact sheet on R-values.

OWENSCORNING
FIBERGLAS



WDTN-TV Reporter Bruce Pompeani, co-anchor of "Planet Earth: The Garbage Glut"

“ We tried to close Ohio's borders and ran into a Constitutional problem. There's a provision in the Constitution that says you can't close your borders to interstate commerce, and garbage is a form of interstate commerce. ”

Ohio Lt. Governor Paul Leonard quoted on
PLANET EARTH: THE GARBAGE GLUT
produced by WDTN-TV, Dayton
A Hearst Television Station

Nobody gets closer to people than Hearst people.

Too much garbage and no place to put it. Not a glamorous issue for politicians, but a problem demanding immediate attention. That is why Hearst's WDTN-TV in Dayton presented a series of news specials on the problem in Ohio. Reporters at Hearst believe that they have a duty to communicate important issues. So when garbage piled up in Ohio, WDTN-TV brought the unpleasant news into viewers' living rooms. Over 100 Hearst companies communicate the information, unpleasant and otherwise, that affects each audience they serve. It's our heritage. It's our commitment.



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cable programming • TV production and distribution
newspaper features syndication

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Terne should be painted as soon after application as conditions will permit with a red iron-oxide, linseed-oil vehicle primer to prevent corrosion. This paint, which is brush-applied, is very slow drying with a 72-hour drying time. This is followed with a compatible linseed-oil vehicle finish coat. In the old days, folks just used two coats of the red iron-oxide primer, which is the reason many of us picture old metal roofs as red. Today, the compatible finish coat is available in a variety of colors. Depending on environmental conditions, expect to repaint about every eight years.

Some of the metal shingles manufactured today are made from galvanized steel, the same way they were at the turn of the century. Like terne, galvanized steel should be painted. This smooth, slick and shiny surface must be etched or roughened up before paint will adhere to it properly. Today, most of the major paint companies sell self-etching primers for use on new galvanized panels.

Self-healing alloys

Terne-coated stainless steel (TCS) blends the best of yesterday and today: the durability and permanence of terne in a virtually maintenance- and corrosion-free product. TCS is Type 304 stainless steel that's coated on both sides with a terne alloy that's 20-percent tin and 80-percent lead. It's considered *self-healing* because the terne coating is anodic to the stainless steel.

In other words, if it's scratched, the terne will act sacrificially to protect the base plate. Because of the way it resists corrosion, TCS is a good choice for severe marine or industrial climates. Under most conditions, its unpainted surface will weather to a warm gray.

Another self-healing alloy used in the manufacture of metal roofing is Galvalume, a sheet-steel product with an aluminum-zinc alloy coating. This material also requires no paint and, if left to its own devices, will weather and eventually look like dark zinc. It's also available in a variety of factory-finished colors.

Installation

Fortunately, installing metal shingles isn't much different from installing any other composite shingle roof. Any roofing contractor should be able to do it. So should any of you do-it-yourselfers who aren't afraid of heights and are willing to tackle a roofing job. Basically, most metal shingles interlock and are secured to the roof with two nails driven through a nailing flange.

Although installing a seamed metal roof is a bit more complicated, it can be done by a sophisticated do-it-yourselfer if it's a pretty straightforward job. A lot of the craftsmanship that used to go into this type of installation has been replaced by machinery.

If you're thinking of doing this type of job yourself, a good book to refer to is the *Architectural Sheet Metal Manual*, published by the Sheet Metal and Air Conditioning Contractor's National Association (P.O. Box 70, Merrifield, VA 22116; \$75.00 ppd.). Considered the bible of the sheetmetal industry, it's an excellent source for sheetmetal practices that have been time-tested and proven.

When it's time to reroof your old house, don't overlook the durability of today's metal roofing products. Choosing metal shingles or sheets is a relatively inexpensive way to add period texture and charm to a Victorian or early 20th-century home.

FM

SOURCE LIST

- Berridge Manufacturing Co., 1720 Maury St., Houston, TX 77026
- Conklin Metal Industries, P.O. Box 1858, 236 Morre St. SE, Atlanta, GA 30301
- Follansbee Steel, P.O. Box 610, State Street, Follansbee, WV 26037
- W.F. Norman Corp., P.O. Box 323, Nevada, MO 64772
- Zappone Manufacturing, 2928 N. Pittsburg, Spokane, WA 99207

WAIT TILL YOU SEE
THIS SAW SAW.



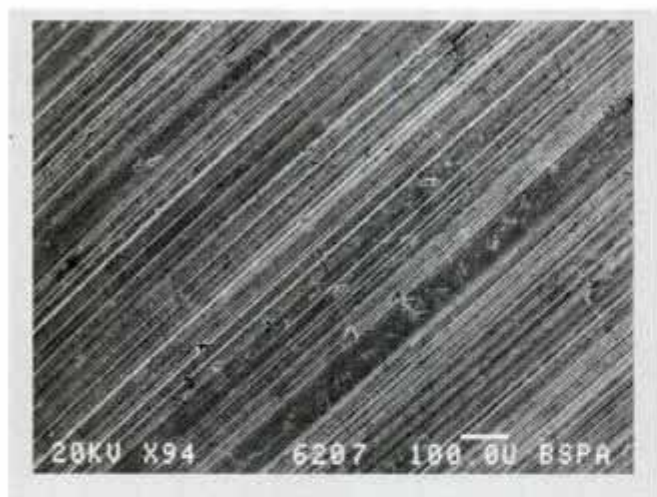
STANLEY
SHORT CUT™
tool box saw

The saw you see here cuts faster than any other saw. For one reason. The teeth. Each tooth has three cutting surfaces while most saw teeth only have one. And, it's short enough to fit neatly into your toolbox. The Stanley SHORT CUT™ saw. The fastest saw you ever saw saw.

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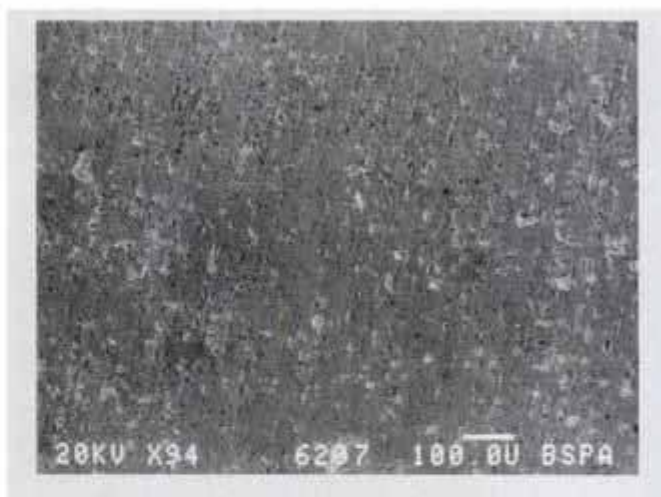
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TWICE AS EFFECTIVE.



LEADING MOTOR OIL

Obvious wear damage. Note the scoring.



NEW EXXON SUPERFLO

No visible wear.

Magnified camshaft photos from accelerated wear demonstration.

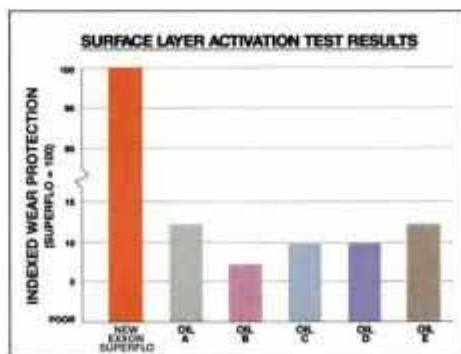


TESTS PROVE NEW EXXON SUPERFLO[®] IS TWICE AS EFFECTIVE AGAINST ENGINE WEAR AS LEADING MOTOR OILS.

If you think all motor oils are the same, we invite you to look at the chart and side-by-side photographs on these pages.

Let's start with the chart. We tested leading motor oils against new Exxon SUPERFLO to see how they stood up against engine wear, specifically in the critical camshaft area.

The results were impressive. New SUPERFLO was at least twice as effective as every one of the leading oils.



New Exxon SUPERFLO compared to leading oils.

Twice as effective. What can that mean for your engine?

On the left, you see photographic blow-ups of 2 camshafts put through an accelerated wear demonstration.

As you can see, the cam with a leading national brand shows obvious wear damage while the one protected by SUPERFLO looks almost new.

How are these dramatic differences possible? Exxon researchers have developed an additive technology that helps SUPERFLO motor oil perform far better, and far longer

against engine wear than any leading oil.

So the choice is obvious. You can stay with one of the leading oils... or switch to a new one that's twice as effective.



For more about this unique motor oil, ask for our free brochure at your local Exxon station or wherever you buy motor oil.



NEW EXXON SUPERFLO. IT'S TWICE AS EFFECTIVE.

ELECTRONICS

BY FRANK VIZARD, Electronics Editor



CD Books You Read On TV

● By now we're all used to the fact that the compact disc is a great source of exceptional sounding music. As it turns out, though, we've only just begun to find uses for the compact disc. The compact disc is not only replacing the old vinyl LP record, it's replacing the books on your shelf as well.

A step in this direction is being taken by Commodore International under the leadership of Nolan K. Bushnell, the man who created the videogame business with the invention of *Pong*. What Commodore has done is wed a computer to a CD player. The result is a machine that not only plays music, but also gives you access to a tremendous amount of data that can be seen on your TV.

One compact disc can store the equivalent of 250,000 pages of text. A CD-ROM (Read-Only Memory) disc can therefore combine graphics, text and audio to explain a subject. For ex-

ample, you could read text about a bluebird, see what one looks like and also hear how the bird sounds. One disc can store the information contained in an entire encyclopedia. Dictionaries, directories, atlases and lots of other materials are already available on CD-ROM discs. CD-ROM drives are built into some computers, like those from Tandy and Philips, and are available as accessories.

Commodore gets around the necessity of owning a computer by incorporating a Motorola 68000 processor, proprietary graphics and audio processors into the CD player itself. And like a computer, the Commodore CD player has many of the same type of features.

For example, there's an external floppy disk drive interface, a serial port for a modem, a parallel port for a printer, and additional ports for an optional keyboard, joystick or mouse.

The Commodore CDTV player can be connected to either a standard television or an RGB monitor. An optional "genlocking" card lets you mix computer graphics with live video.

A more unique feature is a front panel "smart card" port that allows you to save and store up to 64 kilobytes of data. This means if you're in the middle of a project or a game, you can store it and come back to where you left off later.

The CDTV plays musical discs, as well, and there's a display for track, time and volume information. There's also a separate clock. The CDTV uses 8X oversampling and dual 16-bit digital-to-analog converters. A remote control is also included.

Bushnell says the Commodore CDTV will sell for under \$1000 and that there will be about 300 CD-ROM discs available by Christmas. Prices for these discs will range between \$30 and \$100, depending on the material. Discs will include reference materi-

als, games and educational fare.

The Commodore CDTV may be the model for the family computer of the near future. In any event, Commodore won't be alone in trying to develop CD-ROM. Sony, for instance, has developed a prototype portable CD-ROM with an LCD display that industry wags are already calling Bookman. Philips, meanwhile, is working on a CD-I (Interactive) product that promises full-motion video. CDs are clearly destined to offer more than just music.

Wristwatch Messages

Throw away your Rolex. The new symbol of power and affluence may be the wristwatch pager. As developed



Wristwatch pagers: shades of Dick Tracy.

by AT&E Corp. and Seiko, the watch maker, the system seems like a step toward the 2-way wistradio used by comic-strip hero Dick Tracy.

