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And Flying America's Mightiest
World War II Combat Planes

NISSAN 300ZX OWNERS REPORT
SUPER HOT, SUPER BARGAIN



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Chance-Vought
FAU-7 Corsair

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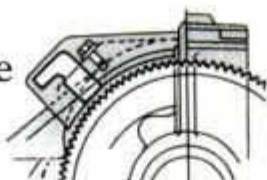
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P R N D 2 1

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This One



L54H-AX9-21UU



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Popular[®] Mechanics

JUNE 1990
VOLUME 167
NO. 6



51 COVER STORY

Restored to mint condition, warbirds like this Chance-Vought F4U-7 Corsair are investments in our nation's history.

—PM photo by
Budd Davisson



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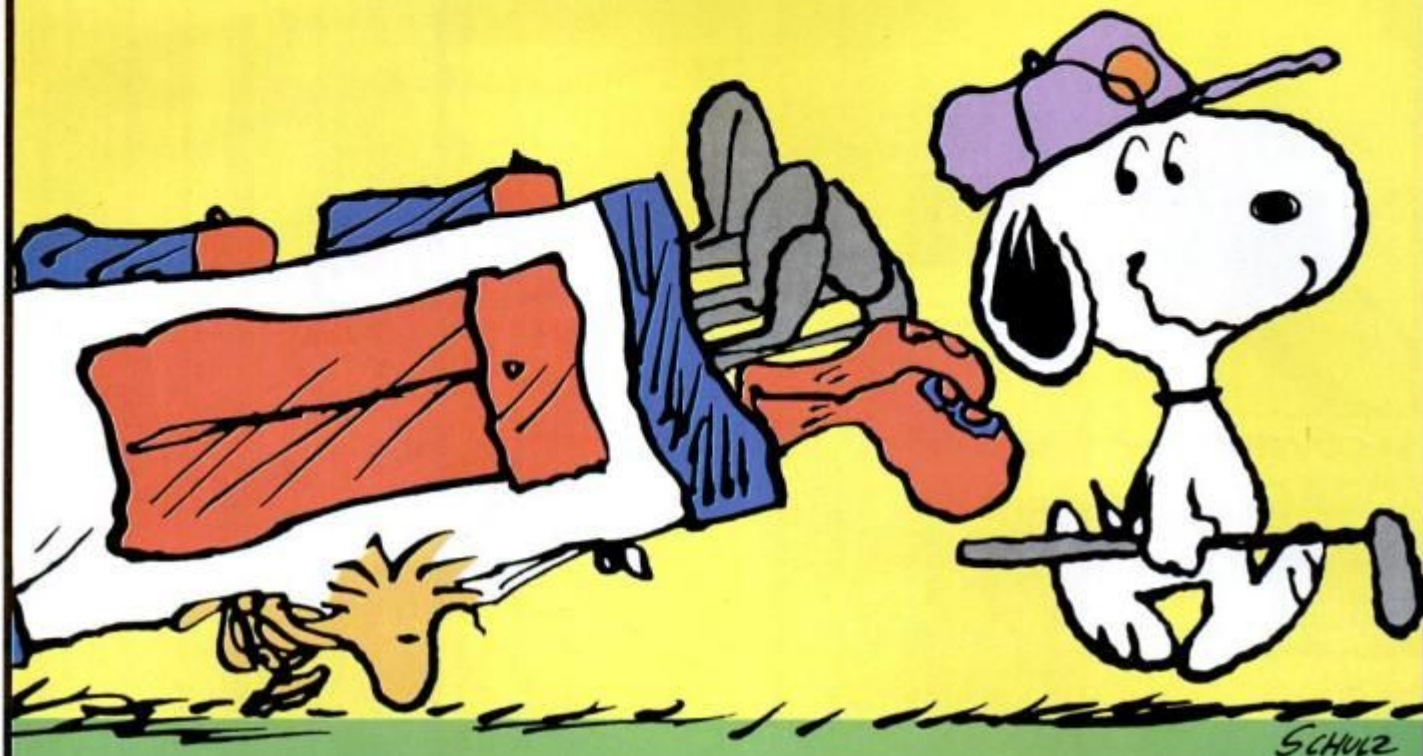
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EDITOR'S NOTES

HAVE YOU EVER seen a ZIL? You know. A ZIL. The Russian car. I've seen one once—last year, when Soviet President Mikhail Gorbachev and his entourage of ZIL limousines cruised past my office window during his visit to New York City. Gorbachev wanted his own cars and had a slew of them shipped over for his visit. In fact, Gorby likes his ZIL limo so much that he has it shipped to whatever country he's visiting. He doesn't leave home without it. I was reminded of my fleeting glimpse of a ZIL while looking over Detroit Editor Jim Dunne's article, "Red Wheels," in this issue (page 55). Dunne visited both the Soviet Union and Eastern Europe last year to chronicle the developments in the auto industries of those areas.



Gorby and his ZIL.

With the political and social changes that are taking place in that part of the world, and with the economic changes scheduled to begin in Europe in 1992, there's no question that Eastern Europe will be a hotbed of activity in the coming years. It's been rumored for years that Russia wants to import cars into the United States, and it's now more likely than ever to happen, due to the lessening of tensions between our two countries. What Dunne found was a rather bizarre collection of automobiles that doesn't exactly make my blood boil. See what you think. . . . If you love aviation, chances are you're also a World War II buff. It was a golden age for aviation and aviators, and the planes of that era remain today as possibly the greatest crop of aircraft ever developed in one 5-year period. It's no wonder so many World War II-era aircraft have become legends. And it's no wonder that those aircraft are being collected and lovingly restored today by a group of dedicated individuals who won't let the legends die. People like Tom Reilly, who runs Reilly Aviation in Orlando, Florida.

People like John Shafthausen, whom you see piloting the Chance-Vought F4U-7 Corsair on this month's cover. Contributing Editor Fred Mackerodt, who wrote this month's cover story, recently spent several days in the company of Tom Reilly, arguably today's greatest warbird restorer. His B-24J Liberator restoration is already being called the restoration of the decade. The best part of the whole warbird story is that all of us can share in the romance of these great planes. Many air museums and private collections are open to the public. We've included a list on page 111. What's more, many of these living legends will be in the air this summer, performing at air shows and fly-ins all over the country. If you love old planes, the warbirds put on a spectacular show you won't want to miss. Till next time.



Mackerodt and Reilly.


Joe Oldham

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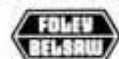
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EVERYTHING HAS TO BE PERFECT

Just two hours until race time. Indy car chief mechanic Larry Curry goes over every detail with the crew. One more time.

Curry knows, to win, everything has to be perfect. Every element of the car has to be "the absolute best I can get." From the 650-plus h.p. Buick V-6 engine to the motor oil that keeps it running.



"There's no room for compromise," Curry says. "As soon as you settle for second best, you settle for second place."

Curry uses high performance Valvoline® motor oil. And over the past ten years, 7 out of 10 Indy 500 chief mechanics also raced with Valvoline.

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LETTERS

Show Of Force

I'M SURE you'll receive several letters, and maybe even a few subscription cancellations, because of your excellent story on aircraft carriers ("Show Of Force," page 49, Mar. '90). Please don't change your magazine because of those few people. Many believe military dollars would be better spent buying needles for drug addicts and staging flag-burnings. I think most rational, informed Americans realize that military spending primarily is to uphold peace. Only when peace and diplomacy fail is our military might brought to bear, and then only to guarantee the safety and way of life of Americans.

Your story served to inform Americans about what their taxes pay for. It made us feel involved, and instilled an appreciation of the extremes to which our fighting men volunteer in order to defend freedom and our way of life. Keep it up.

TOM URYGA
1st LT., USMC
OAK HARBOR, WA

I spent 30 years in the U.S. Navy and wonder how it

went by so fast. I had the honor of serving on two aircraft carriers, the USS *Saratoga* and USS *Enterprise*, as electronics officer for a total of five years.

In my entire 30 years of duty, I was involved in some area of electronics or nuclear weapons.

I would like to correct an error made on your poster of various aircraft carriers. The swirl-shaped, pierced-array radar atop the USS *Enterprise* superstructure was not an early form of the antenna for the Aegis radar system. That swirl-shaped array was an extensive and complex Electronic Counter Measures antenna system and has since been removed from the ship.

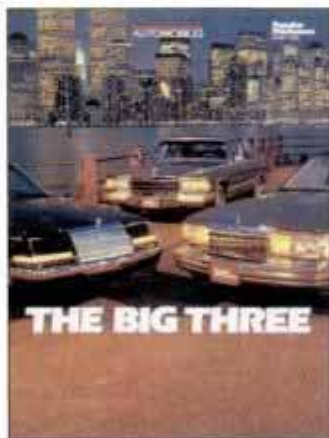
ROY A. NORMAN
LT. CMDR., USN (RET.)
BRUNSWICK, GA

In your poster on aircraft carriers, you make a statement under the artwork for the carrier *Yorktown* that the battle of Midway was the first dominated by carriers on both sides. The first such battle was the Coral Sea, one month before Midway.

DR. THOMAS R. NOLAN
LT. (MC), USNR (RET.)
ATLANTA, GA

I was a little offended that not a single word was written about the thousands of highly skilled shipbuilders who sweated and labored many long years building these fine ships. You also failed to mention that the ships were built at the Newport News Shipbuilding and Drydock Co. in Newport News, Virginia—the only shipyard in the U.S. capable of building such outstanding ships.

FRANK KELSEY JR.
ACHILLES, VA



Impressing the doorman with our luxury limos.

The Big Three

This is in reference to your statement: "We pulled up to the front door of the 21 Club and the doorman looked at us as if we didn't belong there." What a frivolous remark to make in assessing an automobile. Who gives a rip about the expression on the doorman's face at the 21 Club? If this is part of your checklist, your priorities are in need of restructuring.

JACK VANN
HILLIARD, FL

If you rate luxury cars on the basis of how it impresses car jockeys at restaurants, you begin to sound as shallow and ignorant as their owners.

STEVEN A. MATE
BLUE BELL, PA

The article was, at best, mediocre in respect to product knowledge of equipment on the Lincoln Town Car. Concerning your comment on steering, the Town Car has speed-sensitive steering. As speed increases, the power assist decreases, giving improved road feel at higher speeds where it's needed. On your comment about door locks, the remote entry system has the capability of being deprogrammed from the system by simply pushing

two buttons on the remote. Otherwise, the story was a very fair comparison.

JERRY FOXWORTH
DOTHAN, AL

In the pricing list, you claim a 1990 Cadillac Brougham has a "base" list price of \$37,530. This is incorrect. The actual base list is \$27,400. Furthermore, you state that with options, your vehicle came to \$39,300. That's impossible.

SANFORD BLOCK
BLOOMFIELD, NJ

We regret the typographical errors.

—Editor

To Coin A Phase

I read with interest the article, "How It Works: Electric Service Panel" (page 82, Dec. '89). It reads: "If we tap two terminals, plus the neutral, we'll have a 240-volt, 2-phase system." I consider "2-phase" as nonengineering jargon, but, besides that, the service you are indicating is best described as 240/120-volt single phase, comprised of two hots, a neutral and a ground, wired to appliances that require both single-phase voltages, such as a range that has a clock.

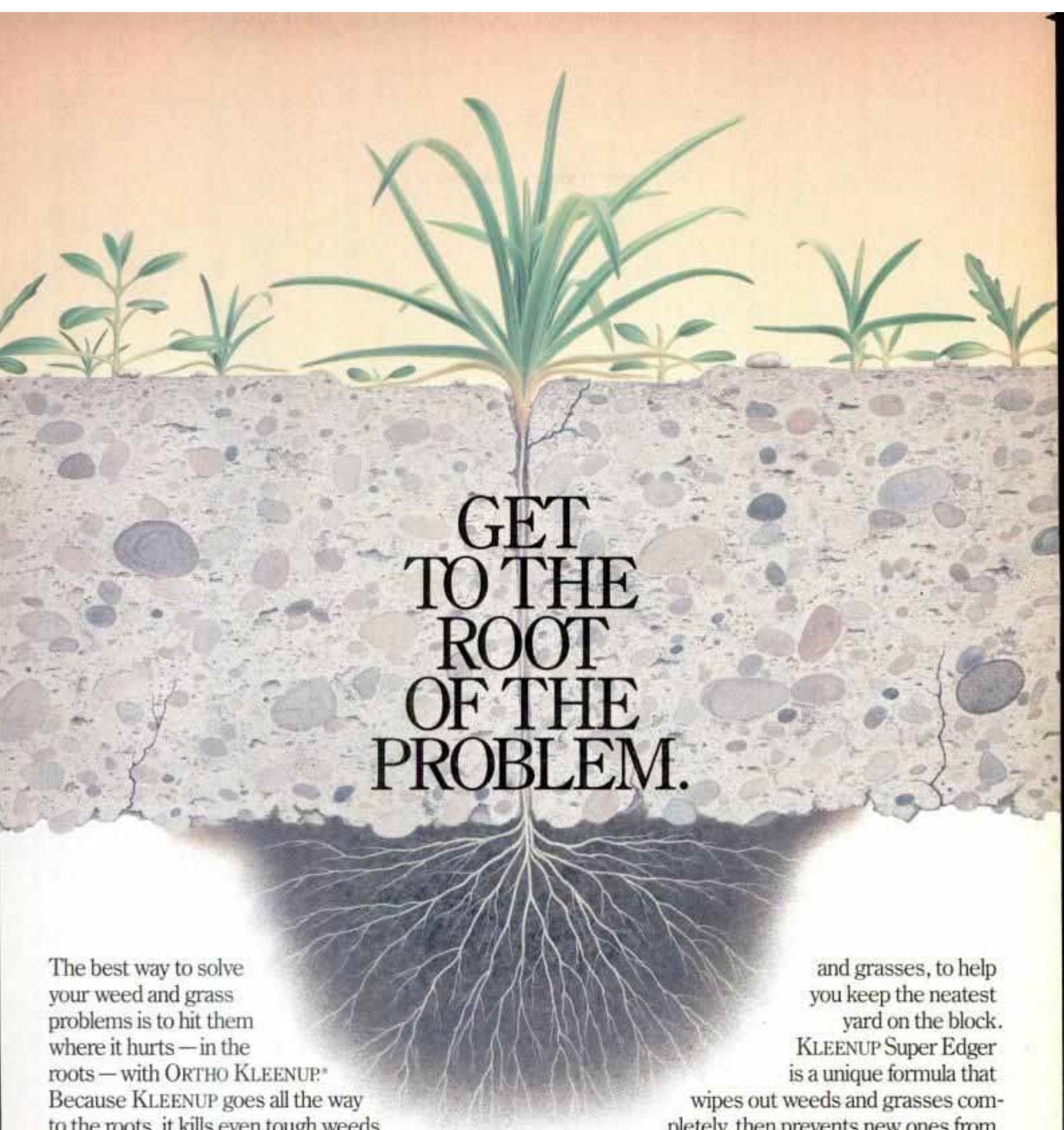
GARY R. GABRIEL
ATLANTA, GA

You are correct in that although two phases may be present in a nearby transformer, a residential service will be tapped from only one phase. In simplified terms, a phase consists of a reduction coil with a hot terminal at each end and a neutral terminal at its center. In a typical residential transformer, each hot terminal of the coil is tapped to feed the separate hot bus bars of the service panel. The center, neutral terminal is also tapped and feeds the

(Please turn to page 10)



Carrier story: appreciation of our fighting forces.



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ORTHO

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neutral bus within the panel. The transformer and service panel are grounded independently. Thus, a residential service will be a grounded 120/240-volt, single-phase system, and not a 120-volt, 2-phase system, as stated.

Posted Posters

Thought you might like to see the bulletin board in my classroom. Our students find your posters attractive, informative, educational and just downright interesting. We're looking forward to the next one.

JOSEPH CRISANTI
MASUK HIGH SCHOOL
MONROE, CT

Gearing Up

In your Tech Update column (page 18, Mar. '90), you discuss the first 5-speed automatic produced by Nissan, the 5E-AT—the first 5-speed automatic for passenger car application. I would like to point out that the Allison Transmission Division of General Motors has been producing a 5-speed automatic for heavy trucks and buses since 1972. They also offer their 5-speed with electronic controls. And going back to the 1950s, Allison used to offer a 6-speed overdrive automatic transmission.

STEVEN R. MACE
ROSWELL, NM



PHOTO BY CLIFF GROWER

Reader Joseph Crisanti and his students at Masuk High School in Monroe, Connecticut.

Passenger cars and heavy trucks are two very different applications. The Allison transmission you describe is not suitable for passenger cars.

Gingerbread Van

Although I'm neither mechanically nor technically inclined, I've turned to POPULAR MECHANICS for the past 40 years to help me grasp, as much as possible,

what's new. In recent years, I've appreciated articles by your automotive contributing editors, Michael Lamm and Rich Taylor.

Rich Taylor's article, "Light Vantas-tics" (page 62, Feb. '90), however, raised my dander. As a proud and appreciative owner of a Chrysler Town & Country minivan, I don't understand his criticism of the upgraded exterior

"Days of Thunder" is a a driver, his car



and leather seats. It's the closest we're going to get right now to practical luxury in minivans.

Rich, reconsider your hastily penned words. Who else is putting out as classy a vehicle in that division? Admit that the gingerbread is nice.

CARL L. DURHAM
MT. LAUREL, NJ

High Seize

I am writing in response to your article, "High-Tech Drugbusters" (page 49, Feb. '90). I am curious as to why you only briefly mention the U.S. Navy's part in drug law enforcement. I am currently serving onboard a Virginia-class cruiser. We are now involved in our third law enforcement operation in the Caribbean. In March, we aided in seizing more than 100 kilos of cocaine. The complex of radar equipment on our Navy ships is very useful in tracking both surface and air contacts. In addition to relaying this information to Coast Guard ships, we occasionally make a bust ourselves. As Navy ships are equipped for extended missions at sea, we are well-suited for these operations. So how about giving some credit where it is due?

RICHARD WATKINS
MM1(SW), USN
USS MISSISSIPPI

Caddy On

The February '90 Car Clinic (page 25) contained the usual interesting car problem tips. One was a service tip on 1986-89 Cadillac Broughams. Specifically, it might not be possible to reach wide-open throttle until the accelerator cable was replaced with one that is slightly longer. My problem exactly. I just purchased an '87 Brougham with the 307 Olds engine from my brother-in-law. On a trip to Florida, with the car loaded and on a slight upgrade, I could not accelerate away from 18-wheelers that came up on my rear bumper at 65 mph. The car was also sluggish at slower speeds. I replaced the cable as you indicated and am amazed at the improvement. The car is now very responsive to the throttle at all speeds, and there is an improvement in downshifting as well.

PAUL J. RANDA
HIGHLAND HEIGHTS, OH

R/C Helicopters

I was pleased to see the article on radio-controlled modeling in POPULAR MECHANICS ("Flights Of Fantasy," page 73, Apr. '90). As a member of the Academy of Model Aeronautics, a local flying club, and an R/C enthusiast, I was glad to see this wonderful hobby getting media coverage.

Recently, I have become increasingly involved in radio-controlled helicopters. I have owned and flown one for about seven months, and the sport really is very enjoyable. Additional information on this subject can be obtained by contacting Don Chapman of the International Radio-Controlled Helicopter Association (IRCHA), 6225 Taylorsville Rd., Dayton, OH 45424.

HAROLD KESTEL
NO ADDRESS GIVEN

Ram Rebuttal

A recent Mazda truck ad quotes a survey by J. D. Powers & Associates, placing Dodge Ram trucks fifth for quality and troublefree operation by owners of new trucks during the first 90 days of ownership.

Growl, I say. I own a 1986 Dodge Ram 50 pickup that I bought in 1987 with 18,000 miles on the clock. I have put on an additional 30,000, and I haven't yet experienced a single problem with the truck. Incidentally, the ad showed a Mazda climbing what appeared to be an exceedingly steep ascent. In Vermont, we call that kind of grade "the road home."

JANICE AITKEN
SOUTH ROYALTON, VT
(Please turn to page 12)

motion picture about and the will to win.



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Linseed Oiler

I read with interest the article Bob Vila wrote on wood shakes and shingles (Old House Restoration, page 24, Mar. '90). Mr. Vila is invariably very informative and enlightening. However, I must take exception to one of his remarks in this particular article.

With respect to moisture control, he states, "No matter where you live, be careful not to use an organic oil, like linseed. Although these oils go into the wood beautifully, they attract fungus which, of course, can ultimately destroy the wood."

It is true that linseed oil, when applied in an unprotected state (without mildewcides), is a very good food source for fungi and molds. The article, however, may have done some harm to the linseed oil industry. Mr. Vila's comments appear also to include exterior, pigmented linseed oil stains which contain mildewcides that retard fungus growth and also act as sun screens that protect against the harmful effects of UV radiation. Other oils, including synthetic resins, are not immune to fungus attack—ask anyone who has to clean mildew off bathroom walls, tiles, and window sash and trim.

Many manufacturers of exterior stains use linseed oil as the principal ve-

hicle ingredient. These stains have been around for a long time and have served the industry and its customers well. Linseed oil products can be very useful in protecting cedar shake and shingle roofs. Moisture is the culprit, as Mr. Vila contends. Nevertheless, linseed oil containing exterior stains can protect wood from rotting.

PAUL TILLMAN

TECHNICAL SERVICE DEPARTMENT
SAMUEL CABOT, INC.

Minimum Movers

In your article, "Car Bizarre" (page 57, Apr. '90), Swiss industrial designer Luigi Colani makes the point that there are many more ways to configure a car than are now being addressed. Most people would agree that other types of cars would fill a need in today's world. One could be a very small vehicle with room for just the driver—a perfect vehicle for someone with a short commute to the office. Such a vehicle, if it became popular, might prompt cities to designate special travel lanes.

ANA GALDOS-BETHENCOURT
BATON ROUGE, LA

Cruiser Comparo

First, let me say that I enjoy your magazine very much and have been reading it

for years. Very rarely do I see anything that I disagree with.

This, however, was not the case regarding the article on Chevrolet's new police vehicles (Freewheeling, page 20, Mar. '90). I have been a police officer for 17 years, and have been a fleet manager for my department, so I feel I speak from good experience. Our police fleet has run Chevrolets, Dodges and Fords. There is no question in our department that the Ford is the best overall car for police service. In this area of the country, Ford is, by far, the favorite police cruiser vehicle for local, regional and state-controlled agencies. The Chevrolets are very peppy, but lack the handling, electrical capacity (note the low-ampereage-draw strobe bar on the demo cars) and overall durability as compared to the Ford Crown Victorias.

In my department, and I'm sure in many others as we motor into the 1990s, we will be motoring in Ford Crown Victorias.

JOHN P. HEBB

SOUTH EASTON, MA

Floats His Boat

The morning muster at Gio's Cafe was abuzz with talk of the crappies biting up on the Shenango Reservoir. Chris was checking in the weekly magazine delivery, and the April PM was on top. I laid

So is this mo



out my buck-ninety-five and dove straight to the Boating column. Tell the boss I said Joe Skorupa deserves a raise. From his description of the Pro-Line 230 test ("Anatomy Of A Boat Test," page 46), I could feel the boat under my feet. More important, even with my BS detector on highway mode, it didn't bark once from start to finish.

FRANK E. LANGE
SHARPSVILLE, PA

People Problem

Incredibly, your April '90 piece, "Earth Day, Then And Now" (Science, page 54), managed to go on for one-and-a-half pages without using the word population (as in "over") even once. Environmental destruction caused by an exploding population too large to be sustained on planet Earth was a major part of Earth Day, 1970. The population equation is much more apparent in 1990. The Mission To Planet Earth must include stabilization of population, or mission failure is assured. You blew it!

(THE REV.) LAWRENCE D. RUPP
NEW LONDON, NH

De-feathered Osprey

How nice to see PM honor the silver anniversary of the XC-142A Tiltwing VSTOL (Time Machine, page 9, Apr.

'90). The unique composite photograph is also a tribute to friend Art Schoeni, retired Vought photographer. The photo generated a wealth of coverage of the V-22 Osprey's predecessor.

Considering the controversy that continues over the expensive continuation of today's V-22 Osprey, in spite of the recommendations of the Secretary of Defense, Dick Cheney, we only wish it had been possible to tell the public more about the successful operation of the XC-142A.

The Osprey, now approaching a decade of development, is yet to duplicate the true firsts on the XC-142A score card. Without the benefits of computer-type design tools so widely bragged about today, only slide rules, talent and manpowered drafting tables, the XC-142A team of Vought, Hiller and Ryan took the aircraft from contract signature in January, 1962, to first flight in just 32 months.

The facts are that the XC-142A flew almost 100 knots faster than the Osprey, had a longer ferry range and a larger cargo capacity.

Built from conventional materials, mostly, and without fly-by-wire controls, the tiltwing aircraft was the first transport-size aircraft to lift off vertically and alight on an aircraft carrier

underway at sea, and to actually fly *backward*. Identified as a "tri-services" project, evaluation was completed in July, 1966, four-and-a-half years after the first design line was drawn on paper. The poor taxpayer did indeed get a bargain, since five aircraft were built and flown—a feat that is evidently lost in the high-technology money sponge of today.

R. M. JOHNSON
DIRECTOR, SMALL AIRBORNE VEHICLES
LING-TEMPCO-VOUGHT
DALLAS, TX

Underinsuring

David Elias's article on homeowner's insurance (Home Finance, page 38, Apr. '90) stresses the need to have adequate house and contents coverage. However, some people may choose to have less than full-value coverage as a means of reducing their insurance premium. They reason that if their house burned to the ground and they lost everything, they would be content to replace, say, only half of their possessions. They say that they don't really need all they have anyway, and so they rebuild a lesser house. I wonder how the insurance companies view this strategy?

MIKE MARTIN
RICHMOND, VA

tion picture.

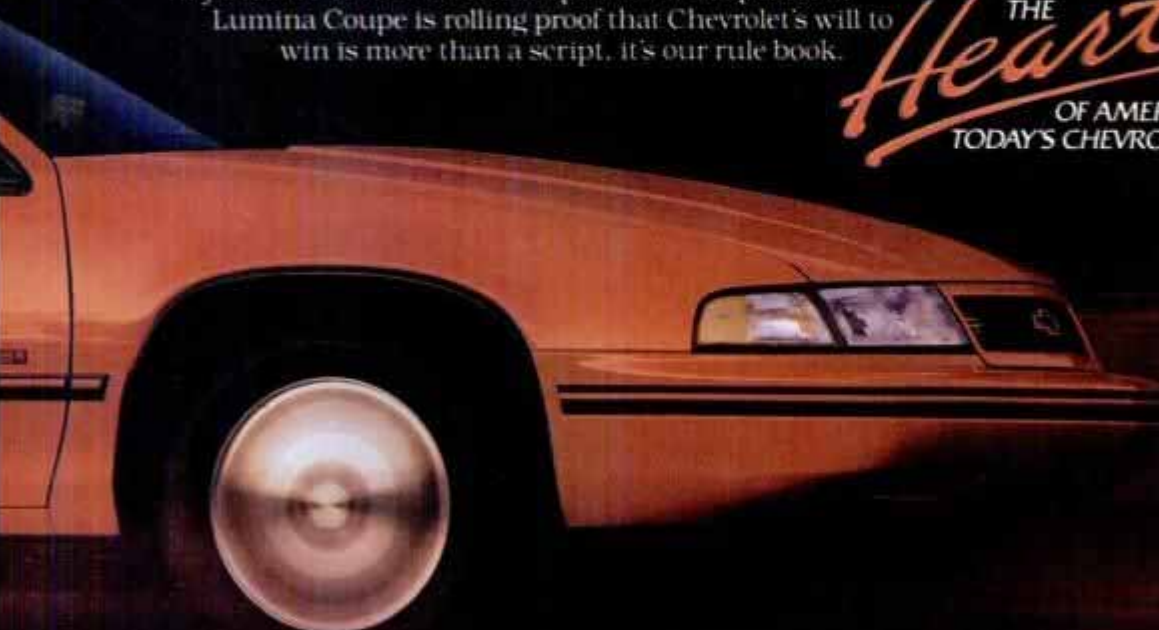
Chevy Lumina Coupe. There are a lot of thrills in Paramount

Picture's new movie *Days of Thunder*. Most notably, Chevrolet winning at Daytona...just like we've done for the past two years. But there's also a Lumina Euro Coupe for the street, because we feel victory shouldn't be confined to the winner's circle. From its healthy 3.1 Liter Fuel

Injected V6 to its Corvette-inspired rear suspension,

Lumina Coupe is rolling proof that Chevrolet's will to win is more than a script. It's our rule book.

THE
Heartbeat
OF AMERICA IS WINNING.
TODAY'S CHEVROLET 



TIME MACHINE

75 YEARS AGO: JUNE 1915



Early RV

Packing up the family, camping gear and a boat for a seaside excursion presented a real challenge to the motorcycle owner. And there to meet it was a certain Eastern sportsman, whose solution graced our cover. He devised a jointed coupling to hook a lightweight, 2-wheeled boat trailer to his sidecar-equipped cycle. Filling up the boat with gear and—although it would make a modern safety advocate blanch—a child or two, he was off for a relaxing holiday.

Subsea Supplier

Out of the teeming mind of Simon Lake, already renowned for pioneering submarine designs, came a scheme to resupply the craft under the noses of enemy guns. Wheeled, cigar-shaped vessels containing fuel, food and ammunition were trailed

behind a tow sub. Divers would exit the lead ship through an airlock and carry supplies back in watertight cases. Liquids were transferred through pipes. The whole operation could be carried out without causing so much as a ripple on the water's surface.



50 YEARS AGO: JUNE 1940



Ski Jump To The Sky

While the capabilities of aircraft had increased phenomenally throughout the first half of the century, one limitation remained intractable: the need for ever longer runways. In Germany, where urban areas left little space for new infrastructure, a giant ski-jump launcher was proposed. Cranes would lift the aircraft to a platform at the top of a ramp, which could be rotated into the wind. Upon release, they would gain speed rapidly with a gravity assist.

Prewar Bird

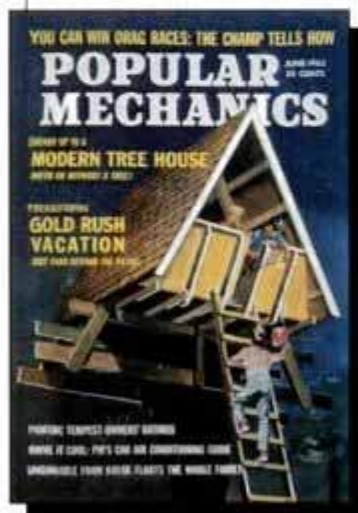
A precursor to today's "black" programs, the Douglas B-19 stayed under wraps

until its wings had to be put on. Even then, secrecy was lifted only because the bomber's 210-ft. wingspan pre-



vented indoor installation. The biggest bomber of its time, the B-19 was planned for transatlantic missions, and had a 6000-mile range with a 28-ton bomb load. It was never mass produced, but it proved technology for later behemoths.

25 YEARS AGO: JUNE 1965



High-Tone Hideout

On the premise that the boys of the '60s were as style-conscious as their parents, we put forward plans for a tree dwelling as aesthetically pleasing as it was fun to play in. Along with five sample designs, including a steeply sloped, A-frame contemporary with red cedar shingles, we presented numerous schemes for attaching platforms to whatever trees might be at hand. Even the treeless could take part in this project by following our plans for stilts.

Missiles Overhead

In the depths of the Cold War, citizens were more compliant than they are now about making sacrifices for the national defense. Witness the overland missile range stretching 425 miles from Utah to New Mexico. Sixteen-thousand-pound Athena rockets were regularly lofted over this space, after evacuations by local sheriffs. An elaborate network of airborne and ground-based sensors studied the flights to determine ICBM reentry characteristics. **FM**





Cars Courtesy of Heavenly Bodies International, Inc., New Milford, NJ.

YOUR PRIZED POSSESSION DESERVES A TOUCH OF 'GLASS.

The Symbols of Pride and Prestige.



Besides protecting and beautifying your aircraft, a sleek Liquid Glass finish reduces surface friction for added fuel economy.



On fiberglass boats, Liquid Glass Pre-Cleaner prepares the surface for Liquid Glass by chemically removing salt water haze, oxidized paint, etc. without damaging the gelcoat.

Presenting the Liquid Glass™ Total Appearance System.

There's nothing like the exhilaration of seeing your prized auto, boat or plane gleaming with a glass-like, satin-smooth glow. One that turns heads while turning away the elements. And now because of a startling breakthrough in appearance chemical technology, you can apply this "showroom" brilliance in minutes – and enjoy its benefits year 'round.

Chemical cross-linking...the nucleus of our system.

Unlike other finishing families, the Liquid Glass System works because each highly-refined product chemically bonds with the next. The concept is simple. The results – simply spectacular. All five products are perfectly safe for use on Clearcoated surfaces, and help retard acid rain and hard water spotting. When used together as a Total Appearance System, they cross-link to give you maximum protection and beauty.

Pour on our Liquid Glass Wash Concentrate, Pre-Cleaner and Polish/Finish today – and see how their dazzling glow reflects on you. Then rejuvenate your leather, vinyl and rubber with our Connoisseur's Choice® duo – the miracle cross-linked mixtures with Mink Oil. But don't wait. Once you experience a touch of 'Glass, you'll never settle for less.

Liquid Glass Polish/Finish is sold only in the gold can with the red Corvette on its face. We do not manufacture or private label an "Advanced" version of any of our products. Never have, never will!

The Liquid Glass Total Appearance System is sold at quality conscious retail stores nationwide, or call now, toll free: 1-800-548-5307 for the name of your nearest Liquid Glass Products Distributor. In N.J., call (201) 387-6755.

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Build a skill in the Army Reserve.

You can get valuable training in any one of hundreds of occupational fields. From heavy equipment to electronics.

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You'll usually serve one weekend a month and two weeks a year at a Reserve unit



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If you're in high school, college or ready to start work, the Army Reserve has educational and financial assistance programs you may qualify for. With benefits that can provide a firm foundation to build your future on.

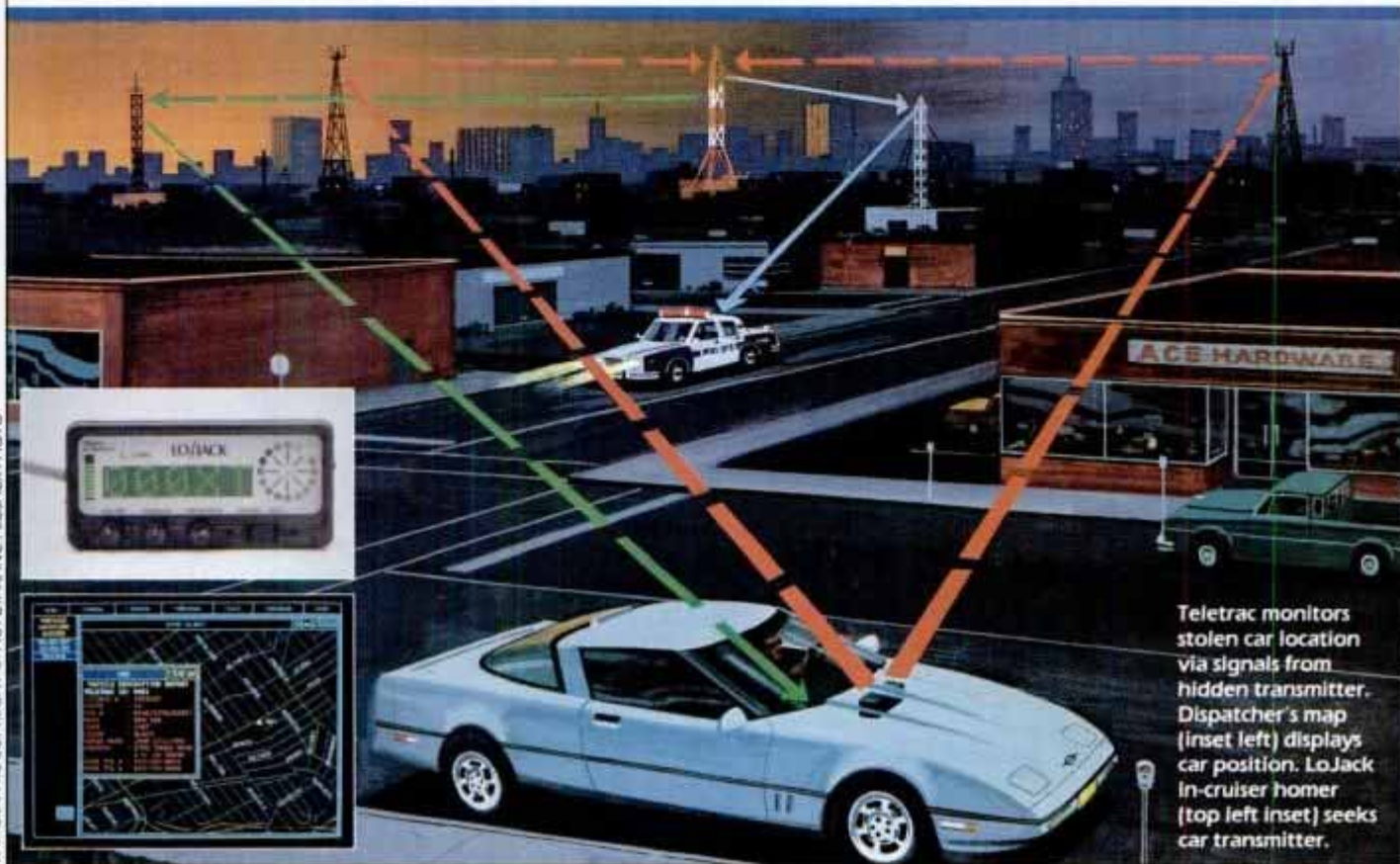
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TECH UPDATE

News Of Tomorrow's Technology Today



Teletrac monitors stolen car location via signals from hidden transmitter. Dispatcher's map (inset left) displays car position. LoJack In-cruiser homer (top left inset) seeks car transmitter.

PM ILLUSTRATION BY DEAN ELLIS

Technology To Catch A Thief

LOS ANGELES, CA—More and more metropolitan police departments are turning to radio location networks to hunt down car thieves.

The linchpin of these systems is a small transmitter buried in the structure of a vehicle. Set off by theft, the transmitter broadcasts a message that is relayed to the police.

Massachusetts and southeastern Florida police departments use a system called LoJack. When the owner of a LoJack-equipped vehicle reports it stolen, the police broadcast a coded signal, which activates a transmitter in the car. The transmitter then puts out its own signal, which the police can follow using dashboard-mounted radio direction

finders. The manufacturer claims a 97-percent recovery rate so far.

Meanwhile, L.A. cops use a higher-tech system called Teletrac, which automatically detects theft after the owner arms the transmitter when getting out of the car. If motion sensors detect unauthorized movement of the car, the transmitter radios a signal to a Teletrac control center. Then, antennas installed across the city periodically broadcast paging signals. An in-car transmitter responds to these by putting out signals that receiving antennas can locate by triangulation, much the way loran navigation systems do. The location data are sent to the

Editor: Abe Dane
Assistant Editor: Greg Pope
Contributors: Mike Fillon, John Williams

police, who can then follow the car's movement on digital maps and dispatch patrol

cars accordingly. Other cities are now testing systems with similar capabilities.

Highlights This Month

- **Blackbird's Last Landing**—The SR-71 retires in a blaze of glory after a quarter-century unrivaled for speed.
- **Farm Tech**—Thirty-ft.-wide X-tractor spares delicate crops.
- **Microchip Wars**—Compact, superconducting electron raceways build faster and smaller electronics.
- **Robot Revolution**—Supercomputing droid thinks for itself.
- **X-31 Unveiled**—Thrust-vectoring experimental jet will maneuver where others lose control.
- **Red Planet Rover**—Insectlike robot could gather Mars samples.

Bye-Bye Blackbird

WASHINGTON, D.C.—The SR-71 Blackbird delivered a spectacular farewell in March, blazing from Los Angeles to Washington in 68 minutes. The trip shaved 2½ hours from an unofficial record set by a Boeing 747 in mid-February of this year. Blackbird's average speed is a record 2153.24 mph.

The plane then checked into its final resting place, the Dulles International Air-



FIM PHOTO BY GEORGE HALL

Retiring Blackbird lands at Dulles after leaving transcontinental trail of sonic booms.

port Wing of the Smithsonian Air and Space Museum. The Air Force has mothballed the remainder of the Blackbird fleet, whose exact number remains classified. Reasons offered for the decision are

budget restraints and the ability of modern spy satellites to perform many of the same missions.

First flown in 1964, the Blackbird set an all-time jet speed record of 2193 mph in

1976. The original stealth plane relied on speed and cruising altitudes above 85,000 ft. to elude detection. Although Blackbirds flew over heavily defended terrain, none were ever shot down.

Widebody Supertractor

SHAFTER, CA—The USDA is planting the seeds of high-yield, mechanized agriculture, experimenting with a supertractor four times the width of the average John Deere.

Called the Wide Tractive Research Vehicle, the \$400,000 tractor houses planting, tending and harvesting tools suspended below its 30-ft.-wide frame. The cab and frame rotate independently, and the tractor turns on its own footprint.

In an alfalfa field specially landscaped for the vehicle, researchers have increased crop yields by 10 percent. Conventional alfalfa fields take a beating from heavy farm vehicles that squash soil, clogging irrigation.

But the supertractor rolls along raised dirt paths, keeping its weight clear of alfalfa-covered soil. TV cameras monitor the wheels' impact on the ground. Next come tests on other crops.



USDA PHOTO

Ultrawide tractor, tested in San Joaquin Valley, boosts alfalfa yields by leaving soil loose and airy.

Muscle Submersible

POVERTY FLATS, CA—A high-speed, 1-man sport submersible powered by a 100-hp marine inboard engine is under development privately by two former aerospace engineers.

Known as Vash, for variable attitude submersible hydrofoil, the 10-ft., 400-pound craft will cavort through water like a flying fish. During leaps out of water, a blowhole will open, allowing a

pump to force air into a turbocompressor. The compressor fills scuba-type air tanks, lungs that feed the engine. A shielded semitunnel drive houses the propeller. Dives of 12 to 15 mph at full power can last 10 to 15 seconds, with a depth of 20 ft. Or else, Vash

can hydrofoil across the surface on twin lower fins at 45 mph. The builders say Vash will be capable of 20-ft. jumps and could inflict 6 G forces during turns.

The canopy is ¾-in., bulletproof Lexan, which can withstand 250-mph crashes or 200-ft. dives. The pilot lies on his back, cushioned by a modular airbag seat, and controls the craft with twin joysticks.

Cutaway (left) shows air-breathing apparatus and 4-cylinder, 2-stroke marine inboard that powers Vash. Prototype (below) is now under construction.



FIM ILLUSTRATION BY ED VALIGURKY



TARCO RESEARCH PHOTO

Bionic Nerve Chip

PALO ALTO, CA—A silicon chip wired directly to a nerve has proven to be an effective way to couple electronics with the nervous system.

Stanford University researchers used the chip to connect severed ends of a rat foot nerve. Nerve fibers regenerated through microholes in the chip. Via the microelectrodes around the holes, the scientists have recorded and triggered nerve activity. Linked to a microprocessor, say the researchers, a nerve chip could one day mediate the motions of an artificial limb.

Nerve fibers grew through microholes one-tenth the width of a human hair. Microelectrodes run through chip and out of slot on left.

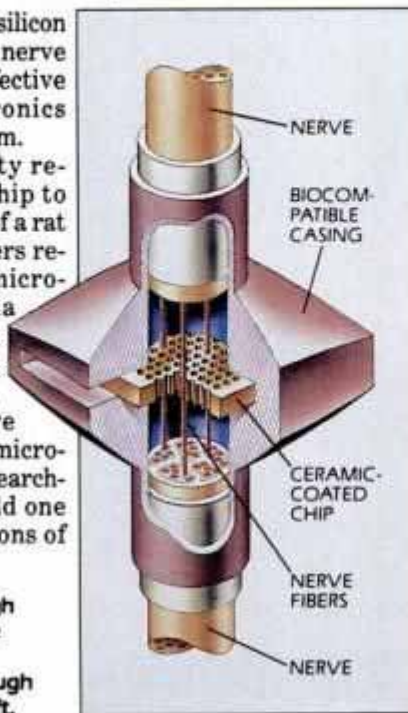


ILLUSTRATION BY ADOLPHE BRODMANN



WIDE WORLD PHOTO

MD-11's First Flight

LONG BEACH, CA—McDonnell Douglas has begun flight testing of its long-awaited MD-11, a follow-up to the troubled DC-10.