The system works as follows: A telephone call is placed to an automated message center, which forwards it to an FM radio station in the area where the subscriber is located. The message is transmitted over a portion of the FM radio band to be received by the Receptor wristwatch.

The messages displayed on the wristwatch are simple, but effective. The display tells you to call home or the office, or shows the word CODE followed by a single-digit number—the meaning of which is predetermined by the subscriber.

The Seiko Receptor costs about \$275, with an average monthly service fee of \$12.50. Motorola is also selling a wristwatch pager for \$300 list that uses the existing pager network. Timex will sell the watch at retail within two years. **PM**



If you remember where you were when you had your first Jack Daniel's, drop us a line and tell us about it.

FOLKS OFTEN ASK US if there really was a Jack Daniel. Well, there he is up on the left.

Keeping his old photo around (as well as the one of his nephew, Lem Motlow) helps us keep true to their whiskey making methods. You see, we still smooth out our whiskey in exactly the same way our founder prescribed—mellowing each drop through hard maple charcoal burned right here on distillery grounds. We think Jack and Lem would still approve the results. And after a sip, we think you'll approve them too.

SMOOTH SIPPIN' TENNESSEE WHISKEY

Tennessee Whiskey • 40-43% alcohol by volume (80-86 proof) • Distilled and Bottled by Jack Daniel Distillery, Lem Motlow, Proprietor, Route 1, Lynchburg (Pop 361), Tennessee 37352
Placed in the National Register of Historic Places by the United States Government.



More muscle, less fat.

The new mid-size Dodge Dakota. Now with V-8 power.

More payload than standard Ford and Chevy half-tons.

Its agility approaches compacts. Its payload capacity holds its own against that of meatier half-tons. And with

available V-8

power, it's the best all-around pickup on

the road. It's the new mid-size Dodge Dakota.*



We revved up our Dakota with a 170 HP V-8.

Dodge Dakota
4x4 Sport

Flexes new V-8 muscle.

To any skeptic who thinks Dakota's a dressed-up compact, take a look under the hood. There you'll find a choice of hard-working engines that no compact pickup can offer. Including a 3.9L V-6. And our 5.2L 170 hp V-8, turning out 262 lbs-ft of torque at 2,400 rpm.

Equipped for heavy loads.

If you want to see what a Dakota can

carry, fill it up with a load of topsoil. We've got up to 2,550 pounds of available payload, depending on engine and model. Standard Chevy and Ford half-tons can't haul as much. And though it's lighter than Chevy C1500, Dakota can carry 300 pounds *more*** Not bad for a truck that's a lot leaner than its full-size competition.



Bodies of all sizes and shapes: 4x4, 4x2 and Club Cab.

The body you always wanted.

Take your pick of Dakotas. From 4x2, 4x4, longbed, shortbed, Club Cab

and Sport models. Every one has been restyled for 1991.

Welcome home to Dodge.

America is coming home to Dodge. And with trucks like Dakota V-8 and our full-size Cummins Diesel, the only turbo diesel pickup you can buy, we think they're home to stay. Come see what we're made of.

*Competitive claims based on '90 data ('91 competitive data incomplete at time of printing).
**Available regular cab 4x2 payload comparisons.

Buckle up for safety.



Advantage: Dodge.



CURING SPARK KNOCK

BY PAUL STENQUIST; PM Illustrations by Fred Wolff

● Just ahead is a steep hill. You're driving in high gear and your car begins to lose speed. You squeeze the accelerator toward the floorboards and you're rewarded with little or no engine response and a noise like marbles in your hubcaps.

You wish it were that simple. Unfortunately, what you're hearing is the death rattle of spark knock. What it means is that uncontrolled combustion in your engine is trying to beat your pistons, rings and rod bearings to death.

But not to worry. Unless you're riding around in a pumped-up muscle car with 10 or 11:1 compression ratio, you can probably solve the problem with some systematic diagnostic work and, in most cases, minimal repairs.

The root of the problem

We call this pinging noise spark knock because everyone else calls it spark

knock, and we want you to know what we're talking about. But, in truth, spark knock is not a very accurate name for this condition because it's not always related to spark or spark timing.

Spark knock is usually the result of *detonation*. Detonation occurs when a second combustion-chamber flame front is ignited some time after normal ignition. Now the air/fuel mixture is burning on both sides of the chamber and there's some unburned mix between the two flame fronts. Heat and pressure rise far more rapidly than in normal combustion, due to the two flame fronts. Eventually, the heat and pressure cause the unburned gases to explode violently, pounding the top of the piston, the ring lands and the bearings.

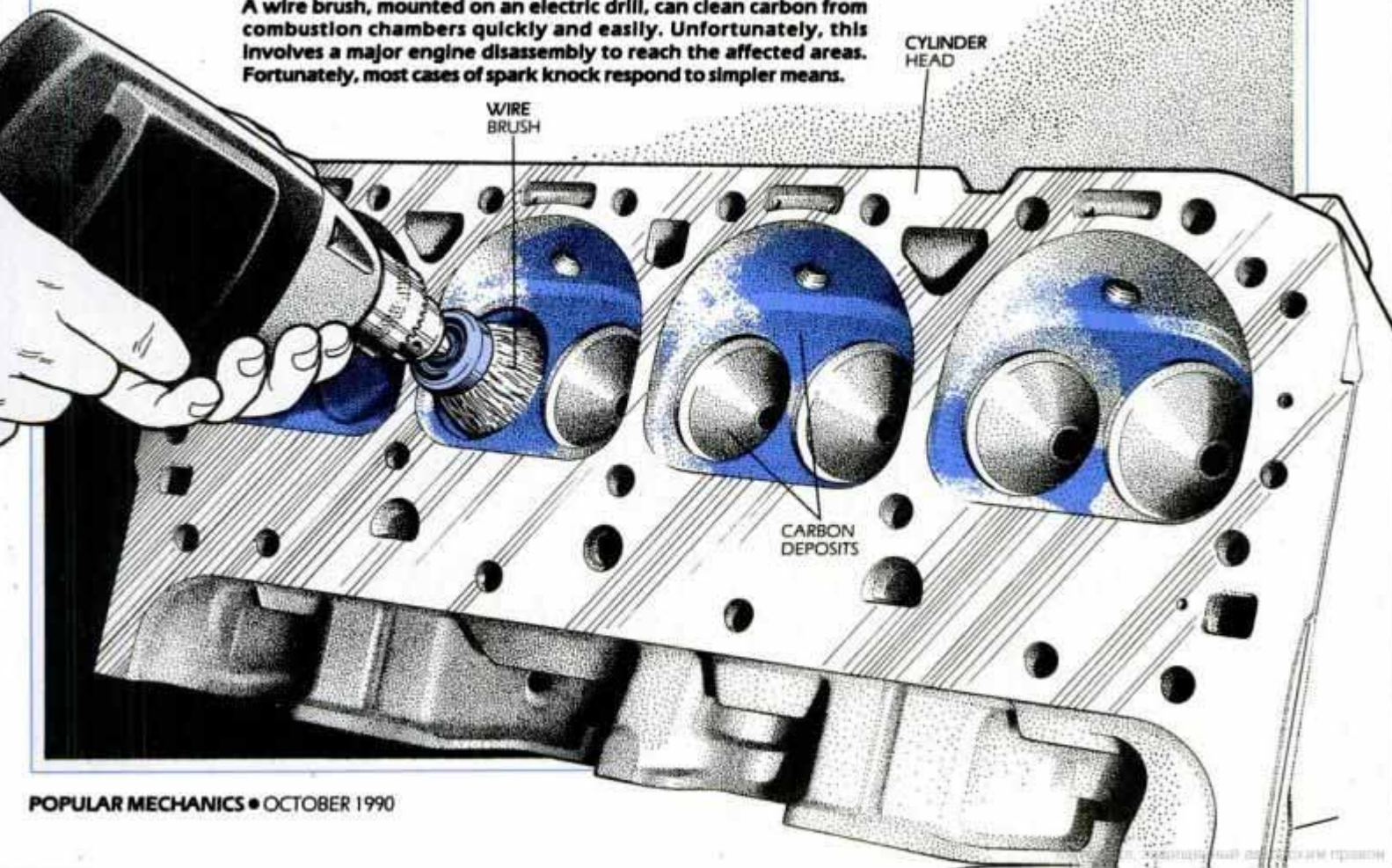
This second flame front is caused by preignition. Preignition occurs when a hot spot on the chamber or spark

plug causes the mix to ignite before the ignition spark occurs. Preignition can also occur spontaneously if overall combustion chamber temperature is already so high that the heat buildup that results from compression of the mixture brings it to combustion temperature.

Now here's the part that confuses even some knowledgeable technicians. The high cylinder pressure that preignition causes can produce spark knock noise even if detonation doesn't occur. In this case, the noise you hear is caused by the piston slamming into a wall of high pressure as it rises on the compression stroke. Preignition that occurs without detonation is usually less damaging than detonation, but it can still cause premature engine failure, and it robs horsepower.

In either case, the fix is the same, so

A wire brush, mounted on an electric drill, can clean carbon from combustion chambers quickly and easily. Unfortunately, this involves a major engine disassembly to reach the affected areas. Fortunately, most cases of spark knock respond to simpler means.

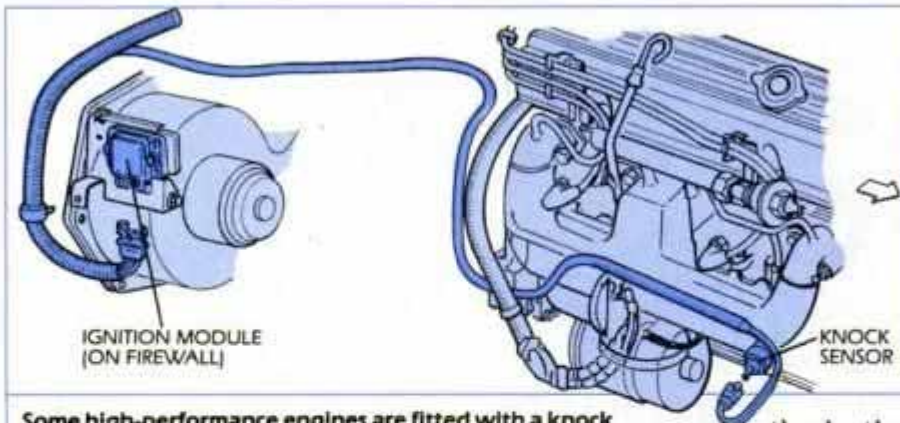


a total understanding of this complex subject isn't absolutely necessary. In the following sections, we'll provide a general guide for eliminating the dreaded death rattles of spark knock. If your car does not have a knock sensor, you can skip the first section.

If you have a **Hearst Motor** or factory service manual, you can supplement this guide with the information you'll find there. Look for the troubleshooting guide in the engine driveability section and see what it has to say about spark knock, detonation or preignition.

Knock sensors

Some of today's high-performance engines are fitted with a knock sensor. This usually consists of a sensor device that can detect the vibration caused by spark knock and a control microprocessor. In most cases, the microprocessor for the knock sensor system is the same one that controls ignition timing. And when the sensor detects knock, the computer retards timing until it goes away. There is, of course, a penalty in fuel economy and power, because retarding the timing makes the engine less efficient.



Some high-performance engines are fitted with a knock sensor. Knock control systems retard ignition timing.

Some of the best knock sensor systems are selective, meaning they localize the knock problem to one or more cylinders and retard ignition only for the offenders. In these cases, the penalty in fuel economy and performance isn't as severe.

A few knock sensor systems used on turbocharged engines reduce boost rather than retard timing. This will also curb spark knock, as it can be a function of both cylinder pressure and ignition timing.

If the knock sensor circuit fails, you might experience severe spark knock in some driving situations. Troubleshooting procedures frequently call for tapping on the engine block with a small hammer while watching for ignition retard with your timing light. On turboboost systems with a boost gauge, drive the car in a manner that usually generates spark knock (uphill in high gear at moderately low rpm with a wide throttle opening, for example). As you drive, watch for boost reduction when spark knock occurs.

On the most advanced systems, a circuit failure will frequently set a trouble code in the microprocessor's memory. If this has occurred, your **CHECK ENGINE** light should be illuminated. See your service manual for details on reading and interpreting trouble codes.

What if your knock sensor circuit is working overtime? In other words, if conditions exist that are causing spark knock even in normal driving, your engine computer could be retarding the timing most of the time, resulting in loss of power and efficiency. Suspect this if your car is a lot more sluggish than it used to be for no immediately apparent reason.

If this is the case, you should check for some of the other conditions, out-

lined below, that can cause spark knock and correct them as needed.

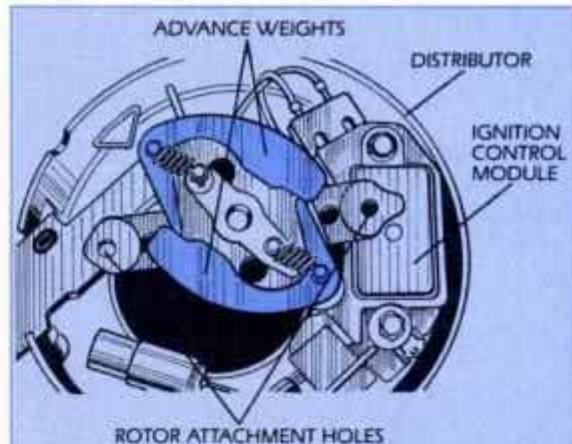
Spark stuff

Many of the spark knock problems are caused by incorrect spark plug heat range or incorrect ignition timing. Check your plugs to make sure that

they're the correct heat range. A spark plug that is too hot can cause preignition problems.

If you don't know what plug your engine is supposed to use, check with your parts store counterperson. Sometimes a manufacturer will change the recommended plug number after the car is in service, so make sure you're consulting an up-to-date listing.

Changing to a spark plug that is colder than the recommended one can sometimes help cure preignition problems, but the cold plug can cause

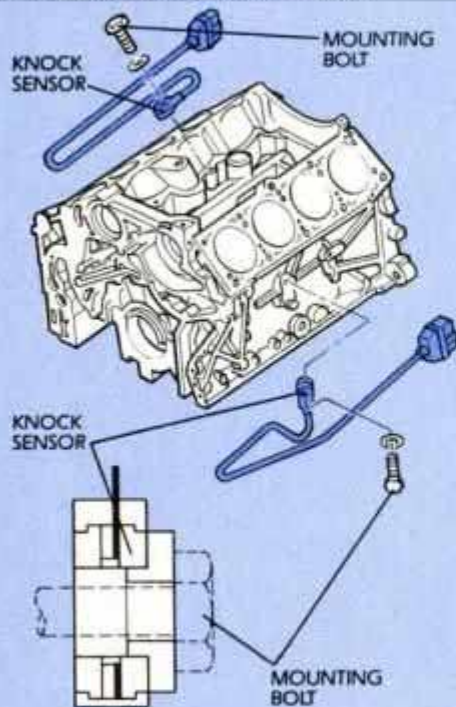


If the advance weights bind in an advanced ignition timing position, spark knock can result.

other driveability problems. If the correct plug runs so hot that it causes preignition, you have a problem somewhere else. In this case, the plug heat is a symptom, not a cause.

Take a look at all the plugs while you're at it. Heavy deposits or hot spots on the electrodes or insulators can cause preignition. If the plugs don't look good, clean or replace them.

When you've determined that your plugs are okay, check initial and total ignition timing. If timing is too far advanced, heat and pressure will build up too soon and spark knock will result. Your timing should be set to the amount recommended by the manufacturer. Retarding it beyond this point may help eliminate spark knock,



Many vehicles have only one sensor. This system has one for each cylinder bank.

but if everything else is okay, you shouldn't have to.

An exception would be extremely high compression engines (10:1 or higher) from the 1960s. With some of these, which were engineered for high-octane leaded fuel, you might have to retard timing or resort to other measures to make them run knock-free on premium unleaded or a 60/40 mix of premium unleaded and regular leaded.

If ignition timing is at spec, check for binding of centrifugal advance weights on cars equipped with a distributor. This is common on GM cars where the centrifugal weights are directly below the rotor. If the weights stick in the fully advanced position, spark knock can result.

If one of the springs on the distributor's advance counterweights breaks, the initial advance and total advance may be correct, but the large total advance can come in at much too low of an rpm. So a physical check of the advance mechanism may be in order. If the distributor shaft bushings are worn enough, the shaft may cock sideways enough to upset timing at higher rpm. Be sure the vacuum advance or retard hoses are intact, not leaking or crimped, and that they are connected to the correct vacuum port on the manifold or carb. A vacuum tap on the side of the carb that sees a port just below the lip of the throttle butterfly will see vacuum only after the throttle is open far enough. Manifold vacuum taps will signal the advance mechanism anytime there is vacuum, which may be too soon.

Engine overheating

If your timing and plugs are okay, it's time to turn your attention to the cool-

ing system. If you haven't been flushing and refilling it once a year, you may have some deposits of gunk in the cylinder heads that cause localized overheating and spark knock. We've seen some extremely severe cases of spark knock that were caused by a dirty cooling system.

Do a flush and refill with a 50 percent solution of antifreeze. If the system is extremely dirty, you may have to find a technician who has a power backflushing machine, or use some cooling system cleaning chemicals, or both.

Once everything is clean, check the fully warmed engine temperature and compare it to manufacturer's spec. If you don't have an engine temperature gauge that reads in real numbers, you can install one. Just replace the cooling system warning light pickup with the gauge pickup and mount the gauge under your dash. If you don't want to install it permanently, you can just hang it somewhere while you take a test drive.

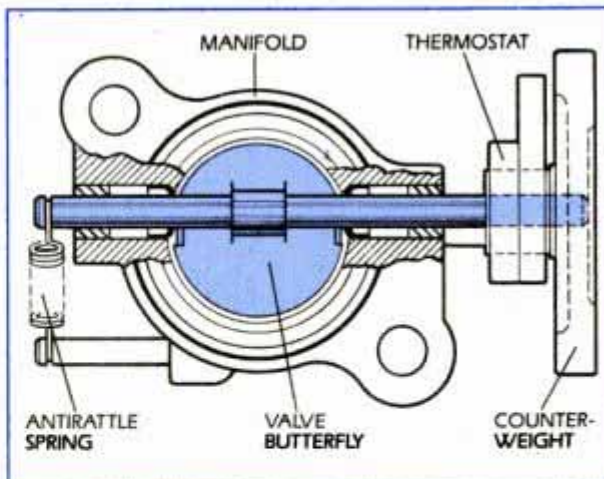
If the running temperature is 10° or more in excess of specs, you should take steps to lower it. High operating temperature can be caused by an incorrect or defective thermostat, slipping fan belt, bad water pump, collapsing radiator hose or defective fan clutch.

Heating the charge

If the air/fuel mix is overheated going in, the chances of spark knock problems are multiplied. There are two systems that can easily cause excessive preheating of

the mix: intake hot-air and early fuel evaporation (EFE). Some cars have both, some have one, others have neither.

Intake hot-air systems draw air from a stove atop the exhaust manifold. On many cars, this system is controlled by a vacuum motor. The vacuum supply that actuates the motor is turned on and off by a thermal switch in the air cleaner. When the



This EFE system directs exhaust gases through the intake manifold with a valve in the exhaust manifold.

intake air is cold the motor closes a door in the air cleaner, and the engine draws its air supply from the stove. When things warm up, the door is supposed to open, allowing the engine to draw cool air. If the door doesn't open, spark knock can result.

If your hot-air door is closed and your engine is warm, check for vacuum at the vacuum motor. If you find vacuum, the thermal switch is defective. (There should be no vacuum supply when the engine is warm.) If you don't have vacuum to the motor, the door is probably stuck closed.

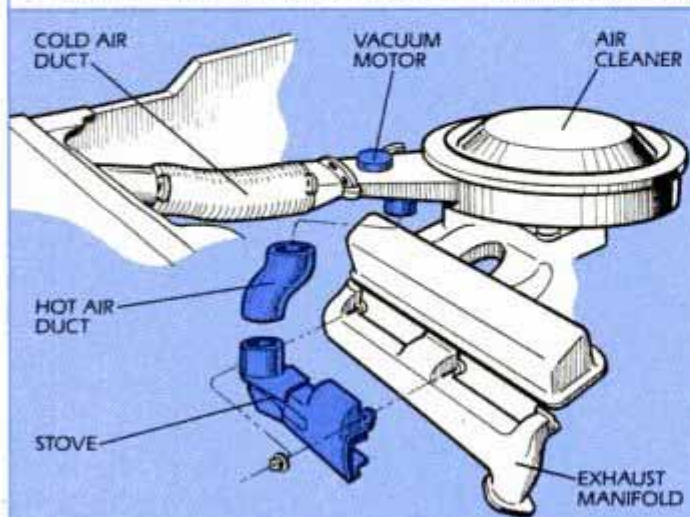
EFE supplies heat to the base of the intake manifold to aid in fuel vaporization. Some systems use an electric grid below the carb to supply this heat. If the heat remains on when the engine is warm, an overheated mix will result.

Other EFE systems route exhaust heat to a passage in the intake manifold. This type uses a valve in the exhaust pipe that closes when the engine is cold by means of a bimetal spring like those used on choke systems. When the valve is closed, exhaust is routed into the intake manifold passage, warming the manifold and the mix. These valves can sometimes stick in the closed position, particularly on cars that are not driven on a regular basis.

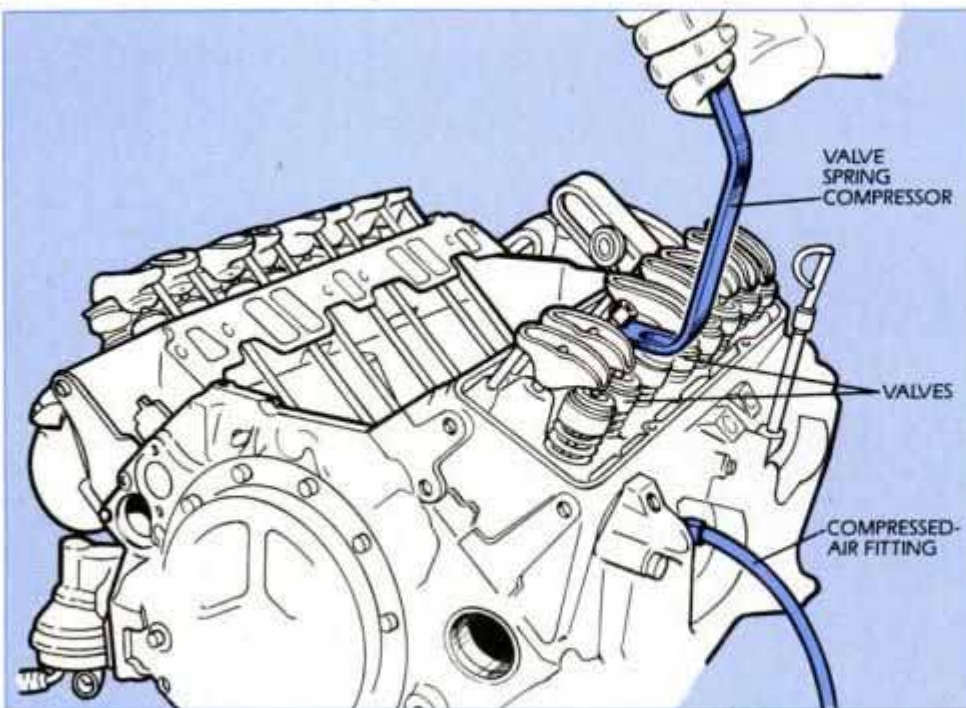
Valve seals

One of the worst spark knock problems we ever encountered was due to a case of bad valve seals. The car, a 1970 Javelin with a V8 engine, would rattle like it had marbles in the hubcaps with just a little squeeze on the throttle. It was also burning a quart of oil every couple hundred miles.