The new McDonnell Douglas trijet will seat between 250 and 400 passengers, depending on class layouts. Its range of more than 8000 miles beats that of a DC-10 by 27 percent. One reason: improved aerodynamics, thanks to wingtip winglets, shorter horizontal stabilizer and an extended tail cone.

MD-11 tests its wings on first flight. Testing is now underway prior to airline delivery later this year.

Further economies will come from a highly automated flight deck that reduces crew size from three to two. Six cathode-ray tubes read out data from operational, navigational and engine systems, and most duties of a flight engineer are handled by computers.

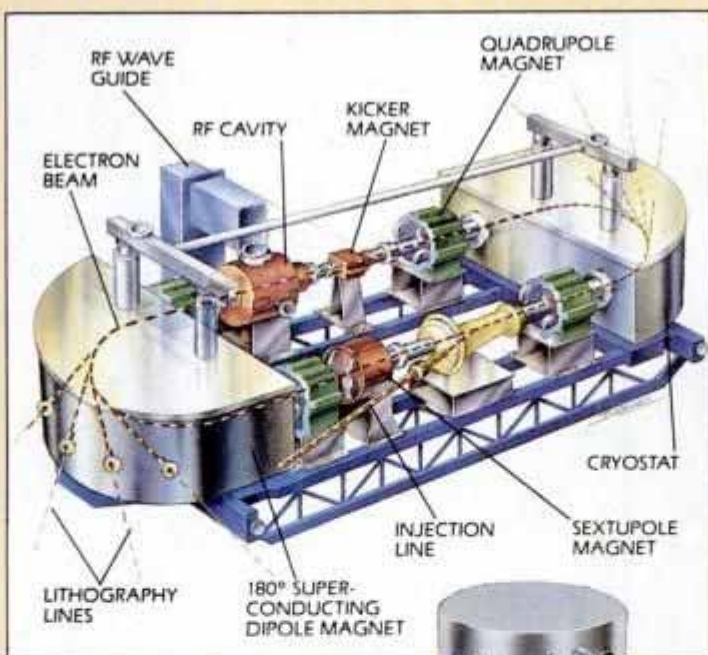
Backlogged orders for MD-11s already top 300.

Miniaccelerators For Tomorrow's Microchips

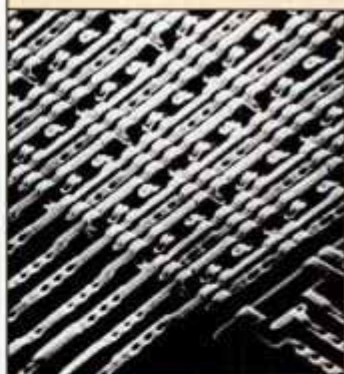
BROOKHAVEN, NY—Once the playthings of high-energy physicists, synchrotron accelerators are becoming a hot commodity among the big computer chipmakers. Now emerging is a new generation of powerful synchrotrons small enough to fit in a factory floor.

Why the need? Circuit patterns on today's brainiest chips are printed by lasers. But to print anything finer, such as the ballyhooed 64-megabit memory chip, requires higher-frequency X-ray beams. Miniature synchrotrons pull such X-rays from electrons whisked around a ring by superconducting magnets.

Commercial synchrotrons are fueling the international struggle for chipmaking supremacy. England's Oxford Instruments is building a racetrack-shaped ring for IBM's East Fishkill, New York, plant. But at least three Japanese companies have built rival models, and one, Sumitomo, says it will begin selling the world's smallest synchrotron, a 3-ft.-wide ring, in 1991. Meanwhile, Brook-



haven National Laboratory is teaming with Grumman and General Dynamics to try to field a U.S. version.



IBM got Oxford Instruments to build minisynchrotron (left) after using Brookhaven's big ring. Densely packed circuit lines (above) from X-ray litho at Brookhaven.



Sumitomo Heavy Industries' Aurora delivers beams radially to X-ray litho workstations.

BROOKHAVEN MICROGRAPH; ILM ILLUSTRATION BY DON MANNES

SUMITOMO ILLUSTRATION

OAK RIDGE PHOTO



HERMIES III and smaller forerunner HERMIES II show off improved manipulators. Both think with high-speed parallel processors.

Hypercube Robot

OAK RIDGE, TN—Cranking up on brainpower may solve many problems that have stymied the evolution of free-ranging robots. The latest example of this approach is now running at Oak Ridge National Laboratories. HERMIES III packs a parallel-processing supercomputer known as a hypercube which enables it to teach itself how to perform such complex tasks as operating valves in accordance with

gauge readouts. Yet HERMIES' greatest accomplishments are actions humans take in stride, such as navigating through obstacle-filled rooms and remembering how to get back. Such learning has traditionally been difficult for robots.

Input from HERMIES' senses—sonar, video and laser—combines in the computer to guide its motions. Parallel processing may give robotics a much-needed boost.

X-31 Sees Daylight

PALMDALE, CA—The Enhanced Fighter Maneuverability demonstrator rolled out in March, revealing a classic silhouette adorned with myriad control utensils. Rockwell International and

EFM, seen here during rollout, is first international X-plane and first U.S.-NATO cooperative development.

Messerschmitt-Boelkow-Blohm collaborated on the X-31, which is funded by the Pentagon and West Germany. The plane is beginning a series of tests to explore post-stall, high-angle-of-attack maneuvering during close-range combat.

Thrust-vector paddles

guard the nozzle, while four leading-edge and four trailing-edge control surfaces chop up each wing. Canard and speed brakes also play roles. With an advanced fly-by-wire system, these features should enable the plane to bring weapons to bear quickly, without exposing the pilot to excessive G loads.

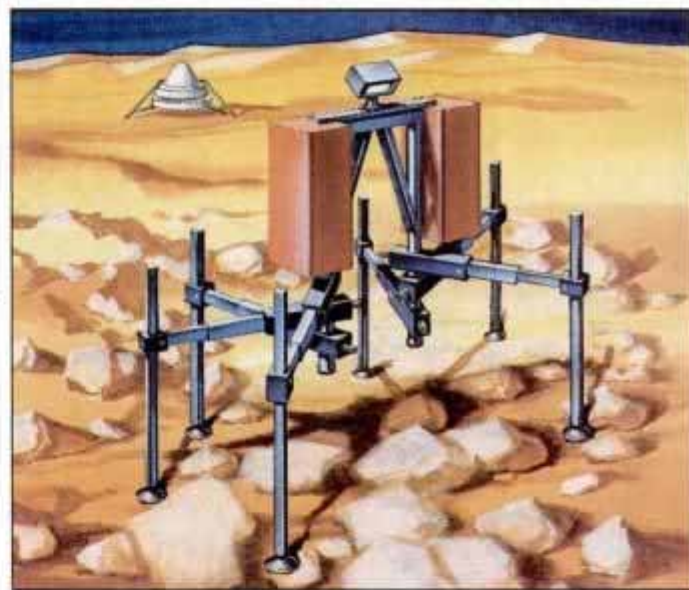
Public Phones For The Deaf

MADISON, WI—A new payphone for the hearing-impaired may spur communications developments for the disabled. The phone is equipped with a telecommunications device for the deaf, or TDD, a keyboard and display monitor that deploy automatically when the user punches in the number. If the dialed party responds with its own TDD, a signal lights up on the payphone. Caller and answerer can then converse using keyboards. A 6000-character memory stores the conversation, so



Keyboard slides out of drawer for use by hearing-impaired dialer.

the caller can scroll forward or backward to review the conversation. The phones may increase the so-far spotty use of TDDs among the hearing-impaired.



Daddy-Longlegs Mars Rover

PITTSBURGH, PA—Ambler, a 10-ft.-high insect designed by Carnegie-Mellon roboticists, is the newest contender for NASA's Mars rover role.

Guided by a laser range-finder, the robot would push and pull its way across the Martian surface on two sets of three legs. Each leg can rotate fully around its central axis, or retract telescopically to negotiate obstacles up to a yard high. Choreographed leg retractions and extensions move Ambler forward. Meanwhile, foot-mounted sensors assess the stability

High-stepping Ambler uses electric actuators to retract and extend legs over Martian obstacles. Sensors guide foot positioning.

of each footfall.

Operating with the range-finder, Ambler can handle about a yard per minute, but running blind, it can hit 5 yards per minute.

The spidery design both simplifies motion control and isolates the shoulder-mounted electronics packages from being jarred by rough terrain. Ambler will be able to scout territory that would stop a wheeled rover.

WIDE WORLD PHOTO

ULTRATEC PHOTO

PM ILLUSTRATION BY ADOLPHE BROTHMAN

225 horsepower at 4200 rpm. 300 ft. lbs. of torque at 3200 rpm. Gas-pressurized struts up front. Quadra-Shock system in the rear. And four patches of extra fat rubber on the pavement. Mustang GT. Grab onto the five-speed and make your move. It's a kick in the tranny.

Best-built American cars.

The best-built American cars are built by Ford. This is based on an average of

consumer-reported problems in a series of surveys of all Ford and competitive '81-'89 models designed and built in North America. At Ford, "Quality is Job 1."

All 1990 Mustangs are equipped with a driver air bag supplemental restraint system.

Ford Mustang GT

225 horses are bound to kick something.



Buckle up—together we can save lives.

Have you driven a Ford...lately?



MAGIC MOUNTAIN PHOTO



King Of The Roller Coasters

VALENCIA, CA—The sting of the roller coaster will be its sharpest yet when Viper opens this summer at Six Flags Magic Mountain. Builder Arrow Dynamics has thrown everything in the book into the new coaster.

Boasting a 171-ft., 55° plunge, and hitting a top speed of 70 mph, the Viper is the world's fastest steel looping roller coaster. In 2½

minutes, riders will turn upside down seven times as they hurtle through three vertical loops, a back-to-back barrel roll known as a boomerang, and a 40-ft.-high corkscrew. Computer-linked air brakes regulate speed throughout the ride.

Under construction in California, Viper will whip 28 riders around 3830 ft. of looping steel track.



CAREQUEST PHOTO
CareQuest kiosk will suggest medication in response to user input of illness data.

My Computer, The Doctor

ROANOKE, VA—Interactive computer kiosks are becoming routine fixtures in retail environments. One likely to raise eyebrows is CareQuest, currently being installed in pharmacies. Armed with a highly detailed databank of medical information, CareQuest will print out coupons, health-care information and local doctor referrals, and could also amass a community's health profile.

New Tallest Building

CHICAGO, IL—Not only the world's tallest structure, but pencil-thin, the 125-story Miglin-Beitler Tower has been approved by the Chicago Planning Commission.

Looming 400 ft. over its neighbor the Sears Tower, the new tower's base will measure only 140 ft. × 140 ft., dimensions that stirred controversy.

But the building's central core will be a concrete tube 26 square in cross-section. A steel frame would have required active damping systems and other wind-countering technology. Instead, the M-B Tower will have steel-reinforced, concrete fins protruding from the core. The design will make the building very rigid to prevent swaying. Building cost estimates range between \$250 to \$500 million.



At 1914 ft., the Miglin-Beitler Tower will dwarf the Sears Tower. Tube-and-fins design will help tower stand up to the Windy City weather.

CESAR PELLU & ASSOCIATES ILLUSTRATION

Rutan's Foxhole Fighter Flies

MOJAVE, CA—LATS, or Light Attack Turbofan Single, is proving skyworthy in a series of tests. Burt Rutan developed the low-cost, battlefield-support craft without governmental funding.

LATS' most striking feature is its lopsided air intake, which leads to a 2900-pound-thrust turbofan. The design compensates for a recoil of a starboard-mounted, 25mm

cannon and keeps gun gases from smothering engine flame. Without wing flaps, the plane depends on twin-boom tail fins and large canards for its maneuverability. LATS can turn twice as sharply as the current A-10 attack aircraft and climb at a 15° angle. Small and lightly armored, it is designed to operate from rough runways and stay under 100 ft., straf-

ing the ground or dogfighting with helicopters. Although primarily intended for use in limited-scale conflicts, some experts contend that the plane could be as effective as the Air Force's new A-16, a version of the F-16 modified to perform close air-support duties.

Twin-boom tail and canards highlight Rutan's design, but customers may like the price better. Rutan says it cost him only \$2 million to build.



WIDE WORLD PHOTO

Build Your Own Classic Roadster



The Marlene 500K
'36 Mercedes Reproduction

Now
with
V-8
power

A POSITIVE OBSESSION. Have you ever become involved in a project that was so enjoyable, so exciting, that time seemed to fly by . . . hours seeming like minutes? A project that was so consuming you found yourself thinking about it all day long, anticipating your next chance to become lost in the fun, fascination and challenge all over again?



504K

the instructions. They were easy to follow and done in such detail that I was able to complete the kit with little difficulty."

— J. Bischoff, Minnetonka, MN

At Classic Roadsters, Ltd., we specialize in fun projects. Building one of our roadsters is very exciting — we like to call it the ultimate positive obsession. In fact, our customers often say they are sorry when the building phase is over, because they so enjoyed the experience.

"... there is nothing like building your own car. Would I do it again? You bet!"

— W.D. Jones, Oklahoma City, OK

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Duke

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Regardless of whether you respond to our offer or not, you will spend time and money on some form of recreation in the future. Why not invest in a project that will entertain and educate you and your family, and at the same time, provide



Saxon

you with a beautifully finished, stylish automobile?

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— The Editors, Kit Car World

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FREEWHEELING

BY CLIFF GROMER



A 50-Year-Old Record Falls

WAR CLOUDS were thickening over Europe in 1939, but a different kind of war was taking shape in the United States. Augie Duesenberg was hammering together a special weapon—a monster streamliner called the Mormon Meteor III. Its mission was formidable—assault and capture the existing land speed/endurance record.

The Mormon was based on a 1932 Pierce Arrow chassis and powered by an enormous 1570-cu.-in. Curtiss Conqueror V12 aircraft engine rated at 850 horsepower. In July, 1940, the awesome machine was declared combat-ready and rolled out to fight its solo battle against the clocks on the Bonneville Salt Flats.

The sun was starting to burn the chill out of the early morning air as Ab Jenkins climbed into the cockpit and cinched his goggles tight against his face. The big Curtiss shook the ground as it thundered to life, drowning out the hiss of the car's air-

craft tires as they skimmed over the dead-flat salt in a huge circle. The Mormon carried enough fuel on board to maintain the thirsty V12 at full roar for 350 miles. By the time the sun would stretch up over the horizon the following morning, Jenkins would have pushed the Mormon to an incredible 240-mph top speed.

Enduring endurance

More important, his 161,180-mph average speed for the 24-hour trial would be good enough to carve the Jenkins name into the record books for a new endurance mark, one that's endured well beyond the expectations of Jenkins or anyone else associated with the Mormon Meteor III.

Now, you'd think that with all the super-duper, razzle-dazzle automotive technology that's come down the pike in the past 50 years or so, someone would have been able to knock off Ab Jenkins' record. Many have tried, but

no one has succeeded.

In September of 1968, automotive legend Mickey Thompson and future Indy racer Danny Ongais tackled Bonneville's "big circle" with a specially prepared Ford Mustang. Among other marks, they claimed an international record of 157.650 mph, but fell short of Jenkins' 24-hour world standard by 3½ mph.

In 1976, a turbodiesel-powered Mercedes-Benz C111/2 streamliner claimed a world record for 5000 miles at the Nardo test track in southern Italy. But its average speed was only 156.827 mph—close, but no cigar. Other auto giants also brought to bear their considerable technical and financial resources, all to no avail. It seemed that Jenkins'

achievement was chiseled in stone for all time.

The reality of the situation, however, was that Ab Jenkins' record was living on borrowed time. The clock, ticking for almost 50 years, was finally winding down. History was waiting for just the right elements to be forged together—elements like the ZR-1 Corvette and the endurance racing savvy of Tommy Morrison—organizer and manager of the time trial.

Ft. Stockton countdown

It all happened on March 1 and 2 of this year. Morrison, along with seven endurance racing drivers, including three Corvette engineers, unloaded two Corvettes—one an L98, the other a ZR-1 model—onto the Firestone 7.712-mile oval test track in Fort Stockton, Texas.

The L98 engine was blueprinted and balanced and modified with a hotter cam, larger fuel injectors and a higher-flow induction system that used longer runners. A custom exhaust system, starting with handmade headers feeding into 2¼-in. pipes going straight back without catalytic converters or mufflers, insured maximum breathing.

The modifications added up to 350 horsepower. The stock ZF 6-speed transmission was retained and rear gearing was a mild 2.72 ratio.

The ZR-1 used a 100-per-

(Please turn to page 26)



ZR-1 Corvette averaged more than 175 mph for 24 hours.

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.....	10,900
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.....	15,813	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."



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FREEWHEELING

(Continued from page 24)

cent bone stock production engine, but with the same custom exhaust system as the L98, from the stock headers back. The exhaust systems on both cars were hung low to keep heat away from the rear end, transmission and other components.

World's fastest mules?

These were not new cars by any means, but engineering mules with tons of test hours, many of them classifiable as pure abuse, on both cars. Morrison's crew prepared both cars the same way he sets up Corvettes for Showroom Stock competition, taking everything apart, checking and replacing questionable components, and then putting it all back together. But these two Corvettes had some interesting extra equipment aside from their engine, transmission and rear-end coolers.

Armadillo repellent

Specially designed 48-gallon fuel cells were installed to minimize fuel stops—there were 15 stops during the 24-hour run. Because of a real danger of coyotes, deer, antelope, badgers, armadillos and Texas-sized jackrabbits crossing the track during the night on their way to their favorite watering holes, the Vettes were fitted with special devices that emitted high-frequency sound to drive off the animals.

The production lighting system was scrapped because the pop-up lights caused too much drag, and, almost as important, didn't throw out sufficient illumination for continuous speeds of 175 mph and more. Besides, the area used to house the stock headlight buckets was put to better use to house auxiliary coolers and ducting. The stock light covers were retained, but raised up about a half-inch, to vent air from underneath the car and kill the tendency for the front end to lift. Fixed high-intensity illumination, consisting of aircraft landing lights flanked by Hella driving lights, was installed to peel back the inky Texas night.

Unusual baggage

More unusual were the two suitcases that were strapped to the rollbars behind the drivers. Antiquated rules that were still on the books required the cars to carry any parts they might need, with the exception of tires and sparkplugs, on board during the record attempt. The total weight of the parts was limited to 5 percent of the car's curb weight plus 44 pounds. That pretty much eliminated major components like transmissions and rear ends.

Morrison figured that if the team was to experience a major component fail-

ure, the repairs, however well executed, would eat up so much time in the pits that they'd never be able to make it back up on the track. So spare parts were limited to mostly electrical components and other items that could be replaced easily, such as wheel bearings. The suitcase idea was to prevent the parts from becoming flying lethal weapons in the event of an accident.

In line with current practice, both cars were lightened and lowered for reduced aerodynamic drag and better handling. Throttles were adjusted so that when the accelerator pedals were planted hard to the floor, the L98 Vette would be running about 85-percent throttle, taching up to 4800 rpm on the back straight, and the ZR-1 would be running about 75-percent throttle with engine speeds reaching up to 5600 rpm. Tires for the torturous high-speed run were specialty items supplied by Goodyear.

At 10:55 am EST, on March 1, after a 3-day delay caused by bad weather, the unmuffled howl of the blood red ZR-1 Corvette shattered the serene calm of the west Texas morning. A scant 17 seconds later, the white L98 began its ride into the history books. In the first 6 hours, the flying duo established eight international records in the Federation Internationale de l'Automobile (FIA) journal.

Shortly after the sixth hour, the L98 was retired. Although it was originally scheduled to run the entire 24 hours along with the ZR-1, the L98 had to be air-freighted to Europe for display at the Geneva Motor Show, where Chevy planned to let the world know about its achievements.

The ZR-1 continued on alone, circling the track at speeds of 179 to 182 mph, stopping for fuel about every 80 minutes. The ZR-1 punched on through the night. Temperatures fell below freezing, but the car and pit crews kept going like clockwork.

New mark on lap 548

It was on the 548th lap when it happened. The ZR-1 shattered Ab Jenkins' 1940 24-hour mark of 161.180 mph by nearly 15 mph. The new record (still to be confirmed by FIA) now stands at 175.885 mph.

But it wasn't over yet. The ZR-1 kept circulating, and continued to bear down on still another record—this one the 5000-mile mark set by the experimental C111 Mercedes. And nearly 5 hours later, 3:40 pm to be exact, the ZR-1 owned this record too.

What's really amazing is that in this endurance/speed trial, where pure race cars feared to tread, history was made by a car that, for all practical purposes, is a production Chevrolet. **PM**

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IMPORTS

BY RICK TITUS, West Coast Editor



Alfa Romeo Snaps Back

IF YOU LIVE or die by the fun-to-run ratio of an automobile, but you put a realistic ceiling on the price-to-pleasure quotient, then we've got good news for you. From Italy, there's Alfa Romeo's latest, and from Japan, a pocket rocket by Suzuki.

Alfa Romeo

Alfa Romeo is on the move, given new-found engineering and manufacturing money following its takeover by Fiat. And, with marketing assistance in the U.S. by Chrysler, new blood flows in the veins of these purely Italian sports cars.

From quality assurance to new product introductions, it is clear that Alfa Romeo is determined to regain the status it once held in the hearts of sports car enthusiasts around the world.

Remodeling for the rather dated design of the Alfa Romeo Spider includes a face-lift, or more accurately, a tail-lift that incorporates a

full-width taillamp, a slight upturn to the rear decklid, and a smooth, 1-piece bumper and lower valance. At the other end, the nose receives a new, cleaner, 1-piece bumper and grille opening that retains the Alfa family lineage. Tying all this together are new rocker panel skirts that give the car an appearance more in step with the contemporary aero look. A monochromatic paint scheme is used on all the exterior colors. The Spider's interior now boasts new door panels, seat design, upholstery materials and center console.

But the big news comes in the form of the now-standard power steering and an automatic transmission option, which, when coupled with refinements made to the Spider's 2.0-liter, 120-hp, 4-cylinder engine, cures the performance shortcomings of the earlier Spiders. The 1991 Alfa Romeo Spider will be offered in two levels of

trim, the base Spider and the Spider Veloce.

In the sport/luxury sedan segment, the all-new Alfa Romeo 164 makes the company a force to be reckoned with. The 164 is clearly capable of owning the market, being the best car Alfa has ever built. The machine is the product of a 5-year, 10-million-mile, research-and-development program.

The all-new, 4-door sport sedan is offered in three levels of trim—base, L and S

automatic transmission.

In terms of detail, the 164 is a high-water mark for Alfa. Fit and finish, from dashboard to trunk lining, is outstanding.

Suzuki

Introduced in 1989, the Suzuki Swift GT returns for 1990 packed with all the right stuff in terms of enthusiast image hardware—painted alloy wheels, ground-effects aerodynamic body package, a sport steering wheel,



Alfa 164 sets a high-water mark in quality.

models. Powered by a 183-hp V6 in the base and L models, and a 200-hp version of the same engine in the S model, the 164 is a snappy performer that lives for the open road. Ride and handling qualities rank with Europe's best, and cornering and stability get strong marks from us. This is a front-driver, but it shows surprising balance and control at the limit. All this, and a comfy ride, too.

The 3.0-liter V6 engine makes lovely sounds and has good midrange to high-end power. You can choose either a 5-speed manual or 4-speed

supportive bucket seats, tachometer and a 100-hp, 16-valve, fuel-injected, 1.3-liter, dual-overhead-cam engine and 5-speed transmission—all for under 10 grand. Today, that's bargain performance.

Low and sleek, the 1784-pound Swift GT hatchback pulls 0-60-mph times in the 8-second range, yet produces EPA-estimated fuel-economy figures of 29 mpg in the city and 36 mpg on the highway. That's a lot of pounce-ounce, which gives the Suzuki Swift GT an excellent fun-to-run ratio. **PM**



Suzuki Swift GT rates high in pounce-per-ounce.



**May the road rise to meet you,
May the sun shine warm upon your face,
May the wind be always at your back,
But when it's miserable,
May you be driving a very dressy V-6, 4WD Montero.**

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Automatic locking hubs, with a 2-speed transfer case, let you slip in and out of 4-wheel drive at will, right from the driver's seat. And whether you're wearing your oldest jeans or your Sunday best, you'll arrive looking like a million. As Motor Trend observed, "The

Montero is more reminiscent inside of a decked out luxury car than an off-road truck."

Considering the fact that Montero gives you nearly a third more cargo space inside than either Cherokee or Trooper II, that's a lot of luxury.

Priced from \$15,519 to \$19,499* (LS model), you couldn't wish anything better upon a traveler than a new Montero.

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SCIENCE

BY ABE DANE, Science/Technology Editor



U.S. ARMY PHOTO

War And Peace In Huntsville

IN THE COOL blue glow of the monitors, Col. John Wilson paces behind six officers sitting at a bank of consoles. In a moment, calm is disrupted by a flurry of bulletins, each of which receives his terse reply.

"Sir, ES."

"ES."

"BSTS alert."

"Roger. SC, go ahead and release and prep ERIS. Also release GSTS."

"Sir, Intel."

"Intel."

"ASW surveillance aircraft detects booster flying up from surface."

"Roger. Com, notify NCA that we have a detected launch off of the West Coast."

"Roger, sir."

"Sir, ES."

"ES."

"We have three detected boosters."

"Com, also notify NCA that I have prepped and released GSTS and ERIS. We

also, at this time, are tracking a total of four boosters."

"Sir, AA."

"AA."

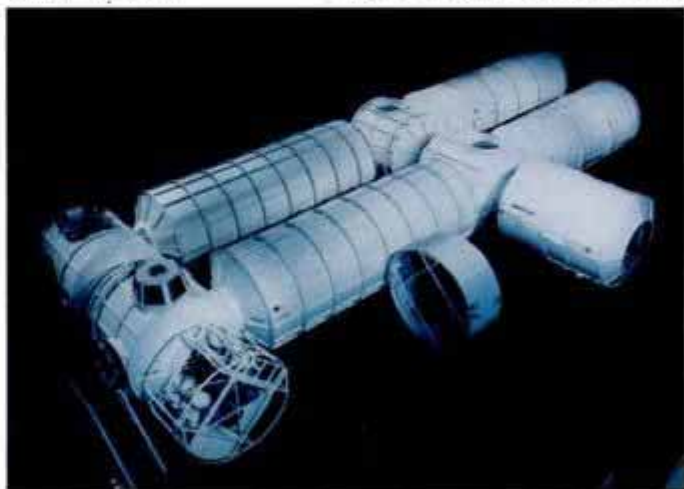
"We've exceeded our alert threshold for hypotheses decap, accident and rogue. We currently show rogue the highest probable hypothesis."

What we're listening to is the onset of a nuclear attack. The AA, or attack assessment officer, has just reported that her artificial intelligence computer estimates that the four nuclear-tipped missiles detected arcing up toward the Southwestern United States from a submarine in the Pacific were probably launched by a Soviet commander acting independently. Less likely possibilities, according to the computer, include an attempt to knock out U.S. command centers prior to a massive nuclear strike, or a simple mistake.

Of course, this whole sce-

nario is a simulation. It was played out on what amounts to the world's most expensive videogame—a prototype of the nerve center for the Strategic Defense Initiative.

I was among a group of journalists invited to view a demonstration of the system at the Army Strategic Defense Command's Advanced Research Center in Huntsville, Alabama.



Freedom mockup is being used to test Space Station configurations.

BOEING PHOTO

Star Wars fights for life

Although only a simulation, the scenario we witnessed was also part of a very real political battle. Proponents of SDI are trying to defend the tremendous cost and technological risk of the program against the increasing scrutiny that has accompanied thawing Cold War tensions. The military believes that redefining SDI's objectives and limiting its scope is one way to keep the program alive.

Speaking to us at a working lunch after the simulation, Lt. Gen. Robert D. Hammond, commander of the Army SDI effort, stressed the system's potential effectiveness against the growing threat posed by nuclear proliferation.

"We no longer live in a bipolar world," he said.

There are now 27 nations that possess the ability to launch a nuclear warhead aboard a ballistic missile.

Although the controversy over the ultimate utility of ballistic missile defense remains as lively as ever, one thing is hard to dispute. The tremendous r&d expenditures made under the Strategic Defense Initiative have

already brought some remarkable technological achievements. (You'll find details on these in next month's Tech Update.)

One other thing. In case you're wondering how the battle we listened in on at the beginning of this column turned out, the Southwestern United States was spared nuclear destruction.

The other side of Huntsville

Meanwhile, just a few minutes drive to the south, a brighter vision for our future in space is taking shape. At the sprawling Marshall Space Flight Center, machine shops and vast assembly buildings left empty after the end of the *Apollo* program are coming back to life. Here, in the shadow of rusting test stands where engines for the Space Shuttle, the *Saturn 1B* and the mighty *Saturn V* were first fired up, work is gearing up on Space Station *Freedom*—our stepping stone for the next giant leap into space.

I had a look at the results of all this activity on a quick tour of the facilities at Marshall. A full-scale mockup resting in building 4755 is the clearest representation of what the astronauts' lives will be like. It consists of the American Habitation and Laboratory modules, along with two others to be contributed by the Japanese and European Space Agencies. Four connecting nodes and a logistics module holding supplies are also included in the mockup, which is being used to evaluate different plans for packing experiments, living quarters and life-support systems into the Station. The present plan is to mount most equipment in double-width racks that swing out so that components can easily be swapped. These racks line the floor, ceiling and walls of the Station, and extend right out to the interior of the pressure hull. Overall, the interiors of the modules seem spacious and pleasant.

Elsewhere in the same building, working prototypes of the Environmental Control and Life Support Systems are being set up in a core module simulator where they will be tested. Covering the interior of the sealed metal vessel is an intricate weave of gleaming metal tubing, wire bundles, collection tanks and glass vials that will process water from sweat, urine and washing activities so that it can be reused.

Checking for leaks

In building 4572, where the Shuttle's solid rocket boosters were once stress tested, a pressurized Space Station module swathed in insulation is leaking minuscule amounts of air. It may not sound like the most exciting experiment, but it's crucial to developing instrumentation needed to make sure that the Station can meet stringent NASA requirements. These call for air leakage

amounting to no more than 1/2 pound per module per day—an amount that could flow through one hole .013 in. wide.

The tests are being carried out on a prototype module constructed of waffle-surfaced 2219 aluminum/copper alloy joined by a new process called variable-polarity plasma arc welding, which is supposed to produce welds so flawless they don't need to be X-rayed. Early data from the recently recovered Long Duration Exposure Facility (see Tech Update, page 21, Apr. '90) appears to back up the belief that these materials will last out the Space Station's 30-year lifetime under orbital conditions.

Not all the news on *Freedom* has been so good, plagued as the program has been with redesigns, funding uncertainties, and most recently, concerns about prohibitive maintenance requirements. Originally scheduled to produce a habitable facility by 1992, the program has now slipped to the point where NASA projects that the first component won't be orbited until March of 1995. But now, for the first time, the program is running on schedule, construction is beginning on the first real pieces of hardware, and Marshall Space Flight Center is again playing its part in midwifing a grand NASA dream into reality. **FM**

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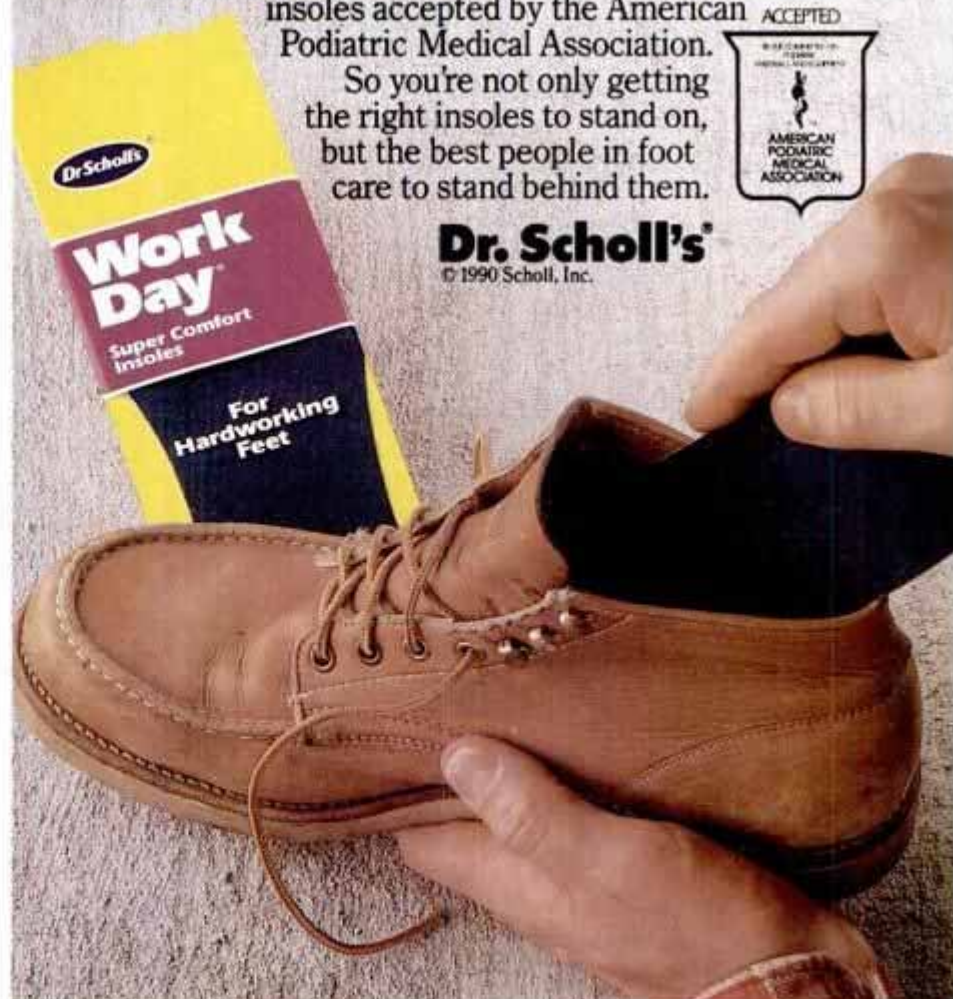
In fact, Dr. Scholl's insoles are so good, they're the first insoles accepted by the American

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So you're not only getting the right insoles to stand on, but the best people in foot care to stand behind them.



Dr. Scholl's
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ELECTRONICS

BY FRANK VIZARD, Electronics Editor



Game Boy Versus Lynx

GIVEN THE portability of audio and video products these days, it was almost a foregone conclusion that videogames would become portable as well. While there are a lot of single-game-dedicated devices already available, the battle for dominance in this field is being fought by two old rivals: Atari and Nintendo.

Like the home versions, both the Atari and Nintendo machines offer the ability to play a multiplicity of game cartridges on just one machine. While there are differences between the products from a feature standpoint, the most obvious point of departure is price. Nintendo's Game Boy lists for \$90, while Atari's Lynx lists for \$150.

Game Boy is actually very reminiscent of a Walkman-type personal stereo player in that the size is roughly the same. The game is viewed on a 2½-in., liquid-crystal-display (LCD) screen. Below

the screen are the game control buttons. Game Boy uses digital sound technology built into the hardware and programmed into each game cartridge. Like a Walkman, Game Boy comes with stereo headphones for private listening.

While Game Boy uses an 8-bit microprocessor like the Nintendo home system, don't expect the type of graphics you'd get in front of your TV. The graphics are basically 1-color images. Sometimes, these images are a little hard to see. In a game like "SuperMarioLand," a title derived from a popular home game, the background has a tendency to fade away if you press the B button to make Mario run faster. The game cartridges are roughly 2½ in. sq. and fit into a slot in the top rear of the machine. Obviously, some of the capabilities of the home system would not fit into a package this small—at least not for a

very reasonable price.

Game Boy does include a video link that connects two units together. This way players can compete tournament-style against each other.

Lynx is best viewed as the step-up model of portable videogames. The unit is slightly larger than a video cassette and incorporates a 3.5-in., color LCD display. Game controls are located on either side of the screen. Operating Lynx, in fact, is much like clutching onto a steering wheel.

In addition to a 16-color graphic display, Lynx is able to generate a seemingly infinite number of sprites (hardware-generated images), and it can vary their size as needed.

In "California Games," for example, this capability means that a realistic, foamy wave can be simulated for surfing. As the player

rides the wave, the individual sprites that make up the picture get larger and smaller to create the feeling of a breaking wave. Size and depth perceptions can also change.

Running the show for Lynx is a 4.0MHz microprocessor of the type generally used in personal computers. Two additional ASIC chips reduce the number of components needed for a machine of this sort—something that keeps both the cost and weight down. One chip called Mikey includes the microprocessor and the



read-only memory (ROM). Suzie handles graphic and animation hardware support. Suzie is essentially a graphic engine that sizes and rotates the on-screen images.

Images can also be flipped to accommodate the game-playing preferences of either left- or righthanded people. A headphone jack is also included as part of the machine.

With this kind of capability built into the hardware, the game cartridge can be programmed to provide more challenging action and detailed character expression.

More Antennas

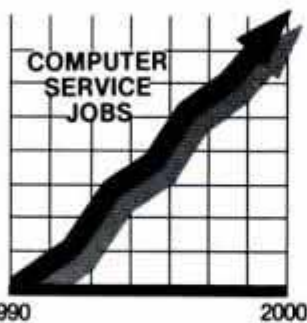
The idea of using multiple antennas to improve car radio reception is not a new one. In the mid-1980s, dual-antenna diversity tuning systems from Clarion and Sony hit the autosound aftermarket. And

(Please turn to page 103)

5 sure steps to a fast start as a high-paid computer service technician

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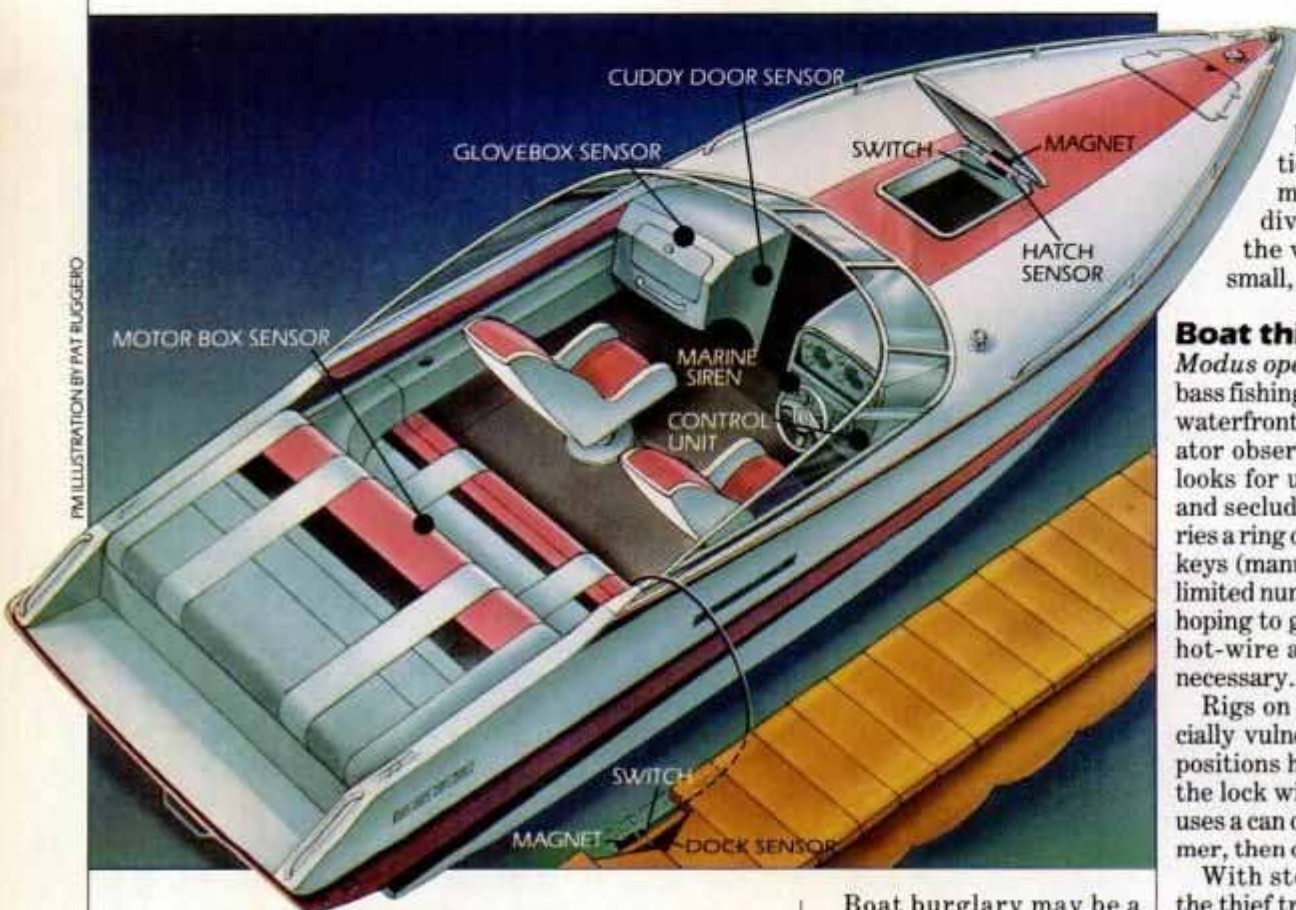
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BOATING

BY JOE SKORUPA, Boating/Outdoors Editor

PH ILLUSTRATION BY PAT RUGGENO



Beat The Boat Bandit

THE SUBJECT was marine theft and a Florida boat mechanic was talking about a nearby boat rental operator. The guy showed up for work one day and discovered every prop on his rental fleet was gone. Stolen.

As he was checking to see if anything else was missing, the owner of an adjacent marine store arrived and prepared to open up. "Hey," the theft victim shouted, "my props are gone. Give me everything you've got so I can open up for business."

After the rental operator put a new batch of steel wheels on his fleet, he went scouting and made another discovery. Every boat up and down the inlet had been stripped by the prop thieves.

"Mirage isn't just the name

for a top-dollar, stainless-steel prop," said the boat mechanic, finishing his story, "it's also a French word that apparently means steal me."

Modern pirates

Everyone who spends time on the water knows similar stories. Boats large and small are being picked clean of equipment or stolen outright at an increasing rate. One estimate I came across put the theft figure for 1989 well into the hundreds of millions of dollars. Comprehensive, reliable statistics are hard to come by since there is no official body or agency charged with keeping these records. Responsibility falls in a seam between the police and the Coast Guard, a sore point for many boaters.

Boat burglary may be a natural outgrowth of the increase in drug-fueled crime, or simply the result of growing awareness by thieves that boats are especially easy and lucrative targets.

Yachts and sportfishing boats, of course, have long been coveted by crooks. But owners of these high-roller rigs can afford passive infrared security equipment or other equally protective alarm systems.

Bandits, of course, don't like to set off alarms. Also, they don't like boats that can be easily traced. Big-ticket models with custom features are difficult to disguise. They're also more difficult to unload without leaving a money trail.

So what's left? The prime target is probably a boat like yours—18 ft. to 26 ft. long. In fact, of the more than 28,000

watercraft that are listed on the computer file of missing boats at the National Crime Information Center, a division of the FBI, the vast majority are small, trailerable rigs.

Boat thief M.O.

Modus operandi: He stalks bass fishing tournaments and waterfront areas like a predator observing its prey. He looks for untended marinas and secluded docks. He carries a ring of common ignition keys (manufacturers make a limited number of variations) hoping to get lucky, but he'll hot-wire a suitable boat, if necessary.

Rigs on trailers are especially vulnerable. He simply positions his pickup, breaks the lock with bolt cutters or uses a can of freon and a hammer, then drives away.

With stolen boat in tow, the thief travels out of state. He books into a motel, buys a classified ad, and waits by the pay phone. When it rings, he offers to sell a \$15,000 to \$30,000 rig for one-fourth of the market price. To anyone who asks, he explains, "I'm going through a divorce" or "I lost my job." But willing buyers are easy to find at fire-sale prices, even though the thief wants cash.

What about laws that require clear title and registration of boats? The truth is that regulation is notoriously lax. Some states require registration, but no titling. Often, where a title is required to obtain registration numbers, monitoring is haphazard. Plus, there's a giant loophole in the law. Home-built boats in most states can be given a title and registration without on-site inspec-

tion. Forms are requested and sent through the mail. The thief simply fills them out. Forgery, of course, is also a quick way to obtain whatever's needed.

This system works with boats, motors, loran units, sonar recorders, VHF radios, radio/cassette players, personal watercraft—the whole 9 yards. Several former boat bandits are now doing consulting work for insurance companies, after serving hard time in prison, and they report making \$3000 to \$5000 per week for up to 10 years.