It turned out that oil was getting into the combustion chambers, combining with the charge and causing



Check the fully warmed engine temp. If the intake air preheating remains on after the engine warms, spark knock can result.



This tool allows removal of Chevy V8 valve springs with the cylinder heads on the engine.

preignition of the mix, probably due to a lowering of the gasoline's octane number. An on-car seal replacement job solved the problem completely.

You can purchase a special tool that will allow you to compress and remove valve springs without removing the heads. Your auto parts store or dealer parts department should have it. You'll also need a compressed-air supply and a spark-plug hole/air hose adapter. Auto parts stores should have this, too.

Filling the cylinder with compressed air while the piston is at the top of its travel on the compression stroke (both valves closed) will allow you to remove the springs. If you remove a spring and its retainer without filling the cylinder with air, the valve will drop into the cylinder, perhaps necessitating removal of the head.

EGR

A defective Exhaust Gas Recirculation system will almost always cause spark knock. EGR routes a certain amount of exhaust gas back into the intake system to help lower combustion chamber temperature. If the EGR system is broken or disabled, the engine is likely to develop

spark knock problems.

Some people disable EGR in the hopes of improving engine performance. On today's cars and with today's gasoline, it has the opposite effect.

The most basic EGR valves use a vacuum signal to open the valve. Because they draw the signal from just above the carburetor or throttle body throttle plates, the signal is not present at idle. A temperature control switch in the vacuum line prevents exhaust gas recirculation when the engine is cold.

You can check this type of EGR in a few minutes. Warm the engine and run it at 2000 rpm. Check for control vacuum to the valve. If there is none, the thermostatic switch is defective.

Then, with the engine idling, apply

vacuum to the EGR valve with a hand vacuum pump. The engine should stumble or die. If there is no change in performance, the EGR valve is defective. Or the valve's exhaust supply is blocked.

To determine which, feel the underside of the valve diaphragm while vacuum is applied. (Wear gloves—it's hot.) If it doesn't move, the valve is defective. If it moves, but there is no change in idle when the valve is opened with the engine running, the EGR passages are plugged.

Other EGR systems are more complex. Some are regulated at least partly by exhaust backpressure. Some are computer controlled by means of a switching solenoid. Some are even more complicated, like the 3-stage system used on some Mitsubishi (Chrysler) 2.6-liter 4-bangers. If your system isn't a simple valve and vacuum switch arrangement, check the diagnostic procedures in your service manual.

Carbon buildup

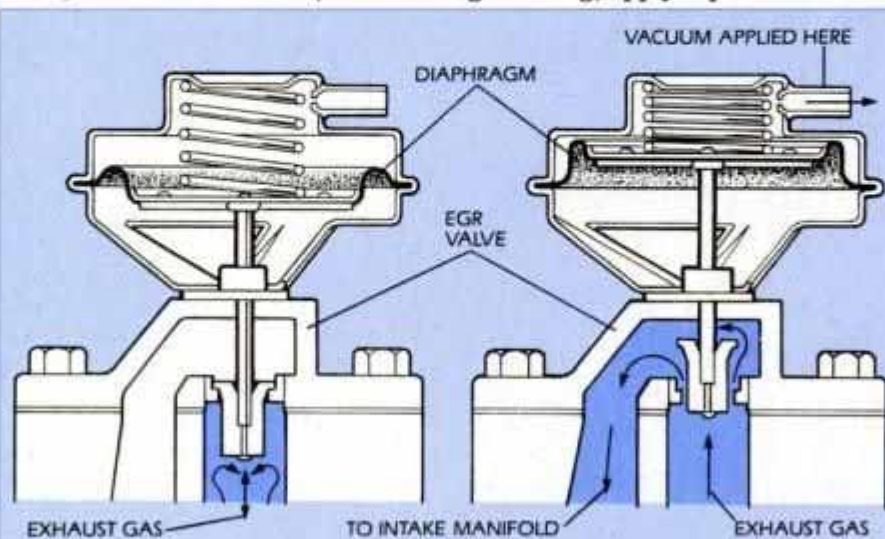
Carbon accumulation in the combustion chambers and on the piston tops can cause detonation or preignition due to a resulting increase in compression ratio and/or hot spots in the carbon. Various top-engine cleaners are available that will remove a lot of this. Sometimes disassembly and a wire brush cleanup are required to completely solve the problem of heavy deposits.

Vacuum leaks

Vacuum leaks can cause spark knock in some cases because it leans out the mixture and leads to localized burning of the mix. This kind of spark knock problem would usually be accompanied by rough idle.

Small vacuum leaks are tough to pinpoint. Check all vacuum hoses for deterioration and hose connections for a snug fit. Apply carb cleaner to gaskets and hose connections while the engine is idling.

Just remember that this stuff is flammable—don't set your eyebrows on fire by spraying carb cleaner near the distributor or any other electrical sparks.



When the EGR valve is open, exhaust gases are mixed with the air/fuel charge.

BOATING

BY JOE SKORUPA, Boating/Outdoors Editor

OMC's Outboard Breakthrough

● Ice cream was the mother of invention—at least for outboards. On a hot summer day at the turn of the century, Ole Evinrude's best gal wanted a scoop of cherry vanilla. The shop was across a lake and the gal, for some reason, couldn't make the trip. Something about a headache, I believe. Anyway, Ole was filled with a passion to impress her. This is what he did: He equipped a gas engine with a prop shaft, hung it on a dinghy, fetched the ice cream, romanced the gal and invented an industry. By 1907, Ole's outboards were in mass production and boating was changed forever.

Since its passion-filled beginnings, development in outboard technology has been less dramatic. Power, efficiency and convenience have improved tremendously, but the changes arrived gradually—loop charging one year, electronic choke a few years later, oil injection next, then microprocessor management and so forth.

Outboard of the '90s

This year, OMC abandons gradual for radical. With the introduction of the V6 Silverstar (Johnson) and Spitfire (Evinrude) outboards, OMC skips the

intermediary steps and takes a giant stride forward. The design at the heart of the new engine features advancements so dramatic that it's sure to become a major milestone.

There are so many innovative systems and components on the engine that OMC has a total of 43 new patents to cover them. It's literally a new powerplant from the ground up.

I first saw the new 158-cu.-in., V6 powerhead at a press preview in Stuart, Florida. I spent some time disassembling it with technicians and then jumped into a 25-ft. Donzi for water testing. Since the preview engine was a prototype, definitive radar and fuel-flow data will have to wait.

But with so many innovations clustered in the basic design, there's plenty to discuss. In fact, it's difficult to choose a place to start. Let's begin with what I believe is the boldest decision by OMC engineers: moving the carburetors from the traditional location aft of the intake manifold to a position on the side of the block. This relatively simple concept achieves two significant improvements: 1. engine length is trimmed by 4 in., and 2. air/fuel induction bypasses the crankcase.

Both of these benefits were clearly demonstrated in Stuart. The new powerhead is an incredibly small package. It displaces a gutsy 158 cu. in., but does so with 30 percent less engine volume than standard 150-horsepower, 149-cu.-in. outboards. Compactness is achieved by the unique placement of the carbs and by slimming down to a 60° V block in place of the standard 90° V block.

To further drive the downsizing point home, OMC showcased its engine next to a Merc and a Yamaha 150. The difference was dramatic, especially compared to the Yamaha, which looked about 50 percent larger under the hood.

On the water, it was obvious that the new air/fuel routing, which OMC calls Power Path Induction, provides a shorter and straighter shot into the cylinder. Throttle response was instantaneous. Hesitation, which is the rule even on dialed-in outboards, was



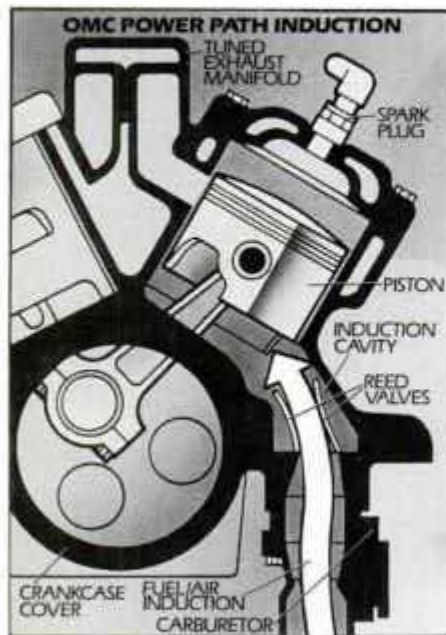
absent during the test run. Nudge the throttle, the boat moves. It's as simple and immediate as that.

Look ma, no foam

In addition to downsizing and improved performance, the new powerhead is a much simpler engine to service and maintain. A number of hoses and lines were eliminated, thanks to pathways molded directly into the block. This was achieved through a process called lost-foam casting. In fact, the new engine features the first powerhead block completely built by this process.

OMC has been leading the way in lost-foam casting throughout the 1980s. Plastic blanks, shaped precisely from master molds, are buried in sand. Molten aluminum is introduced. It vaporizes the blank and displaces it. The cooled component is then ex-

(Please turn to page 126)



Direct air/fuel flow bypasses crankcase.



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tracted from the sand. The process produces stronger, lighter, smaller and more complex shapes than are attainable by die casting.

Prior to the new engine, OMC had been using the lost-foam casting process to make cylinder heads and other parts that are small. The results were encouraging, and five years ago, when planning for the new engine began, engineers decided to use the process for the block.

The benefits are numerous. As noted, a greater degree of complexity is attainable. Also, it reduces the need for a large amount of post-cast handling and machining. The end result is component consistency.

Furthermore, some fuel, air, exhaust and coolant passageways are molded directly into the block, reducing add-on components, hoses and lines. The best example of this is the exhaust manifold. On standard outboards, this part is bolted onto the block. On the new engine, the 3-into-1 unit is integrated, resulting in the elimination of a number of seams, joints, fasteners and gaskets. As a bonus, OMC tuned the exhaust for increased performance.

Who's who

It's a bit confusing, but the new OMC V6 engine will be offered in eight models, four each by Johnson and Evinrude. Johnson calls its models the Silverstar series. Evinrude uses the Spitfire name. Both 150-horse and 175-horse models will be offered. The difference between the two is in carburetion, porting and timing.

In addition to these models, another pair of designations has been created. These lines are designed for the high-performance bass market. Johnson calls its models Silverstar Fast-Strike. Evinrude calls its models Spitfire Intruder. Again, the difference is mostly in carburetion.