Sound the alarm

What many small-boat owners don't know is that there's a relatively inexpensive electronic alarm system on the market that can give them the same level of security found on high-roller boats. It's made by Boat Sentry, of Fairfield, New Jersey, and is specifically designed to stand up to the harsh marine environment and avoid motion-related false triggering. Do-it-yourself alarm kits range in price from \$369 to \$599, and fit boats up to 35 ft. long.

Boat Sentry alarm units operate on either battery or dockside power and accommodate up to 100 sensors. Kits include a control unit, alarm sensors, cutout template, wire connectors, tie wraps, wire and installation hardware.

The heart of the system is the Loyal Sentry control unit, which can be mounted anywhere on the boat. It's activated by using a digital keyboard to punch in a secret code. Once activated, the system prevents the engine from starting and sounds an alarm—either the boat's horn or an optional siren—when a sensor connection is broken.

Sensor connections consist of a magnet and a switch. They are available in either flush-mount or surface-mount configurations. Likely locations are opening hatches, cuddy cabin doorways, gloveboxes and engine covers. Optional sensors can be hooked up for dockside protection, on outboard motors and on individual pieces of electronic equipment. Another interesting option is the Loyal Sentry Snap Switch Sensor, which turns existing canvas snaps into alarm trigger devices. Deactivation of the system simply requires reinserting the secret code number using the control keyboard.

For more information on Boat Sentry, write to 271 Route 46 West, Suite A-104, Fairfield, NJ 07006.

Fighting back

In addition to electronic alarms, boaters have other security measures at their disposal. Although any lock can be bro-

ken under the right circumstances, it may slow down a thief long enough to be an effective deterrent.

Trailer-hitch locks have been around for years, but not all boaters may be aware of transom bolt locks, for both outboards and sterndrives, and propeller locks, which are now starting to appear on the market. Here are a few precautions you can implement in addition to adding locks and alarm systems:

- Never park a trailered boat in a dark, secluded location. Make sure your site is well lit whether at home, the marina or a motel. Light is a thief's enemy.
- Back up trailer against a building, wall, tree or other immovable object whenever possible.
- Remove license plate from trailer if left untended for a length of time. If stolen, a policeman may stop the perpetrator and make inquiries.
- If boat is going to be stored on land in off-season, remove tires from trailer and set up on blocks.
- Remove sparkplug wires if boat is left in water.
- Remove electronic equipment, when possible, as well as props, water skis and other costly accessories.
- Lobby for state laws that require and strictly enforce registration and titling of all boats.

PM

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DETROIT SPY REPORT

BY JIM DUNNE, Detroit Editor



Olds Joins GM's New Sleek Set

A PROTOTYPE of Oldsmobile's 1991 full-size sedan, caught being tested in Michigan recently, displays the changes in styling that will greet 98-model shoppers next fall. Contrasts with the current model are seen from plastic bumper to plastic bumper. A smoother, more aerodynamic body shape features a sharper windshield angle and a softer backlite slope. Door handles are flipper-type, differing from the Cadillac-style thumb-button that Olds used in past years. A fixed quarter window in the front door should relieve

and tire noise levels as the car drives past at different speeds. Adjustments are made as needed to meet Ford's standards.

dans. Like its sister car, the Buick Park Avenue Ultra, the 98 will use an electronically controlled 4-speed automatic transmission. The 8-in.-longer body rides on 15-in. wheels.

Ford Crown Victoria, 1992

Here's what the front end of Ford's full-size sedan will look like in two more years. The Crown Vic follows the successful Taurus style, but has its own personality. Compared with its chief rival, the new Chevy Caprice, the Crown Vic has tighter

body-color grille pieces and only keep the trim in bright metal. Look for the competition between these two flagship sedans to heat up to oldtime levels when the 1½-year-late Crown Vic hits the showrooms in the summer of 1991.

Mustangs and bigger Ford sedans. Cars were brought over from Australia and run here with the engine. This test car was spotted undergoing drive-by noise measurements. A microphone set a certain distance from the roadway measures engine



Australian Ford LTD is undergoing weather tests in the U.S.

U.S. Test Center

In recent years, many foreign carmakers have used U.S. facilities and roads for prototype testing of their new cars. Last winter, Rover prototypes were seen testing in Minnesota and Arizona (see last month's column, page 22). Audi tests new engines on a regular basis each year in the Southwest. Nissan even has its own test track in Arizona. This full-size Australian Ford LTD is undergoing hot-weather testing of its U.S.-built V8 engine at Ford's test track near Naples, Florida. The LTD competes with GM's V8-powered Holden sedan in Australia, and Ford needed a small supply of V8s to stay even with Holden. So the decision was made to use the 5.0-liter V8 built here for

and tire noise levels as the car drives past at different speeds. Adjustments are made as needed to meet Ford's standards.

Tiny Headlights

Smaller headlights will show up during new-car introductions in the next two years, with the tiniest being a headlight no larger than 2.1 in. high by 5.2 in. wide. Camaro and Firebird for 1993 will have the smallest lighting systems with high and low beams set side by side. When lights get this small, proper aiming is critical. So GM has a bubble level built into the light fixtures that allows the car owner to easily adjust the aim. Simply turn a set screw to line up the bubble. Only up-and-down adjustments

(Please turn to page 40)

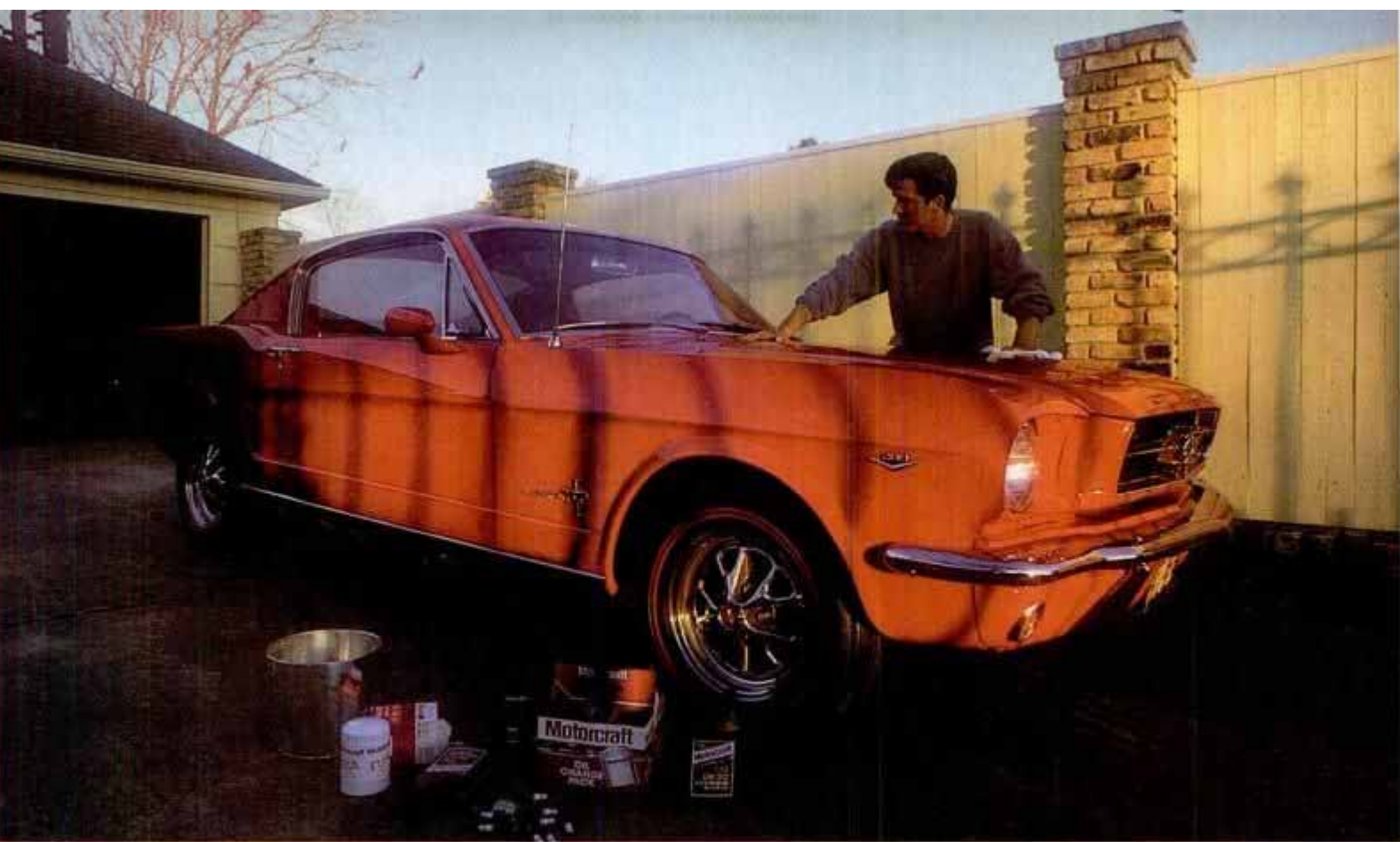


1992 Ford Crown Victoria borrows some of Taurus's styling.

wind noise and assist in the smooth operation of the movable side glass.

Underneath the sloping hood is an improved version of the world-class, 3.8-liter V6 that currently powers the Buick and Olds full-size se-

lines, more definition to the greenhouse and a more massive hood appearance. Both cars have switched to plastic bumper covers in place of metal bumpers. But while the Chevy has bright metal for the grille, Ford will adopt



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can be made with the bubble. Side-to-side adjustments are made the old-fashioned way—by aiming the light on a target wall. Replaceable halogen bulbs are part of the lamp package.

Taillights, Too

Those taillights, high-mounted brake lights and side marker lights will undergo even more changes in the coming years as light-emitting diodes start replacing incandescent bulbs. Advantages of the more expensive LED lamps are longer life, more rugged construction and much smaller size. In addition, the LED red colors are much redder than today's stoplights, which show a lot of orange. While LEDs cost more, they are simpler to install at the factory. LEDs can almost be pasted onto the outside of the sheetmetal, while bulb lamps must be housed in space-stealing compartments. Work life of the LED is an impressive 50,000 hours, compared with a conventional bulb's 10,000 to 15,000 hours. No, LEDs for cars are not new. Several Japanese sporty cars already use them for a high-mounted stoplight where their small size is ideal. Look for Cadillac and Lincoln to have the new lights within two years.

(In)Active Suspensions

Active suspensions, of the type being developed by Lotus for Corvette, are apparently too costly and will not be offered soon on high-priced sports cars or sedans. The complicated suspension that anticipates road dips, bumps or sharp turns, and moves wheels up and down hydraulically will be set aside for the time being while less expensive variable shock absorbers are further perfected. The shock absorber technology, already in production, is said to have come more than halfway toward the advantages of active suspensions, and more progress can be expected. Active suspensions use high-pressure hydraulics to lift or drop wheels along road surfaces, leaving the car body to ride relatively level.

Seat Solution

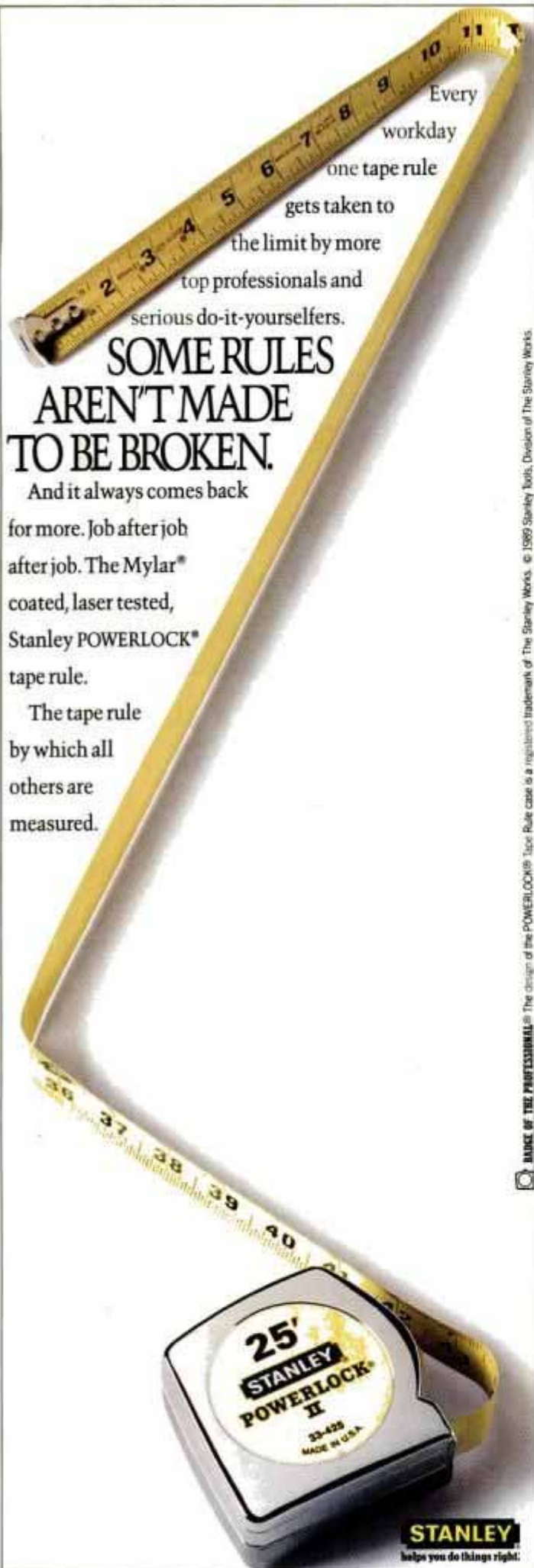
Those wings and bolsters on highly formed seats you find in sporty cars, like Corvette or Thunderbird, make it difficult to get in and out of the front seats. The driver and passenger have to clear the wings before settling down, and bulky clothes aggravate the situation. Lear Siegler has a couple of answers. One is a movable outside section of the seat that can be lifted up and out of the way when passengers enter or leave. The section is made up of both the seat cushion and seatback bolsters. Once inside, you swing the section back down into place. A second solution is even slicker. When the door is opened, the bolsters are automatically powered back into the seat.

Phone Book Fix

Auto industry spending cuts reach into corners you would not believe. Recently, it was decided that the company phone book at Chrysler was too thick—too many pages. It gave the wrong message: Too many white-collar workers on the payroll. The bureaucratic solution was to make the book smaller by printing the type smaller. Now the book is almost impossible to read without a magnifying glass, but its slimmed-down appearance tells outsiders that Chrysler is a taut organization, not bloated with an excessive number of managers.

Fun Machine

Latest brainstorm out of GM's engineering center is a small car, called the Phantom, that seats driver and passenger in tandem. The driver sits in front, the passenger directly behind. The lightweight car is an experiment to develop a car that is more fun to drive—and be seen in—than anything now on the road. Wheels are set outboard from the fuselage-shaped body for good handling, while the engine is set east-west to drive the front wheels. The Phantom could be sold at a price less than \$15,000. But I'll be surprised if it ever reaches showrooms. GM management is just not into niche marketing. **PM**



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OLD HOUSE RESTORATION

BY BOB VILA, Contributing Editor

ANTIQUE HARDWARE STORE PHOTO



A wide variety of restoration hardware is available, including reproductions like these.

pieces can be colored so they look as old as the originals. Cast iron, considered a cheaper material, was generally found in homes of lesser wealth. Today, some foundries reproduce these Victorian period pieces in cast brass or bronze, then chemically finish them in black so they look like cast iron.

Yesterday's art today

Today, old-house restorers are lucky to find a good mix of both hand-forged and hand-cast, as well as machine-made, items available to outfit their homes. The classic blacksmithing operation, hand-forged hardware is made the same way it was 200 years ago at places like Kayne & Son Custom Forged Hardware. A mild steel is usually used for much of today's forging. Basically, a piece of steel is heated in a fire, then beat into various shapes on an anvil. A practiced blacksmith can create just about any shape imaginable by using various parts of the hammer combined with his pulling and pushing of the hot metal.

It's important to note that people weren't as critical back then as we are today. Since we're used to seeing machine-produced hardware, we expect things to be symmetrical. Obviously, this wasn't the case years ago, when everything was done by hand. For example, it's quite common to see an original pair of andirons with one piece shorter than the other. Or a door hinge with uneven sides. But many folks today, even those outfitting old houses with reproduction hardware, expect work to be done to today's exacting

(Please turn to page 44)

Restoration Hardware

NO MATTER what type of house you're restoring, the right hardware will go a long way toward re-creating what once was. The extensive list of reproduction items available today includes things like Colonial and Victorian thumb latch sets, door knobs and plates, and hinges.

Thanks to the few skilled craftsmen who've kept yesterday's blacksmithing and foundry skills alive, it is possible for the serious restorer to find handcrafted hardware that replicates what was used years ago. Many of today's craftsmen can also copy an existing piece or give new life to an old original in need of repair. There are also companies that sell a wide variety of

machine-made production pieces that are perfectly acceptable in many old-house applications.

A part of life

We're enamored with old hardware today, but to our ancestors, these pieces of metal were seen as a necessary part of life. In early Colonial times, for example, a man had to see the blacksmith before the preacher to ensure that he would have hardware for the new home he was building for his bride. Considered *trousseau* items, many pieces from the 17th and 18th centuries were decorated with hearts.

Back then, most hardware was made from hand-forged iron. Since metal was expensive and labor was cheap, everything made out of iron was reused. In addition to paying or bartering with the black-

smith for his services, it wasn't unusual to also pay him with scrap metal—perhaps an old horseshoe or wagon tire—equal to the metal he used to forge the new hardware.

Our ancestors weren't bound by convention, like we are. There were no rules as to the right or wrong way of doing things. They basically used what they had. That's why it wasn't unusual to see locks made for lefthanded doors installed upside down to service a righthanded door.

The heyday of the blacksmith waned as machines, factories and foundries became prevalent. The Victorians cast many items, including the popular curvilinear Blake latches, ornamental door plates and knobs.

Historically, brass or bronze cast hardware was found in the better Victorian homes. Reproductions of these old brass or bronze

Contributing Editor Bob Vila hosted public television's "This Old House" for 10 years.

NIGHT LIGHTS AREN'T JUST FOR THE KIDS' ROOM.



Remember when you were a kid how good a night light used to make you feel? Well, high-efficiency outdoor lighting can do the same thing for your home. Because a house that's well-lit on the outside is one that's much safer for you. And one that's a lot less inviting to prowlers. If you'd like to receive more information on how to use high-efficiency outdoor lighting to enhance the safety, security and beauty of your home, contact your electric utility. Because even a kid knows a night light can help keep the bad guys away.

YOUR ELECTRIC UTILITY

standards. This means care must be taken by the modern blacksmith to ensure pieces match and sides are even.

Fortunately, there are a few foundries around that still do sand-casting the way it was done years ago. This involves making an impression in very fine, high-quality sand with a master or original. Molten metal, usually brass, bronze, cast iron or cast steel, is then heated and poured into this impression. When it cools, the piece is created, or cast. Sand-casting is still a good way to make small numbers of the same piece. It's an old method used to create smooth surfaces and very fine detail.

Another way to make intricately detailed Victorian hardware is called the lost-wax casting method. Dating back thousands of years, this process was used throughout history to create sculptures. Its use for hardware is a relatively new one, and is used by one company I know of called Cirecast, Inc.

In its simplest terms, a pattern of the original piece is made from a durable substance like wood or metal. A mold is made from this pattern. Wax is then poured into the mold, creating a wax pattern identical to the original piece. This disposable wax pattern is surrounded by a refractory material, like plaster. The wax is melted and removed, then hot metal is added to the cavity through surface chan-

nels in the refractory material. The resultant metal casting is usually so smooth and detailed that the only finishing required is a good brushing.

Finding reproductions

Deciding what hardware is right for your old house depends on several factors. Of course, your restoration budget is always an important one. So is the level of authenticity you're striving for.

Although it's impossible to make a blanket statement concerning costs, you will usually pay more for handmade hardware because of the labor involved in its creation. But it really depends on the item and the supplier. You'll have to do some comparison shopping here.

Lots of the machine-made production pieces are really quite good. For many restorers, the right mix of these items will add the period flair you're looking for to your old house. Of course, if you're a purist and are striving for the best reproduction possible, consider choosing a handmade piece. Once you become knowledgeable about the two, you'll be able to tell the difference. A hand-forged item, for example, has a different feel to it than a machine-made one. It's heavy where it's supposed to be heavy and thin where it's supposed to be thin.

Finding period hardware won't be dif-

ficult. Most manufacturers offering machine-made pieces sell through mail-order catalogs. Many of the forges and foundries also publish catalogs containing their popular items. In addition, most of these craftsmen will make an item to your specifications, creating a custom piece that's just right for you.

A good book to consult before you talk to the blacksmith is *Early American Wrought Iron, Three Volumes In One*, by Albert H. Sonn (Bonanza Books, New York, NY, 1989; \$17.99). Considered the bible of the industry by some, it's a great guide for those seeking to replicate antique Colonial hardware. **PM**

Source List

Following is a list of some suppliers of period hardware:

- The Antique Hardware Store, Route 611, Kintnersville, PA 18930
- Arden Forge, 301 Brinton's Bridge Rd., West Chester, PA 19382
- Ball and Ball, 463 W. Lincoln Highway, Exton, PA 19341
- Cirecast, Inc., 380 7th St., San Francisco, CA 94103
- Hardware + Plus, 701 E. Kingsley Rd., Garland, TX 75041
- Historic Housefitters Co., Farm to Market Rd., Brewster, NY 10609
- Kayne & Son Custom Forged Hardware, 76 Daniel Ridge Rd., Candler, NC 28715
- The Renovator's Supply, Millers Falls, MA 01349

The beauty of Thompson's® Wood Protector is the way it protects the beauty of wood.

Thompson's® Wood Protector has a unique way of keeping your house beautiful, no matter how ugly the weather.

In fact, that unique way is really *three* ways. Thompson's protects against mold and mildew, water damage, and helps prevent fading and greying. What's more, Thompson's crystal clear waterproofing protection even gets better with age. With just one coat, your wood can have a longer life expectancy than you ever expected.

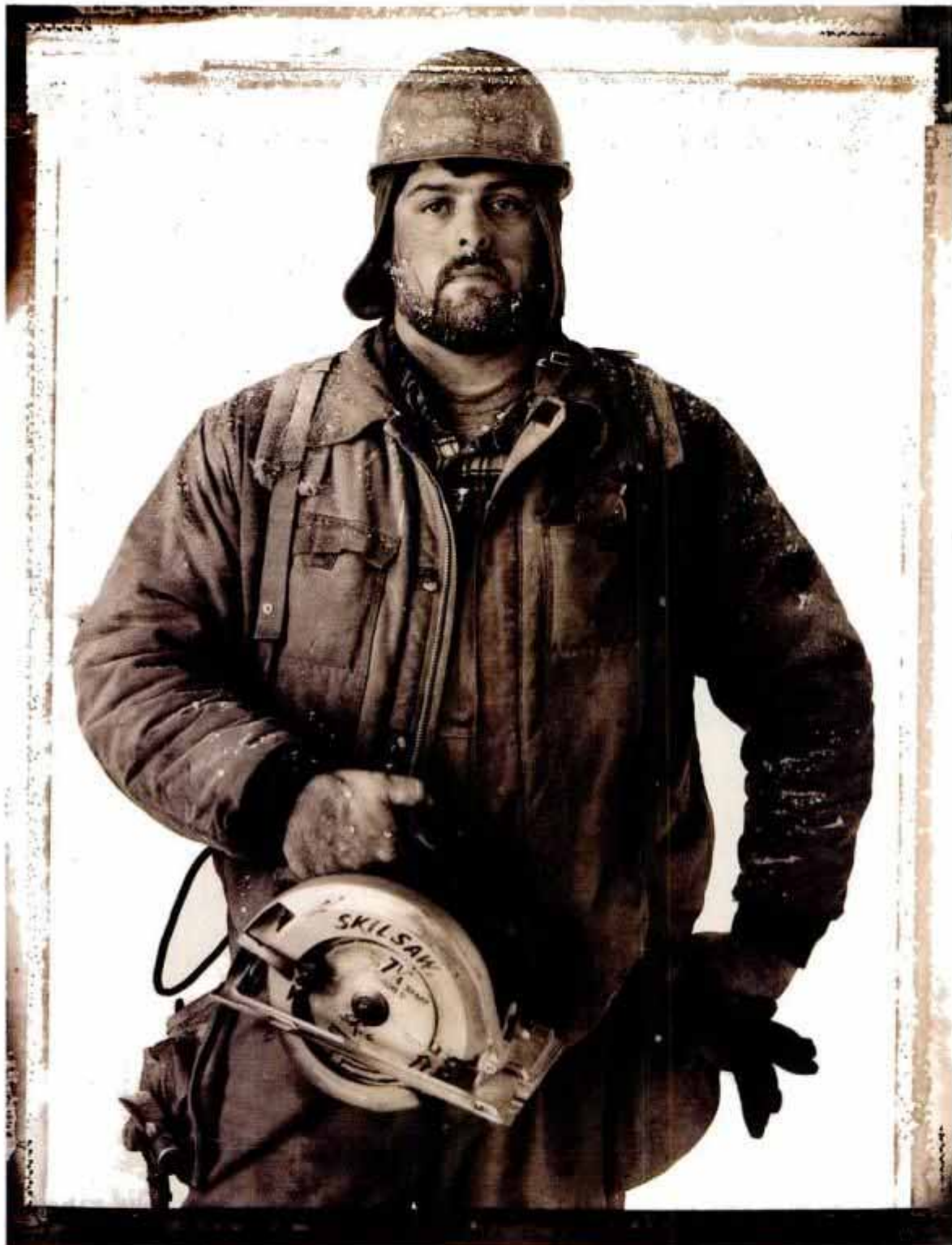


Powerful water-proofer to protect against splitting, cracking and rotting.

Protective sun-screens to help prevent fading and greying.

Strong mildicides to protect against mold and mildew.





Joe Cuffe, Carpenter, Chisholm, Minnesota.
Works in sub-zero temperatures on a daily basis. So does his Skilsaw.

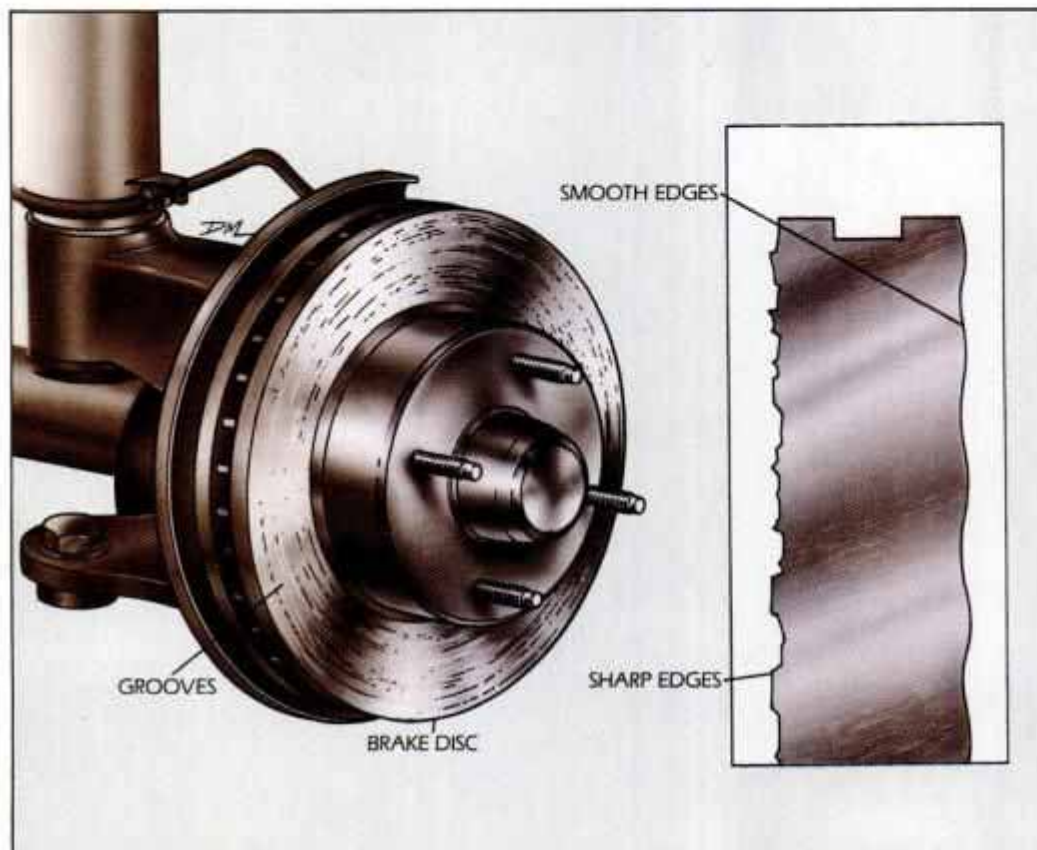
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CAR CLINIC

BY MIKE ALLEN, Assistant Auto Editor



PM ILLUSTRATION BY DON MANNES

Sharp-Eyed

I JUST HAD TO have my front brakes relined. The brake specialty store insisted that the front rotors had to be trued, even before they put the car on the lift. The mechanic just looked at the brake through the wheel when the car was in the parking lot.

I'm not sure I needed to spend the extra money—the rotors looked fine to me.

JOHN SHERMAN
ATLANTA, GA

Brake discs need to be machined for a variety of reasons. If you wore through the pad material far enough to let the backing plate or rivets touch the disc, that's automatic grounds for a trip to the lathe.

If the brake pedal pulsates, or if a dial indicator shows excess runout, it means at

least one disc is out of true, and needs to be turned.

However, it's possible for a disc to be within spec and to not have been trashed by metal-to-metal contact, and still need machining.

The surface of the disc that is swept by the brake pad will wear away slowly. It won't wear uniformly, because of the granular structure of cast iron. The wear will leave circular grooves around the disc, and these grooves will typically have a smooth, wavy texture.

But, sometimes those grooves will develop sharp edges, like in the illustration. If the edges appear sharp, if they are sharp enough to catch your fingernail, then it's time to have the disc resurfaced. This can sometimes happen more often if you drive in dusty environments,

or use metallic pads. But it occasionally happens even with common asbestos-based pad materials.

Incidentally, I always recommend having both discs on the same axle turned to identical thickness. This will prevent one disc from running cooler and pulling or wearing differently.

Was the mechanic able to tell if your brakes really needed to be machined just by looking? If the surface was sharp-edged, yes.

Soft Pedaling

While coming down a hill outside Greybull, Wyoming, I had a very frightening thing happen. I was towing a 26-ft. trailer with my 1983 F-250 pickup. Halfway down the hill, even though I was being careful to leave the truck in SECOND and not use the brakes, when I went to pull off and stop for a while, the

pedal went absolutely to the floor. I managed to stop by applying the trailer brakes.

The front brakes were smoking, but no fluid was leaking. The pedal still went to the floor with absolutely no resistance, but after 20 minutes or so began to improve.

After 30 minutes, they were fine, and we returned home with no problems.

No one can tell me what happened, or how to keep this from happening again.

DONALD HAMLIN
BOTHELL, WA

Donald, you boiled your brake fluid. Apparently, even the careful braking you were doing was enough to build up a lot of heat in your calipers. And once the brake fluid boiled, there was no chance of developing any pressure until the heat had dissipated 30 minutes later. So that's why. Here's how to keep it from happening again.

You were on the right track by downshifting and braking carefully rather than riding the brake pedal—this will keep temps down.

But what most people don't realize is that brake fluid is hygroscopic—it absorbs water from the atmosphere. And the more water it absorbs, the lower its boiling point. Your truck probably had the original 7-year-old brake fluid in it, as few people replace brake fluid unless there is a problem.

Get your hydraulic system flushed and refilled with DOT 3- or DOT 4-approved brake fluid. Use a freshly opened can, and be sure to pump out all the old fluid. Don't use the racing-type fluids—they have higher boiling points, but are much more prone to absorb moisture.

Some people recommend
[\(Please turn to page 48\)](#)

It's not what you say, but how you say it.



The approach of Father's Day can bring about all kinds of emotions. Even panic. And that can result in a hastily chosen tie or bottle of cologne.

While no gift can say it all, one that shows a particular thoughtfulness might come closer to expressing how you feel. The Braun shaver is such

a gift. Every aspect of it has been meticulously thought through.

Its thin profile is designed to fit the face as comfortably as the hand. The rubber knobs provide a firm hold as well as quiet motor noise (a thoughtful feature for early morning).

Its three position switch

ensures a precise shave.

Slide it into Position One and the shaver, with its platinum-coated foil, glides comfortably over the face.

Position Two combines the trimmer with the foil to cut long, awkward hairs under the chin.

And Three extends the trimmer above the foil to trim

mustaches and sideburns.

This approach produces a closer, smoother shave. And that has made Braun the best-selling foil shaver in the world.

Proof that a little consideration goes a long way.

BRAUN

Designed to perform better.

silicone-based synthetic fluids. They don't absorb water at all, and have very high boiling points. However, I've had trouble with them, and you really should completely rebuild or replace the entire brake hydraulic system to change over.

I recommend changing brake fluid every two years, or more often if you tow or live in a very humid climate.

Calling Interference

I connected a CB radio to the radio antenna on my Corsica by means of a connector that I purchased for that purpose. Now I have a lot of static from the car's engine in the radio's AM band.

Is there any material I can use to shield the connector and antenna wires, and eliminate the problem?

DONALD MORTON
AUBURN, WA

Take off that connector, reattach the car's antenna to the radio, and get a separate antenna for the CB.

The interference isn't entering through the connector—it's shielded. It's partly an impedance mismatch, and partly noise from the ignition coming into the antenna lead from the CB rig, which operates at much higher frequencies and isn't intended to deal with ignition noise in the AM radio band.

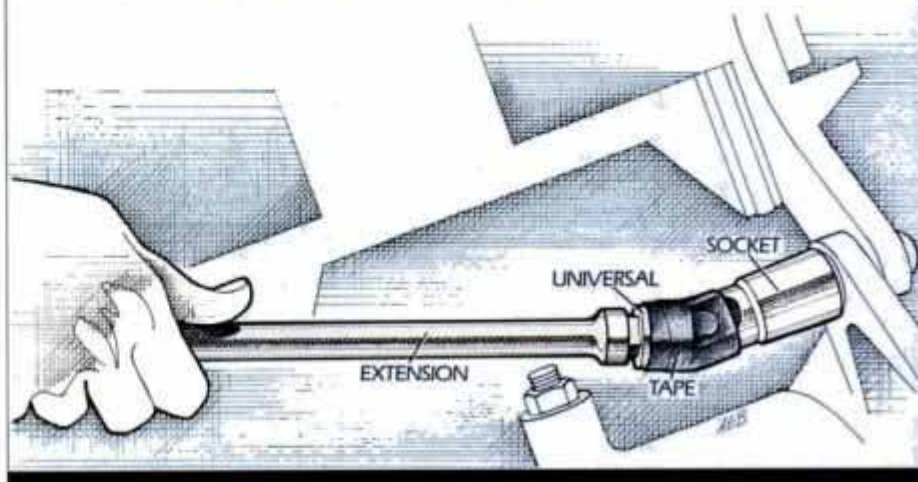
A Turn For The Better

You're installing a sparkplug, say, or a teeny little nut way back in some forsaken corner of your car. You've managed to get the thing started by hand, finally. And after taping the skin back onto your knuckles, you reach for a real long extension to turn it the rest of the way down. Hmmmm—it's not a straight shot, requiring a universal adapter.

But your universal has been around long enough to make itself as supple and compliant as a noodle. It droops. And there's no room for both the extension and your bloody, torn fingers to start the socket over the nut.

Don't panic. Use tape. Put a couple of turns around the universal, which will make it stiff enough to do the job without making it too stiff to swivel the necessary amount.

Used up all the tape on your knuckles? Try a rubber band.



PM ILLUSTRATION BY ADOLPHE BROTMANN



Your Corsica uses radio-suppression ignition wires already—there's nothing to be gained by further trying to quiet the engine wiring. Also, the CB will be much happier with this arrangement, as the car antenna is poorly suited for use at those frequencies.

Dial "O" For Overdrive

I'm confused about 4-speed overdrive transmissions. In the city, should I use the D instead of O, or just keep it in O all the time?

J. ANZALONE
BUFFALO, NY

Leaving the gear selector in D, in most transmissions, locks out the Fourth gear completely. This will prevent a certain amount of busyness in the transmission's shifting while in traffic. It will also improve driveability, as the trans won't have as many downshifts to make when you nail the gas for a brief burst of speed.

If the busyness bothers you, or if you find driveability improved around town, then use D around town and O on the highway. You won't see significant changes in either the drivetrain's longevity or fuel mileage in either case. Just be sure to use O on the highway.

And if you're used to using O full-time, and you're not sure if you'll remember to shift to O after using D—if this whole

explanation seems like splitting hairs—just use O all the time.

Oil's Well

My 1980 VW bus developed a very hard-to-start attitude. I had the oil changed last week—and now it's fine. I know the fast-lube shop didn't change anything except the oil and a leaky valve cover gasket, because I watched.

Why would changing the oil make it start instantly? The mechanic there says he has no idea.

REBECCA GLASER
MIAMI, OH

It's not the oil at all. A leaky valve cover gasket will let excess air into the PCV system, which dumps into the intake plenum after the fuel-injection's metering box. The metering box tells the injectors to inject just enough fuel for the air it's metered—and the leaked air makes the mix way too lean to start.

This will also make your bus not start if the oil filler cap is left off, or if you forget to replace the dipstick.

FM

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

■ Acura TSB 88-019 is intended to discuss paint problems on Integras, but it applies to most modern cars as well. The TSB details the removal of iron-based industrial pollution from painted surfaces using an industrial cleaner. The procedures discussed are substantially different—and mutually incompatible—with those for dealing with acid-rain spotting.

■ Toyota Tercels, Corollas and Camrys equipped with manual transaxles do not necessarily require replacement of stopper-type engine mounts simply because the webs in the mount are broken. The webs are only for ease of assembly, and don't have any function. Adjustment of the mounting bolts may cure excess noise or vibration. TSB 04-28-89.004

■ Owners of 1984-88 Ford products that use a MAX-ADD style of dipstick should check TSB 88-8-89. The MAX line represents an upper limit of ½-quart overfill, not the recommended fill quantity. Use the quantity of oil recommended in the owner's manual—don't just fill to the mark.

■ 1987-88 Chrysler fwd cars and vans with the 3.0L Mitsubishi engines may have trouble with the throttle plate sticking in extremely cold weather. Moisture builds up on the throttle plate, and it may require excess force to break it free first thing in the morning. TSB 18-01-89 covers installation of PN 4419456, which will convert the intake system to use heated, drier air.

How would it feel attacking dry washes, instead of merely surviving them? To literally plow through mud pits, rather than circle them? It would feel like a new Mazda 4x4 Truck.

You'd feel the brute strength of a 2.6-liter engine. The stopping power of a rear Anti-lock Brake System. And the protection of a 36-month/50,000-mile "bumper-to-bumper" warranty.* The best basic warranty in the truck

business. In short, you'd feel in total command.

Now introducing the Mazda Value Pack. Twelve extra features at no extra charge.

Such as cut-pile carpeting and a rear

VALUE PACK

bumper. Plus, cash back for a total savings of up to \$1,779 from Mazda, depending on the model you choose.** So head to your

Mazda dealer for the toughest off-road vehicle you can drive, without going through boot camp.

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IT JUST FEELS RIGHT.™

Vehicle shown is SE-5 4x4. *See your Mazda Dealer for limited warranty details. **\$800 cash back on 4x4s or \$1,000 cash back on 4x2s, plus SE-5 option package (\$479 value) or LE-5 option package (\$779 value) all from Mazda at no extra charge. Offer ends soon. See dealer for details. © 1990 Mazda Motor of America, Inc.

SOME HAVE OUR FLAVOR.

SOME OTHERS HAVE OUR PRICE.

THAT PRETTY WELL SUMS IT UP.



Taste and Compare!

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

© Philip Morris Inc. 1990

17 mg "tar," 1.1 mg nicotine av. per cigarette by FTC method.

LIVING LEGENDS

Restoring World War II vintage planes is an investment in history.

BY FRED MACKERODT, Contributing Editor

KISSIMMEE AIRPORT, 12 miles southwest of Orlando, is unique among the many World War II airfields that dot Florida. Built in 1942, it served as a training base for America's first Stealth airplane, the P-61 Black Widow night fighter. It is, thus, somewhat ironic that although no flying P-61s exist today, Kissimmee

Restored to mint condition, this P-51 is among the fastest piston planes ever to fly.

is still home base for a lot of other operating World War II aircraft.

The airfield is the location of Reilly Aviation and one of the world's finest collections of WWII warbirds, both flying and in the process of restoration. Tom Reilly moves like a man with a mission. It is difficult to tell whether this frenetically active 47-year-old possesses the company with his name on the door or it possesses him.

The human dynamo cautions, "Watch your head," as he ducks under the bomb bay of a Consolidated B-24J Liberator bomber and hauls himself up into the cockpit. I had been told that it was this particular restoration—which is a legend in warbird circles—that did the most to establish Reilly's reputation as

LIVING LEGENDS

the world's leading rebuilder of flying warbirds. It is the only fully restored flying B-24J in the world. "Took 97,000 hours to rebuild," says the slim entrepreneur, as I struggle into the left seat and begin to fondle the throttles which first fed power in 1944 to the airplane's four 14-cylinder, 1200-hp Pratt & Whitney radials. The flight controls, like the rest of the airplane, look no more than a few months old. "It's probably worth a couple of million today," Reilly says of the 37,000-pound behemoth, "but as history, it's priceless."

He motions for me to look out the side window and down at a vacant space on the right wing where the number two engine is supposed to be. "We're swapping out that engine right now," he says. "She'll be leaving for California soon." Reilly says that the B-24 flies 200 to 300 hours a year between air shows, trundling around the country at a sedate 165 mph. It was originally certified with a 290-

mph top speed. "We never push these engines full-out," he says. "There's no point." No sooner do I get comfortable in the cockpit of the bomber than Reilly is rushing me back down through the bomb bay and into the Florida sunlight. "Watch your . . . Oops!" he says, a split second before I smack my head on a bomb rack. As we emerge, a brightly polished North American P-51 Mustang, with "Crazy Horse" lettered prominently on its cowl, fires up on the ramp, its 1490-hp Rolls-Royce Merlin engine thundering in anticipation. "He's going up for a hop around the patch. Gets \$1250 an hour for rides, but that's probably near what it costs him. It's tough to make money in this business. You've got to love it." It was a ride in another Mustang 18 years ago that originally hooked Reilly on warbirds.

Motioning for me to follow, my guide charges across the ramp, jumps on an airport tug, di-

rects me to sit next to him, and begins to push a North American AT6 trainer back into the hangar to fill the space recently vacated by the liberated Mustang. The "Harvard" was the primary training aircraft in the '40s.

A hangarful of history

"I like to keep the hangar full," Reilly says. "Give the folks lots to see."

The Reilly Aviation hangar is only part museum. All of the planes in it that aren't being actively restored are flown regularly.

"Hear that?" Reilly asks, jumping off the tug and pointing to the back of the shop where a rivet gun is loudly chattering away reassembling the firewall of an F4U Corsair fighter. "The visitors love to know that they're here



B-24 LIBERATOR

P-40E WARHAWK



P-47 THUNDERBOLT



F4U-1D CORSAIR



P-38 LIGHTNING



PHOTO BY MICHAEL O'LEARY

PHOTO BY BILLY DAVISON

PHOTO BY MICHAEL O'LEARY

10

BY BILLY DAVISON

where restorations are actually going on," he says.

Moving purposefully ahead, Reilly points up at a ponderous-looking Grumman TBM Avenger, a huge 3-seat, single-engine, torpedo dive bomber. Even though the carrier-based airplane's huge wings are folded demurely back against its sides, the airplane is no less imposing. "The TBM is the plane George Bush flew as a kid in the war," Reilly says. "Pretty big handful for a 19-year-old, wouldn't you say?"

Walking in front of a North American T-28, a '50s tricycle gear trainer, Reilly calls attention to a puddle of oil under the engine. "Great feature of the round engines," he says only half in jest. "If they're not leaking, you know they're out of oil."

He introduces me to the previous owner of the T-28, a 46-

year-old surgeon who is standing next to the airplane in the hangar. I ask why he sold the airplane. "I'm buying a T-33 this weekend," the doctor says, referring to Lockheed's 2-seat version of the F-80 Shooting Star. Why does he fly warbirds? "It's a challenge," he says, "a very serious business. When you do it right, you become one with the airplane and there's nothing else in the world to equal that feeling." I ask about the expense. "Oh, the T-33 will burn 250 gallons per hour but, really, money is no object when you're talking about these things. If you're lucky enough to be able to own one, then you have to just jump out and grab the opportunity."

Reilly whisks me away, stopping in front of a B-25J Mitchell bomber which, he explains, is about three-quarters of the way through the restoration process. It is the eighth B-25 Reilly has restored, and the type of medium bomber used in the Doolittle Raid on Tokyo in April, 1942. "Check this out," he says, pointing up at an intricately and beautifully wired junction box on the wing, just freshly restored. Reaching down, he picks up a large and heavy rat's nest of old wiring harness. "This is the original," he says. "All the old wiring goes. We make all our own harnesses."



P-51 MUSTANG

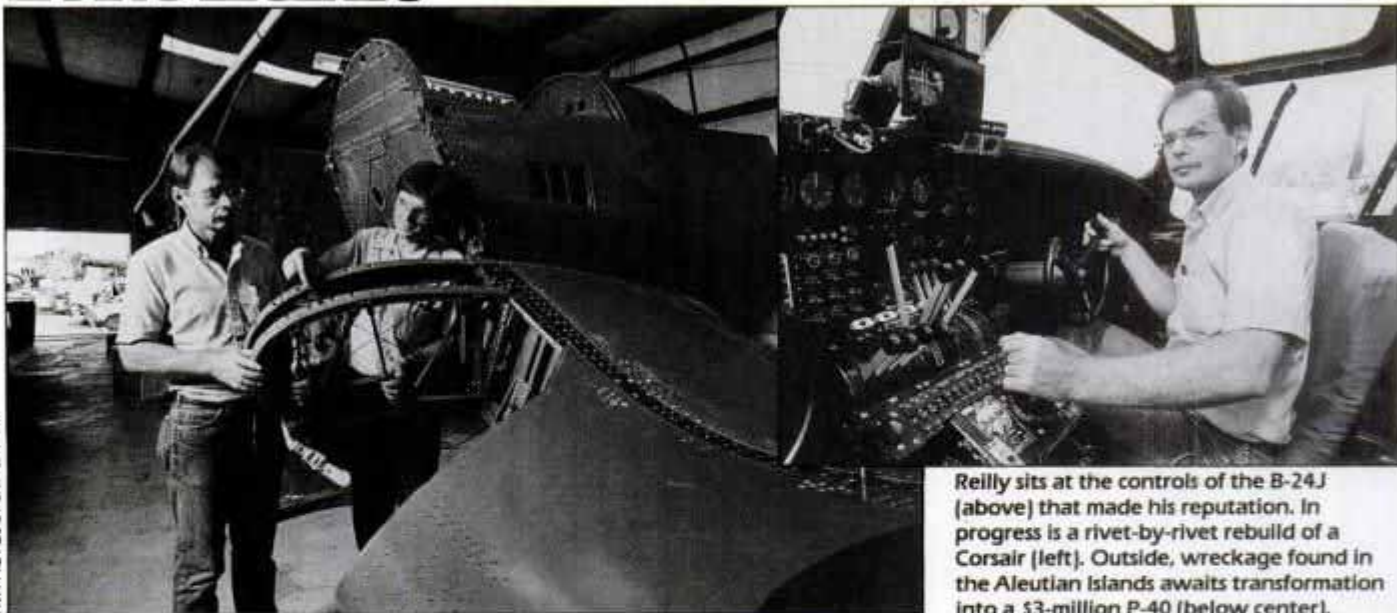


T-33 T-BIRD



T-6/SNJ TEXANS

PHOTOS BY SUP GANDY



Reilly sits at the controls of the B-24J (above) that made his reputation. In progress is a rivet-by-rivet rebuild of a Corsair (left). Outside, wreckage found in the Aleutian Islands awaits transformation into a \$3-million P-40 [below center].

Better than new

Reilly's arm sweeps the hangar. "The planes we restore here are actually better than new when we're finished with them," the ex-New Jersey native adds. "For one, we do much better corrosion protection. The treatments we have today are much better, plus longevity wasn't a prime consideration when most of these aircraft were built. They were made for a purpose—to win the war—and nobody figured that they'd have to last more than a couple of years at most."

He picks up an aluminum aileron. "We delaminate parts like this to check for corrosion. We drill out all of the rivets and separate the individual layers. If there's too much corrosion, we use the old piece as a pattern to make a new one. It's all tremendously time consuming."

Stopping next to the Corsair, which is in the early stages of restoration but already has its distinctive gull-wing configuration clearly in evidence, Reilly uses both hands to heft a big, newly machined piece of aluminum, part of the wing attachment. "This piece probably took a hundred hours to machine. We have to make a lot of parts like this ourselves," he says. "Even if an outside shop were able to do it, they wouldn't. They wouldn't want the liability."

The Corsair is one of the more popular warbirds. During the war, it was referred to as "the cigar" because of its very long engine compartment, which in one version housed the largest engine ever put in a fighter aircraft up to that time, a 3000-hp Pratt & Whitney Wasp Major with 28 cylinders in four rows. "You have to be careful how you add the power to this airplane," says Reilly who possesses a special unlimited LOA (letter of authorization) from the FAA to fly any high-performance, piston-powered



aircraft made. "Put the spurs to it too fast, and it'll take you sideways real quick."

Jet fighters from junk

Next to the Corsair sits one of the last to be built of the '50s vintage McDonnell Douglas TA-4J Skyhawk, a 2-seat version of the famous light jet fighter. The one we are looking at entered service in 1972. At 7700 pounds, it was one of the lightest and most popular jet fighter/trainers ever built. "Look at this," Reilly says, his finger tracing a jagged line going down the freshly green-primed fuselage just behind the cockpit. "This is where the government cut this airplane in half when they junked it. They call the junking process 'de-mil-ing.' We bought both pieces and put them back together." Pausing for a few seconds, Reilly adds, "I guess you could call what we do 're-mil-ing.'"

The government junks the jets to prevent them from falling into the wrong hands, says Reilly, so it's

tough to find examples that can be put back together. He points to a wrecked A-4 sitting on a truck, one of 10 of the type on the premises. "I picked that one up in Pensacola just yesterday."

He sees the jet warbirds as the hot area on the current warbird scene.

Already a lot of the Korean and Vietnam era jets are becoming very difficult, if not impossible, to find. "People are putting them together from parts," he says.

How does a person get into warbirds? I ask. "The Experimental Aircraft Association has a great warbird division," Reilly says, "and the Confederate Air Force also does a great job. Even if you don't have a lot of money to spend, you can volunteer to participate in the restorations or the other activities of the clubs. We have a lot of people doing that here. It's a great hobby. You can get up to your elbows in history."

Reilly rushes out the back door of the hangar and into what looks like a junkyard. Hulks of vintage airplanes are recognizable, but mostly there are just piles of parts. It is a fascinating world where trashy-looking chunks of granulated aluminum are coveted like rare jewels.

"Watch those fire ants!" Reilly cautions, as I step over a log and approach the wingless and tailless fuselage of a gutted PB4Y-2 bomber, the Navy version of the B-24 which was used primarily as a surveillance airplane and for antisubmarine warfare. "A guy lived in this thing in the Everglades for 25 years. It's the only B-24 in the world with a jalousie picture window!"

Risks and rewards

The remains of a burned-out Corsair lie in a heap, its melted engine and contorted prop giving testimony to

(Please turn to page 111)



ZIL LIMOUSINE

RED WHEELS

What does Ivan drive? We lift the iron curtain on the cars of Russia.

BY JIM DUNNE, Detroit Editor

AND I THOUGHT the potholes in New York City streets were bad. They feel like a stretch of brand-new interstate compared to the potholes (or should I say small bomb craters?) that litter the streets of Moscow. I did my best to hang onto the wheel of the bouncing Aleko sedan. Between the holes, the heavy, wet snow, and the possibility of being pulled over by the KGB, I was really having a time of it. The Russians may be picking up on things of the West, but when it comes to inviting journalists to road test some of their cars, they've got a long way to go.

For example, I never did see a test track in my 10-day blitz of test driving five Russian cars. I had to rely on dicing with Russian traffic on public roads—traffic consisting mostly of 12-ton ZIL trucks—and either seat-of-pants or stopwatch-timed runs for acceleration, driveline reaction and chassis behavior. Brake tests consisted of drag racing one of the ZIL trucks for the slot in the next lane and then smashing on the brakes to see if they

would halt the Aleko before the lumbering truck in front did.

Still, in all, I did come away with a strong feel for the Aleko and the other Russian cars I drove while making the rounds of some of the Soviet Union's major car and truck plants.

I found that while many of Russia's



OHTA

car designs are dated—Volga and Lada are two examples—the country is beginning to turn out a modern lineup of subcompacts, minis and vans that approach the design level of small cars built in Western Europe and the United States.

According to current plans, Russian cars will soon be better. That's because their auto industry is tapping Western technology and production knowhow in a massive renewal program. Russian Job One is to build cars of world-class quality. Job Two is to sell a greater number of those cars to the West, especially in Europe. Eventually, in the 1993-1995 time span, according to present plans, you will see the successors to today's Aleko, Samara and Tavrias on streets in the United States.

Aleko 141

Like other modern Russian cars, Aleko is similar in chassis and powertrain to many Western designs. It carries features like front-wheel drive, lefthand steer, disc brakes, 5-speed transmission and hatchback body.

Dimensions are similar to a Dodge Shadow or Ford Tempo, though the Aleko is only offered as a 5-door hatchback. Length is 171.4 in., wheelbase 101.6, and height is 52 in. Front and rear track are a fairly narrow 56.7 and 55.9 in. Aleko's overall design



FM PHOTO BY MARGUS-HANS KLUJSE

LADA SAMARA 2109

appears to be Renault derived, with a longitudinal 4-cylinder engine of 1.6- or 1.5-liter displacement and a light curb weight of 2200 pounds.

Inside are many of the comfort features you see in Western cars, including lean-back front seats and folding rear seats that change the luggage compartment into a spacious cargo-carrying section. Large, round gauges for speedo and tachometer are European style, easy to read and propped directly in front of the driver for quick viewing. A little disconcerting is the hard material that covers the inside of the doors. The instrument panel produces an appearance of Spartan simplicity, almost starkness.

Typical of European low-price cars, Aleko seems underpowered by U.S. standards. Engine revs must be kept high to make best use of transmission ratios. Aleko's manual rack-and-pinion steering is tight, responsive, but at the same time highly sensitive to Moscow's numerous potholes. The steering wheel saws back and forth as the road wheels drop, then rebound.

Overall, Aleko's ride and responsiveness is more like a European car than one of American or Japanese design. For comparison, the ride is firm to the point of being stiff, engine power is borderline low, and the interior lacks the comfort and softness of the more popular cars sold here.

ZIL Limousine

This is the car that caused a sensation last fall when Secretary Gorbachev visited America and spoke at the U.N. He brought along a few ZILs for his short tours of the city. Even without the police escort, the ZIL would have been a traffic stopper.

First thing you notice is the car's

length. Alongside the compact cars that dominate Moscow's traffic, the ZIL looks enormously long. And stately. Its dimensions rival those of some of our own limos. Wheelbase spans 144 in., or 137 for a shorter version, while overall length is 247 in., 226 on the compact. (Lincoln's Town Car, by comparison, has a wheelbase of 117.3 in. and a length of 219 in.)

Under ZIL's hood is a husky 7-liter, overhead-valve, all-aluminum V8, with a 4-bbl. carburetor that develops 300 horsepower. ZIL's unusual 5-speed automatic transmission is Russian-made and moves the 6000-pound ZIL easily at speed.

If you measure by feel, ZIL is solidly built. Doors seem as heavy as those in a small vault, though they swing open easily and close with an impressive thud.

Inside, the front compartment looks like most luxury cars. Leather seats and burl walnut trim are features. Air conditioning, tilt and telescope steering column, electric windows, stereo cassette player and

the gearshift lever atop a center console are familiar to prestige car drivers. A glass partition closes off the rear-seat passengers from the driver.

Driver and front-seat passenger sit in seats that combine bucket-type comfort with La-Z-Boy size. Comfort is the number one goal here, and the ZIL delivers. ZIL's ride is on the soft side, as befits a luxury limo. Critics may even notice a touch of float. But its suspension soaks up Moscow's potholes easily. Riders feel neither the shudder nor shock that shake Russia's compact sedans. On turns, however, the whole body rolls severely.

ZILs have never been sold to private persons, but that may change soon.

Lada Samara 2109

We tested the Samara by making straightline acceleration runs down the wide, mile-long avenues in Togliatti where the car is built. Zero-to-60 mph runs were clocked by stopwatch, and run with green engines, so elapsed times are close esti-



FM PHOTO BY MARGUS-HANS KLUJSE

TAVRIA



ALEKO 141

PM PHOTO BY MARGUS HANS KLUGE

mates at best. On the plus side, the roads were dry and flat level, and the contribution of wind speed was negligible.

Best acceleration time to 60 mph from a standing start was in the 16-second range, an indication that the 1.6-liter Four is a bit small for U.S. driving standards. Lada executives are aware of the performance demands of U.S. drivers, and plan to have a more competitive car ready for U.S. sale before 1995. Still, with a curb weight of 1980 pounds, the Samara design is on the right track toward good performance and fuel economy.

Offered with front-wheel drive and 5- or 3-door body, Samara could fit right in with the smaller sedans you see running in Western European capitals. Its dimensions of 157.8-in. overall length, and 96.9-in. wheelbase are slightly shorter than those of the Plymouth Horizon. Interiors are laid out to be flexible. The rear seats swing down to the floor to convert the rear compartment into a large load area.

Oka

Smallest of the group of modern Soviet cars, Oka is a special vehicle, designed to fill the needs of low-income buyers, and also to serve as transportation for handicapped citizens. At 3750 rubles, or \$6000, Oka is less than half the price of the Samara, and well within the reach of Togliatti workers.

Oka is just getting up steam in the production line, but it should soon be one of the most common new cars on Soviet roads. Built in a tiny 3-door hatchback design exclusively, the car is powered by a 2-cylinder engine, and has front-wheel drive. Overall, the



2-CYLINDER OKA

PM PHOTOS BY JIM DUNNE



Tiny 3-door Oka has a 2-cylinder engine. Talk about basic transportation.

car is a simple execution of a design intended to be purchased by most Soviet workers. Its interior is small by most measurements.

Despite the car's light weight, it will only accelerate to 60 mph from a standing start in 20 seconds. This is not a car for export, but a specialized design to meet special market needs in the U.S.S.R.

Tavria

A catch-as-catch-can test drive on Moscow's snowy nighttime streets was my introduction to Tavria, a Festiva-like, 3-door hatchback that is one of the newest high-production cars in the Soviet lineup.

Even with four adults aboard, Tavria accelerated briskly through its four lower gears (I never got going fast enough to try overdrive). Steering through the rack-and-pinion connection was direct enough to jerk the steering wheel as the car passed through the potholes.

Tavria is considered a small family car, but one that furnishes a number of items that place it above the basic transportation class. Major dimensions are within an inch of those of the Honda Civic. Overall length is 146 in., while wheelbase is 91.4 in.

Chassis design is similar to those found in most small cars. Brakes are disc/drum, while the suspension uses MacPherson struts in front and a solid axle with coil springs in the rear. And the car is fairly quiet.

Tavria is designed for young persons choosing a first car, the kind of vehicle "indispensable for people who travel to and from work," according to a Soviet brochure.

PM

BASS



BY JOE SKORUPA,
Boating/Outdoors Editor
PM Photos by Tom King

THESE ARE THE bad ol' boys of bass. The bubbas named Hoot and Hank and Skip and Ty. They drive semicustom Suburbans and tow matching, tandem-axle trailers. Their boats are embedded with enough metalflake to blind a man not wearing polarized sunglasses. And they're equipped with the biggest powerhead the transom will hold.

We're talking ultimate bass boats here, son. Tournament rigs. The fastest flat-water performance hulls on the market. You know which boats I'm talking about—20 ft. long, equipped with 200-hp outboards

(Evinrude XPs), jack plate, 4-blade prop, three batteries, dual-aerator livewells, trolling motor, multiple sonar units, immense fuel cells and lockable storage for more rods and reels than you can afford to buy.

PM brought together five of these ultimate rigs for a shootout at the Butler chain of lakes in Central Florida. We went over the boats with a fine-tooth comb, wrung out the last rpm we could find, and even did a little fishing. The test produced a winner, but each of these boats is a fine choice in itself. After a little high-tech tweaking, each cracked the 70-mph barrier and proved to be a true assault weapon for catching fish.

Hydra-Sports DV 225

Bragging rights for this year's top bass attacker go to the new DV 225

from Hydra-Sports (our test boat was hull number one). Unofficially nicknamed the "Big Banana" because of its bright yellow gelcoat, the DV 225 blistered the water in hole shot and top speed. Fishability, due to ideal layout and numerous sport-specific features, was second to none.

Fit and finish on all Hydra-Sports models is top-notch and this one is no exception, right down to the color-matched, tandem-axle trailer with blue-anodized modular wheels. Some of the noteworthy detail work includes: recessed fore and aft cleats turned inward, deep-lipped aluminum hatches, plush glasswork in hull, adjustable bucket seats, radio/cassette unit and OMC remote ignition.

Fishing features are numerous and begin with a single-console layout that has plenty of cockpit space to place open tackle boxes during the heat of battle. Others include: in-dash sonar, bow sonar recorder, air induction system for large recirculating livewells, and immense, raised casting decks.

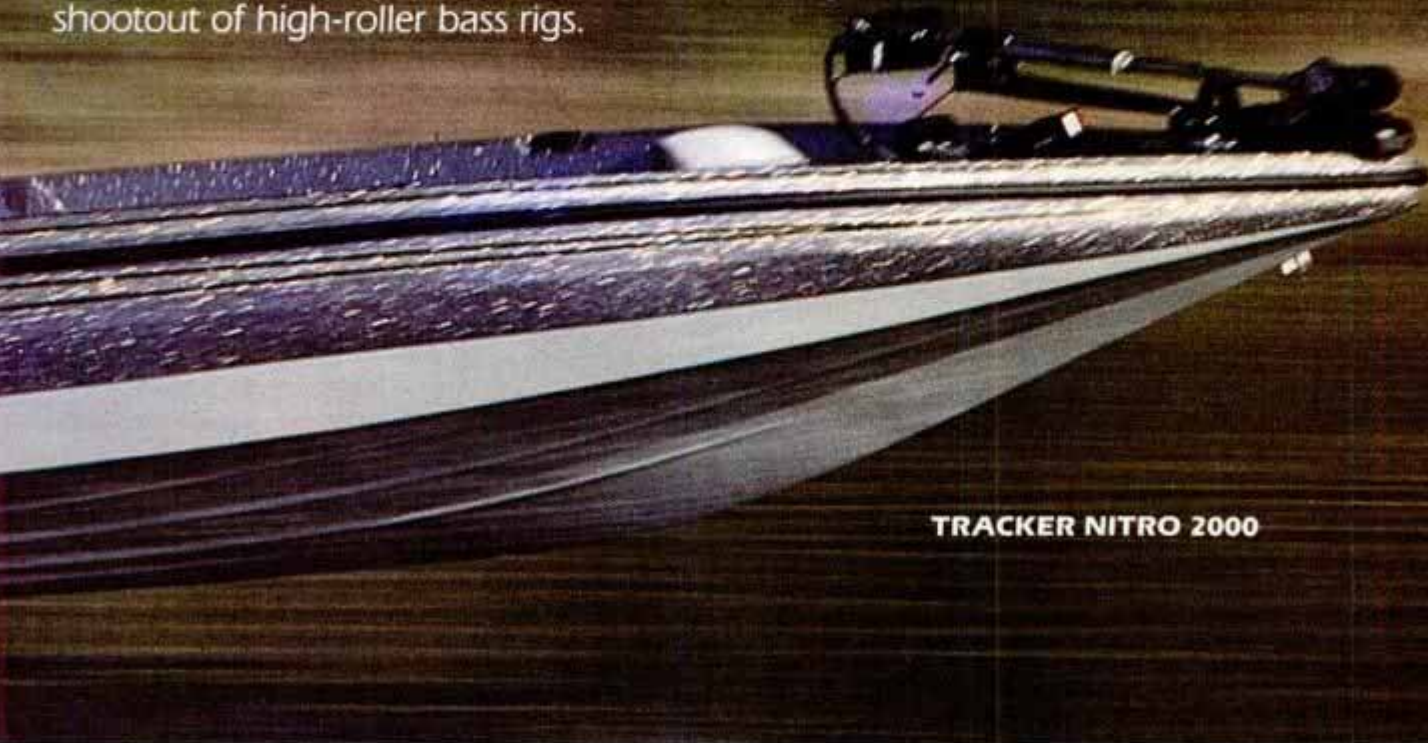
About the only glitch we could find had to do with handling during wheel-lock turns, which was poor due to a high jack-plate setting. But this setup—using a 27-in. OMC Shooter prop—worked well in straight-ahead, flat-water tests. To get better prop bite for improved handling and rough-wa-



HYDRA-SPORTS DV 225

BLASTERS

Warp speed and fishability converge in a 5-way shootout of high-roller bass rigs.



TRACKER NITRO 2000

ter performance, you can always drop the drive unit deeper into the water.

Skeeter 200 SX

The sport-specific design of Skeeter's new 200 SX elevates the concept of tweaking to a fine art. In addition to being the fastest boat in the fleet (tied), it was also voted best-dressed by the test team for an outstanding level of fit and finish.

The 200 SX may appear like a standard, single-console bass rig, but look closely. Two separate livewells have induction jets to add fresh air to the recirculating water and night lights, too. Aluminum hatch lids are lined with insulation to prevent build-up of condensation. Four are equipped with pneumatic lifts. Beneath the wide cockpit bench is a dedicated spare-prop box and pedes-

tal seats have removable padding (liner is attached with Velcro) to aid drying and avoid rot.

Other features of note are a recessed rubber bow pad with grip studs, two large lockers holding 36 rods and reels each, padded dash, jack plate and a tandem-axle trailer with mag wheels, radial tires, center roller, Bearing Buddies and a unique bow locking pin. To further emphasize a top-of-the-line approach, the boat came with two leading-edge Lowrance LMS-200s, units that interface sonar and loran functions.

Two items you can't see are also noteworthy. The hull has a balsa-reinforced running pad and the transom features directionally laid glass set along stress lines. To the test team, this is a boat without glitches. A prop swap might improve hole shot, but

few fishermen need a boat that goes any faster.

Cajun Grand Prix TX

The assault weapon of the fleet is the new Cajun Grand Prix, with a new-concept layout that has a center-mounted cockpit and enough raised deck area to land an F-14 Tomcat.

This boat is unique in several ways. The walkaround deck and small, 2-man cockpit produce fleet-leading casting area and the only fully protective windscreen, which performs an important function at 70 mph.

Another unique feature is a mid-mounted gas tank. Most bass boats favor aft mounting. The test team was divided on this decision. On the one hand, it resulted in bow-down hole shots for improved visibility and fleet-leading handling in corners and rough water. On the other hand, a few mph were lost on top end, although no jack plate was used.

Some features we liked include fore and aft livewells, in-dash sonar, bow sonar recorder fixed to reversible hatch lid (flip it over to store), map storage box beneath dash, fore and aft recessed cleats, Lifetime Transom (50-year limited warranty), and Trailboss tandem-axle trailer with chrome wheels and Bearing Buddies. A radio/cassette unit was also included.

The Lifetime Transom deserves



CAJUN GRAND PRIX TX

BASS BLASTERS



SHADOW 210 V

special mention. It's an aluminum grid filled with a glass and resin mixture sandwiched between layers of glass. It could probably withstand a direct mortar hit and is a good example of the kind of leading-edge design thinking that goes into a Cajun boat.

Tracker Nitro 2000

Nitro is a good name for a boat that scorches water like its engine is running on racing fuel. Our Tracker Nitro, which comes from a company renowned for affordability, ran with a very conservative set up (no jack plate) and still led the fleet in top-end speed (tied). It was among the leaders in hole shot, too.

And yet, this is actually a hybrid boat for 2-income families. Dad gets a screamer with loads of rod storage, dual aerated livewell and dedicated tackle-box space, while mom gets a protected twin-console cockpit with an option to add snap-on foredeck pads for extra seating. Hard-core bassers may not want a second console, which is an obstacle that eats up deck space, but the Nitro 2000 is so solid in other areas that it works as a serious fishing machine *and* as a compromise for the second wage earner.

A few of the features we especially liked are the aluminum hatch lids, in-dash sonar, built-in water temperature gauge, bow and helm sonar

recorders, compass, pH and water-clarity gauge, removable aft hatch for access to batteries, oil reservoir, aerators, Trailstar tandem-axle trailer with mag wheels and the lowest price tag of the fleet.

Shadow 210 V

The dark horse of the fleet is the new 210 V, made by small, Kentucky-based Shadow. Not only did this bass battler keep up with the better-known names, but it distinguished itself in hole shot, top-end speed and several fishing categories.

This is a genuine state-of-the-art tournament rig with sound fundamentals—single-console layout,

TEST PARAMETERS

Speed and timing data are result of runs with two riders and matched fuel loads. Solo top-end figures achieved with single rider and change of prop and/or engine height. Top-end ranking is average of solo and double-rider figures. Chart begins with bold number indicating rank.



OVERALL RANKING/MAKE/MODEL	1. HYDRA-SPORTS DV 225	2. SKEETER 200 SX
LOA/Beam/Weight/Fuel Capacity	20'2"/96"/1500 lbs./50 gal.	19'7"/91"/1275 lbs./44 gal.
Top End Double/Solo	2. 69.0 mph/72.0 mph	1. (tied) 73.1 mph/75.0 mph
Acceleration 0-35 mph	1. 5.8 sec., straightahead screamer	4. 8.0 sec., prop swap might help
Deck Area Raised/Cockpit	2. 69.65 sq. ft./13.83 sq. ft.	3. 63.8 sq. ft./18.6 sq. ft.
Livewell Volume	3. 45 gal., two separate wells in stern	4. 31 gal., two aft compartments
Rod Stowage Space	4. 13.44 cu. ft., big single locker	2. 18.46 cu. ft., two separate boxes
Dedicated Stowage Space	4. 14.4 cu. ft., large livewells cut into space	3. 15.04 cu. ft., ice chest and prop box included
Fishability	1. (tied) Single-console layout, large casting areas	1. (tied) Single console, air jet in livewells
Fit and Finish	1. (tied) Super glasswork, trailer, recessed cleats	1. (tied) Superb seats, hull and trailer
Price	\$20,900	\$21,000
Address	Hydra-Sports, 100 Oceanside Dr., Nashville, TN 37204, (615) 385-3652	Skeeter Boats, P.O. Box 230, Kilgore, TX 75662, (214) 984-0541

Boats equipped with 90° V8 Evinrude XP 200 designed especially for high-performance bass boating.



Plush bucket seat is adjustable. Copious leg- and knee-room. Remote ignition. No windscreens.



Unobstructed sightline of gauges. Note folded-down Ioran antenna for interface with sonar graph.





SKEETER 200 SX

stepped hull, planing pad, jack plate, 3-across bench seat, handy locations for electronics, and affordability.

The 210 V was the only boat with a foot throttle, allowing the driver to keep both hands on the wheel at 70-plus mph. This feature, plus a well-behaved hull that handles corners at speed, made the Shadow a fleet leader in overall handling. Other outstanding features are cockpit-level tackle-box storage with tie-down hooks, removable flipping deck (optional), trim controls on steering wheel and drive control, fore and aft cleats, and well-placed grab handles.

Hull construction is another Shadow strong point. The stout transom is

made of a solid piece of 2 $\frac{3}{4}$ -in. mahogany, the planing pad has a balsa core and the hull and deck are through-bolted then glassed together. These boats are built to last and Shadow appears here to stay.

The muscular Evinrude XP 200 is the main reason all five test boats cracked 70 mph. This 200-hp, loop-charged powerplant, designed specifically for bass boaters, comes with race-type engine mounts and is designed for high rpm. Overheat protection and variable-ratio oil injection help the 90° V8 powerplant run near the 6000-rpm redline, where all the rigs wanted to be. This was especially true when we turned the reps loose to

dial in their rigs for solo rider top-speed runs. (PM's standard method is to run with two riders.)

Top-of-the-line bass boats, today, are highly developed creatures, so much so that trying to find differences in fit and finish, construction, fishability, deck area and stowage is like splitting hairs. Several top names in the field, in fact, refused to participate in our test because the boats in our fleet are nipping at their heels and comparison-testing was considered potentially threatening.

If warp speed and sophisticated sport-specific design get your adrenalin flowing, then one of these bass blasters is the boat for you. **PM**



3. CAJUN GRAND PRIX TX

- 19'6"/94"/1500 lbs./44 gal.
- 4. 65.9 mph/70 mph
- 5. 8.4 sec., forward fuel tank slows it down
- 1. 74.19 sq. ft./9.56 sq. ft.
- 1. 53 gal., two separate units, fore and aft
- 3. 16.71 cu. ft., three boxes
- 2. 16.14 cu. ft., generous, unique map box
- 2. (tied) Huge walkaround casting, flipping deck
- 2. (tied) Hideaway bow sonar, Lifetime Transom

\$20,000
Cajun Boats, Box 333, Route 3, Winnsboro, LA 71295, (800) 873-2628

Wide dash on center console. Fleet's only protective windscreen. Immense glovebox.



4. (TIED) TRACKER NITRO 2000

- 20'/93"/1550 lbs./50 gal.
- 1. (tied) 72.6 mph/75.5 mph
- 2. 6.4 sec., fast even with conservative setup
- 4. 61.59 sq. ft./19.86 sq. ft.
- 5. 30 gal., single divided livewell
- 1. 24.97 cu. ft., the fleet leader by far
- 5. 14.37 cu. ft., adequate, emphasis on rod boxes
- 3. Good, but second console not for everyone
- 2. (tied) Deep-lipped boxes, grab handles

\$18,190
Tracker Marine, 1915-C S. Campbell, Springfield, MO 65807, (417) 882-4444

Well laid out instruments and gauges. But knee-room is somewhat tight for tall drivers at both consoles.



4. (TIED) SHADOW 210 V

- 20'8"/93"/1275 lbs./45 gal.
- 3. 68 mph/72 mph
- 3. 6.5 sec., excellent speed and handling
- 5. 59.33 sq. ft./21.53 sq. ft.
- 2. 46 gal., two wells aft
- 5. 12.18 cu. ft., single port box
- 1. 16.31 cu. ft., no opportunity missed
- 2. (tied) Single console, flipping deck
- 3. Piano hinges, aluminum hatches

\$19,500
Shadow, P.O. Box 1370, Corbin, KY 40702, (606) 528-0110

Foot throttle. Trim buttons on wheel and drive control. Plenty of leg- and knee-room for short or tall drivers.



DIESELS ARE

Diesel-powered cars are on the rise once again—with some new twists.

BY JIM DUNNE, Detroit Editor



IF YOU THINK it's hard making a Chevy believer out of a Ford enthusiast, that's nothing compared to convincing a diesel enthusiast to switch to gasoline power. Diesel fans are a hard-core bunch indeed, and they've been watching the decline in recent years of the number of cars that have been available with their beloved oil-burner.

But just when it looks like the diesel is down for the count, this industrial-strength engine is on the verge of a comeback—and without the traits that many found objectionable. Helping to pave the way are tough new emissions laws and fuel-economy



Back on the diesel track, Mercedes-Benz has introduced two new models—the 6-cylinder 350SDL Turbo and the 5-cylinder, 2.5-liter 300D Turbo (engine shown above). Redesigned prechamber improves combustion and reduces emissions.

standards being thrashed out in Washington. Diesels get excellent fuel economy, and new technology has tamed their emissions—including particulates.

Spearheading the new wave in diesel power is Mercedes-Benz, which has just introduced a pair of diesel sedans, the \$39,700, 5-cylinder, 2.5-liter 300D Turbo and the \$56,800, 6-cylinder, 3.5-liter 350SDL Turbo, that will convince shoppers that diesels can be quiet, quick and free of noxious exhaust odors.

In test drives, we found that the new engines have all but eliminated diesel odor and noise, even when idling along in stop-and-go traffic. Acceleration, with

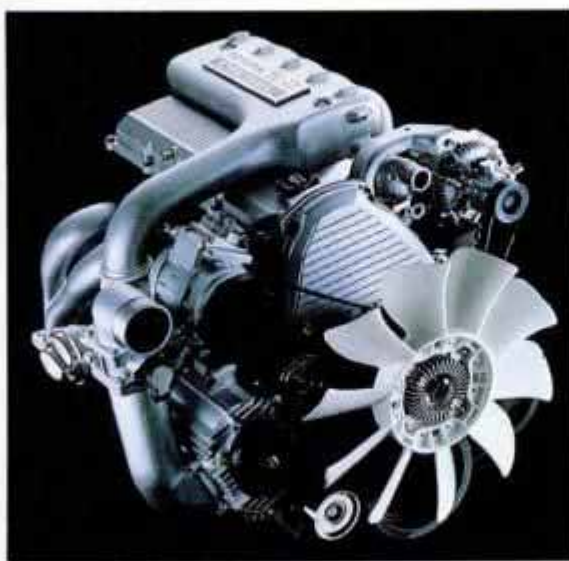
BACK!



the turbochargers kicking in at low engine speeds, is strong and smooth with none of the on-off acceleration you get with many other turbos. Zero-to-60 times may not be in the sports car class, but they will cut through the 12-second barrier.

Passenger compartment noise is little different from cars powered by gasoline. Except for a louder noise during hard acceleration, the average passenger won't notice the difference. Vibration levels inside the diesel cars are similar to gas versions.

Fuel economy is outstanding. The 2.5-liter, 5-cylinder engine averages 34 mpg in combined city/high-



Toyota's experimental 2-stroke S-2 diesel has twice the number of power strokes as 4-stroke diesels. Vibration at idle is said to be less than one-fifth that of a 4-stroke powerplant.

way driving while the 3.5-liter Six gets almost 26 mpg on the average, on the EPA test cycle.

Mercedes diesels use indirect injection of fuel into the cylinders. The fuel is mixed with air in a prechamber where it ignites from the heat of earlier combustion or from a glow plug. The fuel-rich prechamber mixture expands into the air-rich main combustion chamber where it burns more completely. Compression ratios of up to 22-to-1 give the diesel its power and account for the rugged construction of the engine block and head. Gasoline engines usually have compression ratios of between 8- and 10-to-1.

In the Mercedes engines, radical changes were made in the position of the prechamber ports and air/fuel mixing flow, with the main purpose of cutting emissions. To insure firing, glow plugs remain hot for a period after a cold engine is started. The changes result in reduced emissions of particulates (coal-like flakes), hydrocarbons and carbon monoxide.

Other manufacturers

Volkswagen officials foresee a rise in the Corporate Average Fuel Economy requirement by the federal government, and are looking to the diesel as an answer.

VW's Jetta line took on a diesel engine for the first time this year. The Jetta GL is designed for the same type of buyer who wants the Mercedes diesel—fuel economy and durability being foremost concerns—only at a much more affordable price: \$10,495. Fuel economy for the VW is excellent, averaging 40 mpg (EPA) in combined city/highway driving.

Audi is counting on a new engine that is designed with direct injection of fuel into the combustion chamber. The engine is a 2.5-liter, 5-cylinder, boosted with a turbocharger and intercooler. In its largest sedan, the Audi 100, tests show that fuel economy will average 39 mpg when a 5-speed manual is installed. Audi also claims 0-60 mph acceleration times in less than 10 seconds and a top speed of 124 mph. Look for this direct-injection diesel to be on U.S. roads in small numbers within 18 months.

Earlier this year, Toyota displayed an experimental 2-stroke, 6-cylinder inline engine of 3-liter displacement that will be developed in both gasoline and diesel versions. Toyota engineers promise extremely clean exhaust, and quiet operation for the S-2 type diesel engine. The 2-stroke is also a direct-injection arrangement.

Trucks

Unlike the automobile, it is boom time in the light truck diesel field where

DIESELS ARE BACK!

sales of pickups, vans and sport/utility vehicles have been on an upward spiral for the past two years. This year, insiders expect to see even more gains. Here, Ford, Chevrolet and Dodge are the major competitors. Muscular diesels in the 5.9- to 7.3-liter size dominate the scene. They power vehicles that are used for recreation (great for trailer towing where high torque at all speeds is a necessity), personal transportation, construction and farming.

Ford has the largest engine, a 7.3-liter V8 supplied by Navistar. It is no coincidence that Ford is also the biggest diesel seller in this market. Buyers of the Ford diesel pay \$1200 more than the price of its biggest gasoline engine, but that seems no deterrent to sales thus far.

Dodge is a latecomer to the pickup diesel field, but the Chrysler truck di-

vision is straining to meet demand for its turbocharged 5.9-liter Cummins-supplied inline Six. Turbocharging gives the Cummins more power to

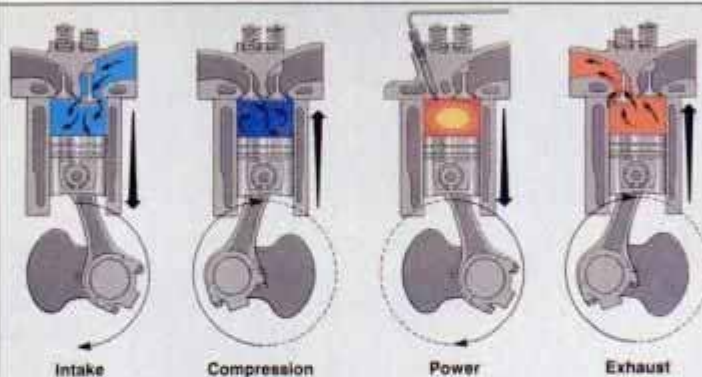
liter diesel V8 that is rated 145 horsepower at 3600 rpm and 225 lb.-ft. of torque at 1900 rpm. It's not as strong as the much larger Ford diesel

V8. GM insiders admit that a bigger diesel engine is needed, but it will be several years before the new 6.5-liter V8 is available to the public. Meanwhile, buyers of GMC Suburbans who opt for the diesel can arrange with their dealer to have the engine turbocharged by Gale Banks Engineering (see "Super Suburban," page 104, Aug. '89).

Emission laws will play a big part in the future of diesel engines. Already, California's emission standards have forced the engine out of showrooms, and federal laws covering all of the states are expected to become just as stringent.

The way things look, there may be many more diesel converts joining the ranks of the hardcore enthusiasts. **PM**

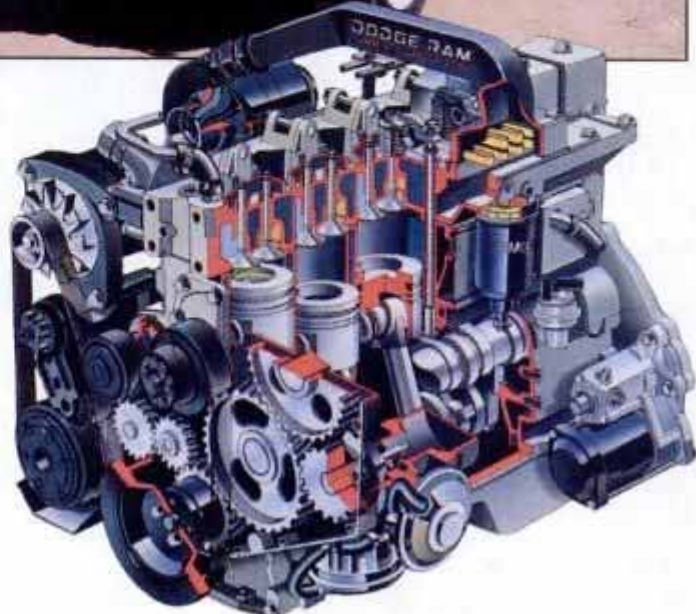
DIESEL ENGINES: HOW THEY WORK



Direct-injection diesel cycle relies on high temperature of compressed air to ignite fuel injected into cylinder.

compete with the Ford even though it's a liter smaller in displacement.

Chevrolet and GMC sit right in the middle of this light truck diesel lineup. The GM divisions both offer a 6.2-



Detroit's Big Three all offer diesel power for their pickups and Suburbans (clockwise from top left): GMC Suburban, Ford F-350, Dodge Ram D-350, Cummins 5.9L 6-cylinder turbodiesel for the Dodge, GM 6.2L V8 diesel and Chevy's K1500.



NISSAN 300ZX

Does everything it's supposed to—and more.

BY MICHAEL LAMM; PM Photos by Rich Cox

NISSAN HIT a grand slam home run with its original Datsun 240Z in 1970. And did it again with the current 300ZX. The company went back to the car's roots in creating the new Z-car as a true sports machine. The original 240Z was a lithe, refined sports car that quickly made its mark as one of the best all-around 2-seater packages of its day—and for just \$3596. Nissan freely admits that subsequent incarnations of its Z-car drifted away from the focused intent of the 240Z, holding more appeal for Disco Dans than real sports car enthusiasts. The newest 300ZX, in both 2-seater and 2+2 versions, definitely gets the car back with the program.

For 1990, the 300ZX delivers even more. The promised twin-turbo, intercooled version has come on stream



Nissan rethinks the Z-car with slick styling from bumper to bumper.

and fulfilled early expectations of 300 horsepower from a beefed version of the normally aspirated, 222-horse, 3-liter, 4-valve V6.

If all this sounds inviting, it's no surprise that the 300ZX has been a runaway seller since it first hit the showrooms. And, according to our

Owners Report survey, most owners went wild when they first laid eyes on this latest rendition. Three-quarters told us they bought the car for its looks ahead of everything else, and 82.6 percent said styling is what they still like best about the 300ZX. Next comes handling at 52.1 percent and then performance at 36.9 percent. Roughly a quarter had owned Z-cars before, and all previous owners agreed that this is far and away the best Z ever.

Rated just about as high was the Z's dependability and workmanship. Of our survey group, 82.5 percent reported no mechanical problems of any sort. People mentioned owning earlier Z-cars for nine, 10, 12 years with nary a problem. That, plus conscientious, caring dealers, kept them coming back.

Even price received a share of

NISSAN 300ZX



praise—a rare event in these days of sticker doubletake. Many owners felt their average out-the-door cost, \$29,011, made the 300ZX a great value for the price. Several pointed out savings of \$3000 over the standard Corvette coupe, and \$4000 to \$13,000 over the Porsche 944 S2. One attorney described the 300ZX as a “poor man’s 928.” (Only 0.8 percent of our respondents had purchased 300ZX Turbos, mostly because we surveyed early buyers, before Turbos became widely available.)

On standards of performance, handling, braking and sheer driving fun and excitement, owners enthusiastically put the 300ZX in a league with the world’s best, regardless of price. Many spontaneously mentioned that the new 300ZX is a head turner and ego booster. A physician mentioned



A better sports car value would be hard to find. Normally aspirated V6 is good for 222 hp, while gear shifter and control ergonomics are rated tops.

that he felt like a celebrity every time he got behind the wheel.