As noted above, innovations are plentiful and so are standard features. Here's a rundown:

- The flywheel is covered by a plastic cap to prevent saltwater corrosion. Until now, flywheels were exposed under the hood. Saltwater sometimes came in through air slots in the cowl, due to splashing from wave-action or backing-down maneuvers. Now, the flywheel is sealed even from mist that occurs during evaporation.

- Ducting channels are molded into the engine cowl to direct air to each bank of carburetors and to guide any possible water intrusion to the most neutral part of the engine. This ducting system, plus tighter tolerances throughout the powerplant, make the engine noticeably quieter.

- Head gaskets have been eliminat-

ed. Molded-in channels in the cylinder heads, thanks to the lost-foam casting process, permit the use of reusable O-rings.

- Loop charging. The tuned air/fuel-flow pattern inside the cylinder improves burn efficiency.

- Variable Ratio Oil (VRO) injection.

- High-charge 35-amp alternator.

- Electronic, choke-free starting. It automatically adjusts timing for cold engines and is called Quickstart.

- Speed limiting overheat warning system called S.L.O.W. II.

- Modular fuel system assembly. This unique, preassembled unit incorporates a filter, vapor separator pump, primer solenoid, engine warning device and VRO oiling system. Since all items are integrated in one bracket assembly, connecting lines are eliminated. Only three lines connect the unit to the engine.

- Modular power pack, another unique, preassembled unit. This one contains the coil and brain box, and connects to a wiring harness.

- Optical Ignition System (OIS 2000). For the first time in a production engine, the signal to fire is controlled by an infrared beam of light. Standard ignitions use a magnet.

- Weight of 150-horse engine is 365 pounds, which is down 20 pounds from the standard 150-horse engine. Gains were made thanks to casting and use of composites.

- Cylinder sleeves have five ports instead of three for greater induction/exhaust flow volume.

- A flushette below the powerhead enables engine flushing, either while running or shut off. It's equipped with a threaded, garden-hose adapter.

- FasTrack midsection. It features a trim range of 21°, up from 15°. There's also an additional 12° of tilt. To prevent the possibility of damage, tilt locks can be set. For trailering, a special bracket locks the drive at 40°. The system is noticeably faster and quieter. FasTrack will become standard on outboards 70 hp and up.

By the time you read this, the new OMC outboard should be ready for delivery, but, at press time, no retail price had been set. As a guideline, OMC suggested calling it "premium priced." When pressed, OMC estimated an increase of several hundred bucks above XP or GT 150-horse prices, which are the current premium-priced models. Will any present 150-hp or 175-hp models be retired in favor of the new engine? Perhaps, but not for the near future.

As ice-cream fetchers go, the new outboard from OMC is the hottest news since Ole Evinrude's passion-filled summer at the turn of the century. It's about time. **PM**

SHOOTING STAR

(Continued from page 50)

structure and bring it home in this one streamlined package. Absolutely inspired simplicity.

Instant obsolescence

Unfortunately, the very pressure that forced the Shooting Star's birth, the German jet effort, was to doom the XP-80 (later F-80 after a separate Air Force was formed) to a short life as a frontline fighter. From the very beginning, Willy Messerschmitt had relied upon sweptwing technology, which gave the Germans the edge in pushing the airframes faster and faster. At war's end, that technology fell into the hands of both Russia and America, which meant that by the time Lt. Brown was pumping .50-caliber rounds up a MiG's tailpipe, the F-80 was already obsolete, in terms of performance. Thus, it served most of its time in Korea as a ground-attack machine. The glory of the dogfight was left to its sweptwing cousin, the F-86 Sabrejet.

Every new concept has at least one basic flaw that may not show up until well into the application phase. In the case of the jet fighter, it was the frequency of accidents, which occurred at an alarming rate. In fact, over 60 XP-80s were involved in serious accidents, almost all of which were attributed to pilot error.

To put it simply, America had taken such a huge step in performance over its previous aircraft, that training hadn't kept up. The fledgling jet jockey still took advanced training in the 600-horse, 160-mph AT-6 Texan that had trained thousands of Mustang and Thunderbolt drivers. This in no way prepared him for what he was about to experience. The final phase of his training was his instructor leaning over him, as he sat in the Shooting Star's cockpit, patting him on the head and saying the military equivalent of: "Have a nice day." In a single-place airplane, the entire adventure is one of self-discovery. In this case, it sometimes proved to be too much.

Out on a limb

Kelly Johnson and Lockheed management recognized the problem, even as it was developing, and decided the Air Force needed a jet trainer, whether it knew it or not. An experienced instructor pilot had to be part of the Shooting Star formula, and that meant that room had to be made for him in the airplane itself. In this case, it was as easily done as said.

By inserting a 33.6-in. plug in front of the wing and a 12-in. plug behind it, Johnson and his team were able to put a complete cockpit, ejection seat and

all, behind the pilot. Initially referred to as "The Lockheed Trainer," it was officially known as the T-33 T-Bird.

When Lockheed began the T-33 project, it climbed way out on a spindly limb because the government hadn't uttered a word about needing or wanting a trainer. But, the company was willing to gamble its own money on the concept, and it turned out to be a winning hand, as it went on to build nearly 6000 T-33s.

The Korean War gave the entire world a very clear message: Three-dimensional warfare was going to be conducted by flashing streaks of fire fueled by kerosene. Propellers were no longer frontline defense equipment. In a matter of only a few years, every major nation in the world had designed or acquired a jet air force, and almost every one of them turned to the same place for a jet trainer—to the school teacher from Burbank, the T-33. While the F-80 Shooting Star was cashiered out of the Air Force less than a year after Korea ended, the T-Bird went on to gain worldwide recognition as the most important trainer of the jet age.

The T-Bird was America's only jet trainer from 1948 until 1957, when the Cessna T-37 was introduced as a primary trainer. Still the T-Bird soldiered on until its advanced training role was taken over by the ultrasexy T-38 Talon.

When the T-Bird was released from its teaching chores, it went on to do practically everything a single-engine airplane could do, and then some. Until only a couple of years ago, every fighter unit had at least a few T-Birds that were used as hacks for running personnel around, chasing parts, being used for ECM targets—for doing everything that was needed in the air. After giving up their T-birds at the end of 1988, many units still don't know what to do to fill the void. In fact, one reported plan was to send Air Force personnel via airlines. Or, if some urgency is attached, to put them in the back of an F-16B or similar 2-place mount. That's an expensive way to run errands.

As a fighter, the F-80 Shooting Star was killed off by rapidly advancing technology. As a trainer in air forces around the globe, it appears, it may continue on forever, because its lack of technology gives it a serviceable naiveté that is not only becoming, but endearing to the military because it almost always works. In this day, when everything is so overly sophisticated that it is easy to lose sight of the primary mission, it is refreshing to know there is always something around that will do the job every time. And that is the Lockheed T-Bird. **PM**

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IMPORTS

BY RICK TITUS, West Coast Editor



Rodeo Leads Isuzu's New-Model Rollout

● Isuzu may be a small company, but it has still managed to put together one of the most aggressive product campaigns in the industry. Three new vehicle launches in as many months is no small change.

The all-new 1991 Rodeo—as in cowboy, not the Beverly Hills shopping mecca—is a 4-door, long-wheelbased, 2wd or 4wd platform, offered with either a 2.6-liter inline 4-cylinder or a 3.1-liter V6. Its ride is carlike, it looks upscale and its American-built (Lafayette, Indiana) fit and finish is second to none. Rodeo's interior is roomy, comfortable and driver/passenger friendly, and the cargo hold will handle a 4 × 8-ft. sheet of plywood. The 120-horsepower sohc 4-cylinder is surprisingly capable, but we found the torquier V6 more pleasant to drive.

Though the Rodeo enters a field crowded with talent, its looks, quality and, best of all, pricing (which starts at a base of \$12,500 and caps at a fully loaded \$18,000 and change—includ-

ing leather seats and hi-line stereo system) should ensure it a segment-leadership position.

On the heels of Rodeo comes the new Impulse, a badge not used at Isuzu for several seasons. For 1991, the new Impulse, which shares its platform with the Geo Storm, will be produced in small numbers, but with the deliberate intent of showcasing both Isuzu's engineering skills and its direct link to Lotus (of Grand Prix racing fame) in England.

Lotus has done the suspension homework, and the final result is a car of superior handling. As applied to the base Impulse, the Lotus-suspension program is a bit overkill. However, when linked to the all-wheel-drive turbocharged and intercooled Impulse RS, it's wonderful.

The 160-horsepower twin-cam RS, which will share its driveline with the upcoming and long-awaited Lotus Elan, is a delight to drive. Its low-end power response is a bit luggy, but

once it gets a lungful, hang on. We found its midrange and top-end performance outstanding, which went a long way toward helping us forget the Impulse's somewhat awkward looks.

The car may be billed a 2+2, but if the age of your rear-seat passenger exceeds seven years, forget it. We're talking briefcase storage here.

The base Impulse is more a working sports car, not unlike the Geo Storm. Its buyer is looking for a reliable, yet sporty ride home. In the case of the Impulse RS, we suspect owners will be of the more technically informed variety.

The all-new Stylus is offered in 4-door trim only, and there are three models in the lineup. As with the Im-



1991 Stylus sports a uniquely designed nose cone.

pulse, Stylus has a Lotus-tuned suspension available in its XS model.

Two engines are offered in the Stylus—a 1.6-liter, 12-valve, overhead cam 4-cylinder that powers the base S models, and a 1.6-liter, 130-horsepower twin-cam 1.6-liter Four for the upscale XS model.

Like much of its competition, the Stylus is well designed, appears to be well built, easy to use and more than just competent on the road. Styling is smooth-edged and the interior is nicely appointed. However, in a class of car for which these attributes are the basic requirements, we can't help but wonder if that's really enough. **FM**



Impulse gets an upscale suspension developed by Lotus.