Most owners, too, were up on the high-tech details of their new Z-cars. Several commented on the antilock brakes, even noting the aluminum cal-

ipers with opposed pistons. Others touched on the steering-control benefits of Nissan’s multiple orifices in the hydraulic boost circuitry that make response quick and accurate at the same time. Most conventional power

SUMMARY OF 1990 NISSAN 300ZX OWNERS REPORTS*

Total miles driven	1,324,902	Specific overall likes:					
Average miles per gallon:		Exterior styling	82.6%	Poor	0.0	Good	43.3
With 5-speed manual trans		Handling	52.1	Comfort opinion:		Average	7.9
In town	18.1	Performance	36.9	Front Seats:		Poor	2.8
On the highway	22.9	Power	25.4	Excellent	71.9%	Number of vehicles owned:	
With automatic 4-speed trans		Comfort	20.3	Good	25.3	This car only	15.5%
In town	18.0	Riding qualities	20.3	Average	2.4	Two cars	39.7
On the highway	22.9	Specific dislikes:		Poor	0.4	Three cars	21.0
Transmission chosen:		Poor rear vision	13.4%	Rear seats (2+2 only):		Four or more cars	10.4
Automatic 4-speed	50.6%	Noises and rattles	12.9	Excellent	7.6%	Would you buy a 300ZX again	
Manual 5-speed	49.4	No complaints	12.4	Good	12.7	next time?	
Series chosen:		Air conditioner saps power	8.1	Average	49.4	Yes	79.9%
Standard 300ZX GS	99.2%	Air conditioner	7.2	Poor	30.4	Maybe	18.1
300ZX Turbo	0.8	What changes would you like		Had any mechanical trouble?		No	2.0
Body styles chosen:		to see done?		No	82.5%	Would you buy a different Nissan	
2-place coupe	66.8%	No changes	20.8%	Yes	17.5	product next time?	
2+2 coupe	33.2	Better rear vision	9.1	What type of trouble?		Maybe	41.6%
Major options chosen:		Better stereo value	6.9	Electrical	18.6%	No	33.7
Bose sound system	85.8%	Fewer noises and rattles	6.5	Wheel alignment	14.0	Yes	24.7
Pearlglow paint	54.1	Add tilt-wheel option	5.6	Power windows	9.3	Principal driver:	
Leather upholstery	41.4	How much did you pay?		Did you repair it yourself?		Male	73.0%
Why did you choose the 300ZX?		Average	\$29,011	No	100.0%	Female	24.6
Loved the styling	75.8%	Range	\$24,700-\$33,500	Yes	0.0	Equal	2.4
Performance	30.0	Workmanship opinion:		Dealer repairs satisfactory?		Age distribution of owners:	
Past experience with Z-cars	27.1	Excellent	81.7%	Yes	74.3%	Under 29 years	12.0%
Handling	15.0	Good	17.9	No	25.7	30-49 years	63.1
Price	8.3	Average	0.4	Dealer service opinion:		50-plus	24.8
				Excellent	46.1%		

* Percentages might not equal 100 percent due to rounding or an insufficient amount of data.

steering systems suffer from deadness in quick maneuvers and others feel overboosted—twin problems that Nissan has apparently solved.

A number of owners wished out loud that they'd waited for the twin turbocharged 300ZX Turbo, not that the normally aspirated, 24-valve, 222-hp V6 lacks punch. Another group complained mildly that the 16-in. Michelin XGT-V tires are expensive to replace. Wheel alignment seems slightly more delicate and harder to maintain with the new Z's complicated front- and rear-suspension systems. In fact, 11.6 percent of our respondents reported needing realignments soon after delivery.

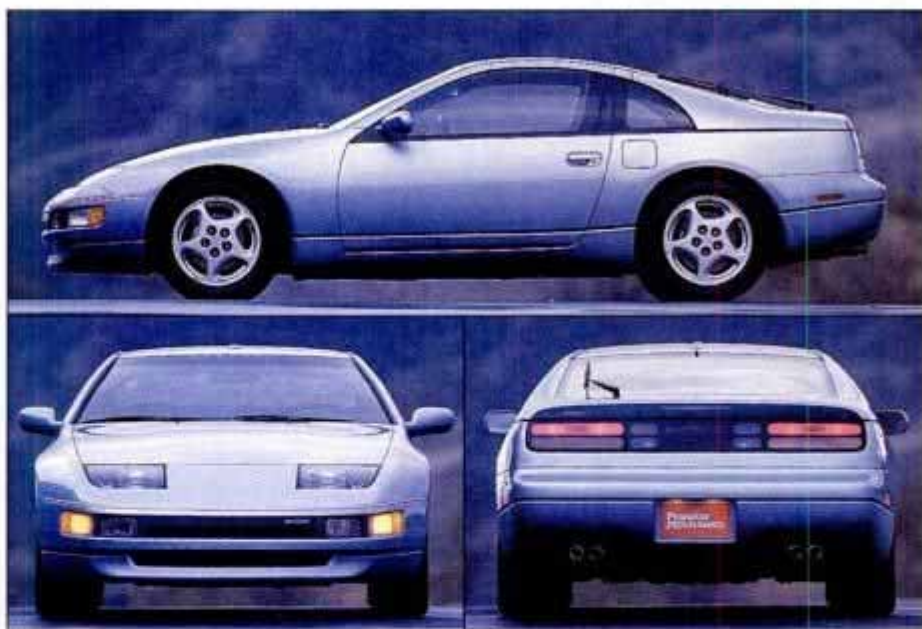
Cars in our survey were just about equally divided between the manual 5-speed transmission and the 4-speed automatic. Fuel mileage was almost identical for both: 18 mpg in town and 23 on the highway.

Most buyers (85.8 percent) ordered the optional Bose stereo, and while most liked it, a minority felt that sound quality wasn't up to the \$700 price tag. If they had it to do again, they'd go for a less-expensive system.

Another area of complaint centered on rear vision. Blind spots caused by the bulky headrests and C-pillars were mentioned by 13.4 percent of our respondents. Likewise, a few grumbled about noises and rattles inside the cockpit, and 8.1 percent cited a noticeable drop in acceleration when the air-conditioner compressor kicked in. Others suggested adding body side moldings to the clean body flanks to prevent parking dings.

In both the sport coupe and 2+2, the two front bucket seats took top marks, with 97.2 percent of our owners rating front comfort good to excellent. Ergonomics—the placement of gauges, pedals and controls—needed no improvement in anyone's book. Several drivers commented on the cozy feeling that comes from being close to the faired dash with its up-front controls. Rear seats in the 2+2, however, might be a tad too cozy. Here, 79.8 percent rated comfort average to poor. Overall, though, the comfort pleased a resounding 99.6 percent, which means the rear seats weren't that important anyway.

According to the vast majority of those surveyed, the significant attributes of any successful sports car—fun, fleetness of foot, sleekness of styling and an all-around even temper—abound in the 300ZX. Nearly 80 percent said they'd grab this car again next time around. That's an unusually high figure for a car of this type and configuration. It means that the 300ZX does everything it's supposed to, plus a little more. **PM**



New 300ZX takes a step back from its former Disco Dan cruiser image to return to its roots as a hard-charging, all-around performing sports car. Turbo version is a match for standard Corvette and Porsche 944 S2.

EDITORS REPORT

A Balanced Temperament

IT'S BEEN AWHILE since we've felt the need to slip on the old driving gloves before folding ourselves into a Nissan ZX. There simply was no reason to. Late-model ZXs, big in size, with curb weight bordering on the ponderous, were devoid of the visceral inputs that quickened our pulse and tempted us to push our demands of the car to hero levels. And, to be bluntly honest, ZX styling of the past three or four years was more to the liking of the gold-chain cruiser set than ours.

The 1990 300ZX changes all that. No question the car's a looker. A point soundly brought home in normally jaded midtown Manhattan when a couple of pedestrians crossing the street stared and walked into the side of a cab.

In the cockpit, the ergonomics rate very high. The dash layout is very clean with simple analog gauges—white numerals on a black background—just the way we like them. Nissan managed to put just about every control function short of the sound system at the driver's fingertips, and they did it without nine stalks growing out of the steering column.

Clutch pedal pressure is very light. We didn't find this a drawback, but one staffer complained that the pedal was *too* easy and he had trouble modulating a precise release. Gear shifting is an exercise in pure enjoyment with very short, precise throws. In fact, the shift mechanism is one of

the best-feeling transmission controls in any car, anywhere.

The 300ZX begs to be driven very fast, thanks to its stiff chassis and excellent suspension. Our biggest complaint concerns a degree of numbness in dead-ahead steering. It lacks real high-speed, center-of-the-lane accuracy. We've found this to be a characteristic of many Japanese cars in their effort to insulate the driver from road-harshness feedback. Overall, it's a minor flaw in an otherwise precise and very forgiving machine. Forgiving, that is, unless you get a little heavy-footed on wet pavement. A slick city street is not the Z's favorite element. We found out as even moderate amounts of throttle on wet streets fishtailed the rear end.

In the dry, the 300ZX's road manners are near impossible to fault. Our test car was a normally aspirated 5-speed model, and truthfully, we would have liked more power. The chassis and suspension work so well that the car doesn't feel its speed. This is one machine you can drive really fast while keeping all the blood flowing through your knuckles. The standard Z is no slug by any means, but it takes boost to make Nissan's V6 competitive with the standard Corvette's V8 and the 944 S2.

The real beauty of the 300ZX, though, is its balanced temperament. It does so many things so well. And with a \$27,300 price tag, it's a performance bargain, too.—Cliff Gromer

O N L Y O N



*Emerson Fittipaldi's 1989 Indy 500-winning Penske PC 18.
Exclusive tires: Goodyear Eagle racing radials.*



*The 1990 Chevrolet Beretta Indy 500 Pace Car.
Exclusive tires: Goodyear Eagle "Gatorback" street radials.*

E A G L E S .

The best-known racing event in the world runs exclusively on the best-selling performance tires in the world: Goodyear Eagles.

On race day, more than a quarter of a million people will be in attendance at the 74th running of the Indianapolis 500.



A Goodyear Eagle "contact patch." Where an Eagle demonstrates its superiority.

And for the last eighteen years, the winning car at the world's best-known racing event raced to victory on the world's most successful racing tires. Designed, engineered and made by Goodyear.

This year will be no different.

All 33 cars, including the Penske Chevy 90 of 1989 winner Emerson Fittipaldi, will be on Goodyear Eagle racing radials.

The 130 mph, V6-powered, Chevrolet Beretta Indy Pace Car, will also be on Goodyear Eagle radials.

But in this case, they will be V speed-rated Goodyear Eagle "Gatorback" high-performance street radials. From the best-selling line of performance tires in the world.

So once again, every single team at the world's number one racing event, the Indy 500, has chosen to use Goodyear Eagles.

And only Goodyear Eagles.

GOODYEAR
The best tires in the world have Goodyear written all over them.



TECH ART

In the search for truth about art history, scientific sleuthing is answering questions that centuries of scholarship have not been able to solve.

BY DAVID W. FREEMAN

FOR THE PAST decade, something momentous has been happening in Rome. There, at the Pope's behest, a small team of Italian conservators has been restoring what is arguably the greatest masterpiece of the Renaissance, Michelangelo's vast fresco spanning the ceiling of the Sistine Chapel.

By the time their task is completed in 1992, chief restorer Gianluigi Colalucci and his assistants will have spent more than 12 years ridding the spectacular 130 × 45-ft. painting of five centuries of accumulated dust, candle soot, mineral deposits and varnishes. But already their work has occasioned a startling revision of certain long-held ideas about Michelangelo: Far from dark and foreboding, the 16th-century master's palette was bursting with vibrant hues.

In their work, carried out on a tiny platform atop 70 ft. of canvas-draped scaffolding, the restorers rely on natural sponges, natural-fiber brushes, deionized, distilled water and a gentle solvent of sodium and ammonium carbonates. But not all their tools are so humble. Facilitating the restoration are a host of scientific techniques, ranging from low-power microscopy and infrared spectrometry to ultraviolet fluorescence, liquid chromatography and photogrammetric mapping.

Who painted what

These and other sophisticated techniques have enabled the Sistine team to do what was, until recently, all but impossible—to peer beneath layers of grimy paint to identify the pigments and binding oils used by Michelangelo, so they can be left intact, while later touchups are cleaned away.

This application of high-tech tools to art conservation is not unique. The Sistine restoration is emblematic of a

worldwide shift toward high-tech solutions to questions of art conservation, scholarship and even forgery detection. Since the 1950s, the number of scientific techniques used has grown markedly, and the conservation departments of leading museums, once reserved for tweedy academics, have opened their doors to scientists. Only a decade ago, the National Gallery of Art in Washington, D.C., had but a single staff scientist—and he labored at a laboratory in another state. Now the museum has a full-time scientific staff of seven, and the staff is growing. And at museums around the world, collaboration between traditional conservators and scientists is increasingly the norm rather than the exception.

The past few years have been marked by numerous examples of how science can bring about startling revisions in scholarly opinion:

■ In 1986, computer scientists using digital image-processing techniques discovered a previously hidden strand of pearls around the neck of the "Mona Lisa," as well as additional mountain scenery. Someone, perhaps Leonardo da Vinci himself, clearly painted over the necklace. Remarkably, the work was done without direct access to the painting. All that was needed was a high-resolution photograph.

■ In 1977, Ross Merrill and other conservators at the Cleveland Museum of Art discovered that a painting attributed to the 16th-century artist Matthias Grunewald was actually a modern forgery. The fake, for which the museum had paid more than \$1 million, was found out through modern pigment analysis.

■ A 15th-century map suggesting the Vikings reached North America long before Columbus, branded a forgery



by one leading expert, was deemed authentic in 1985 after being studied with a technique known as proton-induced X-ray emission. In this procedure, a cyclotron bombards a sample with protons. The expert maintained that titanium in pigments on the map confirmed that the map was of recent origin, since titanium dioxide pigment was not invented until this century. However, analysis of 150 separate points on the map showed that titanium was present in such small quantities that it could not have been in the pigments.

■ Antibodies developed at the National Gallery, and the National Institutes of Health, in Bethesda, Maryland, help reveal whether a picture was painted with egg tempera or oils—crucial information for conservators choosing what solvents to clean it with.



Perhaps the best illustration of the versatility of scientific techniques is the recent restoration at the National Gallery of Giovanni Bellini's "The Feast of the Gods."

The painting, which portrays gods, goddesses and satyrs enjoying a forest bacchanal, had long puzzled experts. Though completed and signed by Bellini in 1514, the picture was known to have been repainted by Titian sometime within the succeeding 15 years, most likely in 1529. But why Titian had been allowed to paint over a picture by Bellini, considered by many of his contemporaries as the greatest painter of his day, was an absolute mystery. David Bull, head of painting conservation at the museum, set out to solve the puzzle almost five years ago.

Bull's first step was to remove more than 190 years of grime and yellowed



A new light dawns on the Sistine Ceiling (top), as a conservator plans operations on a photogrammetric computer map. Before and after shots of the head of Eve (above) show how badly the frescoes had deteriorated over the centuries.



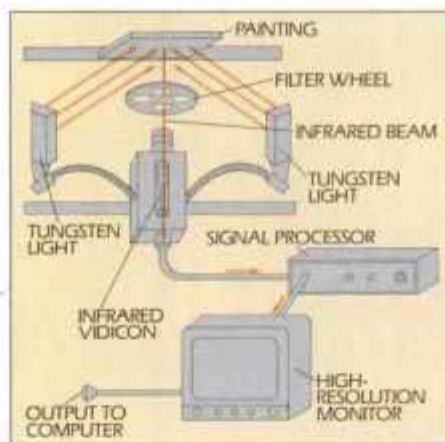
Three paintings in one: Underlying the present version of "The Feast of the Gods" (above) was not only the expected original by Bellini (top right), but an intermediate overpainting (above right) tied to Dosso Dossi by the infrared reflectography technique shown below.

varnish and scrutinize the painting from top to bottom. First, high-power stereoscopic microscopy was used, then X-ray radiography. In the latter procedure, which is similar to the familiar medical radiography, X-rays passing through the picture expose a photographic film. Many pigments, especially the widely used lead white, block X-rays. Consequently, the X-ray photograph provides a detailed image of paint patterns not only on the uppermost layer of paint, but also on all underlying layers.

Three layers deep

The resulting radiograph revealed the painting as completed by Bellini in 1514, prior to Titian's repainting. But the radiograph also revealed something entirely unexpected: a cluster of buildings on a hill surrounded by trees. Significantly, the paint used to render these buildings lay above the original Bellini, but below the paint of Titian. This strongly suggested that "The Feast of the Gods" had actually been repainted not once, but twice. But by whom? Oddly, the brushstrokes of the cluster of buildings resembled neither Bellini nor Titian. Bull began to suspect a third painter.

To investigate his hypothesis, detailed pigment analysis was necessary. Several different types of pigment analysis are now in use. One of the simplest is to remove a tiny



sample of paint, then examine the microscopic crystals of pigment. Alternatively, various forms of spectroscopy and chromatography can be used to identify the pigment's precise chemical composition. This technique is particularly effective at uncovering forgeries. Because conservators often know the precise years when particular pigments came into use, they can judge authenticity.

In the case of "The Feast of the Gods," Bull removed from the picture paint samples smaller than the period at the end of this sentence. These were embedded in polyester resin, turned on edge and viewed with a 200-power microscope. These samples gave Bull a sense of the layer-by-layer application of paint—first by Bellini, then the second painter, then Titian.

But for more useful evidence, Bull went on to infrared imaging.

In this procedure, a beam of infrared light is beamed at the picture, and the reflected light is photographed with a special high-resolution, IR-sensitive camera called a vidicon. Like X-ray radiography, IR reflectography enables scientists to peer inside a painting. But whereas X-rays go all the way through and show layers, one atop the other, IR light shows only those layers lying just below the surface.

Curiously, the IR light revealed that the foliage added in the first repainting was identical to that found in another painting owned by Alfonso D'Este, Duke of Ferrara, the man who commissioned "The Feast of the Gods." This other painting was by Dossi, the Duke's court painter.

To Bull, all the pieces of the jigsaw puzzle now fell into place. Bellini completed the painting in 1514. Soon thereafter, D'Este had Dossi repaint half of the canvas, perhaps to match other paintings by Dossi already on the walls. Then, in 1529, Dossi's rather crude efforts were almost completely obliterated by the brush of Titian, giving the painting its final form. Precisely why Dossi was asked to repaint the Bellini remains a mystery. Maybe someday a document will turn up that sheds light on this issue. But after four years of restoration and a little detective work by Bull, most of the questions that have shadowed "The Feast of the Gods" have finally been answered. **PM**

JOURNAL

ILLUSTRATIONS BY MARIO FERRO



MADE IN THE SHADE

A shady retreat for hot afternoons.

TEXT AND ILLUSTRATIONS BY MARIO FERRO

THE FIRST SUMMER after we moved into our present home, my wife, Evelyn, and I discovered that on hot, sunny days, we would roast if we tried to sit out on our deck early in the day. We were at the mercy of the sun from early morning until about 3 pm when the shadow from our house finally provided shade. Even our table umbrella did little to help.

Color photo: Humphrey Sutton
Photo stylist: Gabe Herrick
Outdoor furniture: Winston Outdoor Seating Group from Fortunoff, Westbury, NY

It didn't take us long to decide that we needed some shelter from the sun if we were to continue enjoying the summer weather, and a gazebo seemed the ideal answer.

We designed our gazebo to provide shade, but also to allow for plenty of air circulation. The key is its louvered roof. It allows air to circulate while providing shade and keeps you dry in a light rain. The roof consists of rafters notched to seat 1 × 6-in. pressure-treated slats pitched down 10° and spaced ¾ in. apart. Each slat

overlaps the one below it to allow rain runoff.

We wanted the gazebo to be durable and maintenance free, so we built it with pressure-treated lumber and clear, rot-resistant cedar, and we used galvanized hardware throughout.

While its construction may seem complex, if you've done some carpentry before, you should be able to handle the project without much trouble.

One of the best things about the design is that it's adaptable to your

but stand away from it to allow you room to dig. The intersection of the layout strings marks the outside faces of the corner posts.

The strings also mark the top of the gazebo's deck. Our gazebo's deck is positioned so it's a 5-in. step down from the patio adjacent to it. If you position the gazebo on level ground, you might place the deck so it is a 7½-in. step up from ground level.

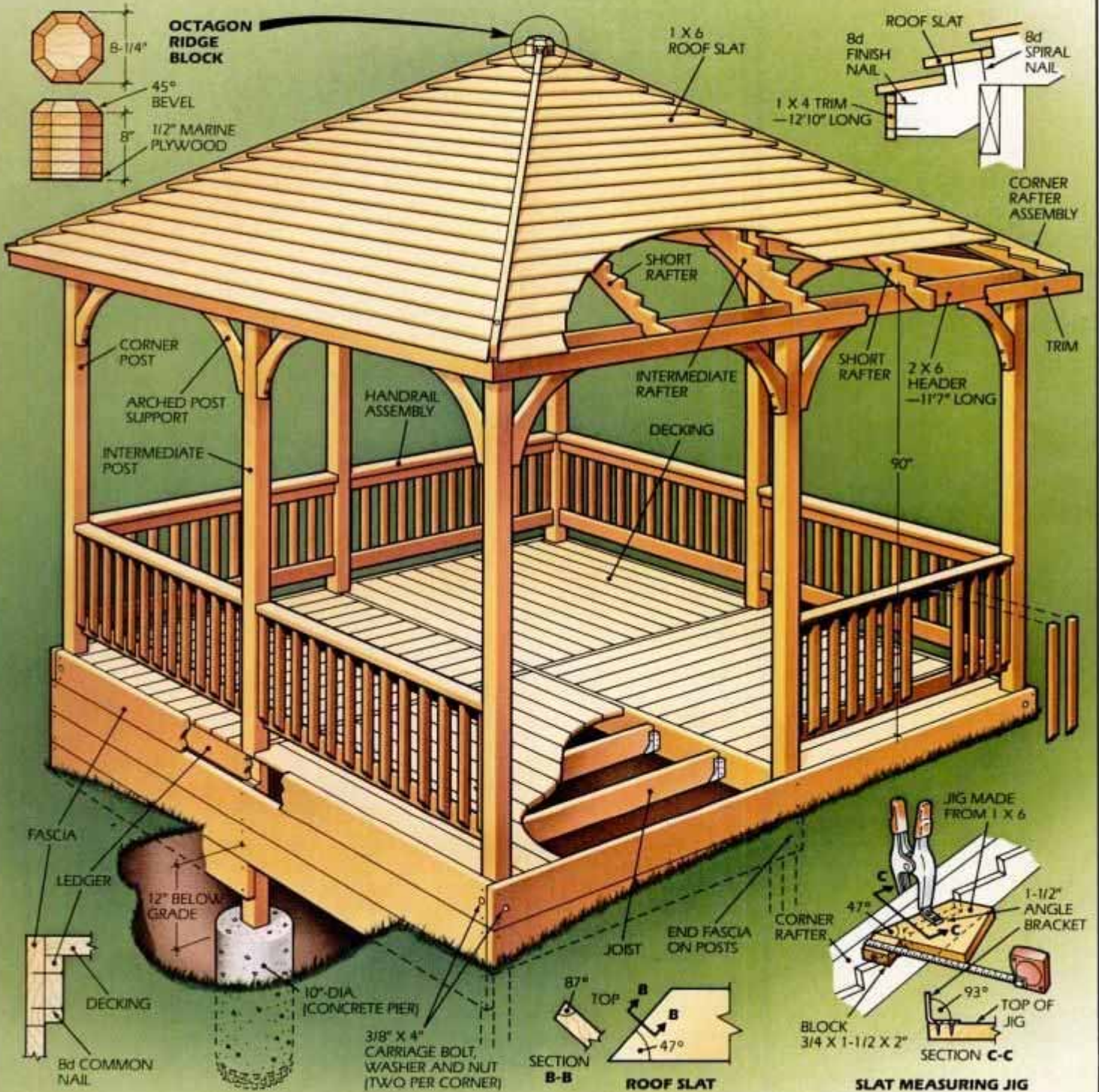
If you like the look of an elevated gazebo, there's no reason why you couldn't place it two or three steps

above level ground. Each of the steps should be the same height, and be sure to include a sturdy pair of handrails if you decide on such a design.

Using a tape measure, mark out one side of the gazebo and drive the second batter board. Stretch the string to the second batter board and slide a line level over the string. Adjust the string to bring it level. Mark out the other three sides of the gazebo in the same manner, adjusting by sight the position of the batter boards to get them reasonably square to one

another. Measure diagonally across the strings to check the layout for square. Adjust the position of the strings on the crosspieces as necessary to achieve a square shape. To mark the gazebo's perimeter, use a flat spade and carve into the turf about 4 in. outside of the strings. Temporarily remove a string to wheel away the dirt and dig up the turf inside the perimeter.

Next, mark the location of the corner posts. You can mark the center of each post location with a stake, or, as

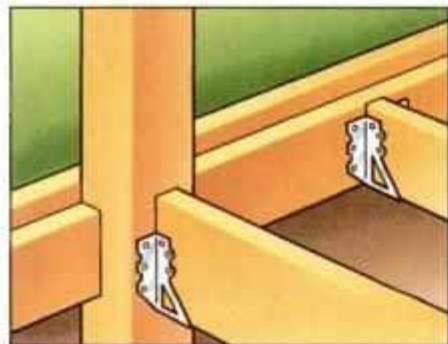


we did, pound a short piece of 4 × 4 into the ground to make a square impression. Stretch strings from the four corners to locate the center and mark the central pier.

Dig the postholes and the central pier with a posthole digger. Each 10-in.-dia. hole is about 36 in. deep with a few inches of gravel thrown into the bottom. (This was below the frost line in our area.) Pour the concrete footings 2 ft. deep and 1 ft. below ground level. Cover each hole with a piece of plywood to slow the concrete's drying and increase its hardness. This also stops dirt from falling in the hole.

Setting the posts on footings, rather than into wet concrete, allows you to position the posts to bring them square to one another. Making the posts square to one another (and the same height at the header) is important. If the posts are out of square, or different heights, it will be difficult to get the rafters to fit properly.

Posts And Joists



Crosscut the four headers to their exact length on the radial-arm saw or with a circular saw. Then, with the saw set at 45°, miter their ends. Do not crosscut the corner posts, but position them oversized on the footings and brace them up with a pair of 2 × 3s. Reattach the strings to the batter boards and position the posts using the strings as guides. The strings should just graze the outside of the posts.

Measure up from the strings and, marking the two outside faces of one post, indicate the position of the header. To extend the header marks to the other three posts, place a level on a 14-ft.-long 1 × 4, and use it as a straight-edge to mark the adjacent posts. Double-check the header height by measuring up from the strings. Finally, mark where the strings cross the posts to mark the top face of the deck.

Take down a pair of posts, crosscut them to length and cut the rabbet for the header with a dado blade in the radial-arm saw. Or, make the cut with

multiple passes using a circular saw and chisel out the waste between the saw kerfs. Bore bolt holes to attach the header, test fit the header, remove it and stand up the two posts. Line up the posts with the string and bolt the header in place. Repeat this for the opposite pair of posts and install the remaining two headers.

Cut to length the fascia boards, that hide the posts, and bolt them to the posts. The top edge of the top fascia board should be flush with the gazebo's deck. Make a final check for squareness among the posts and adjust as necessary. Backfill the postholes and tamp down the dirt.

Next, crosscut the ledgers. Rip down a 2 × 2 (1½ × 1½) out of some scrap lumber and clamp it to the top of the fascia to help you position the ledger. Butt the ledger under the 2 × 2 and nail it to the fascia.

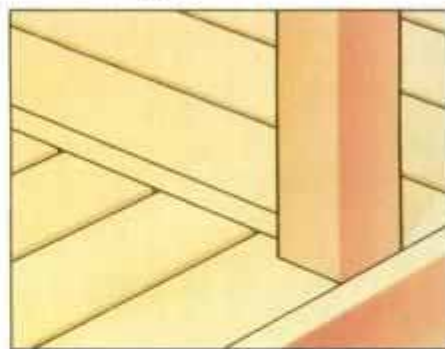
Now, stand up the intermediate posts in their holes and plumb them. Mark for the rabbet where they meet the header and mark for a dado where they meet the ledger. Crosscut, rabbet and dado the posts. Stand them up, check for plumb and bolt them in place. Backfill and tamp their holes. Using a handsaw, cut the bevel on the outside of the header miters to clear a space for the "bird's mouth" notch near the end of the rafters.

Nail on the rest of the fascia boards to suit the height of your deck. Backfill against the fascia boards and tamp down the soil. Because the fascia is several boards deep on our gazebo, we nailed vertical support pieces on the backs of the fascia midway between the corner and intermediate posts. This helps keep the front of the fascia boards even. You can omit the vertical supports if the fascia is only one or two boards high.

Install one long floor joist and two short 2 × 8 floor joists using joist hangers nailed to the centers of the intermediate posts. These joists divide the deck into four quadrants, and we refer to them as deck spacers. Their tops are flush with the cedar decking. I made a concrete form from scrap plywood and centered it under the intersection of the floor joists directly above the central pier. I shoveled concrete into the form so it mounded up under and around the bottom of the intersecting joists.

Complete the floor frame by nailing ledgers to the long and short joists. Nail the remaining joists in place using joist hangers. Mark around the ledgers for 16½ in. on center joist spacing, then nail the joists in place.

Decking

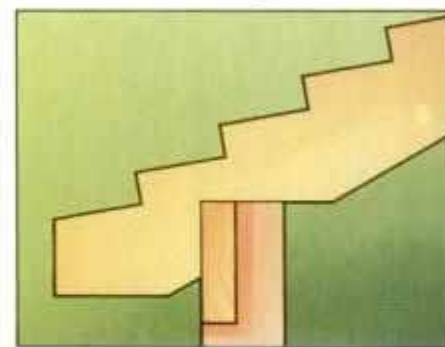


Measure and cut the deck boards oversize then lay them over the joists. Mark across their edge, using a square and a sharp pencil, even with the inside edge of the fascia. Cut them so they fit snugly against the fascia and the deck spacer floor joists. It helps to use a fine-toothed saw blade while doing this cutting, otherwise the deck boards will have a slightly ragged edge, caused by splintering.

Notch out those boards that fit around the posts. Face nail the deck boards at every joist with a pair of 16d spiral-shank deck nails. Pre-drill the nail holes near the ends of the boards to prevent splitting them, and leave about a ¼-in. space between boards. Apply two coats of water sealer to the completed deck.

After the sealer has dried, protect the deck from falling pieces of lumber, during roof framing by covering it with pieces of plywood or a folded-up tarp.

Roof Framing



Begin the roof construction by making the octagon ridge block. As shown in the drawing on page 75, the ridge block is built up from six layers of 2 × 10s glued together with waterproof resorcinol glue.

There are a number of ways to make the ridge block, and the way that you make it depends on how you like to work and the type of equipment you own. The most accurate way is to glue up the layers and then cut the glued-up assembly on the

bandsaw or radial-arm saw. However, you can cut each layer individually or in pairs and simply glue and nail the pieces together. The 2 × 10 that forms the block's top layer has its front edges beveled at 45°. The block's bottom is sealed with a piece of ½-in.-thick marine plywood.

In order to test fit the rafters, the ridge block must be positioned as it will be when the roof is finished. To do this, build a support as shown in the drawing on page 74. First, cut the short 4 × 4 post and nail the octagon support to it. Place the octagon ridge block in the support and drive several nails through the support into the ridge block. Drive in the nails so that enough of their heads are showing to pull them out later.

Span across the headers with a 2 × 8. Nail the 2 × 8 to the headers and drop a plumb line down from the 2 × 8 to find the center of the gazebo. Mark the center on the plank. Position the short post so it's centered on the gazebo and nail from under the 2 × 8 into the bottom of the post. Brace the short post up with a piece of 2 × 2 and support it from underneath with a long 4 × 4 post toenailed to the bottom of the 2 × 8.

Cut to shape the four 2 × 6 corner rafters, and the eight 1 × 4 nailer boards, based on the rafter patterns on page 74. Use a heavy cardboard pattern to trace the steps in the nailer boards. The rafter and the nailer boards are nailed together and form the corner rafter assembly.

Test fitting a rafter assembly is not a job you can undertake alone. Aside from pushing the ridge block out of alignment, the corner rafter assembly is just unwieldy and is best handled by two people. You may find when fitting the roof components together that they might not go together exactly as you had planned. Notch or shim them as necessary to get the pieces to fit.

Counterbore a hole for a ⅞-in.-dia. × 6-in. lagbolt near the top of each rafter. Next, attach the rafter assembly to the ridge block with a lagbolt and fender washer below the bolt head. When the lagbolts are tightened, fill the holes with clear silicone caulk. Repeat the process to attach the rafters to the tops of the corner posts. Remove the supports holding up the ridge block.

Cut out the intermediate rafters based on the rafter plans, again using a template to trace the steps. Test fit each using a straight piece of lumber to line up its steps with the steps in

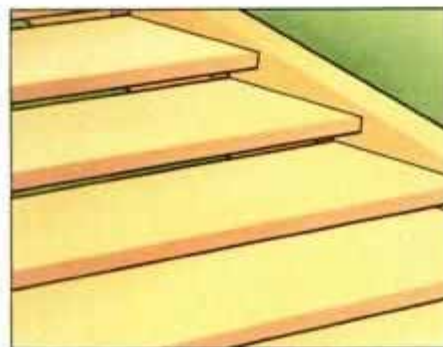
the corner rafter assembly.

Note in the drawing that the intermediate and short rafters are placed below the corner rafter assembly to accommodate the roof slats.

The short rafters are made from 2 × 4s. Their top edges are compound beveled to meet the corner rafter assembly. Cut out four corner rafters with the bevel in one direction and four with the bevel facing opposite.

Bolt the intermediate rafters to the ridge block and the header as was done with the corner rafters. Nail the short rafters to the corner rafter assembly. Check that the short rafters are parallel to the intermediate rafter, adjust them as necessary, and nail them to the corner rafter assembly and header.

Roof Slats

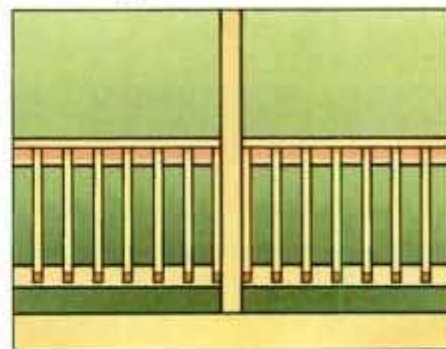


We measured and cut the roof slats in batches (for each roof facet) before nailing them in place. To do this, use a pair of slat-measuring jigs (one is shown on page 75). The jigs (a left- and a righthand pair) are clamped to each corner rafter, and a tape is stretched from the tip of one jig to the tip of the other. This measures the outside lower corners of each slat.

Cut the compound angle on the end of each slat (shown on page 75), and test fit the slats against the corner rafter assembly. You may have to trim the slats and notch out some steps with a handsaw and chisel to get the slats to fit. Starting at the bottom, attach each slat to the rafter with a pair of galvanized 8d, spiral-shank nails driven into predrilled holes. Use two nails per rafter location.

Caulk along the edge of the top roof slats and along the edge where the slats meet the corner rafter assembly. Crosscut and miter the cedar trim boards. Predrill the nail holes near their ends to prevent splitting the slats and nail them to the ends of the rafters with 8d galvanized finish nails. Finish the roof and fascia with two coats of water sealer—on top and underneath.

Railing Construction



Crosscut the handrails and aprons to fit between their respective posts, and cut an apron groove in the bottom of each handrail using dado blades in the radial-arm saw or a straight bit in a router. With a router and ⅜-in.-rad. rounding-over bit, cut a decorative profile on the railings' top edges.

Rip and crosscut the balusters so they have one beveled end. Using resorcinol glue and clamps, fasten the top apron to the handrail. Space the balusters as shown, and attach them to their aprons with a pair of 6d galvanized finish nails driven into each apron. Butt a framing square against each baluster to square it to the apron, and be sure the beveled end is at the bottom and facing the outside of the railing. Attach all but the first and last balusters to the aprons.

The remaining balusters are screwed to the corner and intermediate posts, and the handrail assembly is attached to them. Clamp the balusters to the posts 1⅜ in. from the posts' front. Bore and countersink pilot holes through the balusters for 3-in. galvanized drywall screws.

Hang the handrail assembly on the balusters, and bore one countersunk pilot hole through the top apron into the end balusters and bore two countersunk holes through the bottom apron. Fasten the handrail assembly to the balusters with 2-in. galvanized drywall screws.

Make a template of the arched post support brackets. Trace the pattern on a piece of 2 × 6 clear cedar and cut out the brackets using a sabre saw. Sand out the saw marks. Use a ⅜-in.-rad. rounding-over bit in the router to round the brackets' edges, or simply soften the edges with sandpaper.

Hold the brackets against the posts or bore their pilot holes with the brackets held upright on a workbench. Either way, bore a pair of 5/16-in.-dia. pilot holes in each bracket. Counterbore a 1⅜-in. hole on top of that. Using lagbolts and washers, attach the brackets to the posts. **PM**

NEW EQUIPMENT

**PAIN
T SPRAYERS**

BY ROY BERENDSOHN,
Assistant Home & Shop Editor



AS UNLIKELY as it sounds, there are many homeowners who dread the return of warm weather. It's not just their hay fever that brings about this anxiety, it's the fact that they'll have to paint their house, or pay someone to paint it. Either can be unpleasant.

The two paint sprayers shown here are designed to be considerably faster than manual painting while eliminating the trouble and expense of using a compressor. Both are airless applicators and propel the paint with an oil-pressure diaphragm pump. The homeowner model, AL-1200 (left), costs about \$350, and is really a paint applicator in that it sprays and rolls paint. The AL2305 (right) is designed for contractors, and sprays paints and stains. It costs about \$500.

The AL-1200 weighs 30 pounds and is powered by a 1/2-hp motor. Its polyethylene plastic tank holds 1.75 gallons of paint. It comes with both a sprayer and a 9-in. roller with a 20-in.-long handle. The tungsten-carbide-tipped sprayer is adjustable to deliver a pattern from 3 in. to 10 in. in diameter. It can pump 1 quart of paint a minute to the spray tip or roller.

It comes standard with a 15-ft.-long hose, and an accessory 25-ft. hose is available, as is a swivel connection that eliminates hose twisting and kinking.

To use the sprayer, fill the hopper with paint or stain, prime the pump and spray or roll the paint. When you're done, pour out any remaining paint. Remove the sprayer or roller and pump out remaining paint. Rinse out the hopper with the sprayer or roller attached. Flush out the hose and attachments until the water or paint thinner runs clear.

Contractor's model

The AL2305 is operated in basically the same manner as the AL-1200, but two important features set it apart.

First, its 1/2-hp motor is enclosed and fan cooled for continuous use.

Second, its pressure control is on the oil-reservoir side and not on the paint hopper side. Excess pressure circulates oil, not paint, as with the AL-1200. Thus, it avoids the component wear caused by circulating paint pigments which, especially in latex, can be quite abrasive.

The contractor model weighs 44 pounds, and pumps paint at a slightly faster rate of 1/3 gallon per minute. The hopper is eliminated because it pumps paint out of a 5-gallon bucket. It comes with a 25-ft.-long hose.

The contractor model is also available with a vertical or horizontal stand, without wheels, as Model AL2300 and AL2301, respectively. Each costs about \$500.

The AL-1200 is sold at home centers, and the AL2305 is sold at larger paint supply centers. For more information, write to Campbell Hausfeld, 100 Production Dr., Harrison, OH 45030. **FM**



REVIEW

**NEW TRIM
CARPENTRY
BOOK/TAPE**

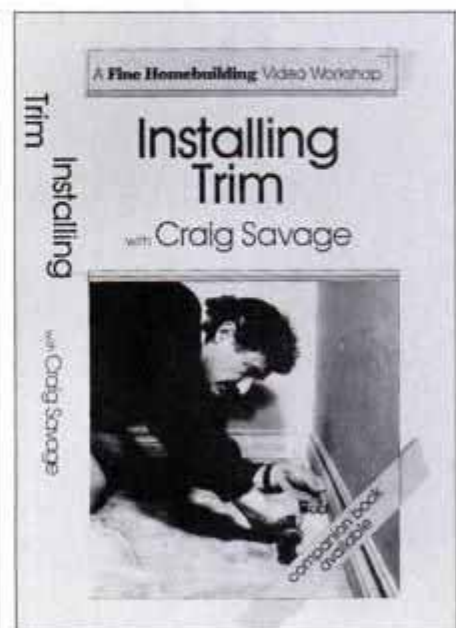
THIS NEW BOOK and video on installing trim fills a need for information left unattended for many years. We've all seen books and videos on building furniture, finishing, carving and even lathe work. But there's been relatively little information produced on fitting door and window trim, baseboard, crown molding, and installing doors and windows.

The book adroitly covers these subjects and treats the reader to a general discussion of making raised panels,

wainscoting and moldings; finishing and painting trim; and using power and hand tools in trim work. The briskly paced tape covers how to miter door and window trim, how to miter and cope crown molding, and the tricks that are necessary to tightly fit trimpieces together.

Author Craig Savage is obviously a trim carpenter of wide experience and his emphasis, throughout, is on how to trim quickly and neatly around bulges in drywall, sloppy door casings or out-of-square windows. This makes the combination more than just a treatise, but a realistic guide to handling some of the toughest jobs in carpentry.

The book/videotape costs \$42.45 postpaid from the Taunton Press Publishers, Main St., Newtown, CT 06470. **FM**



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INSTALLING A TIN CEILING

BY JOSEPH JAMES
PM Illustrations by
George Retseck

DO YOU remember where you first saw a pressed-tin ceiling? Perhaps it was at the corner drug store, ice cream parlor, bank, town hall or even in your grandmother's kitchen. At one time, tin ceilings seemed to be everywhere, adding style and grace to a new era of American architecture. And then, just as quickly, they disappeared, falling victim to rapidly changing styles and tastes.

Well, if you'd like to recapture the style of a more innocent time, we're glad to report that tin ceilings are back. And best of all, you can easily install one in your own home by following our step-by-step instructions and illustrations.

Case history

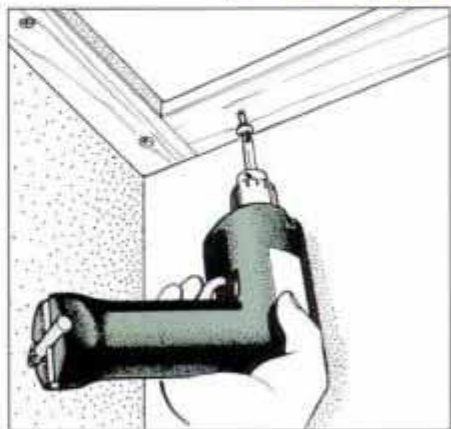
Tin ceilings were first introduced in the late 1860s as a quick and inexpensive way to cover up old, damaged plaster ceilings. They were also very durable, and water and fire resistant. Tin ceilings reached a peak of popularity between 1895 and 1915. But, by the end of the 1920s, their popularity started to wane. And by the late '30s, tin-ceiling production slowly ground

to a halt. However, by the late 1970s, pressed-tin ceilings were once again back in style—after nearly 40 years. Today's product is known as a pressed-metal ceiling because it isn't made of tin, but of 28-gauge steel. A ceiling comes in panels, typically measuring 2 × 2 ft., 2 × 4 ft. and 2 × 8 ft. Panels are offered in dozens of styles, that have strikingly different

(Please turn to page 82)



1 Hold a furring strip and length of cornice molding against the ceiling to be sure the furring is wide enough to provide nailing support for the cornice strip.



2 Fasten 1 × 3 furring strips around the room's perimeter with 2-in.-long (or longer) drywall screws. Be sure to drive the screws into solid framing above ceiling.

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NEWSFLASH! / POPULAR SCIENCE DECEMBER 1986 PAGES 74 - 77 SUPERCONDUCTOR ARTICLE ABOUT US!

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See NASA Tech Briefs for technical details, 1986, 1987 and 1988.

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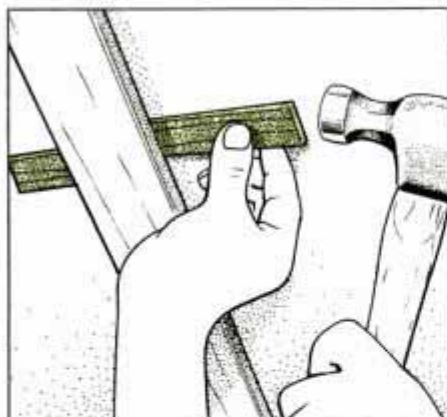
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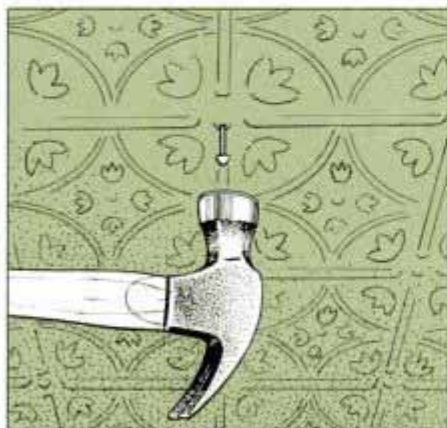


3 Compensate for an irregular ceiling by driving cedar-shingle shims behind the furring. Check the furring for flatness with a long straightedge or taut string.

looks, to suit virtually everyone's taste. Various sizes and styles of cornice moldings come in 4-ft. lengths and add a nice finishing touch to the room. It's interesting to note that many of today's manufacturers are using the original power presses and die patterns that produced the first generation of tin ceilings.

Pressed-metal ceilings cost about \$2 per sq. ft., which is a pretty good deal for a piece of America's past. The ceiling we installed is made by Shanker Industries, Box 3116, Secaucus, NJ 07096. The 2 x 4-ft. panels (model No. 209) feature a 6-in.-sq. multiple pattern. And, we chose a 2½-in.-high cornice (No. 803) for trim.

Installation requires only standard hand tools and a good pair of tin snips. However, there's one point that can't be overemphasized. These panels have razor-sharp edges, especially after they are cut. For this reason, always wear work gloves when handling the panels or cornice moldings. And, when working overhead, wear eye goggles.



6 Drive each decorative cone-head nail through the center of a raised button. Space the nails 12 in. apart. Drive the nails carefully to avoid damaging the panel.

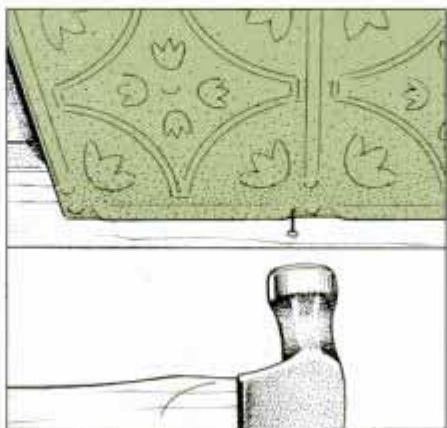


4 Install short cross furring to support the panel ends (every 4 ft. on this job). If there's no framing above ceiling in this area, then use hollow-wall screw anchors.

Ceiling preparation

The first step is to fasten 1 x 3 furring strips around the perimeter of the room. Be sure to check that the furring is wide enough to provide nailing support for the cornice (Fig. 1). If the furring is too narrow, simply bring it away from the wall, as needed, and fasten it in place. We attached the furring with 2-in. drywall screws driven with a cordless drill/driver (Fig. 2). However, you could nail up the furring, as well.

Next, lay out the positions of the rest of the furring strips by starting in the center of the ceiling and working out, every 12 in. on center, toward either side wall. Be sure to orient the furring strips so they run perpendicular to the ceiling joists. If the ceiling is uneven, shim the furring with cedar shingles (Fig. 3). You can use a long straightedge or stretch a dry line over the strips to check that the furring is straight. The strips do not have to be perfectly aligned because the metal panels will cover up minor alignment problems. As long as each strip is no



7 At the panel edges that will be covered up with the cornice molding strips, secure the panel with ½-in. wire nails. Note that the nail is beside the button, not through it.



5 Before installing the metal ceiling panels, protect the back surfaces with an oil-based primer coat. Let the back coat dry, then paint finished surface, if desired.

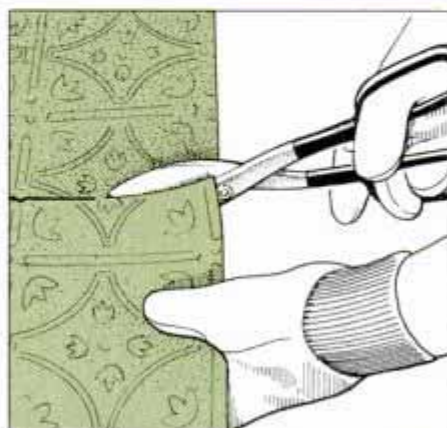
more than ¼ in. higher or lower than the others, you should be all right.

Also, install cross furring every 4 ft. on center to provide nailing support at the ends of the 4-ft.-long metal panels (Fig. 4). Be sure to lay out the cross furring starting at the ceiling's center and working out to the walls.

The ceiling panels come unpainted with a protective coat of polyurethane varnish on the finished (down-facing) surface. However, the panel's back surface is bare and untreated. As additional protection against rust, it's wise to apply an oil-based primer coat to the back side of each panel (Fig. 5). If you decide to paint the finished surface—though it isn't necessary if you like the shiny-metal look—apply two coats of an oil-based paint before the installation. It's much easier to paint the panels when they are flat on the floor than when they're installed. Then, touch up spots and nailheads once the job is complete.

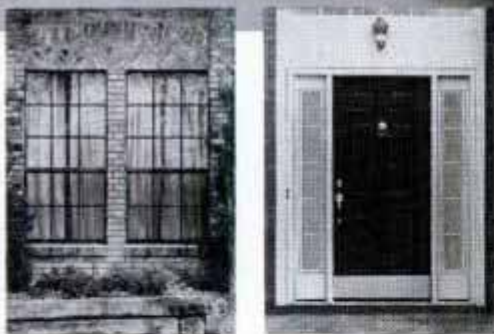
When working with 2 x 4-ft. or 2 x 6-ft. panels, it's advisable to have

(Please turn to page 85)



8 The 28-gauge metal panels are cut easily with a sharp pair of tin snips. Just be sure to wear heavy work gloves since the panel edges are extremely sharp.

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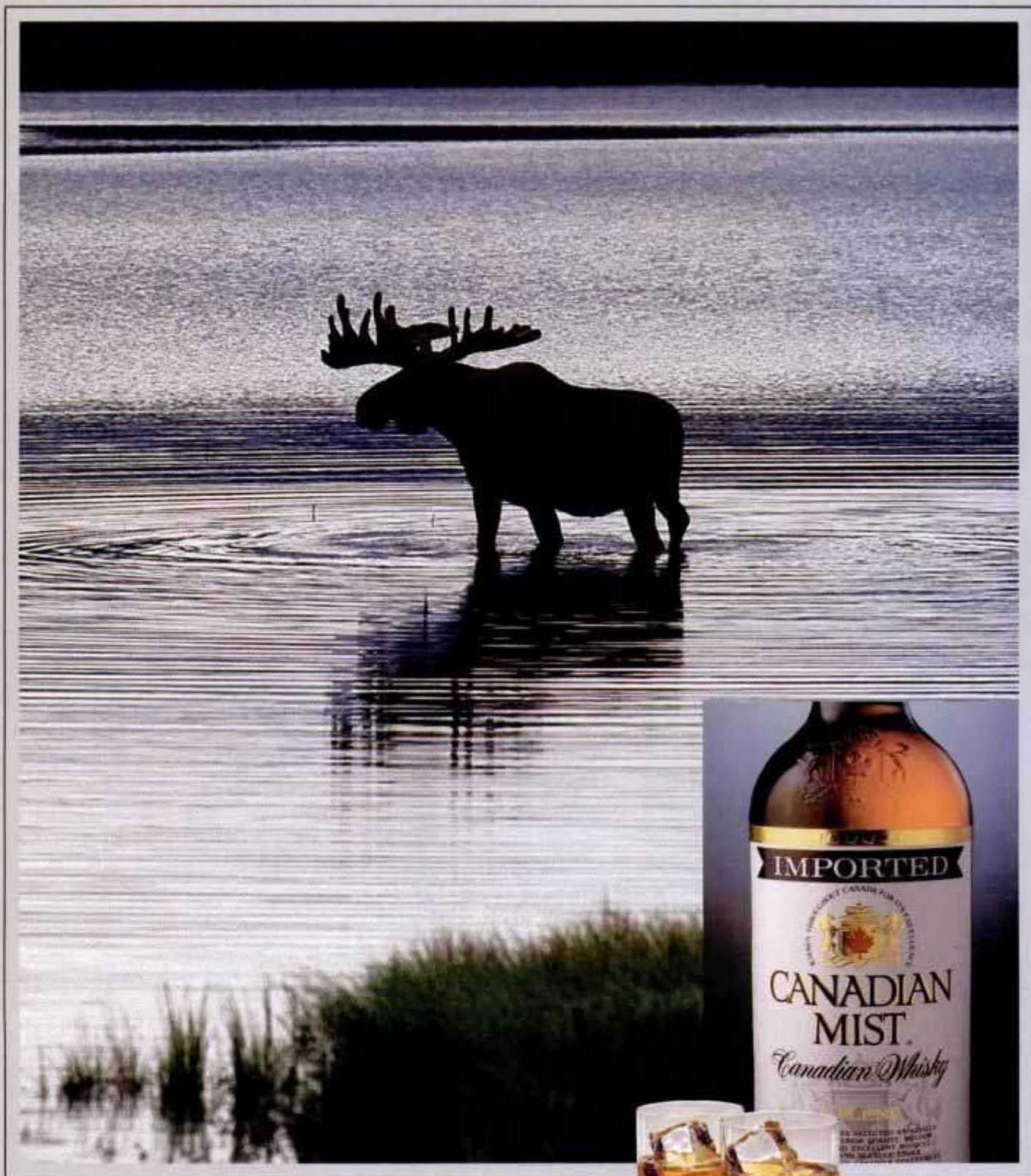
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9 Where ceiling panel corners meet, four sheets of metal overlap. Because of this increased thickness, it's necessary to drill a 1/8-in.-dia. pilot hole for a cone-head nail.

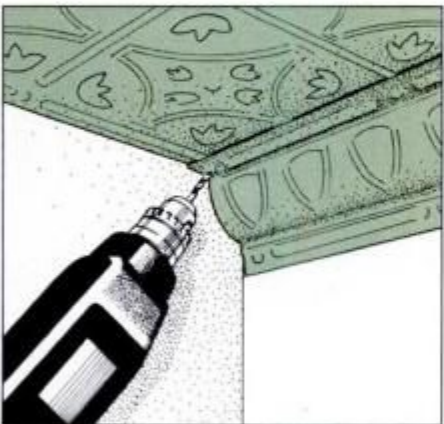
someone help you hold the panels in place for nailing. The ceiling panels come with special 1-in.-long cone-head nails. Use these decorative nails in the center of the panels, on overlapping edges and wherever else they will be exposed.

Ceiling panel installation

Secure the panel edges that will be covered by overlapping panels or by the cornice molding with standard 1/2-in. wire nails. Note that the panels have small raised bumps, or buttons, in the pattern.

When hammering the cone-head nails, drive them directly through the center of the buttons (Fig. 6). When nailing the panel edges, drive 1/2-in. wire nails off to one side of the buttons (Fig. 7). Use this technique so the wire nails don't interfere with the overlapping panels and cone-head nails that secure them.

Starting in the center of the ceiling, install full-size panels the length and then the width of the room. When it comes time to cut a panel, simply flip



11 To make it easier to nail up cornice moldings, first drill a 1/8-in.-dia. pilot hole. Be sure that the bit goes through both the molding piece and the ceiling panel.

it over, mark the cutline with a pencil and make the cut with tin snips (Fig. 8). Keep in mind that this job will proceed so much better if you are using a decent pair of snips that are properly sharpened. If your snips are old and dull, either have them sharpened or buy a new pair. As you progress, there will be seams where the corners of four panels will overlap (Fig. 9). To make it easier to drive a cone-head nail through all four sheets of metal, first drill a 1/8-in.-dia. pilot hole.

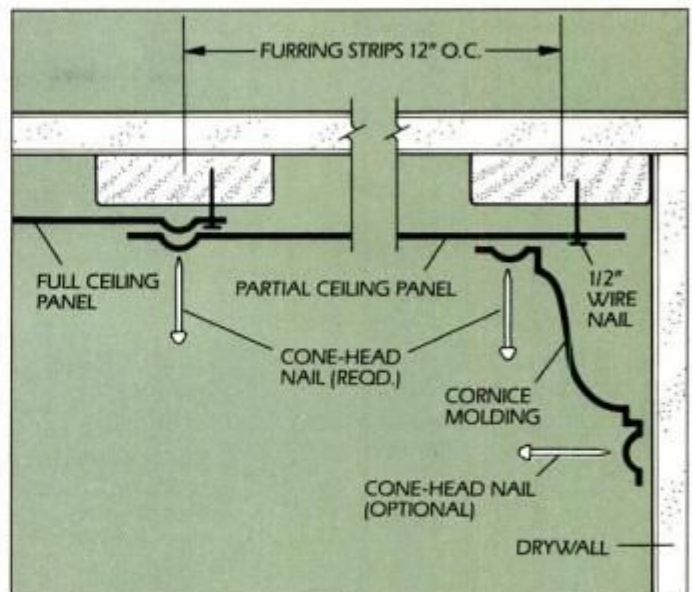
Cornice molding—the crowning touch

Cornice molding is installed where the ceiling meets the walls. The size of the cornice depends on the size of the room and height of the ceiling. Typically, a high ceiling in a large room will accommodate wider moldings. Since this installation was in a small room with standard 8-ft.-high ceilings, we decided on a cornice that projects from the wall only 2 1/2 in. Cornices with projections up to 9 1/2 in. are commonly available. A quick look at Figure 10 shows the relationship of the cornice to the metal ceiling panels and furring strips.

Like the ceiling panels, the 4-ft.-long cornice moldings are fastened



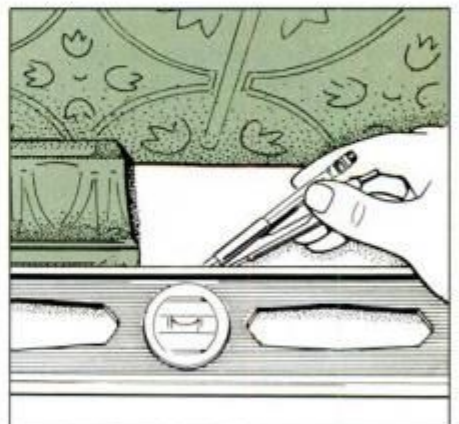
12 Fasten cornice with cone-head nails driven through buttons into furring. For a professional-looking job, be sure cornice buttons line up with ceiling-panel buttons.



10 This illustration shows the relationship between ceiling panels, furring strips and cornice molding. Note how the concealed panel edges are fastened in place with wire nails.

with cone-head nails. However, since the nails driven up into the furring strips are at a slight angle and must pass through a metal ceiling panel, too, it's best to first drill pilot holes through the panels, but not through the furring strip (Fig. 11). Be sure to leave enough solid wood so the nail will hold securely once driven. Drive the nails through the buttons in the cornice (Fig. 12). Note how our cornice buttons line up exactly with the ceiling-panel buttons. Try to do the same when you are laying out your cornice molding and keep this in mind as you nail up the cornice to ensure a professional-looking installation. Also, we found that it wasn't necessary to nail the cornice to the wall. The nails in the ceiling provided sufficient pressure to hold the cornice flat to the wall. Continue to install the cor-

(Please turn to page 86)



13 As a guide for installing cornices, use a level to mark a level line across the surface of the wall. Hold the level against bottom edge of cornice that's installed.

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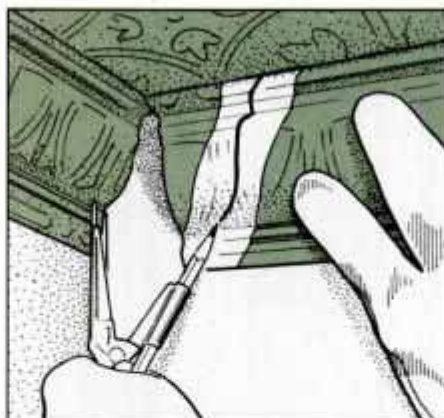
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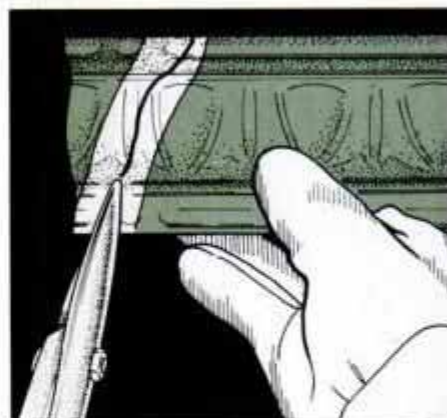


14 Transfer the cornice molding profile onto the mating molding with a compass scribe. A strip of masking tape on the molding makes the pencil line easier to see.

nice around the room overlapping the ends by about 4 in.

At an inside corner, run one cornice piece square into the corner. Then, using a coping cut technique, trim the second piece on the adjacent wall to fit. Here's an easy way to cope a perfect inside corner: First, place a strip of wide masking tape across the end of a piece of scrap molding. Hold the scrap molding in the corner and use a simple compass or scribing tool to transfer the profile of the nailed-in-place cornice to the scrap piece (Fig. 14). Next, cut along the pencil line and test fit the coped cut (Figs. 15 and 16). You may have to make a few minor trim cuts or do a small amount of filing to make the parts fit together. Once the coped cut fits perfectly, use this scrap piece as a template to mark a length of cornice for installation.

Fitting cornice molding to an outside corner is clearly the toughest part of a metal ceiling installation. But again, there's a procedure that, along with a little patience, will produce perfect joints. Since most cor-



15 Execute the coped cut on the waste side of the line with a pair of tin snips or aviation snips. Use the front half of the cutting jaws to maneuver along the curved line.

ners—outside and inside—aren't precisely square (90°), you must first determine the angle of the outside corner using a sliding bevel square. Place the square up to the corner, tighten the wingnut and then measure the angle of the square with a protractor. Next, divide this angle by two and, using a protractor, set the bevel square to this angle.

Now, place a strip of masking tape on the ceiling running out from the corner. Hold the bevel square against the wall with its blade aligned perfectly with the outside corner. Mark a pencil line along the blade and onto the tape (Fig. 17). This line represents the point where the two moldings will meet.

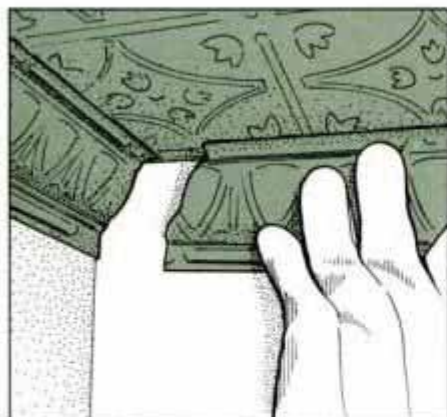
Hold a section of scrap molding against the wall in its proper position and so it extends past the line on the ceiling. Mark the molding's bottom edge where it touches the outside corner of the wall and its top edge where it intersects the line (Fig. 18). Now draw a line connecting the two marks across the face of the cornice and



17 Bisect the angle of the outside corner and mark it on the ceiling with a pencil and sliding bevel square. A strip of masking tape shows the pencil line clearly.



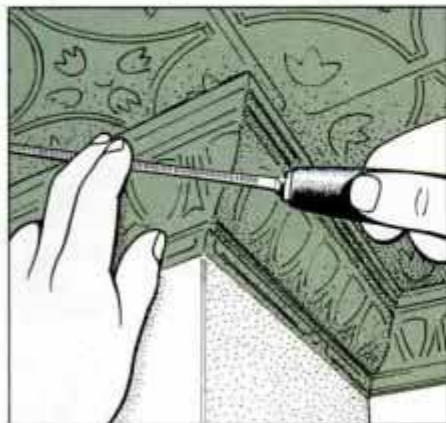
18 Hold length of cornice molding in place so that it extends past the line on the ceiling. Then, mark where the molding meets the line and the outside corner.



16 Slide the cornice molding in place to check the fit of the inside corner joint. Some minor trimming with the snips is often needed to obtain a perfect fit.

make this angled cut with tin snips. Repeat this procedure for the opposite mating length of molding using a piece of scrap.

Next, hold the two pieces together at the corner to check the joint. At this point, the two won't fit together very well. It's difficult to get a perfect fit because the surface of the cornice is so uneven that cutting a straight line is difficult. However, it's simply a case of trimming and fitting until they do. It may take several attempts, but with a little patience and a keen eye you should be able to get the two parts to fit together tightly. Once you're satisfied with the fit, transfer the end cuts to the cornice molding pieces and make the cuts. Be sure to cut and install the cornice pieces so their buttons line up with the ceiling buttons once all the pieces are nailed in place. Nail up the two outside-corner molding pieces and check the fit once again. If the moldings are to be painted, fill the joint line with caulking. If the molding is to be left unpainted, file the joint for a perfect fit (Fig. 19). **PM**



19 The final step to forming a perfect outside corner is to file the joint smooth and flat. You'll need various small files including round, triangular and flat types.

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BLACK & DECKER®

TOOL TEST
**NEW
PLUNGE
ROUTER**

TEXT AND PHOTOS BY
ROSARIO CAPOTOSTO,
Contributing Editor

PORTER-CABLE recently introduced a versatile plunge router that should prove of interest to amateur and professional woodworkers alike.

What impressed me most was the way it's quickly and easily locked and unlocked during plunging. Its locking lever is conveniently located near the left grip and can be moved without moving your hand far from the grip. Push the router down and hold it in place by flipping the lever. Move the lever back and the springs enclosed in the two posts push the router back up.

A unique design, the router's plunge base can be bought separately, so you can convert most Porter-Cable or Rockwell routers with 3.5-in.-dia. motor housings, Bosch models 1601-1606 and Black & Decker model 2720, to plunge routers, while saving the



The Model 693 is versatile and well made. Its base (inset) can be bought separately.

cost of a new router.

The router has infinitely adjustable 2.5-in. plunge capacity, and features a depth scale and a 6-position depth-stop turret with three fixed and three adjustable settings.

The 11.5-pound router has a reasonably powerful 1.5-hp, 10-amp motor that effortlessly drives 1/4- and 1/2-in. shank bits. I did a variety of edge and surface routing with it and was quite satisfied with its comfort-

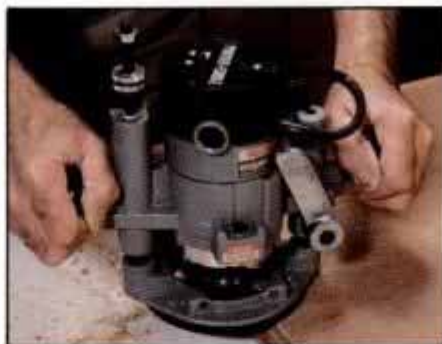
able feel, weight and balance.

It comes with 1/4-in. and 1/2-in. collets which I think grip better than slip-in reducer sleeves. Additional accessories include edge guides, a template guide kit and a clear subbase for big diameter bits.

The Model 693 costs about \$280 and the plunge base, \$120, at hardware stores and industrial suppliers. Write to Porter-Cable Corp., P.O. Box 2468, Jackson, TN 38302-2468. **PM**



1 Pivot the lever down to lock the router in plunge position. Lever's location near handle makes for smooth and safe use.



2 With the lever pivoted down, molding bit is locked below subbase. The router can now be used for standard edge shaping.



3 At the end of a plunge cut, the lever is pivoted up, and the router is switched off after the bit is safely retracted.



4 The 6-position turret and the adjustable rod control the depth of cut. The turret has three fixed and three adjustable stops.

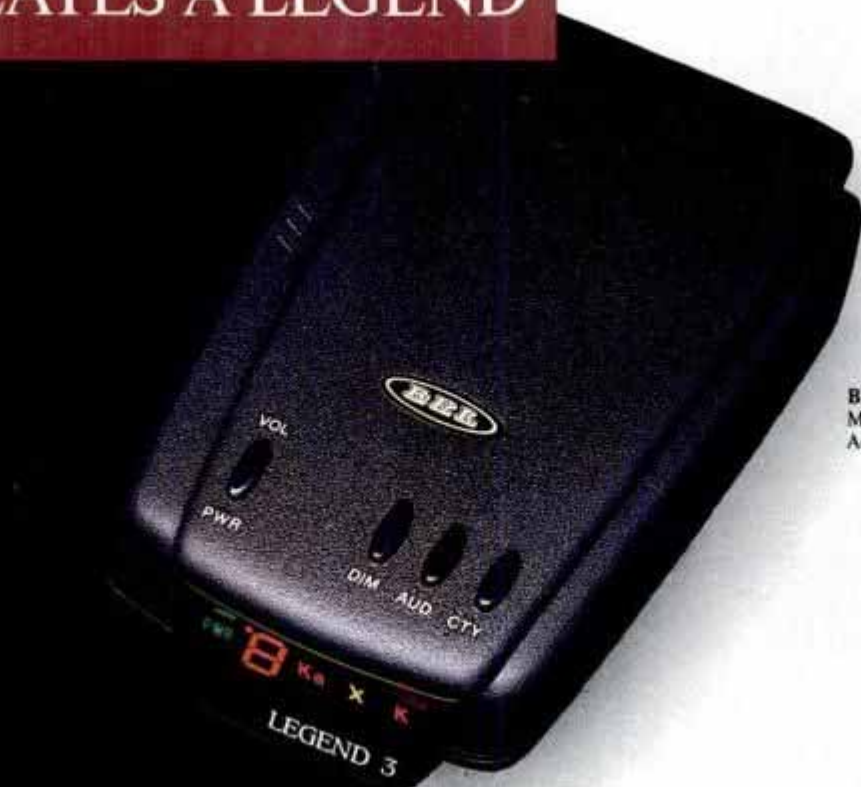


5 The router uses a standard Porter-Cable subbase, edge guide (not shown) and 2-piece template guide, being installed.



6 A pair of wrenches and 1/4-in.- and 1/2-in.-dia. split collets come with router. A 3/8-in.-dia. collet is sold as an accessory.

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BEL LEGEND 3
Model 966
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HAND TOOLS

HAND PLANE HERITAGE

Your hand plane's history is nearly as old as woodworking itself.

BY ROB STEVENSON

WITH A WORKSHOP full of power tools that weren't conceived before the turn of this century, it's easy to view the ordinary hand plane as a venerable example of woodworking tradition. After all, it's probably been around for a few hundred years.

The fact is, actual planes have survived from first-century A.D. Rome. And, although no earlier planes have been discovered, the pre-Roman Greeks did have a word for plane—*rhykane*—indicating that this tool was known and used then. Because the even earlier Egyptians have left no evidence of the hand plane, it seems reasonable to assume that this most commonplace tool of today was invented sometime between the Egyptians and the Greeks, and boasts a roughly 3000-year history.

Exactly *how* it came about is another question. While the basic plane appears to be nothing more than a wide chisel held firmly in place for controlled surfacing operations, some have suggested that it evolved from another, but more primitive, wood-surfacing tool—the adze. The early adze was unlike the models that we're familiar with today. It had a separate cutter that was held in place by a wedge. By adding wood in front of and behind the cutting edge, something resembling a plane appeared. The blocks of wood around the cutter acted as a kind of jig that limited and controlled the depth of cut.

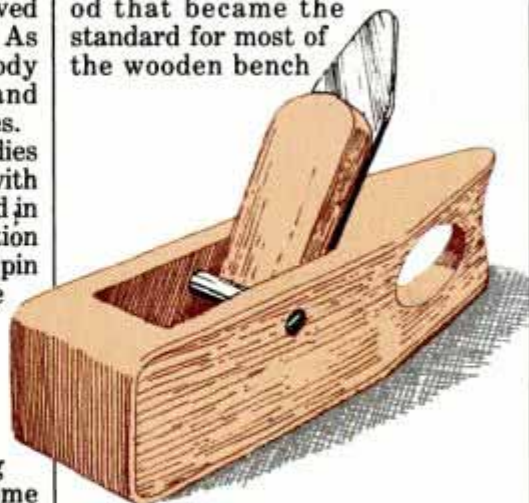
There was, though, another tool common to the period that has all but disappeared from the workshops of today called the scratch stock. This tool was used to cut moldings and had a narrow, profiled cutter that scraped the wood to the desired shape. The cutter was secured to a block of wood or stock that acted as a handle for guiding the cutter along the wood.

Because the earliest surviving planes had narrow cutters and almost all were molding planes, it seems possible that the very first planes evolved directly from the scratch stock. As the tool developed, the plane body and cutter were made wider and straighter for handling flat surfaces.

The early Roman planes had bodies either entirely of wood, or wood with an iron sole and side plates riveted in place. The cutter was held in position by a wedge that pressed against a pin that ran from side to side across the opening. Like our planes today, the Roman tools were made in different lengths to suit the job at hand and many had elongated holes to serve as handles. The wedge-and-pin, cutter-securing system is still used today by some makers and remains a popular design for shop-built planes.

Surprisingly, the period following the Roman culture provided little in terms of physical hand plane evidence. Only a few smoothing planes made from bone or horn, and one with a bronze sole, survive from the Dark Ages (about 476 to 1000 A.D.). And, the Middle Ages (up to about 1450 A.D.) have left no planes at all. However, illustrations depicting daily life

a wedge. However, instead of using a pin to force the wedge against the cutter, it employed an alternative method that became the standard for most of the wooden bench

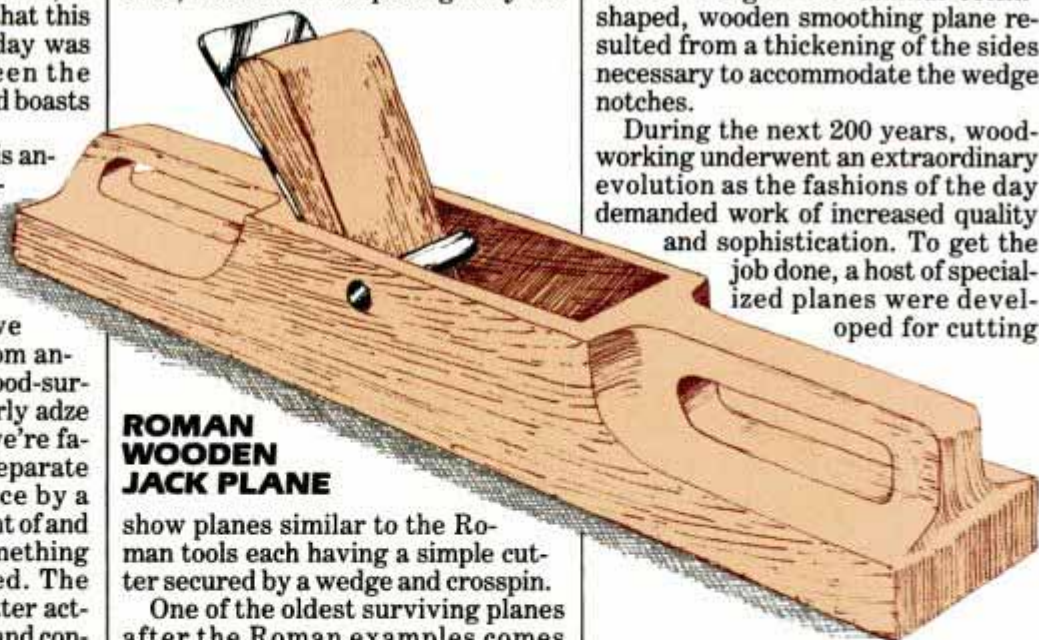


ROMAN IRON-SHEATHED SMOOTHING PLANE

planes later made in North America.

This second method features tapered notches on both sides of the blade opening. The wedge slides in these notches and locks the blade in place. The notches increase the bearing surface on the wedge and eliminate the weak pin-to-body joint of the earlier design. The familiar coffin-shaped, wooden smoothing plane resulted from a thickening of the sides necessary to accommodate the wedge notches.

During the next 200 years, woodworking underwent an extraordinary evolution as the fashions of the day demanded work of increased quality and sophistication. To get the job done, a host of specialized planes were developed for cutting



ROMAN WOODEN JACK PLANE

show planes similar to the Roman tools each having a simple cutter secured by a wedge and crosspin.

One of the oldest surviving planes after the Roman examples comes from the 1596 shipwreck of a Dutch vessel. Found in the remains was a wooden smoothing plane body in excellent condition. Its most obvious feature is a horn-shaped handle mounted on a slightly lowered front section. This type of front handle remains characteristic of planes made in Germany today.

Like the Roman tools, this plane would have had a single cutter held by

every conceivable molding required. A typical set of molding planes might include a dozen different profiles, each made in a range of sizes. Plough planes with interchangeable cutters were developed for cutting grooves of various widths. These had adjustable fences and were sometimes elaborately constructed with exotic wood and ivory. Rabbet planes in a wide variety of styles and sizes were built,

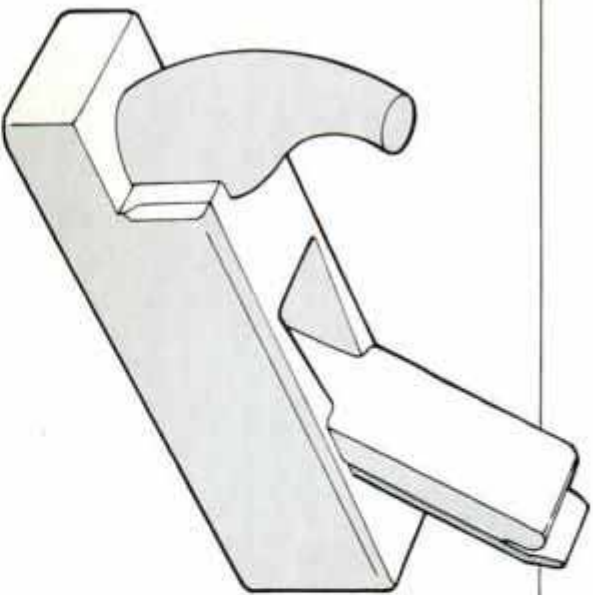
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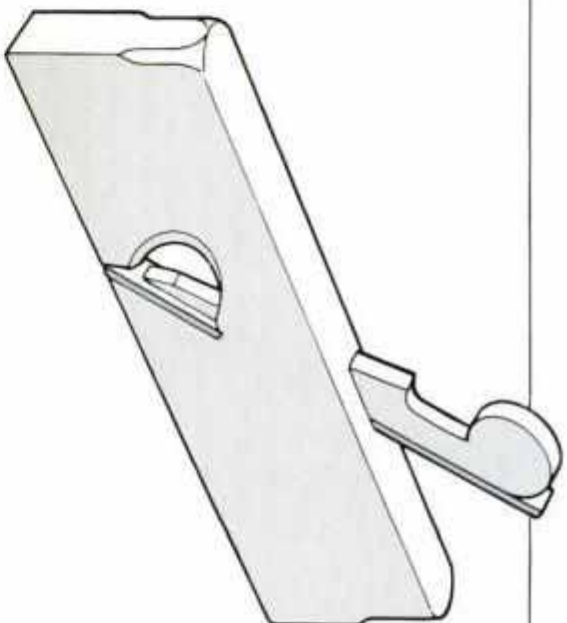
LEVER CAP
CAM

LATERAL-
ADJUSTMENT
LEVER

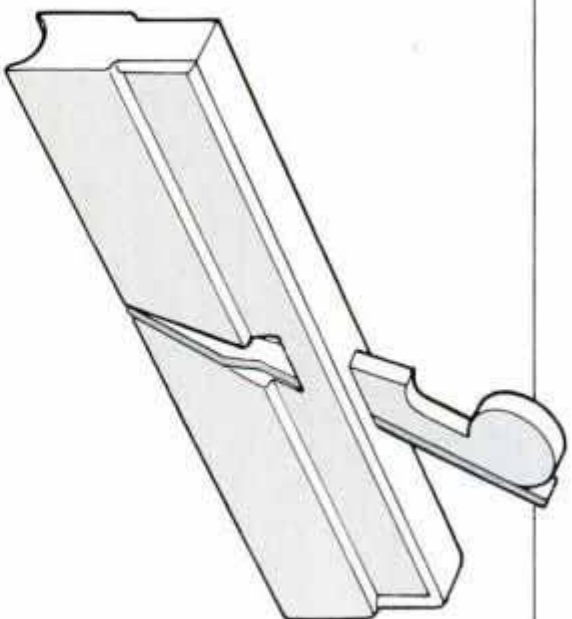
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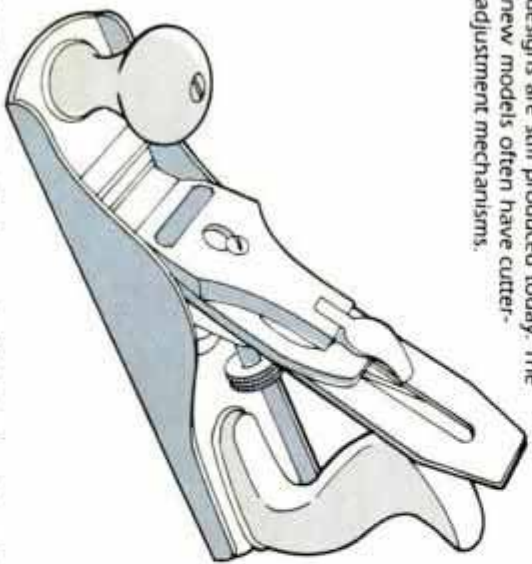
Smoothing plane with horn-shaped handle — Wooden planes with carved front handles were typical to Germany, Switzerland and Scandinavia, and examples of this type have survived from the 16th century. Usually limited to the smaller smoothing and jack planes, similar designs are still produced today. The new models often have cutter-adjustment mechanisms.



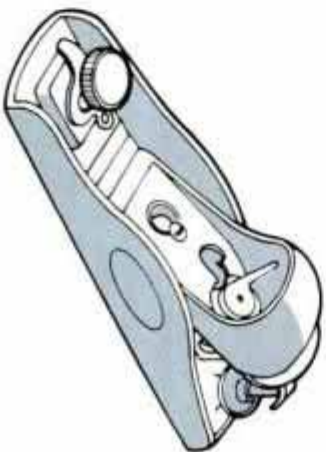
Wooden rabbet plane—The open-sided rabbet plane cuts steps and shoulders, or rebates, on the edges of stock. Later versions were equipped with spurs for scoring the wood when planing across the grain, and some models had a skewed cutter for a smoother shearing action. The single-iron cutter was held in place by a narrow wedge.



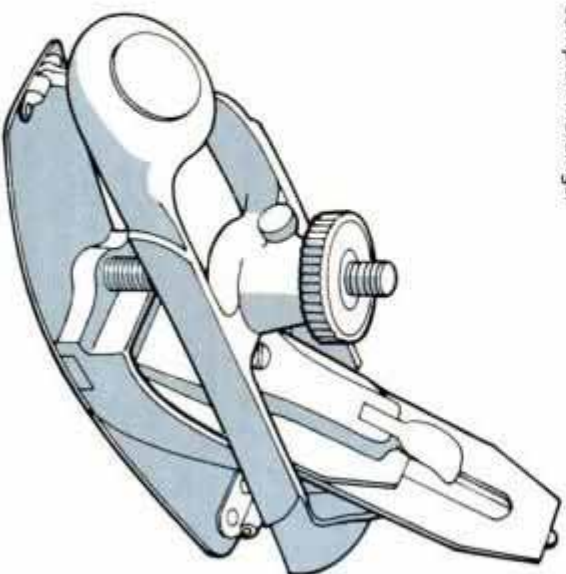
Simple molding plane—Simple wooden molding planes for shaping hollows and rounds had profiled cutters and matching plane soles. They were often made in sets composed of a range of sizes. Different sizes, along with other simple profiles such as the quarter round and cove and bead, could be used in combination to produce complex moldings.



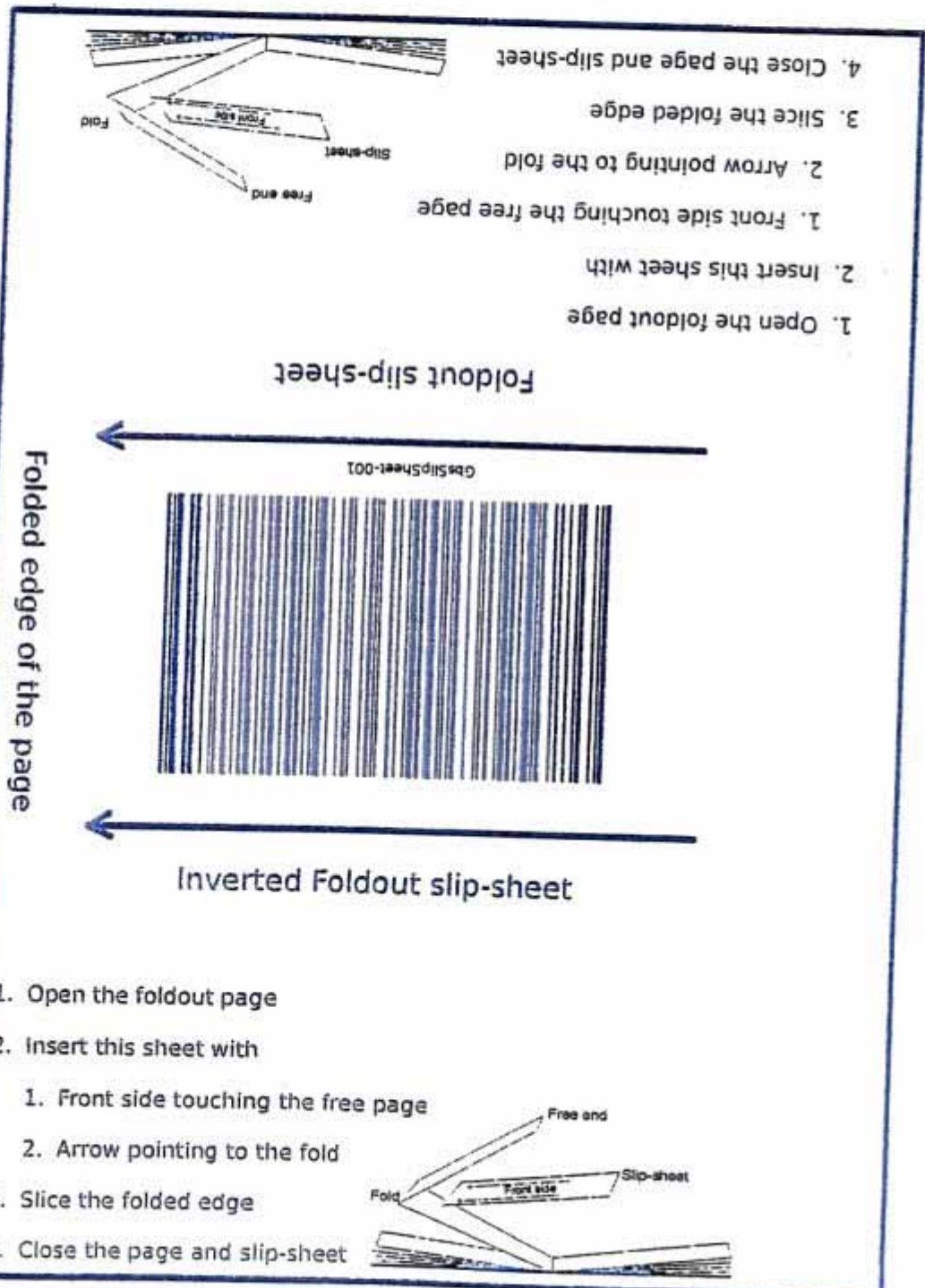
Cast-iron smooth plane—In 1870, Stanley offered the No. 4 smoothing plane that was designed by Leonard Bailey. Featuring the same cutter-adjustment system found on the transitional models, its cast-iron base provided greater durability and precision. Stanley produced this design in 11 sizes ranging from



Block plane—This Stanley No. 9 1/2-block plane was first offered in 1873. It had a cutter angle of 20° with a screw-feed adjustment mechanism. The cutter was a single iron placed bevel up in the plane. The sole front was adjustable for controlling the cutter opening. By 1922, eight versions of this plane, and another eight with a cutter angle of 12°, were available.