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1990 OWNER'S MANUAL

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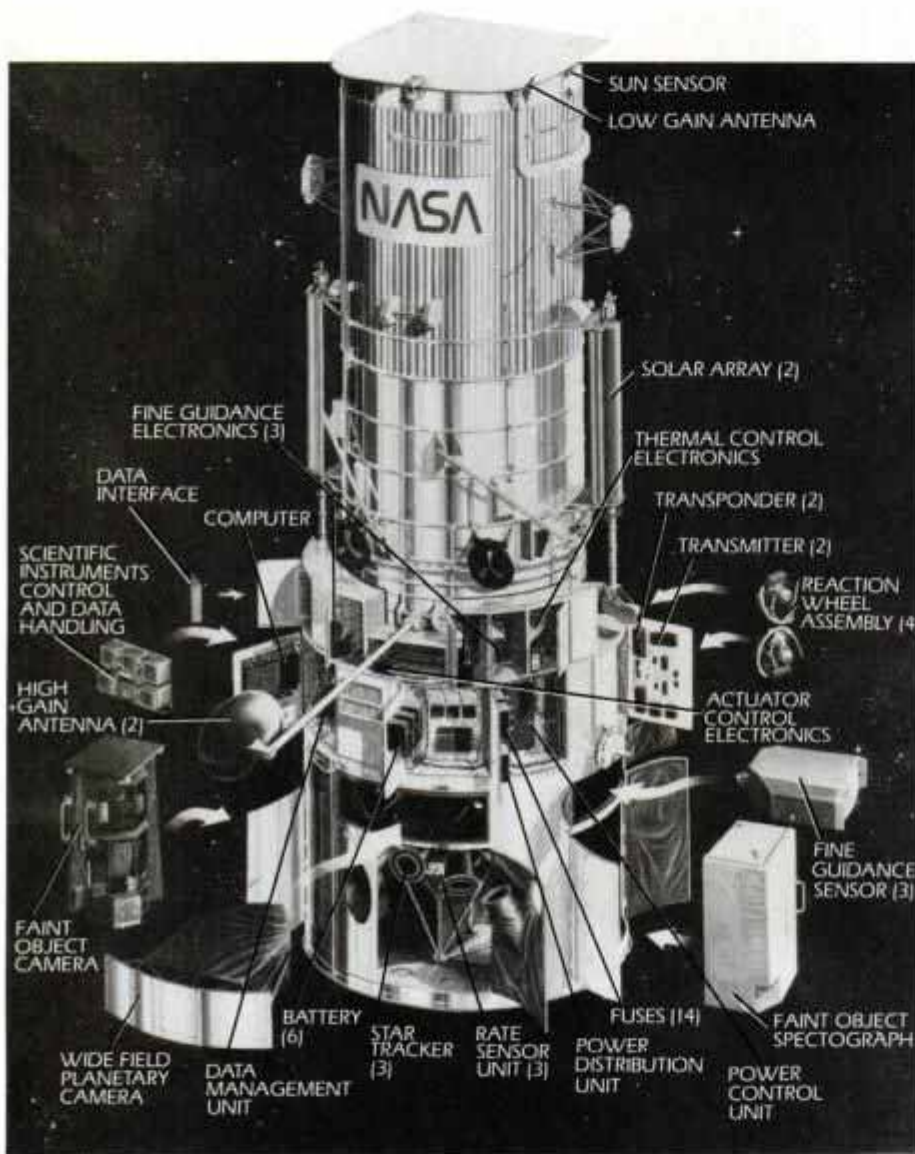
Chances are, spelled out in black and white, you'll see a listing for your car's spark plug specifications. And without searching much further, you'll find that the brand which meets those specs perfectly is NGK.

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with engine builders like NGK to design the precise plugs your import needs. Not only to meet today's strict standards for leaner-burning engines, but for maximum ignitability, power, fuel efficiency and prolonged life.

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LOCKHEED ILLUSTRATION

Hubble: Heartbreak And Hope

● In the winter of 1978, a 2000-pound mirror blank arrived at Perkin Elmer's Electro-Optical Division in Danbury, Connecticut. A little more than two years later, the 94-in.-dia. disc emerged from a computerized grinding and polishing process with a surface smoother than any mirror of its size had ever been. It was considered a triumph. For many who worked on it, it was the crowning achievement of a long career at the leading edge of optical technology.

Ten years later, the triumph has gone sour. Now at the heart of the Hubble Space Telescope orbiting 380 miles above the Earth, the mirror appears to have been ground to the

wrong shape. It has thus probably crippled the largest, most expensive and most eagerly awaited instrument ever put into space.

The mirror's flaw, known as a spherical aberration, is one of the most elementary mistakes in telescope optics. It means simply that the mirror is too flat, resembling too closely the contour of a sphere, rather than conforming to the de-

sired hyperboloid shape. As a result, light falling on different parts of the mirror converges at different distances from its surface, and cannot be brought to a single, sharp focus. It's not a flaw you'd expect in a \$1.5-billion piece of space hardware.

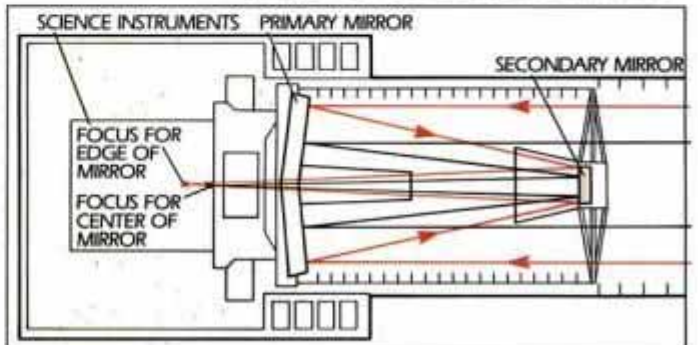
So how could this have happened? NASA has convened a distinguished independent panel to investigate, but it may be a while before they report their findings officially. In the meantime, a look at how the mirror was made yields some strong clues about where the problem might lie.

After an initial grinding that shaped the mirror's face into a spherical bowl, the blank was placed on a computer-controlled device called a Draper-style polisher, where it should have been brought to within the length of one lightwave of its proper aspheric shape. Apparently things were okay up to this point, since the error now plaguing Hubble amounts to only about half a lightwave.

Next came a series of polishing, grinding and testing procedures that were to bring the mirror to its final specifications. Perkin Elmer's Computer Controlled Polishing facility smoothed the surface, while trips back to the Draper-style polisher corrected the shape. Progress was monitored through laser interferometry, and after eight months, it was determined that the mirror was finished—in fact, it was significantly better than NASA had required.

Room for error

There could have been an error in the software instructions guiding one of the grinding or polishing devices, but a flaw as severe as the one now affect-



Spherical aberration keeps light from focusing on a single spot.

PM ILLUSTRATION BY HANK KERN

ing Hubble would have shown up instantly on the interferometric tests. Unless, of course, there was something wrong with the test equipment.

Laser interferometry is a precise and unambiguous measuring technique, and theoretically, it is perfectly reliable. However, there is room for human error. Most of that comes in the construction of a device called a null corrector, which must be custom-tailored for the mirror being measured. Essentially, the null corrector is meant to exactly cancel out, or null, the effect that a mirror of the desired curvature will have on a laser beam emitted by the interferometer. Thus, when the mirror being tested has exactly the right shape, the beam it reflects back will produce interference patterns the same as those from a perfectly flat mirror.

Although setting up a null corrector is not the most difficult task in building a precision mirror, it must nonetheless be done with great care. Because the nulling optics serve, in effect, as the master template for the mirror, there's no way to check them. "If you make a mistake, nothing tells you that you have," says University of Arizona astronomer Dr. Roger Angel, a member of the Hubble investigation panel. "It's an insidious fault."

The investigators have impounded the original nulling optics used 10 years ago, and, as of press time, they will begin inspecting them in about a week. More will be at stake in the inspection than finding out who's to blame. Any inaccuracies found in the nulling optics will be important in precisely diagnosing, and correcting, the Space Telescope's blurred vision.

Resurrecting Hubble

NASA estimates that Hubble can currently do about 50 percent of the work it was originally supposed to. But Dr. Frank Six, NASA's deputy program scientist for the telescope, said to me recently: "Over a 5-year period, I think the effect on the science is going to be nil. We'll get it all."

Dr. Six's optimism stems largely from the fact that Hubble was designed from the start with in-flight repair in mind. Although there's no hope of replacing the defective primary mirror, about 70 of the spacecraft's components can be changed. That gives NASA considerable latitude for improvising solutions.

Most of the fixes have to do with replacing the instruments that convert the light gathered by the mirrors into images and data. Modified optics on the new instruments would refocus

the light to the originally expected sharpness.

Only three of the telescope's six instruments are badly impaired. Unfortunately, two of them—the Wide Field Planetary Camera (WFPC) and the Faint Object Camera (FOC)—were expected to do some of the most exciting science.

Plans were already in the works to replace WFPC with the improved WFPC II on a 1993 Shuttle mission. In the meantime, scientists on the ground are studying ways to restore the present instrument's performance with computerized image processing. But such techniques will not work on the data from the FOC. It's up to the European Space Agency, which contributed the camera, to decide if they will build another.

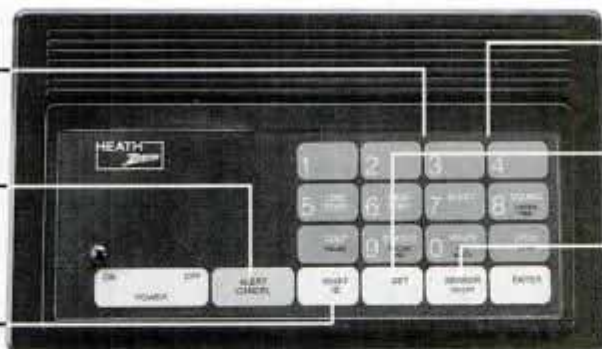
For the moment, though, Hubble looks like a legend before its time. There's no excuse for the mistake in Hubble's optics, and astronomers and taxpayers have every right to be angry. However, the error in no way diminishes the promise of discovery that has kept the Space Telescope alive through 20 years of technical challenges and political turmoil. We've waited this long. We can wait a few more years for Hubble to multiply the visible universe by 350. **PM**

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No one thinks the things described here will ever happen to them. But you can never be certain. Whenever and however you use cocaine, you're playing Russian roulette.

You can't get addicted to cocaine.

Cocaine was once thought to be non-addictive, because users don't have the severe *physical* withdrawal symptoms of heroin—delirium, muscle-cramps, and convulsions.

However, cocaine is intensely addicting *psychologically*.

In animal studies, monkeys with unlimited access to cocaine self-administer until they die. One monkey pressed a bar 12,800 times to obtain a single dose of cocaine. Rhesus monkeys won't smoke tobacco or marijuana, but 100% will smoke cocaine, preferring it to sex and to food—even when starving.

Like monkey, like man.

If you take cocaine, you run a 10% chance of addiction. The

risk is higher the younger you are, and may be as high as 50% for those who smoke cocaine. (Some crack users say they felt addicted from the *first time* they smoked.)

When you're addicted, all you think about is getting and using cocaine. Family, friends, job, home, possessions, and health become unimportant.

Because cocaine is expensive, you end up doing what all addicts do. You steal, cheat, lie, deal, sell anything and everything, including yourself. All the while you risk imprisonment. Because, never forget, cocaine is illegal.

There's no way to tell who'll become addicted. But one thing is certain.

No one who is an addict, set out to become one.

C'mon, just once can't hurt you.

Cocaine hits your heart before it hits your head. Your pulse rate rockets and your blood pressure soars. Even if you're only 15, you become a prime candidate for a heart attack, a stroke, or an epileptic-type fit.

In the brain, cocaine mainly affects a primitive part where the emotions are seated. Unfortunately, this part of the brain also controls your heart and lungs.

A big hit or a cumulative overdose may interrupt the electrical signal to your heart and lungs. They simply stop.

That's how basketball player Len Bias died.

If you're unlucky the first time you do coke, your body will lack a chemical that breaks down the drug. In which case, you'll be a first time O.D. Two lines will kill you.

Sex with coke is amazing.

Cocaine's powers as a sexual stimulant have never been proved or disproved. However, the evidence seems to suggest that the drug's reputation alone serves to heighten sexual feelings. (The same thing happens in Africa, where natives swear by powdered rhinoceros horn as an aphrodisiac.)

What is certain is that continued use of cocaine leads to impotence and finally complete loss of interest in sex.

It'll make you feel great.

Cocaine makes you feel like a new man, the joke goes. The only trouble is, the first thing the new man wants is more cocaine.

It's true. After the high wears off, you may feel a little anxious, irritable, or depressed. You've got the coke blues. But fortunately, they're easy to fix, with a few more lines or another hit on the pipe.

Of course, sooner or later you have to stop. Then—for days at a time—you may feel lethargic, depressed, even suicidal.

Says Dr. Arnold Washton, one of the country's leading cocaine experts: "It's impossible for the nonuser to imagine the deep, vicious depression that a cocaine addict suffers from."

Partnership for a Drug-Free America

PM ON WHEELS

Battery Care

● If you have a maintenance-free battery that appears to be over the hill, you might be replacing it prematurely, according to manufacturers who tested "dead" batteries that were returned to them. In many cases, the batteries could have been revived, but the shade-tree mechanics as well as professionals didn't know how to do it.

Here are some facts about maintenance-free batteries that will help you get the most service from them:

- Cars of the '80s have electronic devices that can draw 8 to 20 milliamps from a battery continuously. This parasitic load, plus a battery's normal self-discharge rate, can result in a deep enough discharge to fool you into replacing a battery that seems dead after the vehicle hasn't been driven for a while. To guard against this, use a trickle charger to compensate for the drain.
- You probably know that if a green dot (some batteries have a different color dot, such as blue) is visible in the eye (built-in hydrometer) of a maintenance-free battery, the battery is charged. If only darkness shows in the eye, the battery is undercharged and should be recharged. If the eye is clear or light yellow, the fluid level is low and the battery should be replaced. But don't be fooled if your battery has a translucent case. Daylight passing through the case may make a dark hydrometer appear clear or light yellow, thereby deceiving you into replacing a battery that could be brought back up to snuff by recharging. One way to be sure that you're really seeing a true condition of your battery's state of health is to block light by taping cardboard to the sides of the battery before peering into its eye.
- If a dead battery fails to take a charge, your charger may have a polarity protection circuit which keeps the charger off if the battery isn't connected correctly. To activate the charger when polarity is correct requires a small amount of current output from the battery. A discharged battery, however, may not emit even that minimal voltage and the charger may not switch on. In this case, check the charger manufacturer's instructions on how to bypass this circuit.



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Undercar Safety

● Most Saturday mechanics don't hesitate to pop the hood for routine service in the engine compartment. But many are reluctant to dust off the old creeper and slide underneath the car to check out components that are critical to their car's steering and stopping.

The underside of your car may be doused with a barrage of road salt, mud and water, in addition to any number of road hazards. Regular inspections at 3000-mile intervals can help spot problems before they develop into serious trouble.

To ensure your personal safety when working under your car, make sure you use high-quality jackstands and ramps, and only support one end of the car off the ground at any one time. Never work on a car that is supported by a lifting jack of any type—use jackstands for support. Locate the jackstands only in your car's approved jacking positions, and give your car a good shaking after it's up on its supports to make sure it won't slip off.

Wear safety glasses to keep debris, which commonly falls when working under your car, out of your eyes.



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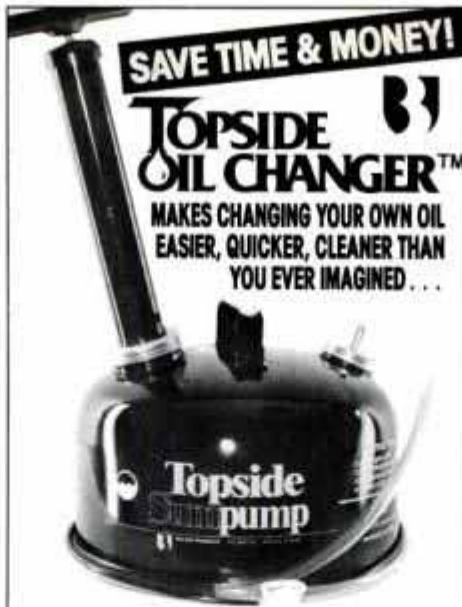


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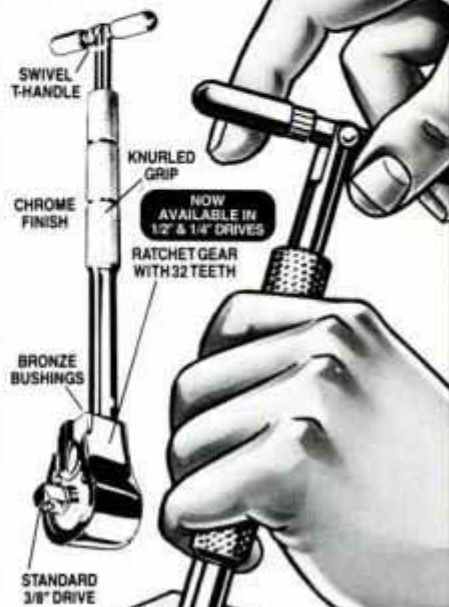
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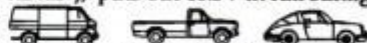


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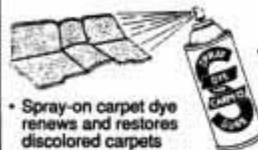
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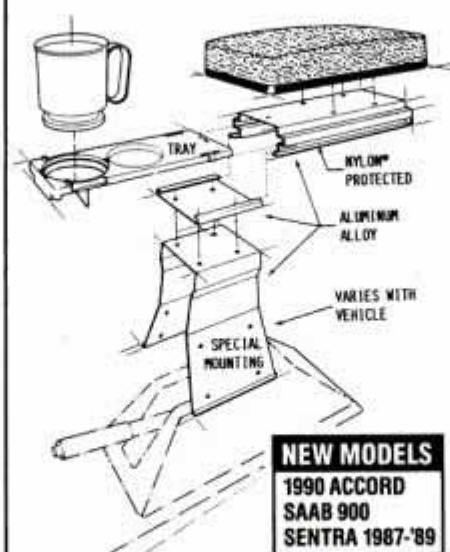
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Dear Friend,

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My name is John Wright. Not too long ago I was flat broke. I was \$31,000 in debt. The bank repossessed my car because I couldn't keep up with the payments. And one day the landlord gave me an eviction notice because I hadn't paid the rent for three months. So we had to move out. My family and I stayed at my cousin's place for the rest of that month before I could manage to get another apartment. That was very embarrassing.

Things have changed now. I own four homes in Southern California. The one I'm living in now in Beverly Hills is worth more than one million dollars. I own several cars, among them a brand new Mercedes and a brand new Cadillac. Right now, I have a million dollar line of credit with the banks and have certificates of deposit at \$100,000 each in my bank in Beverly Hills.

Best of all, I have time to have fun. To be me. To do what I want. I work about 4 hours a day, the rest of the day, I do things that please me. Some days I go swimming and sailing — shopping. Other days, I play racquetball or tennis. Sometimes, frankly, I just lie out under the sun with a good book. I love to take long vacations. I just got back from a two week vacation from — Maui, Hawaii.

I'm not really trying to impress you with my wealth. All I'm trying to do here is to prove to you that if it wasn't because of that money secret I was lucky enough to find that day, I still would have been poor or may be even bankrupt. It was only through this amazing money secret that I could pull myself out of debt and become wealthy. Who knows what would have happened to my family and me.

Knowing about this secret changed my life completely. It brought me wealth, happiness, and most important of all — peace of mind. This secret will change your life, too! It will give you everything you need and will solve all your money problems. Of course you don't have to take my word for it. You can try it for yourself. To see that you try this secret, I'm willing to give you \$20.00 in cash. (I'm giving my address at the bottom of this page.) I figure, if I spend \$20.00, I get your attention. And you will prove it to yourself this amazing money secret will work for you, too!

Why, you may ask, am I willing to share this secret with you? To make money? Hardly. First, I already have all the money and possessions I'll ever need. Second, my secret does not involve any sort of competition whatsoever. Third, nothing is more satisfying to me than sharing my secret only with those who realize a golden opportunity and get on it quickly.

This secret is incredibly simple. Anyone can use it. You can get started with practically no money at all and the risk is almost zero. You don't need special training or even a high school education. It doesn't matter how young or old you are and it will work for you at home or even while you are on vacation.

Let me tell you more about this fascinating money making secret:

With this secret the money can roll in fast. In some cases you may be able to cash in literally overnight. If you can follow simple instructions you can get started in a single afternoon and it is possible to have spendable money in your hands the very next morning. In fact, this just might be the fastest legal way to make money that has ever been invented!

This is a very safe way to get extra cash. It is practically risk free. It is not a dangerous gamble. Everything you do has already been tested and you can get started for less money than most people spend for a night on the town.

One of the nicest things about this whole idea is that you can do it at home in your spare time. You don't need equipment or an office. It doesn't matter where you live either. You can use this secret to make money if you live in a big city or on a farm or anywhere in between. A husband and wife team from New York used my secret, worked at home in their spare time, and made \$45,000 in one year.

This secret is simple. It would be hard to make a mistake if you tried. You don't need a college degree or even a high school education. All you need is a little common sense and the ability to follow simple, easy, step-by-step instructions. I personally know a man from New England who used this secret and made \$2 million in just 3 years.

You can use this secret to make money no matter how old or how young you may be. There is no physical labor involved and everything is so easy it can be done

Here's what newspapers and magazines are saying about this incredible secret:

The Washington Times:

The Royal Road to Riches is paved with golden tips.

National Examiner:

John Wright has an excellent guide for achieving wealth in your spare time.

Income Opportunities:

The Royal Road to Riches is an invaluable guide for finding success in your own back yard.

News Tribune:

Wright's material is a MUST for anyone who contemplates making it as an independent entrepreneur.

Success!

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Money Making Opportunities:

John Wright has a rare gift for helping people with no experience make lots of money. He's made many people wealthy.

California Political Week:

... The politics of high finance made easy.

The Toluca:

You'll love ... *The Royal Road to Riches*. It's filled with valuable information ... only wish I'd known about it years ago!

Hollywood Citizen News:

He does more than give general ideas. He gives people a detailed A to Z plan to make big money.

The Desert Sun:

Wright's *Royal Road to Riches* lives up to its title in offering an uncomplicated path to financial success.

whether you're a teenager or 90 years old. I know one woman who is over 65 and is making all the money she needs with this secret.

When you use this secret to make money you never have to try to convince anybody of anything. This has nothing to do with door-to-door selling, telephone solicitation, real estate or anything else that involves personal contact.

Everything about this idea is perfectly legal and honest. You will be proud of what you are doing and you will be providing a very valuable service.

It will only take you two hours to learn how to use this secret. After that everything is almost automatic. After you get started you can probably do everything that is necessary in three hours per week.

PROOF

I know you are skeptical. That simply shows your good business sense. Well, here is proof from people who have put this amazing secret into use and have gotten all the money they ever desired. Their initials have been used in order to protect their privacy, but I have full information and the actual proof of their success in my files.

'More Money Than I Ever Dreamed'

"All I can say — your plan is great! In just 8 weeks, I took in over \$100,000. More money than I ever dreamed of making. At this rate, I honestly believe, I can make over a million dollars per year." A. F., Providence, R.I.

'\$9,800 In 24 Hours!'

"I didn't believe it when you said the secret could produce money the next morning. Boy, was I wrong, and you were right! I purchased your *Royal Road to Riches*. On the basis of your advice, \$9,800 poured in, in less than 24 hours! John, your secret is incredible!" J. K., Laguna Hills, CA

'Made \$15,000 In 2 Months At 22'

"I was able to earn over \$15,000 with your plan — in just the past two months. As a 22 year old girl, I never thought that I'd ever be able to make as much money, as fast as I've been able to do. I really do wish to thank you, with all of my heart." Ms. E. L., Los Angeles, CA

'Made \$126,000 In 3 Months'

"For years, I passed up all the plans that promised to make me rich. Probably I am lucky I did — but I am even more lucky that I took the time to send for your

material. It changed my whole life. Thanks to you, I made \$126,000 in 3 months."