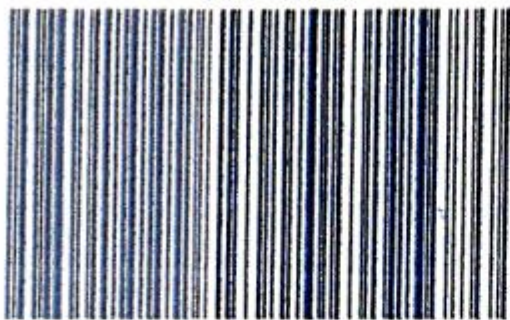
Circular plane—Until this plane was developed, woodworkers used an assortment of nonadjustable wooden compass planes to smooth circular components with a



1. Follow instructions on the other side

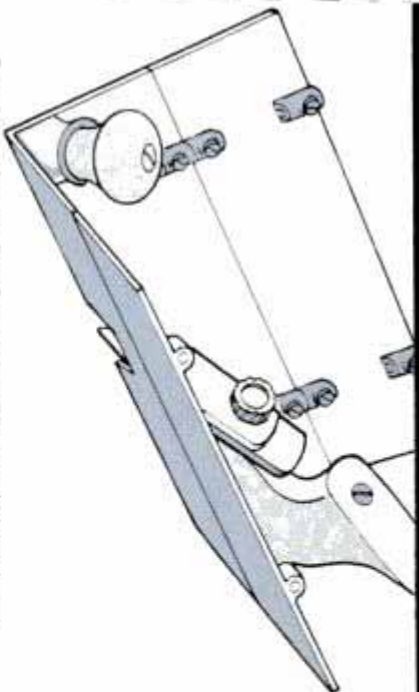
Back

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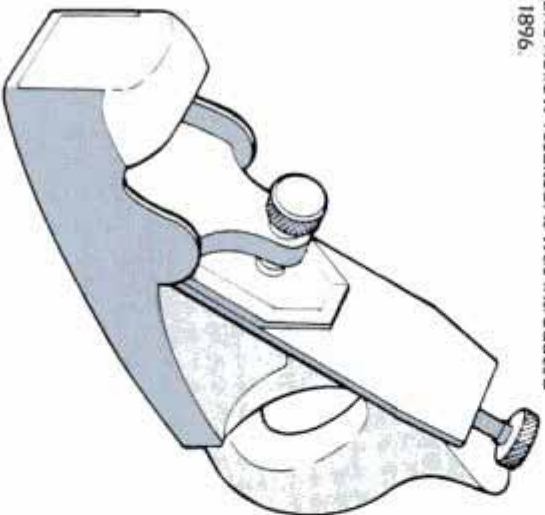


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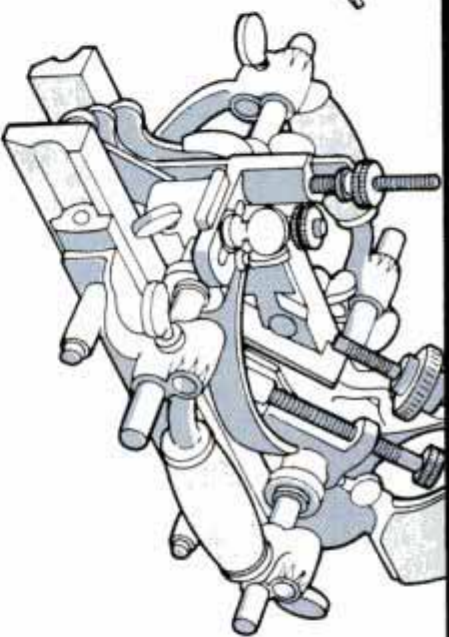
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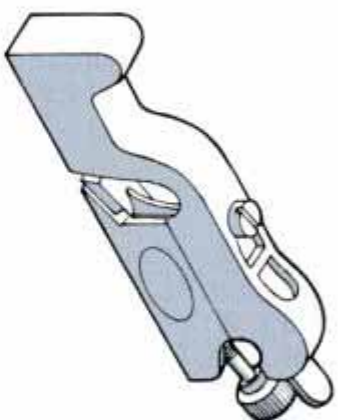
Corebox plane—This Stanley No. 57 had a 90° V-shaped sole and central cutter. It shaped semicircular hollows—two of which could be used as a pattern for a hollow core in metal casting. Planing was started in a groove and, as the plane was angled from side to side, an accurate half-round hollow resulted. It was introduced in 1896.



Wood-filled smooth plane—While several companies had offered similar wood-filled, smoothing plane designs since the middle 19th century, the addition of a patented screw-feed cutter adjustment in 1913 gave this Norris A5 a level of precision appropriate for the most demanding work. It remains, today, a favorite tool of skilled woodworkers.



Universal combination plane—Claimed to be "A Planing Mill Within Itself," the Stanley No. 55 represented the peak of the combination plane's evolution. With three adjustable rails, two fences and 96 cutters, this tool did the job of all previous types, and it handled a wider range of molding profiles. The 55 was first offered in 1897.



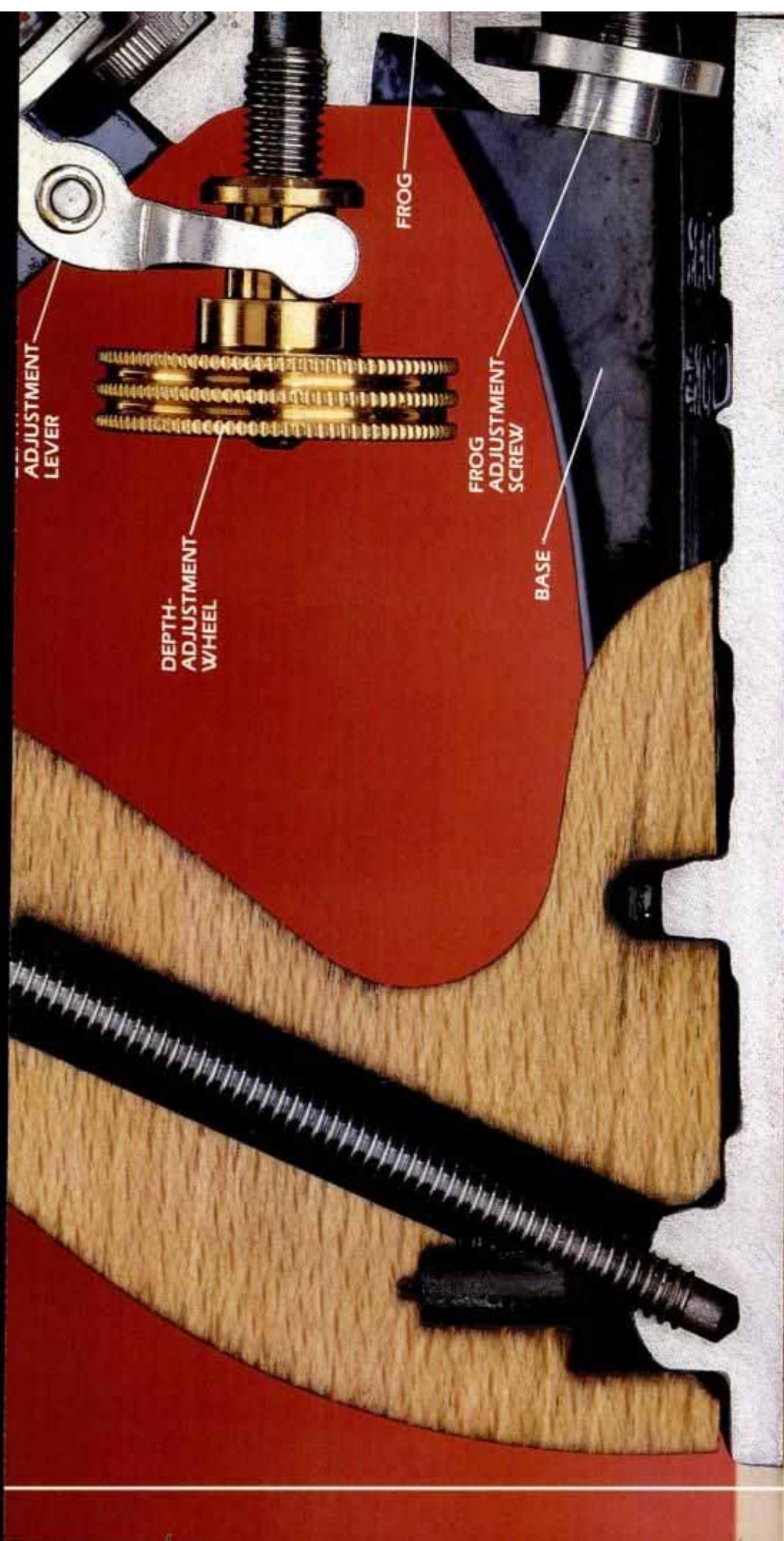
introduced in 1880, had a flexible metal sole that could be adjusted for different size arcs and convex or concave work.

Shoulder plane—The Stanley No. 93 was also called a cabinetmaker's rabbit plane. It featured a low-angle cutter position which facilitated trimming end-grain tenon shoulders. It was offered in three sizes, from 5½ to 7 in. long, and had a removable front section for working into corners. It was introduced by Stanley in 1902.

HAND PLANE HISTORY

Throughout the history of woodworking, hand planes have been made in a multitude of shapes and sizes for handling nearly every conceivable wood-shaping operation. The collection shown represents a small sampling—in roughly chronological order—of the many planes used over the past 150 years. Although many individuals and companies played a role in hand plane design and development, the period was eventually dominated by the Stanley Rule and Level Co. While most of these traditional tools are no longer produced, actual examples have survived and are a source of enjoyment both to the tool collector and the woodworker. They not only provide insight into the technology of the past, but continue to serve an important function in the woodworking shops of today.

Popular
Mechanics



ADJUSTMENT
LEVER

DEPTH-
ADJUSTMENT
WHEEL

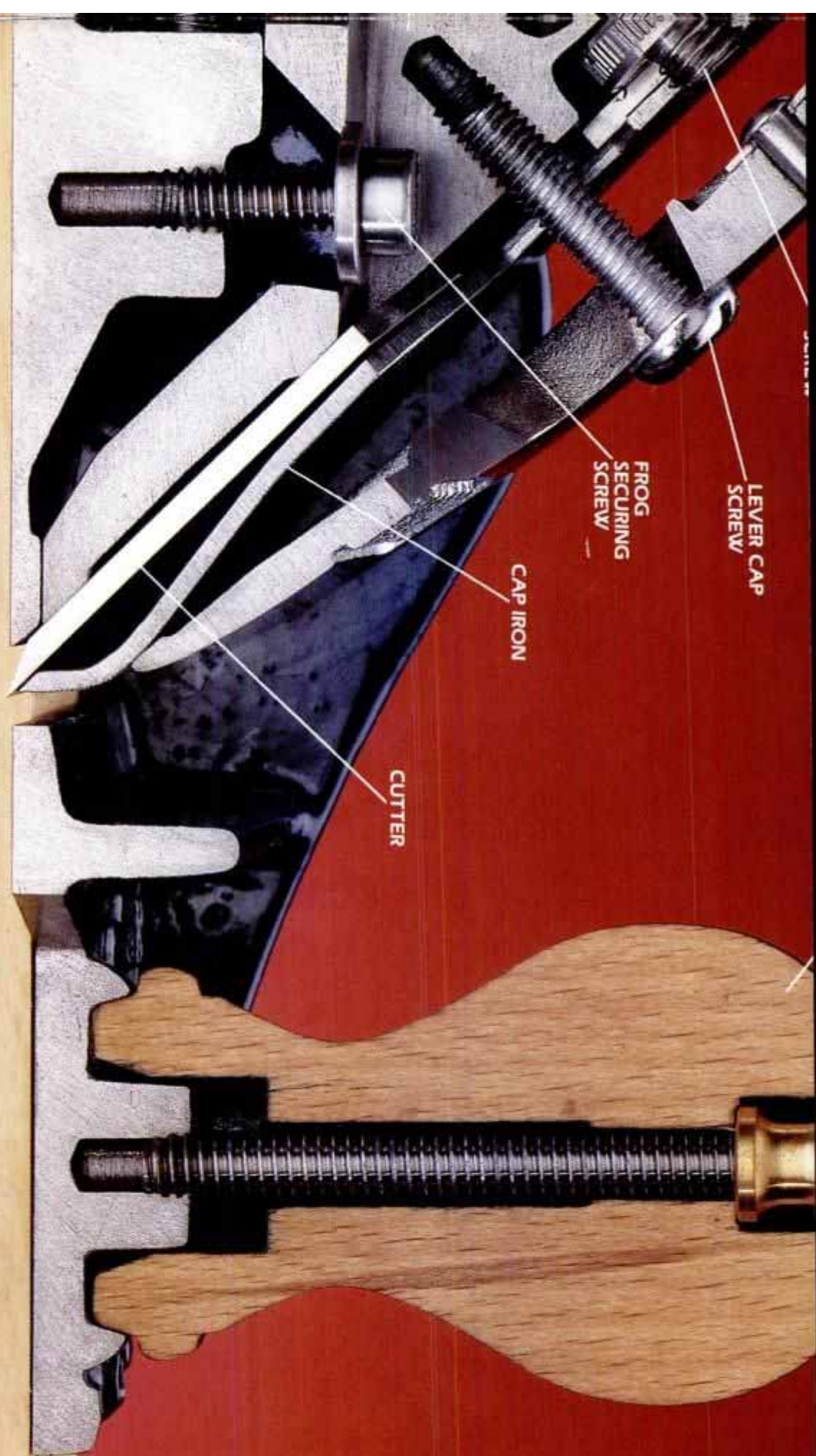
FROG

FROG
ADJUSTMENT
SCREW

BASE

Popular Mechanics

PM PHOTO BY BRIAN KOSOFF; CUTAWAY PLANE BY HERBERT KLENCK
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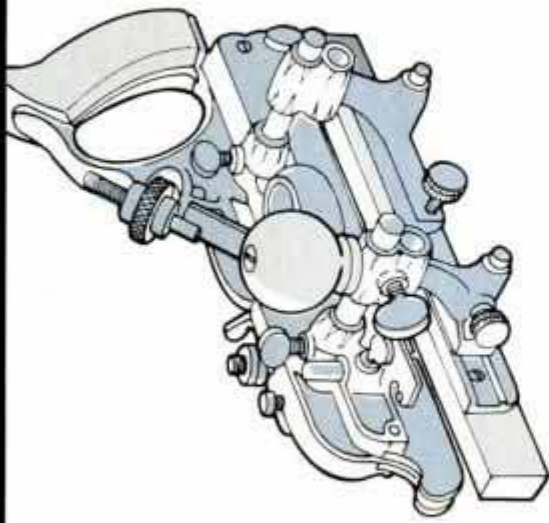


LEVER CAP
SCREW

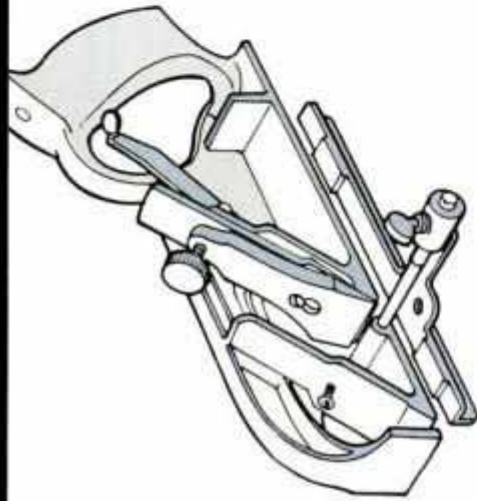
FROG
SECURING
SCREW

CAP IRON

CUTTER



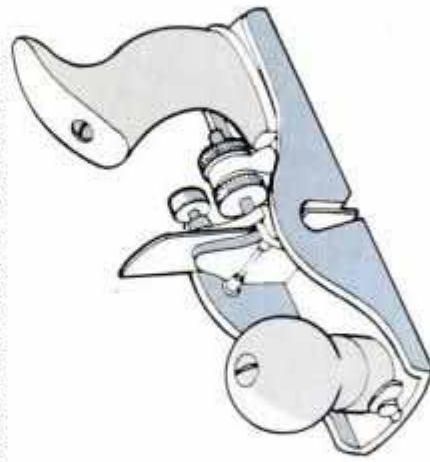
Combination plane—Based on the traditional wooden plough plane, the Stanley No. 45 was introduced in 1884 and came with an assortment of cutters. It was capable of shaping rabbets, grooves, dados, beads, sash moldings, tongue-and-groove joints, simple moldings and, with the addition of add-on bases, hollows and rounds.



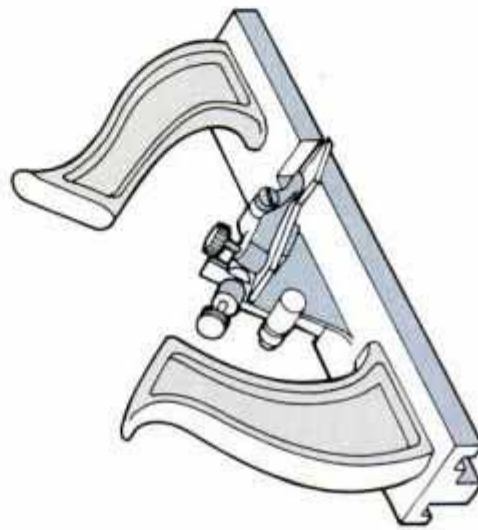
Rabbit plane—In 1885, Stanley introduced this improved No. 78 rabbit plane. It featured a fence that could be fitted on either side of the plane body, a depth stop and a cutter-adjustment lever to control cutter depth. This all-metal plane also had a forward cutter position for working in confined areas, and it had a spur for crossgrain work.



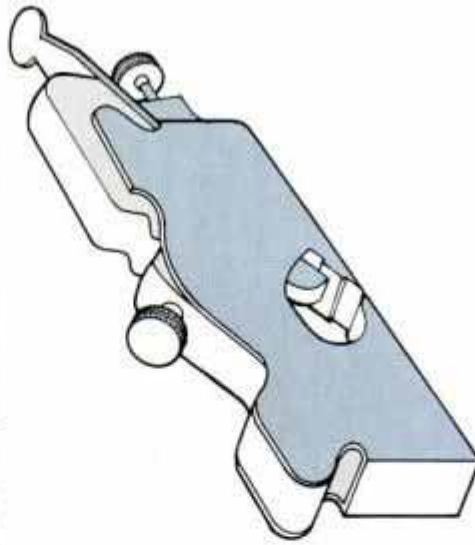
Chamfer plane—The Stanley No. 72 chamfer plane was designed to produce uniform, consistent chamfers easily and efficiently. The flat front section of the base held the cutter and could be adjusted for chamfer width. The rear section was shaped to hold the plane at 45° to the stock surfaces. The plane was first offered in 1886.



Scraper plane—Stanley's 1922 catalog showed six different scraper planes. This model, No. 85, was first offered in 1905 and called a cabinet scraper. Used to prepare a surface for finishing, the scraper removed all traces of hand planing. Other scrapers had side handles instead of the typical plane handles of this model.



Tongue-and-groove plane—In 1905, Stanley introduced the model No. 148 for producing both halves of a tongue-and-groove joint. Basically two planes in one, it was used in one direction to shape the tongue and the other direction to cut the corresponding groove. The plane came in three sizes for stock of different thicknesses.

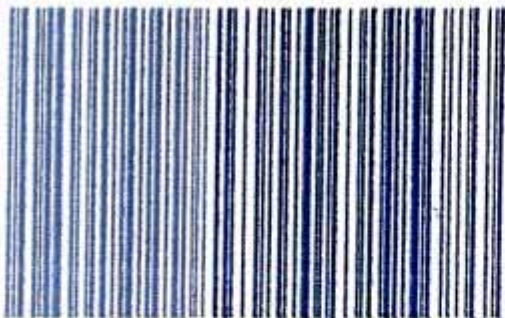


Wood-filled shoulder plane—Throughout the 19th century, toolmakers in Great Britain produced a more traditional wood-filled, steel-body plane. This late Norris No. A7 shoulder plane was rosewood filled, with steel sides and a sole that was dovetailed together. It had a screw-feed adjustment system and 1¼-in.-wide, low-angle cutter.

1. Follow instructions on the other side

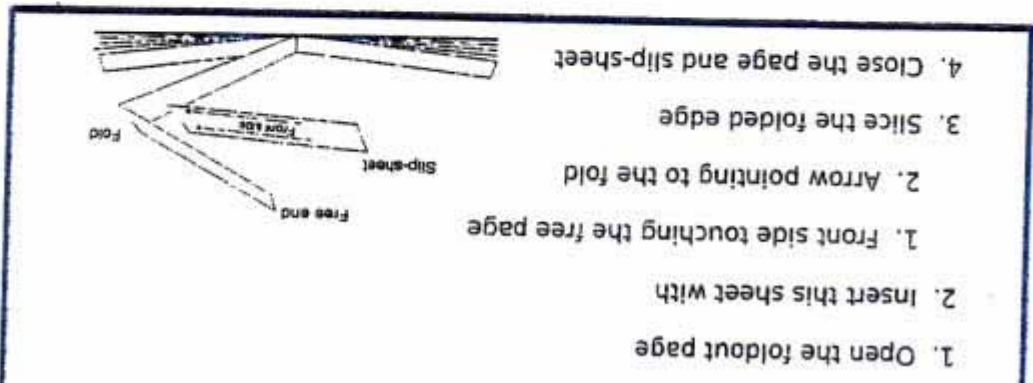
Back

Gbs5lipBack-0018



Inverted Back

1. Follow instructions on the other side

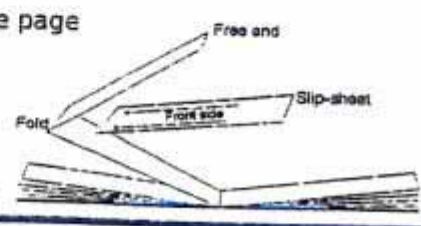


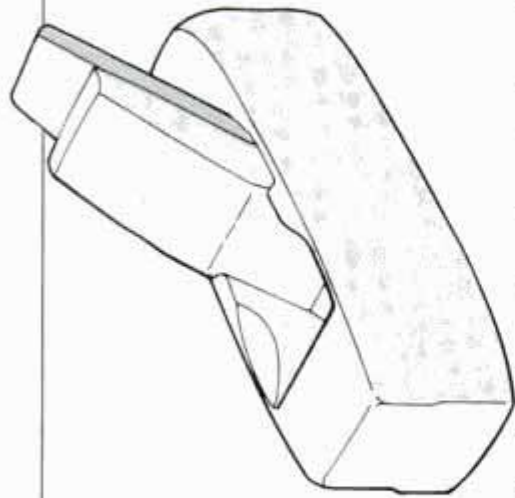
Foldout slip-sheet



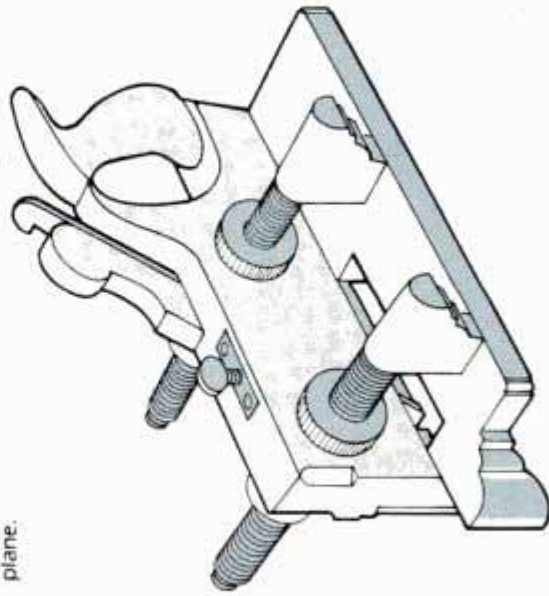
Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

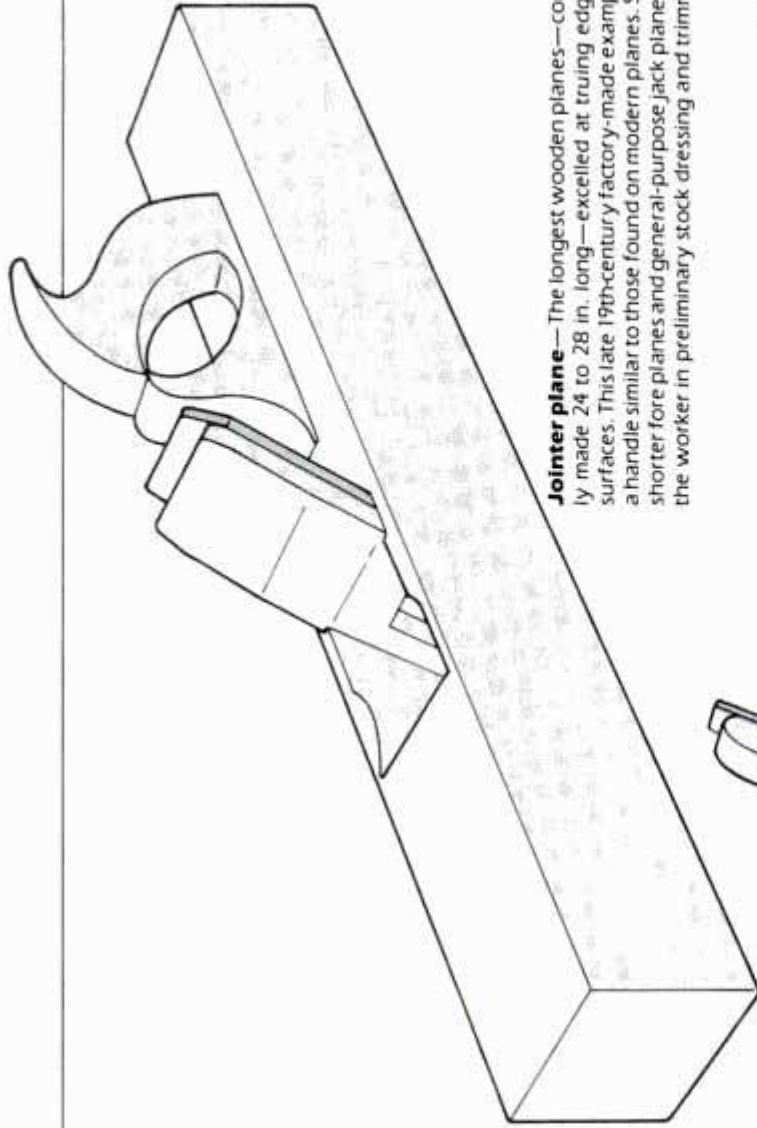




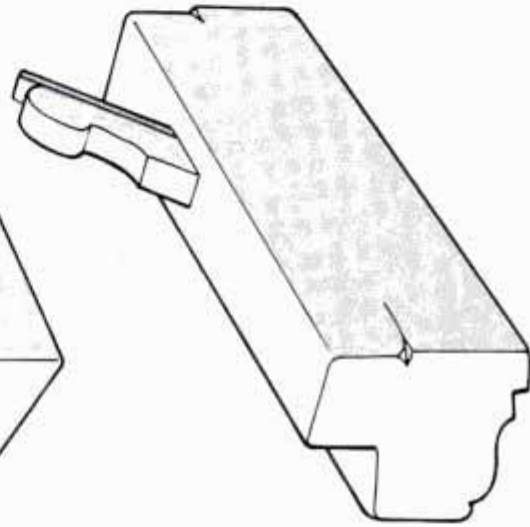
Coffin-shaped smoothing plane—Used for the final smoothing of surfaces, this plane was developed some time before 1500 and continued to be made and used well into the 20th century. Cutter was held by a wedge that fit into notches in the sides. Slightly curved sides provided greater wall thickness where the wedge entered the plane.



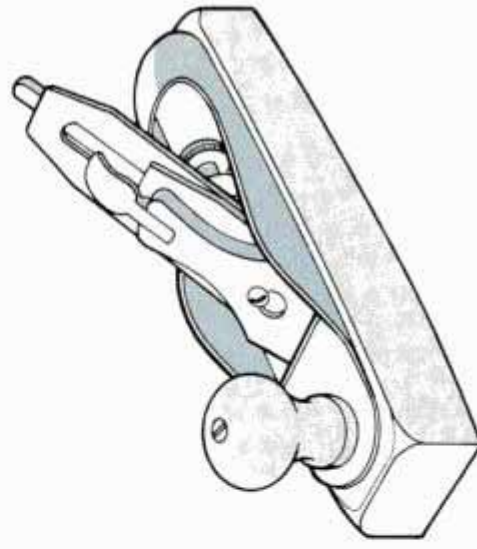
Wooden plough plane—With a narrow, straight-edged cutter, this plane shaped grooves along the grain. An adjustable fence mounted on two wooden screws guided the tool along the stock edge. Other models used wedges to lock the fence securely on the arms. Plough planes had a rail-type sole and usually accepted eight cutter widths.



Jointer plane—The longest wooden planes—commonly made 24 to 28 in. long—excelled at truing edges and surfaces. This late 19th-century factory-made example had a handle similar to those found on modern planes. Slightly shorter fore planes and general-purpose jack planes aided the worker in preliminary stock dressing and trimming.



Complex molding plane—After 1600, elaborate ornamentation became popular, and molding profiles became more standardized. This 19th-century molding plane produced a 3-in.-wide crown molding. The sole of the plane had a built-in fence that was guided against the stock edge. Like many molding planes, this tool was held at an angle to the stock face.



Transitional smooth plane—American innovations in the middle 19th century led to a steel cutter-adjustment and securing mechanism that was screwed to a wooden plane body. This Stanley No. 24 was introduced in 1870. A rear-handled version was also offered, and the design was applied to the longer jack and jointer planes.

DRIP PLANE

Virtually unchanged since its conception in the mid-19th century, the modern hand plane represents a union of design, craftsmanship and technology. It answers the need for a tool that is completely adjustable, capable of precision cutter control, solid, durable and relatively inexpensive to produce.

The body of the tool is cast iron with wooden handles. The frog supports the blade at the correct angle and is solidly screwed to the base. The frog can be adjusted forward or back to decrease or increase the cutter mouth opening. Mounted in the frog is the depth-adjustment control lever, which is activated via the brass wheel. Riveted to the top frog face is a lateral adjustment lever for setting the cutter edge parallel to the sole. The cutter is reinforced by a cap iron that also serves as a chip breaker to reduce tearout. The lever cap locks the blade in place through a lever-activated cam and a lever cap screw. A revolutionary design when developed, this plane quickly gained universal acceptance over its wooden predecessors and remains today the quintessential tool for handcrafting wood.

LEVER CAP

CAP IRON

KNOB

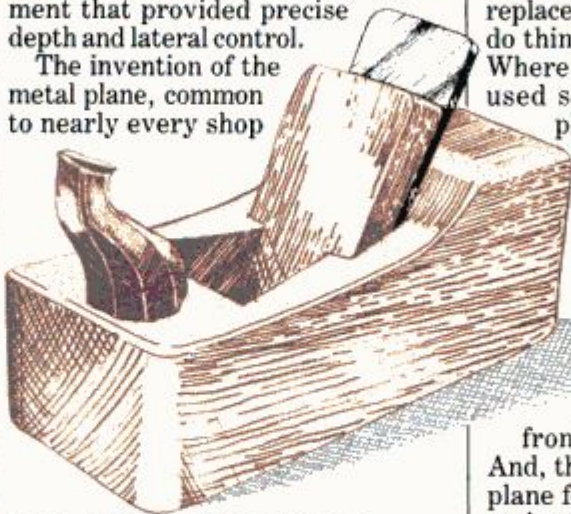
and complete sets of hollows and rounds became common to the woodworker's toolbox. The woodworkers themselves also became more specialized and each group developed planes to suit their specific needs.

However, it wasn't until about 1760 that a truly important change in the engineering of the plane occurred. Before this period, the cutter was a single metal component tapered thicker at the cutting edge to increase rigidity. Now, a second piece of metal—called the cap or back iron—was secured to the face of the cutter. This not only stabilized the cutting edge, but caused each shaving to break in short, but connected, segments, reducing tearout in the planed surface. This also meant that the blade could be stamped out of thinner sheet steel making it easier and cheaper to produce.

During the early 19th century, three companies in Great Britain independently developed planes that, to this day, are considered to be the finest in the world. The firms of Alex Mathieson & Sons, Stewart Spiers and Thomas Norris made wood-filled, metal-

further improved this design through a patented screw-feed cutter adjustment that provided precise depth and lateral control.

The invention of the metal plane, common to nearly every shop



16th-CENTURY DUTCH SMOOTHING PLANE

today, was an extended process that began on this side of the Atlantic around the mid-1800s. It started with the development of a metal blade-securing and adjustment mechanism that was simply fixed to the top of wooden plane bodies. In principle, this design is the same as that found on the modern plane. A lever cap locked the cutter in place on a cast-iron bed—called the frog—and an adjustment wheel controlled the depth of cut.

These transitional wood/metal planes led quickly to the development of today's cast-iron body that we know so well.

In 1869, the Stanley Rule

And Level Co. entered the plane-making business by acquiring the patents held by Leonard Bailey, one of the chief developers of the cast-iron plane, and buying the Bailey, Chaney Co. Bailey was installed as head of the newly formed plane department, and, one year later, Stanley's catalog boasted a line of 28 different planes.

Over the next 20 years or so, Stan-

ley went on to offer dozens of metal specialty planes designed to either replace their wooden counterparts, or do things no plane had done before.

Where the wheelwright previously used several curved-sole wooden

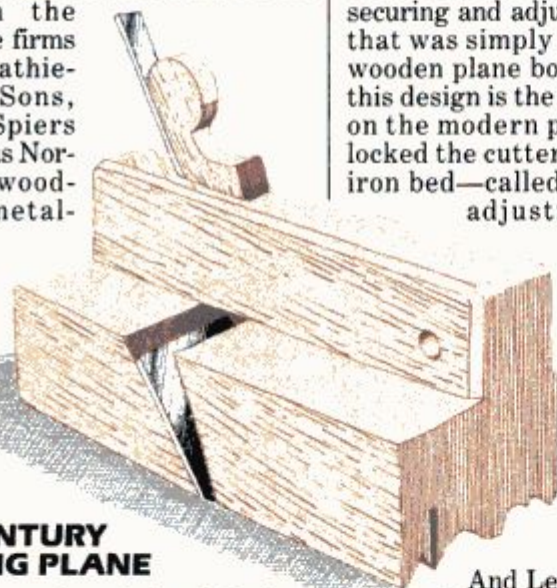
planes for smoothing various circle arcs, a completely adjustable, flexible steel sole circular plane was now available. Long-wearing metal rabbet planes acquired screw-feed adjustment mechanisms and easy-to-use fences. Shoulder planes became more versatile with removable

fronts for working into corners. And, the completely adjustable block plane found its way into woodworkers' pockets and shop aprons across the country.

Notable among these efforts was the development of a series of models that transformed the ordinary plough plane into a tool capable of cutting hollows, rounds, beads, grooves and simple moldings. This evolution culminated in the elaborate Stanley 45 and 55 planes. While both claimed to do the jobs of a toolbox full of wooden planes, their days were numbered almost as soon as they were introduced. The technology that enabled these tools to be made to a consistent standard was also beginning to offer the average woodworker stock machine-cut moldings at a very attractive and reasonable price.

And, as the 20th century progressed, many of the other unique and intriguing designs fell by the wayside as routers, shapers, jointers and planers took over many of the heavy, tedious chores of woodworking.

Today, the hand plane in all of its guises continues to play a role in the workshop. Although many types are no longer in production, the original tools are still available through collectors, used tool dealers and can even be found at yard sales and flea markets. And, the renewed interest in traditional ways of working has spurred manufacturers to offer both reproductions of old designs and new innovations that are sure to carry the heritage of the hand plane into the 21st century. **PM**



18th-CENTURY MOLDING PLANE

body planes of traditional design. Often, these composite plane bodies were dovetailed together from three sheets of mild steel with other models cast in steel or gunmetal. Both types were filled with two pieces of wood: one for the front knob and the other for the rear handle. In 1913, Norris

FRENCH CARPENTER'S RABBET PLANE (ABOUT 45 IN. LONG)



APPLIANCE CLINIC

BY STEVE TOTH,
Contributing Editor

Hot Burner

A problem has developed with the small, right rear burner on my G.E. built-in cooktop, model No. JP6510-C1AD, serial No. VM759501 G. Regardless of the setting, whether it is turned to HIGH through WARM, it continues to burn only on HIGH and can't be turned down. As a result, I am unable to use the burner. Is this a problem I can solve without calling in a G.E. repairman?

KENT THOMAS
MAGALIA, CA

From all the symptoms you've described, it would appear that the infinite heat switch for the right rear burner needs to be replaced. Possibly, the switch may have an open bimetal heater, or the switch contacts may be welded closed, preventing any temperature control. The heat switch cannot be repaired and should be replaced.

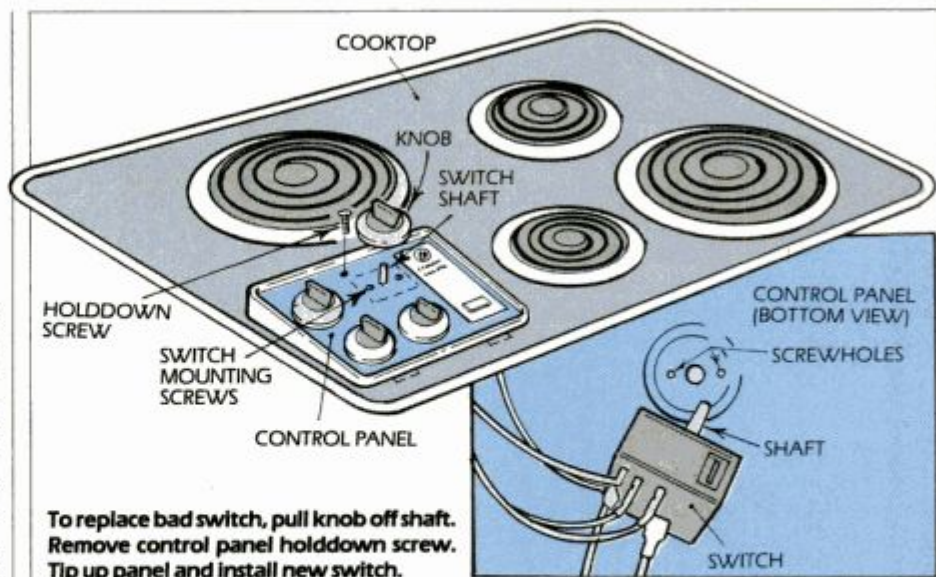
First, purchase a replacement switch from any G.E. parts or service center or appliance repair parts store in your area. The G.E. part number for the switch is WB21X5217.

Disconnect the electrical power to the cooktop. Then remove the control knob from the bad switch by pulling it off the switch shaft. Remove the small Phillips-head holddown screw on the back edge of the chrome control panel.

Lift up the control panel, slowly unhooking it at the front from the locking tabs. Then, turn the control panel on its side. Next, remove the two Phillips-head mounting screws that hold the switch on the control panel. Pull the switch free.

Place the new switch alongside the old switch and remove one wire at a time. Install it on the corresponding terminal that's on the new switch.

Slip the new switch back into the hole in the control panel and install the two mounting screws. Push the control knob on the switch shaft, then slip the control panel back in position. Check that no wire has become pinched between the control panel and the mounting flange. Reinstall the holddown screw. Connect the cooktop's power and test the burner.



Broken Bellows

I have a Gibson air conditioner. The pleated vinyl panels that expand to fit my bedroom window are broken. I have tried to write to Gibson in Greenville, Michigan, but the letter was returned as "Expired Forwarding." The air conditioner works very well, and I don't want to get rid of it. Would you know where I can obtain or order replacements for the panels?

BETTY COMEN
WALDWICK, NJ

The side panels are still available. To locate either parts or service for your air conditioner, call the toll-free Gibson consumer information number at (800) 458-1445. Give them your postal zip code, and they will give you the name, address and phone number of your nearest factory-authorized parts or service center.

Needs Gasket

My Amana refrigerator is 24 years old, and the door gasket needs to be replaced. I am unable to find the gasket or a replacement in New Orleans. It is model No. BRS15L, serial No. K2350381.

LAURENT CAMES
NEW ORLEANS, LA

According to the Amana Co., the door gasket for your model refrigerator is no longer available. I suggest that you fit a universal replacement magnetic door gasket kit to your refrigerator door.

These kits come with four L-shaped gaskets with factory-sealed corners. The magnetic material is also supplied in a roll. Both the vinyl gasket material and magnetic material can easily be cut to fit the door, and each kit has instructions.

These kits are available from most appliance parts distributors. When ordering the kit, supply the store with the outside dimension of your old gasket (it should be about 32 in. x 60 in.), and tell them your gasket has mounting screws that go through the gasket into the door frame.

Can't Find Cooker

We have a Presto electric pressure cooker made by National Presto Industries, Inc., model No. KE02AT, serial No. 3968. The cooker is still working, and we would like to have another. We have been unable to find another one, and we received no answer from Presto. Do they still make them, or is there any company that makes one?

JAKE PADILLA
LAS VEGAS, NV

Presto discontinued making the electric pressure cooker about 10 years ago. They still make a rangetop pressure cooker, however. These operate at 15 pounds of pressure with the range burner supplying the heat (as opposed to a built-in heating element). Presto still has some parts for your model cooker like sealing rings, pressure regulator, cover, handles and controls, but the body assembly with heating coil is no longer in stock.

You can contact the company's parts department at (715) 839-2121, and/or write National Presto, 3925 N. Hasting Way, Eau Claire, WI 54703, Attn.: Parts Dept.

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.



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EQUIPMENT TEST MULCHING MOWER

TEXT AND PHOTOS BY STEVEN WILLSON, Home and Shop Editor

IF YOU ARE tired of collecting your grass clippings, then this mulching mower may be for you. Bolens, the manufacturer, claims that this 4-hp, manual-start, 22-in., self-propelled mower has a deck and blade that were designed to cut the grass and suspend the clippings in the mowing chamber so they can be recut several times, yielding clippings that are too small to see on your lawn.

We thought this was a pretty bold claim, so we tested the unit shown through an entire mowing season, and must say that the results were very impressive. On dry, 4-in.-high grass the mower cut a smooth, uniform surface with no evidence of clippings left behind. When we attacked 6- and 8-in.-high wet grass, the mower yielded a similar smooth carpet. The wet grass clippings did, however, tend to collect on the rear wheels and peel off, leaving behind some clumps.

We also tested the mower's mulching capability on autumn leaves. It

performed very well on dry leaves, but couldn't pull wet leaves off the ground.

If you'd like to occasionally collect the clippings for composting, optional collecting bags and discharge chutes are available. The model No. 8653 mower costs about \$530 at Bolens dealers. For more information, contact Bolens Corp., 102nd St. and Ninth Ave., Troy, NY 12180. **PM**



Dual control levers are located on right side of handle. Inside handle engages front-drive mechanism. Outside handle controls speed.



Handle has two height positions and can collapse over mower deck for storage or transport. Push spring-loaded bolt to change.



Mower deck height is easily adjusted by one D-handle mounted on rear of deck. Just turn handle, and all four wheels move at once.



As deck height adjustment handle is turned, scale on adjustment linkage moves over cutting height arrow to indicate change.



Fuel shutoff valve (arrow) should be turned off when mower is not in operation to keep fuel in carburetor instead of draining out.



Engine crankcase oil fill tube is conveniently located on the top of the engine. Easy-to-read dipstick is attached to fill cap.

since 1986, Toyota has used the technology in the premium-sound option for selected cars.

Now it seems that Blaupunkt and Philips seem intent on developing even more sophisticated multi-antenna systems for better radio reception. Blaupunkt, in fact, doesn't even use the term diversity tuning—preferring to call its system a product derived from the phased-array technology used in mobile radar systems.

Hills, buildings, utility poles and even other passing vehicles can disrupt line-of-sight FM waves. But the same FM signal blocked from the front antenna by a tall building might be visible to another antenna at the rear of the vehicle. The difference is simply antenna location. Anyone who has ever gotten trash on the radio while stalled in traffic, then moved up just a few inches and received clear sound, has an idea of the relationship between antenna location and mercurial radiowaves.

Although some multi-antenna systems have used two aerial masts, most complement the standard fender whip with a more discrete antenna that is adhered to or etched into the glass of a rear window or lighting assembly. But the mere presence of additional antennas on a car does not alone improve radio reception. What's needed is a way to select the best signal, whence the term antenna diversity tuning. Engineers have devised a variety of ways to achieve this.

One method is the dual-receiver system. Here, there are two receivers aboard, each with its own antenna. A so-called comparator mounted elsewhere in the car monitors the signal quality of each receiver and routes the better one to the sound system for amplification.

A variation is called scanning diversity. This type of system uses only one receiver, equipped with an outboard detector that scans the antennas constantly, switching to whichever antenna provides the best signal at a given moment. Although scanning diversity systems can use more than two antennas, two is usually all you get.

The new Philips PSM (Phase Shift and Mix) system employs scanning diversity with two antennas, but uses electronic sleight-of-hand to make its two transducers work like four.

According to Philips, its PSM circuit adds and subtracts the inputs from the real antennas to create two additional virtual or adaptive antennas. Moreover, these electronic antennas operate directionally, like a multi-element home rooftop antenna. The usual car mast is omnidirectional, and therefore prone to

(Please turn to page 105)

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1302-060

HOMEOWNERS CLINIC

BY NORMAN BECKER, P.E., Contributing Editor

Gurgling Toilet Tank

I had a Fluidmaster 400-A tank valve installed in my toilet recently, and have since noticed a gurgling sound coming from the toilet. It sounds as if the valve is stuck open, allowing water to run into the bowl. The water level in the bowl doesn't change. Any ideas?

DENNIS WERTHEIMER
WEST ORANGE, NJ

The condition may be the result of a sediment buildup. Often, sediment in the plumbing is loosened when the new valve is installed and is carried by the water stream into a Fluidmaster's valve.

To flush out the deposits, turn off the toilet's water supply. Unscrew the valve's cover by pushing down and turning 1/8-turn counterclockwise. Hold an overturned cup above the valve and turn on the water supply again. Flush out valve thoroughly.

Check that an angle adapter has been installed on the overflow pipe. Without it, water will be siphoned from the tank, down the pipe and into the bowl. Also, check that the flusher is properly aligned over the valve seat so water won't leak past it.

If sediment continues to clog the

valve, you may need an inline water filter on the house water supply line.