S. W., Plainfield, IN

'Made \$203,000 In 8 Months'

"I never believed those success stories... never believed I would be one of them... using your techniques, in just 8 months, I made over \$203,000... made over \$20,000 more in the last 22 days! Not just well prepared, but simple, easy, fast... John, thank you for your *Royal Road to Riches!*" C. M., Los Angeles, CA

'\$500,000 In Six Months'

"I'm amazed at my success! By using your secret I made \$500,000 in six months. That's more than twenty times what I've made in any single year before! I've never made so much money in such short time with minimum effort. My whole life I was waiting for this amazing miracle! Thank you, John Wright."

R. S., Mclean, VA

As you can tell by now I have come across something pretty good. I believe I have discovered the sweetest little money-making secret you could ever imagine. Remember — I guarantee it.

Most of the time, it takes big money to make money. This is an exception. With this secret you can start in your spare time with almost nothing. But of course, you don't have to start small or stay small. You can go as fast and as far as you wish. The size of your profits is totally up to you. I can't guarantee how much you will make with this secret but I can tell you this — so far this amazing money producing secret makes the profits from most other ideas look like peanuts!

Now at last, I've completely explained this remarkable secret in a special money making plan. I call it "The Royal Road to Riches". Some call it a miracle. You'll probably call it "The Secret of Riches". You will learn everything you need to know step-by-step. So you too can put this amazing money making secret to work for you and make all the money you need.

To prove this secret will solve all your money problems, don't send me any money, instead postdate your check for a month and a half from today. I guarantee not to deposit it for 45 days. I won't cash your check for 45 days before I know for sure that you are completely satisfied with my material.

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Do you realize what this means? You can put my simple secret into use. Be able to solve all your money problems. And if for any reason whatsoever you are not 100% satisfied after using the secret for 30 days, you may return my material. And then I will not only return your original UNCASHED CHECK, but I will also send you an extra \$20.00 cashiers check just for giving the secret an honest try according to the simple instructions.

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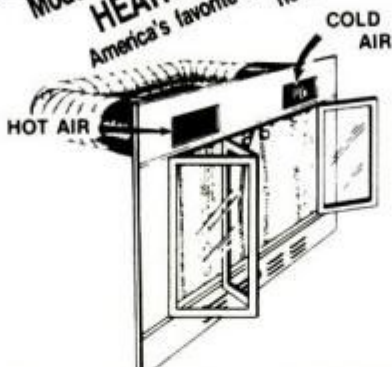
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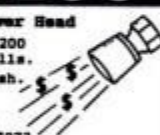
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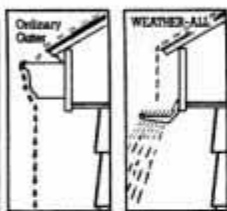
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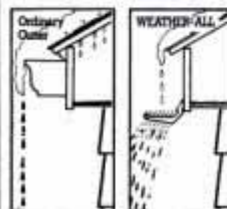
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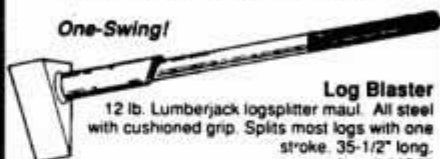
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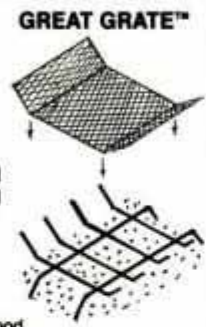
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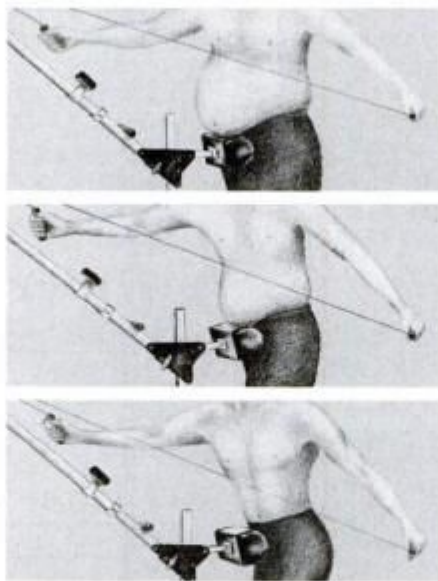
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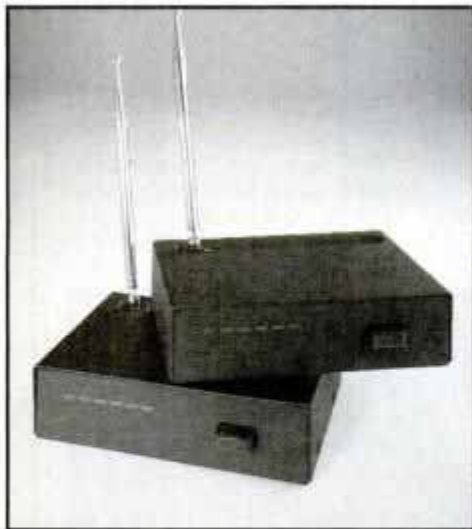
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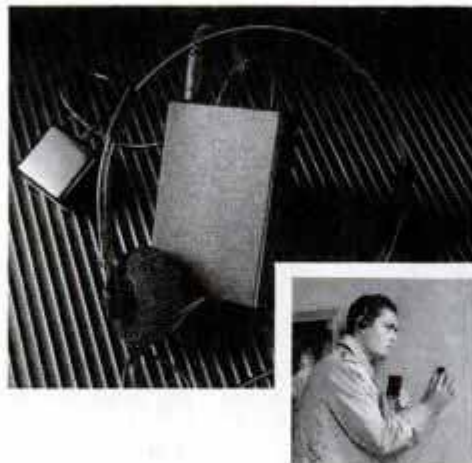
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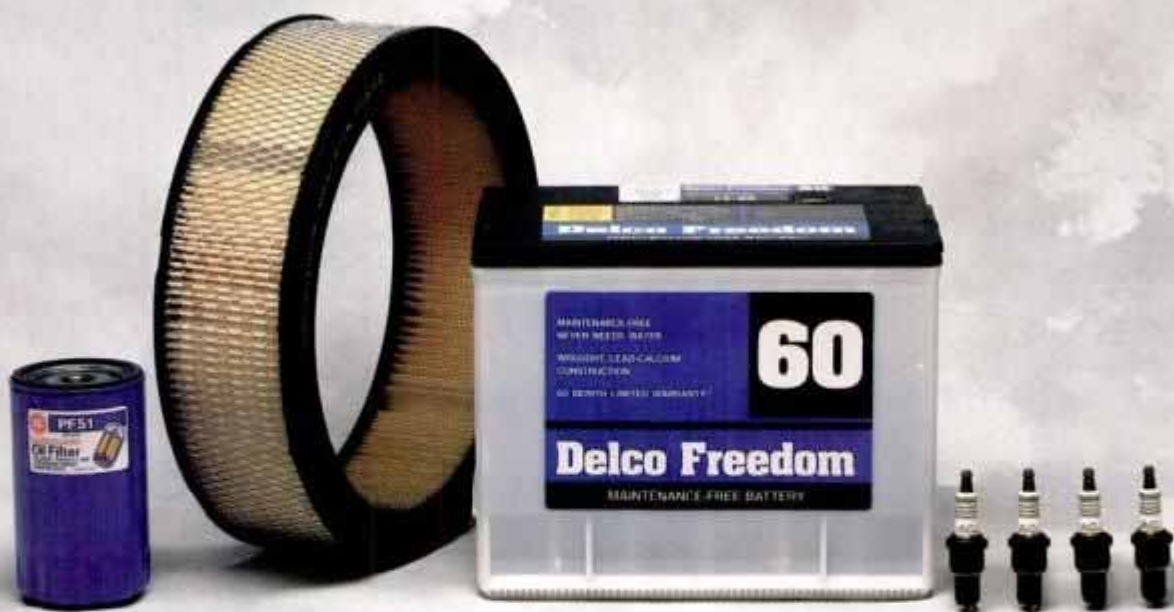
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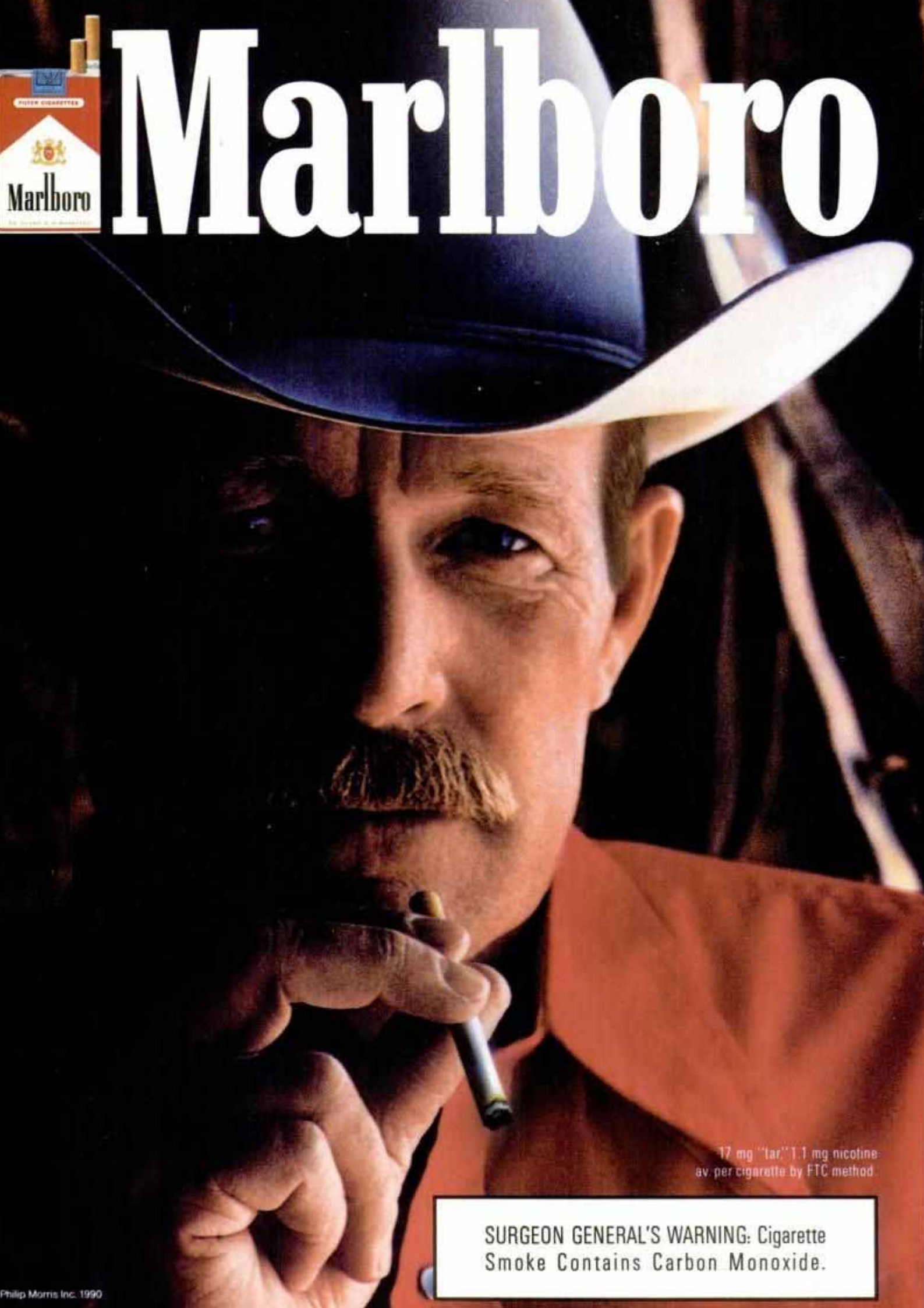
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