For more information, write to Fluidmaster, Inc., Customer Service, 1800 Via Burton, P.O. Box 4264, Anaheim, CA 92803.

Tempered Glass

How can I cut tempered glass to the size that I want?

LAWRENCE GARLOCK
MASSILON, OH

You can't cut tempered glass. Used as a safety glass, it is 4- to 5-times stronger than ordinary plate glass of the same thickness. It cannot be cut or drilled after tempering. If you try to cut tempered glass, it will break into small, cubelike fragments, unlike plate glass which breaks into large shards.

Pocket Doors

Can I fix sliding pocket doors that came off the rail without cutting into the wall to gain access? The hangers and rollers either come loose, or the rail becomes loose due to screws falling off.

M. MARCHESE
NORTHRIDGE, CA

You may be able to solve the problem by adjusting the hardware the door hangs from. If, however, there is a problem with the tracks inside the wall, it may be necessary to open one side of the wall for access.

If you decide to replace the door, you'll find good tips in PM's "How To Install A Pocket Door," page 103, Oct. '86. To adjust and repair an old door, see the July '83 issue of The Old House Journal, 435 9th St., Dept. PM, Brooklyn, NY 11215 (a back issue of the OHJ costs \$3.50 postpaid).

A Small Plumbing Noise

Shortly after moving into my 3-year-old home, I noticed a small plumbing noise. Since then, the noise has increased and often occurs after running water through faucets or flushing the toilet. It happens with both hot and cold water, in the kitchen and the bathroom.

The sound is like someone tapping the water pipes with a hammer.

Help!

V. SIMPSON
NEWBURY PARK, CA

Water hammer could be the culprit. This happens when flowing water is shut off. The water slams into the valve or the end of the plumbing run. You can install an air cushion to stop this.

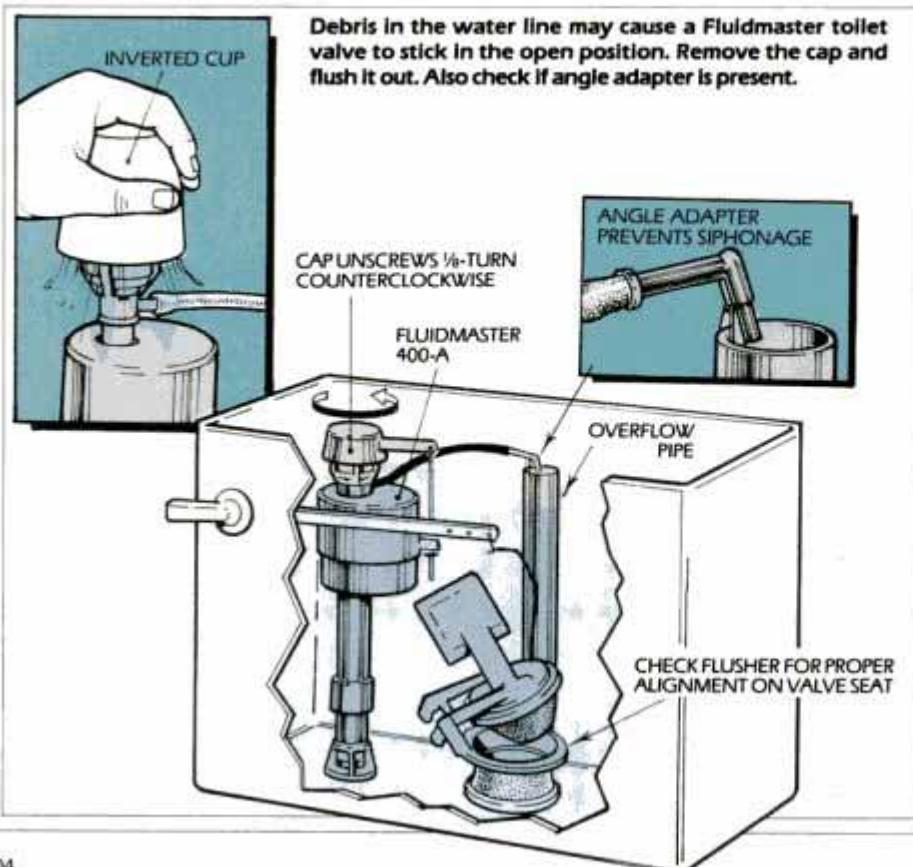
The water meter may also be to blame, since this occurs when the toilet is flushed (usually not a cause of water hammer). Listen to the meter while water is flowing from a faucet to see if it is the noise source. Also, pipes that are inadequately secured to framing may vibrate against the framing, causing the noise.

Ultrasonic Repellers

We've received many letters from readers looking for ultrasonic pest repellers, since we ran our survey on that subject in the Sept. '89 Homeowners Clinic (page 89). One manufacturer is Sonic Technology Products, Inc., Grass Valley, CA (800) 247-5548. One of its single plug-in units costs about \$20. **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.



pick up and mix in audio ghosts—those unwanted multipath signals reflected by buildings or terrain.

The practical result of the PSM scheme is that the tuner gets input from four antennas. These are scanned every one-ten-thousandths of a second, but only when needed, that is, when signal quality drops below a predetermined level. Switching noise, says Philips, is not audible. All the added electronics can be accommodated within a standard DIN chassis, so that the only additional component to be installed is the second antenna, preferably glass-mounted. Philips' front-ends are currently being manufactured with two antenna inputs.

Blaupunkt also uses four antennas—but real ones. Moreover, there is no switching among the quartet in its Auto Directional Antenna (ADA) system. Instead of scanning for the best signal, as in diversity tuning systems, ADA links the four inputs electronically to create a single phased array that acts as a rotating, directional antenna.

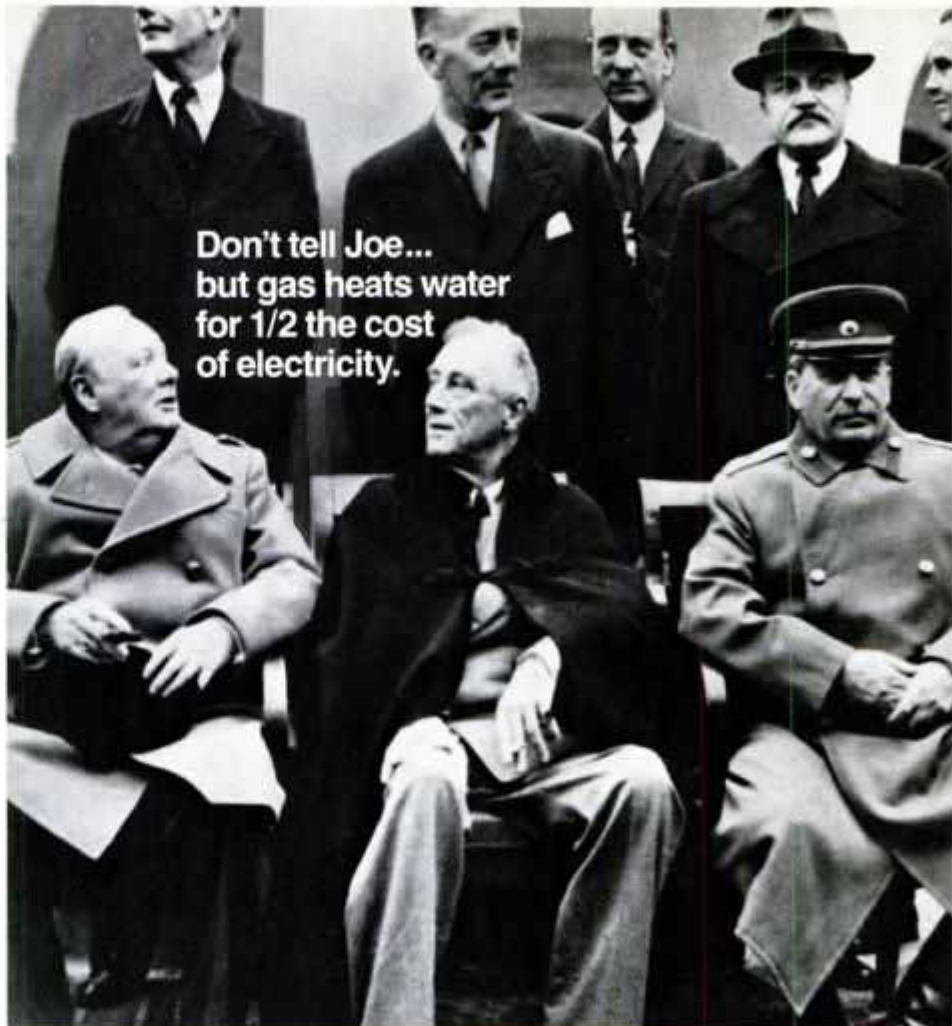
The antennas themselves are foil strips embedded in the corners of the composite-plastic bumpers. Each is connected via coaxial cable to its own tuner. The four tuners share a common oscillator, and may be mounted on a hybrid board in the front end or outboarded. ADA's electronics analyze the summed incoming signal, and electronically rotate the antenna for best effect. For example, if the incoming signal is clean but weak, it orients the antenna in the direction for maximum gain. If the signal is strong but noisy, it adjusts the array for minimum distortion. The analysis is ongoing. The electronic rotation takes microseconds and is, according to Blaupunkt, inaudible.

Blaupunkt's ADA system is a production prototype, and though the company is currently shopping the system among carmakers, it says it intends to offer it for aftermarket installation under its own brand name. For the time being, it appears that OEMs will have the upper hand in offering multi-antenna systems.

Automakers can cosmetically integrate the additional components at the design stage and more easily conceal the extra cost in the total option price.

Year Of The Laser Disc

For the past 10 years, Pioneer Electronics has carried the ball for the laser disc format. Recently, Sony, Philips and others have also added their support for the format. Now, Panasonic is putting its manufacturing and marketing muscle behind the format with the introduction of two laser disc machines. Panasonic is known for delivering high-quality goods at low prices. Expect low-priced laser disc machines soon. **PM**



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There we go, stretching the rules again.

Okay, maybe you have a right to be upset with us. First, we cheated you out of an easy decision when buying a pickup. It used to be full-size or compact. Simple. Then we had to come along with the Dakota, the first mid-size.

In time, we were forgiven for that moving violation because many of you found the Dakota to be not just a happy medium, but the perfect-size truck.

You'd think we'd leave well enough alone. But, no. Here we are introducing the Dakota Club Cab. Pretty gutsy, huh?

With its new extended cab, not only can this Dakota handle the payload of some full-size pickups, but the gear storage as well.

Sorry to do this to you again. But you know what they say: All's fair in love and Detroit.

The tough new spirit of Dodge.



In order to stretch this ad a bit further, we'd like to point out that this Dakota has an available 3.9-liter V-6. And, it's protected by 7/70. See this limited powertrain warranty and its restrictions at your dealer. Buckle up for safety. That's one rule that even we don't mess with.

Dakota 4x2 Club Cab



WHAT TO DO WHEN YOUR CAR OVERHEATS

BY PAUL STENQUIST; PM Illustrations by Fred Wolff

IT'S HOT. You're in bumper-to-bumper traffic, creeping along at a couple of miles per hour. Hot fumes from the car in front of you are being sucked through the cooling fins of your radiator. The temperature gauge climbs. Steam starts curling out from under your hood.

This is the kind of trouble you don't need. A little bit of diagnosis and repair time can put your cooling system into tip-top shape.

Diagnosis

Coolant spurting out from under your hood or puddling on the ground every time you shut your car off is a sure sign of cooling system problems. However, other cooling system problems may only make themselves known in terms of high coolant temperature and boilovers.

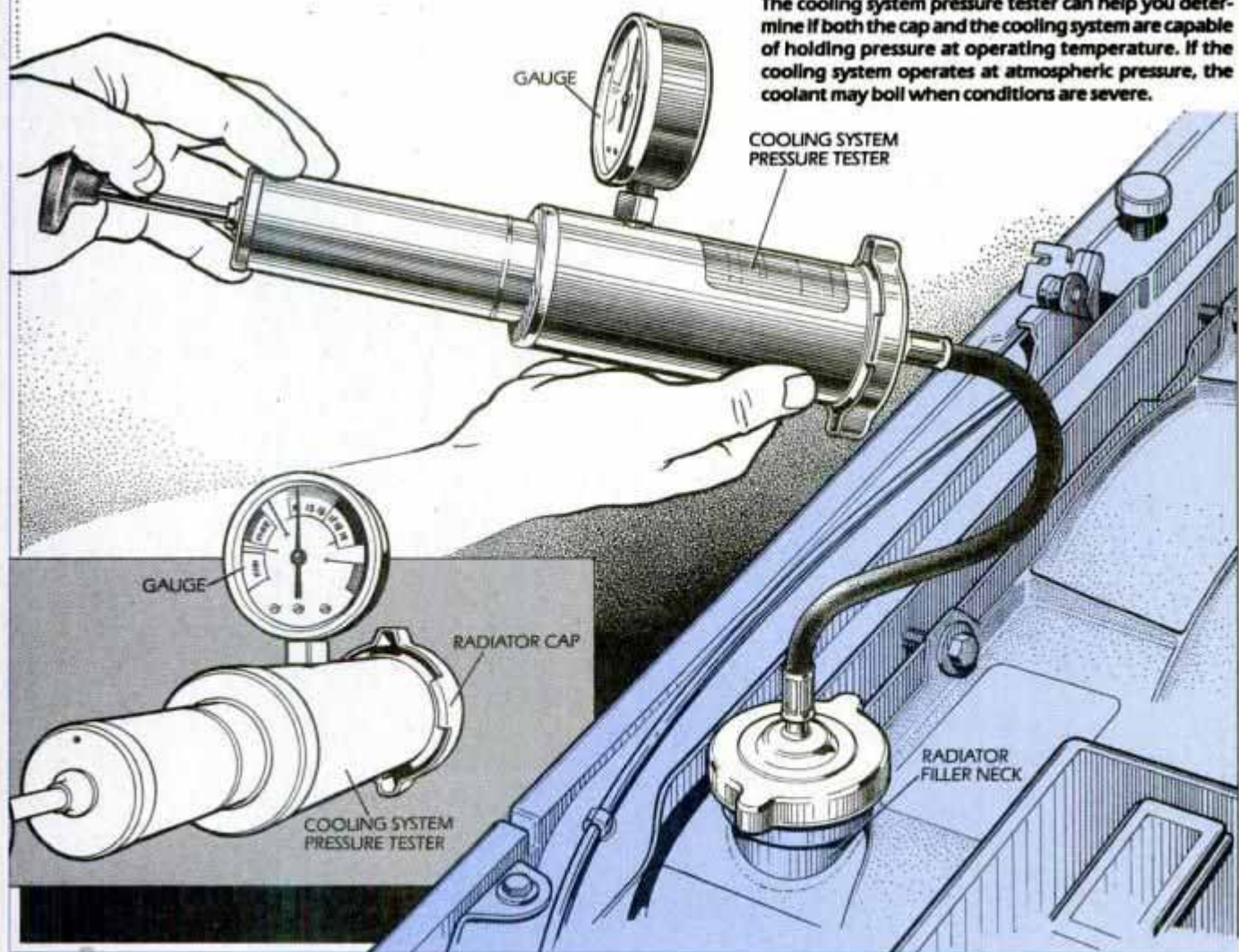
Does coolant escape before your car overheats, or only after the temperature gauge has redlined or the warn-

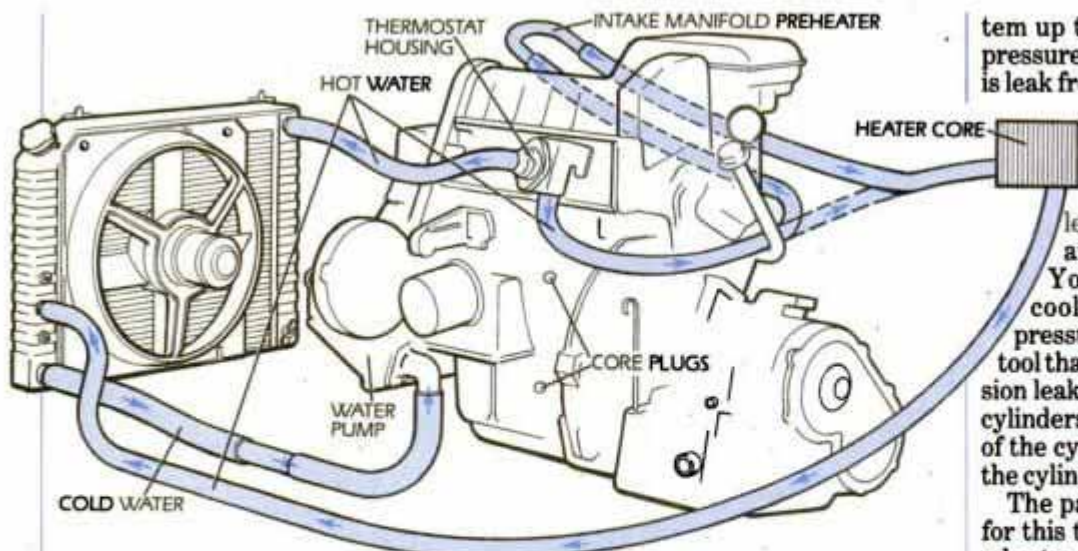
ing light has switched on? Your answer will help determine where you should begin looking for a problem.

Preliminary checks

If your cooling system loses coolant before your engine overheats, begin by looking for obvious visually detectable leaks. With the engine running, check all hoses in the cooling system (Fig. 1). While you're at it, look for cracking, drying out or soft spots that

The cooling system pressure tester can help you determine if both the cap and the cooling system are capable of holding pressure at operating temperature. If the cooling system operates at atmospheric pressure, the coolant may boil when conditions are severe.





1 Water is circulated through block and head by pump, while part is routed to heater core and intake manifold. As engine warms, thermostat opens, sending heated water to radiator. Cool side of radiator returns water to inlet side of pump.

may cause future problems. Carefully examine the exposed radiator. If drips are detected near a hose connection, make sure it's not just a loose clamp. Check the thermostat housing, the radiator drain plug, the coolant recovery tank, heater control valves and the heater core. Sometimes a leaking heater core will spill coolant into the car's interior.

Raise the car on jackstands or ramps, following the manufacturer's recommended jacking procedure. Then, crawl underneath and look for signs of leaking core plugs. You won't have to run the engine to check the core plugs, as the drip should continue for a while after the engine is shut off. What's more, you should find some residue or other visual indication at the point of the leak. If you can't see all the core plugs in the side of the block, use a small dental mirror or a pocket mirror. Some cars have core plugs on the back of the engine block that are hidden by the bellhousing. If one of these plugs leaks, coolant will run out through the vent hole in the bottom of the bellhousing.

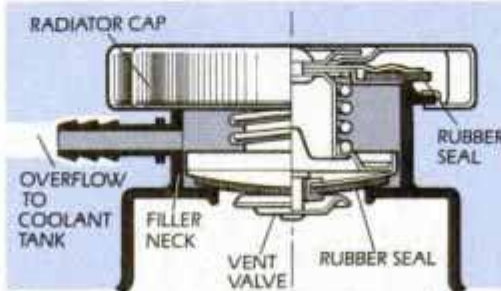
Cooling system pressure test

If your coolant loss isn't due to an immediately obvious leak, you'll have to pressure test the cooling system to determine if there really is a leak (remember, your coolant loss could be just a result of overheating). The pressure-test tool is available at all auto parts stores. It's indispensable for any home mechanic who wants to be able to diagnose cooling system problems.

The tool allows checks of both ra-

diator caps and the cooling system. An adapter is provided for testing the cap. The cap is actually more than a cap (Fig. 2). It's really a system pressure regulator with an internal valve and seal and an external safety valve. The internal valve vents to the recovery tank when pressure in the cooling system exceeds the cap's rating. A second seal keeps air out, but opens to rapidly vent steam in the event of a boilover. A cap that won't keep the system pressurized will lead to loss of coolant as it heats and expands into the recovery tank. What's more, an unpressurized system lowers the boiling point of the coolant, which can result in boilover and coolant loss.

To check the cap, simply attach it to your tester using the adapter and pump up pressure until the tester gauge indicates the amount of pressure specified for your vehicle's cooling system. That figure is in the manufacturer's service manual (or in a general repair manual, like the *Motor Manual*). If the cap won't hold pressure to the specified figure, it must be replaced. Once you're sure the cap is okay, attach the tester to the radiator neck and pump the sys-



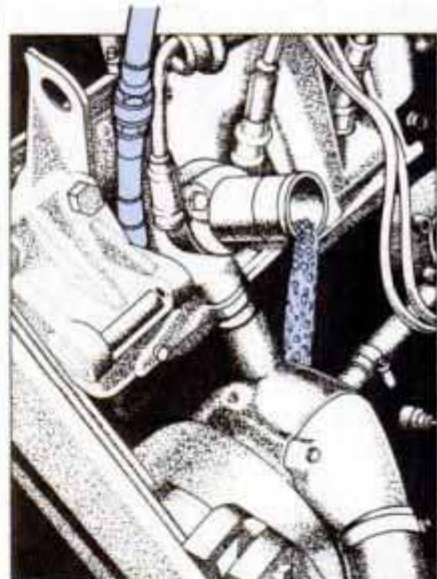
2 Radiator cap vent valve maintains a seal, so system becomes pressurized as the temperature rises.

tem up to the pressure specified. If pressure remains steady, the system is leak free.

Internal coolant leaks

If you can't find an external leak, you should look for a coolant leak inside your engine. You can detect many internal coolant leaks using a cylinder pressurizing tool. This is the same tool that is used to pinpoint compression leaks. It allows you to pressurize cylinders with air. (If air can leak out of the cylinders, coolant can leak into the cylinders after shutdown.)

The part of the tool that you need for this test is the sparkplug air-hold adapter—nothing more than an air fitting that screws into your plug hole. You'll also need an air compressor or a large air tank pressurized to about 100 psi. You can purchase the



3 Use compressed-air fitting to pressurize cylinders and find failed head gaskets or cracked blocks leaking into water jacket.

air hold from an auto parts store, or you can make one by welding an air fitting to the base of an old sparkplug.

To test, remove the upper radiator hose, thermostat housing and thermostat. Reinstall the housing without the thermostat and top off the system with coolant.

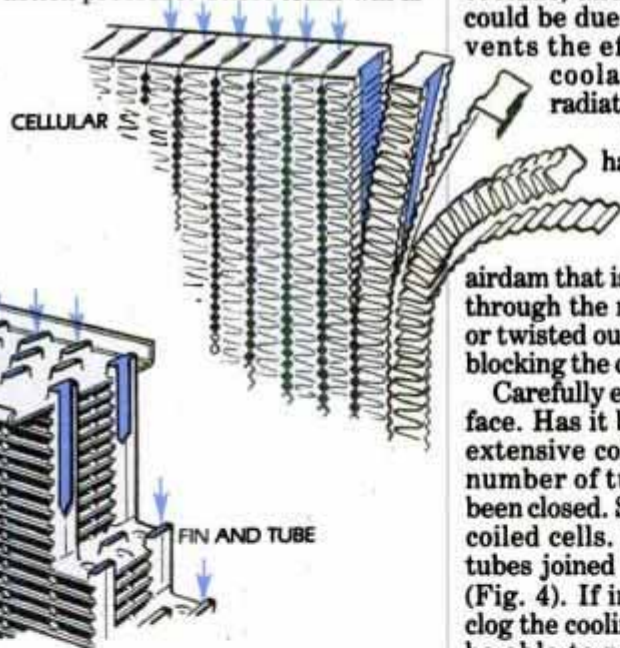
Remove the plugs and install your air-hold adapter into the number one plug hole. Turn the engine to TDC compression stroke for the number one cylinder. Attach your air-compressor hose or the outlet hose of a pressurized air tank to the air-hold chuck/plug adapter. If your engine's well worn and loose, or you have all the plugs out, you

may have to hold the engine with a wrench on the harmonic balancer bolt to keep it from turning. Prop the end of the wrench on something solid—there's plenty of force generated when the air hits the cylinder.

Watch for bubbles of air in the outlet neck (Fig. 3). A cylinder that produces bubbles has a leaking head gasket, cracked cylinder wall or cracked combustion chamber. This kind of internal leak allows combustion gases to escape into the coolant while the engine is running and probably allows coolant to escape into the engine after shutdown.

If you don't want to attempt this test yourself, have a professional mechanic check for combustion gases in your coolant with an emissions analyzer. With the engine running, he can hold the probe of the analyzer over the open radiator. If combustion gases are escaping into the cooling system, he'll get a reading.

Of course, some internal coolant leaks could be in parts of the water jacket that are not exposed to combustion pressure. These leaks will al-

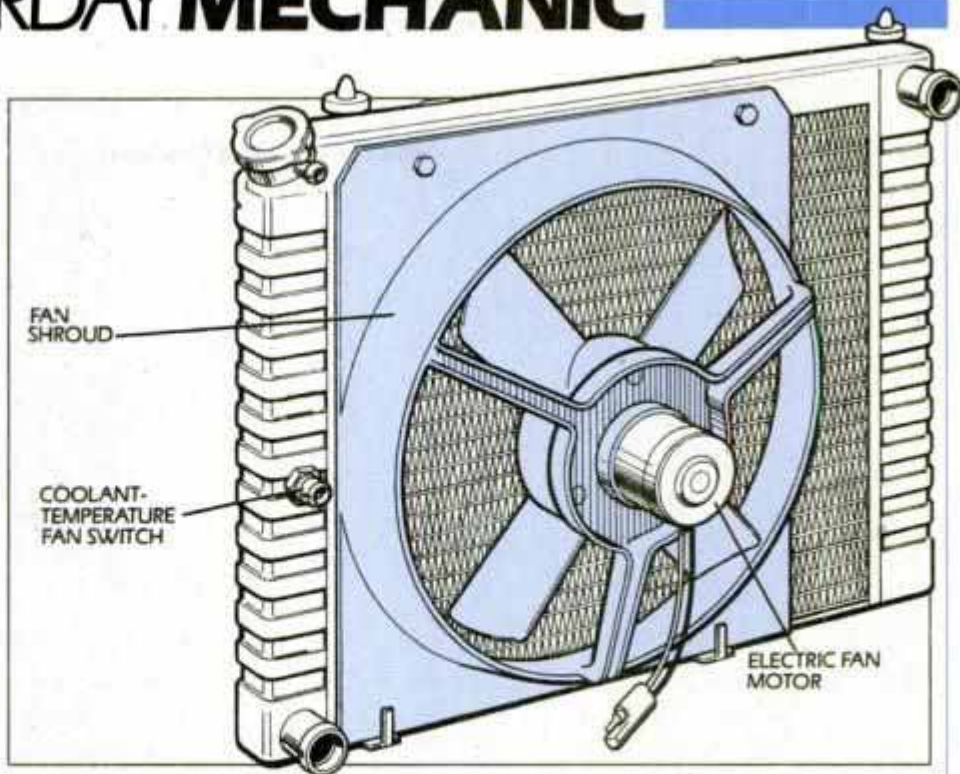


4 Radiators and most heater cores are of cellular construction. Fin-and-tube radiators route the coolant through the tubes.

low coolant to mix with the oil. This is usually detectable by oil condition. Look for discoloration of the oil: It can turn milky or light brown. In less severe cases, you might only notice foam or scum on the dipstick.

Unexplained bollover

What about the cooling system that passes a pressure test and holds coolant just fine until engine temperature reaches blast furnace level? In this



5 If the coolant-temp switch fails, the electric fan won't run when the engine warms.

scenario, the problem is due to something that prevents the normal exchange of heat between engine and coolant, and/or coolant and air. It could be due to something that prevents the effective circulation of coolant or air through the radiator.

Begin by taking a long, hard look at that radiator. Is the shrouding missing or damaged? Does your car have a front airdam that is designed to push air up through the radiator? If so, is it torn or twisted out of shape? Is something blocking the car's grille?

Carefully examine the radiator surface. Has it been repaired following extensive collision damage? If so, a number of tubes or cells may have been closed. Some radiators consist of coiled cells. Others are made up of tubes joined by heat-dissipating fins (Fig. 4). If insects and other debris clog the cooling fins or coils, air won't be able to pass through, and heat won't be exchanged.

Working your way back, take a look at the fan. If it's an electric fan (Fig. 5), it must switch on when the engine reaches a certain temperature. Your service manual can provide a spec, but, obviously, the fan should switch on before the engine overheats. To check it, simply run the car until coolant temperature comes up to the upper end of the normal range and see what happens.

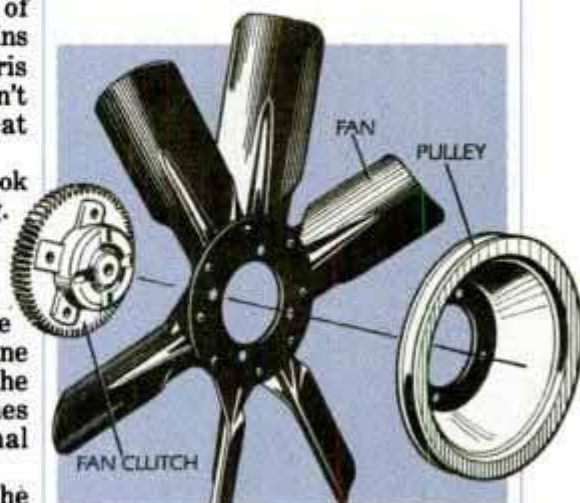
If the fan doesn't work, either the coolant switch that operates it is bad, or the fan motor is shot. You can tell

which it is by hot-wiring the fan to the battery. If it won't run, it's bad. If it runs on direct battery current, the switch is probably defective.

If you have an engine-driven fan, check for missing or misshapen blades. Any fan damage is grounds for replacement even if it doesn't cause a cooling problem, because loose or damaged blades can be deadly if they come off when the engine is running and you're bent over the hood.

Most engine-driven fans are clutched (Fig. 6), so they partially disengage at low temperatures when they're not needed. If the clutch slips after warmup, the engine will overheat.

To check your fan clutch, start the engine cold and listen to the fan as the engine warms. When the clutch begins to engage, the sound of the



6 If the viscous-coupled fan clutch fails, overheating can result.

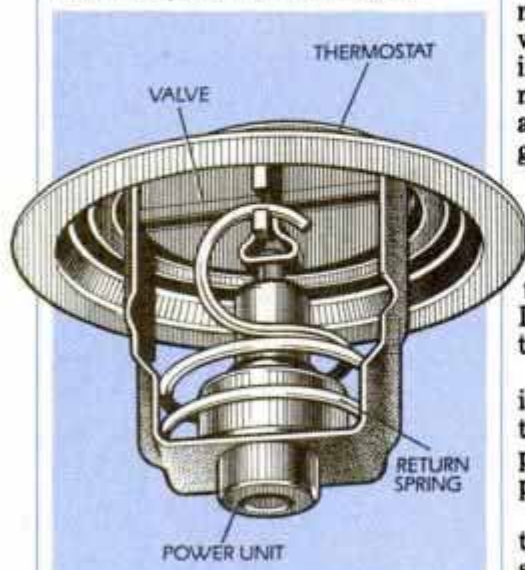
engine should change noticeably as load increases. You can speed engine warm-up by limiting the flow of air through the radiator. To verify your diagnosis, have a helper shut off the warm engine while you watch the fan. If the clutch is engaged, the fan should stop spinning immediately.

Circulation checks

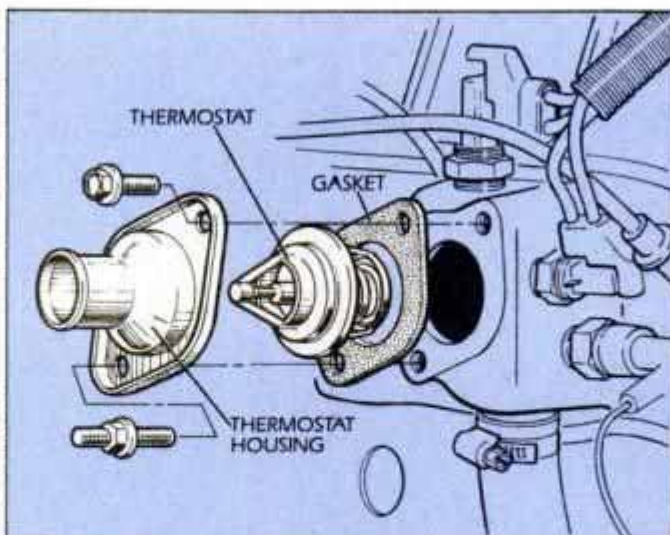
Water pump failure is certainly among the leading causes of overheating, and if your overheating problem is severe and sudden, the pump may well be the culprit. On the other hand, the thermostat (Fig. 7) is just as likely to be the source of your problem.

To determine whether or not your pump is pumping and your thermostat is opening, simply warm the engine to operating temperature with the radiator cap removed. When and if the thermostat opens, coolant should start flowing through the radiator. You'll be able to detect the flow quite readily just by looking through the cap opening. If the engine reaches the point of overheating and nothing is moving in the radiator, either your thermostat isn't opening, or your water pump isn't pumping.

To determine which, you can remove the thermostat after everything has cooled down. As noted above, you'll probably find it under the connector neck housing that joins the upper radiator hose to the engine. If it's not there, check your service manual for specific information.



7 Power unit will push valve open when coolant temp rises to correct temperature.



8 Install thermostat with power unit aimed toward engine block.

To test a thermostat, check for the proper spec in your service manual. Then suspend the thermostat and a thermometer in a pan of water. Heat the water and note the temperature at which the thermostat opens. If it doesn't open at all or opens only partially at the specified temperature, it is the cause of your overheating. (If it opens too soon, it could cause inefficient heater operation and engine condensation.)

Replace a bad thermostat with the recommended unit. Don't think you're doing your engine a favor by installing a thermostat that opens at a lower temperature. A cool-running engine allows condensation of water vapor and subsequent sludging of oil. For the same reason, never operate an engine without a thermostat.

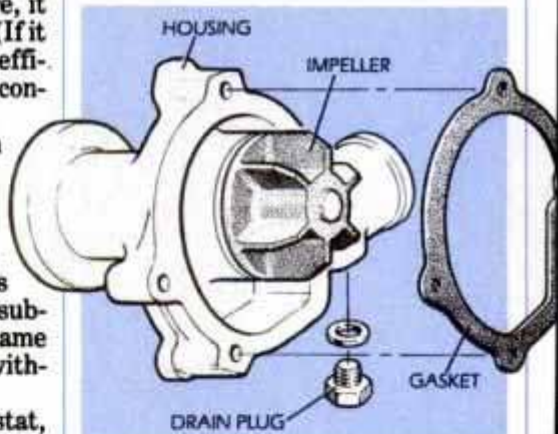
When installing a new thermostat, note which end of the unit goes toward the engine and make sure it fits in the housing recess (Fig. 8). Remove all old gasket material, and use a new gasket or high-temp silicone gasket material as recommended by the manufacturer. If you use a gasket, lightly coat both sides with a nonhardening gasket compound. Reinstall the water neck and torque the bolts to the recommended figure. Don't overtighten: It's easy to crack the neck.

If the thermostat is okay, but there is no coolant flow in the radiator after the engine has warmed, the water pump is defective and should be replaced (Fig. 9).

If flow in the radiator is okay, check the water pump drive belt for signs of slippage. Even a slightly slipping belt can contribute to overheating at high engine speeds.

An incorrect water/antifreeze solution can allow premature boiling of the coolant. If your coolant contains less than 50-percent antifreeze, you're not maximizing your boilover protection. As you increase the percentage of antifreeze above the 50-percent mark, the boiling point rises. However, as antifreeze percentage rises above a 68-percent concentration, freeze protection is lost. Furthermore, a coolant mix that leans too high to the antifreeze side will not dissipate heat as effectively.

Thus, our recommendation is a 50/50 antifreeze/water mix for most parts of the country, including places where the temperature might never drop below freezing. For extremely cold areas, where temperatures might drop to 30° below zero or lower, use approximately 65-percent antifreeze, 35-percent water.



9 Some water pumps are installed with a conventional gasket and gasket sealer.

Cooling system blockage

Okay, everything seems to be working fine, but your engine still overheats. It could simply be the result of dirt and deposits restricting the flow of coolant through your engine and radiator.

If you've been following proper maintenance procedures, which include annual backflushing and refilling of the cooling system, dirt shouldn't be a problem. But if you've neglected your cooling system, some of the passages in your engine could be blocked by corrosion. A professional power backflush and chemical treatment might solve the problem. But teardown could be necessary if other solutions fail.

Where To See—And Hear—Them

Reilly Aviation is just one of the places where warbirds live on. Check the listing for a collection near you.

- **Champlin Fighter Museum**
4636 Fighter Aces Dr., Mesa, AZ 85205
Phone: (602) 830-4540
Open: 10am-5pm, except holidays
- **Pima Air Museum**
6000 E. Valencia, Tucson, AZ 85706
Phone: (602) 574-0462/791-2929
Open: 9am-5pm, daily
- **Planes of Fame Air Museum**
7000 Merrill Ave., Chino Airport, CA 91710
Phone: (714) 597-3722
Open: 9am-5pm, daily
- **New England Air Museum**
Bradley Intl. Airport, Windsor Locks, CT 06096
Phone: (203) 623-3305
Open: 10am-5pm, daily
- **Smithsonian Institution National Air and Space Museum**
Washington, D.C. 20560
Phone: (202) 357-2515
Open: 10am-5pm, daily
- **U.S. National Museum of Naval Aviation**
Naval Air Station, Pensacola, FL 32508
Phone: (904) 452-3604
Open: 9am-5pm, daily
- **Weeks Air Museum**
14710 S.W. 128th St., Miami, FL 33186
Phone: (305) 233-5197
Open: 10am-5pm, Saturday-Sunday
- **Frasca Air Museum**
Frasca Field, Urbana, IL 61801
Phone: (217) 367-8441
Open: By prior permission only
- **Valliant Air Command**
8600 Tico Rd., Titusville, FL 32780
Phone: (305) 266-1941
Open: Not yet open to the public
- **New England Escadrille**
P.O. Box 605, Kendall Square Station, Cambridge, MA 02142
Phone: None available
Open: By prior permission only
- **Kalamazoo Aviation History Museum**
3101 E. Milham Rd., Kalamazoo, MI 49002
Phone: (616) 382-6555
Open: 10am-5pm, Monday-Saturday, 1pm-5pm, Sunday
- **The Air Museum—Planes of Fame East**
14771 Pioneer Trail, Eden Prairie, MN 55344
Phone: (612) 941-2633
Open: 11am-5pm, Saturday-Sunday, Memorial Day through Labor Day, or by appointment
- **Cradle of Aviation Museum**
Mitchel Field, Garden City, NY 11530
Phone: (516) 222-1191
Open: Noon-5pm, Friday-Sunday, May-Oct.
- **Intrepid Air-Sea-Space Museum**
Intrepid Square, W. 46th St. and 12th Ave., New York, NY 10036
Phone: (212) 245-2533/0072
Open: 10am-5pm, Wednesday-Sunday
- **National Warplane Museum**
P.O. Box 159, Geneseo, NY 14454
Phone: (716) 243-0690/9887
Open: 9am-5pm, Monday-Friday; 10am-5pm, Saturday-Sunday (call in advance)
- **Old Rhinebeck Aerodrome**
42 Stone Church Rd., Rhinebeck, NY 12572
Phone: (914) 758-8610
Open: 10am-5pm, daily, mid May-October
- **U.S. Air Force Museum**
Wright Patterson Air Force Base, Dayton, OH 45433
Phone: (513) 255-3284
Open: 9am-5pm, daily
- **Wings of Freedom Air and Space Museum**
Willow Grove Naval Air Station, Willow Grove, PA 19090
Phone: (215) 443-6039
Open: On permanent display along fence
- **Combat Jets Flying Museum**
8802 Travellair, Houston, TX 77061
Phone: None available
Open: By prior permission only
- **Breckenridge Aviation Museum**
P.O. Box 338, Breckenridge, TX 76024
Phone: (817) 559-3201
Open: 8am-5pm, Monday-Friday
- **Confederate Air Force Ghost Squadron Flying Museum**
P.O. Box CAF, Harlingen, TX 78551
Phone: (512) 425-1057
Open: 9am-5pm, Monday-Saturday; Noon-5pm, Sunday

the inferno where it had been center stage. "This is a sad case. The pilot did a gear-up landing a couple of years ago at an air show, with minor damage. But in his haste to leave the cockpit, he neglected to turn off the master switch. A couple of minutes later, the plane caught fire. It went out when it wanted to."

Reilly recognizes the risks of operating these flying WWII relics, 2000 of which are left of the 3 million originally built. But he thinks the benefits far outweigh the risks. "Seeing and hearing these things fly is one of the greatest history lessons a person can have."

Moving over to a very small pile, Reilly identifies it as the junk pile, which he spells "junque" because of its value. "We don't throw out much here," he says. "Most of the stuff that leaves here goes out on the wind in the form of dust."

"It's almost impossible to discover a previously unknown warbird today. Sure, there are still airplanes up in

the woods in Alaska, but you can't touch them. They're treated as national monuments.

"This is my pride and joy," he says, standing next to a pile of parts undistinguishable to the untutored eye from the many others surrounding it. "We found this in a garbage dump in the Aleutians. It's a Curtiss P-40 Warhawk." I comment that it looks like he forgot the airplane and took the dump. He ignores the crack. "There were 10,000 of these originally built, and only 15 are left. Six or seven are in civilian hands."

Reilly continues, bending over to pick up a tattered strip of aluminum, "We're going to have to build everything on this airplane from scratch. The only thing we'll be able to use is the shadow. It will take years."

As we speak, the P-51 screams overhead making a low pass down Kissimmee's Runway 15. A thrill runs through my body as we look up in unison. "That's what it's all about," Reilly says. "That's what it's all about." **PM**



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A special service. Service? Yes. You have already read and heard untold millions of times that "service" is the fastest growing segment of our economy. Is this true? Of course.

On we go.

"I need a service business," is what you say. Naturally, for the best chance of success, you do. Choose one. Dry cleaners. Mailing/Packaging store. Check cashing. Janitor service. Lawn Care. On and on the list goes. Too many to name. Two important things... These service businesses are common. Look around you. There's too much competition. Then, it costs between \$10,000 (bare minimum) and \$100,000 to get started. Let's say \$35,000 average. Agreed? (Please say yes?)

"But I don't have it," you say. Calm down. Flip your imagination button on. Let's, for one eternal second, pretend that you do have the dough. Lo and behold, you are now lucky enough to own the same type of business as thousands of others. If you work like a madman 16 hours a day you might get your investment back in a year. (Or maybe never.) Isn't that a sobering thought?

A TOTALLY UNIQUE BUSINESS

Now, what if I set you up in your very own totally unique service business? Taught you how to rake the cash in? Big time. What if I told you to forget the \$35,000 nonsense? Forget waiting a year to make profits? Forget the risks? Forget about competition? Forget working from dawn to dusk? Is this possible? Read on.

We are all ignorant, only in different areas. And we are all brilliant, only in certain fields. As true and profound as this statement is, I can surely make all these delightful, blissful things happen for you, so you can pocket \$500 a week - minimum*. Yes. I will do all of this for you at MY risk. Here's what you must do...

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Fully refundable deposit? What do you mean? After your 6th transaction, I'll refund every penny of your \$39, so you actually get your special business for FREE.

TAKE A FREE LOOK

What's more, because I know you're skeptical, you get my special business kit on a NO-RISK 10 DAY FREE TRIAL AND INSPECTION. Use it. Actually make money. See for yourself. Then if you aren't 10 feet off the ground, if your eyes aren't as big as saucers, return it. You get your money back. Full refund. No hard feelings. No hassles. Someone else is waiting to take it.

YOU RECEIVE 66%

Why would I do all this for you? Simple. I actually provide the service to the customer, not you. You receive a whopping 66% of the money from each transaction. I keep the rest. The more money you make, the more money I make. My success is riding on your success. And the best part is that the customer wants, needs and most importantly, really benefits from this totally amazing service.

PARTICIPANTS ARE SEVERELY LIMITED

What you have to understand is that I am severely limiting the number of participants, otherwise the market will eventually become saturated and no-one will make any money. Honorable friend, this is first come, first serve. No jokes.

Think of this offer as an airplane which is about to crash, and all of you are the passengers. I hold a limited number of parachutes. Not enough for everyone. All the shouts, all the prayers, all the tears, all the hopes, all the everything, will not make any more parachutes appear. Hundreds, just as honest, just as worthy, just as deserving as you, will go down. I can only save as many as I have parachutes for. So get in before the crowding, before the waiting lists, before the howling and performing, because then it's too late. Do it now at my risk.

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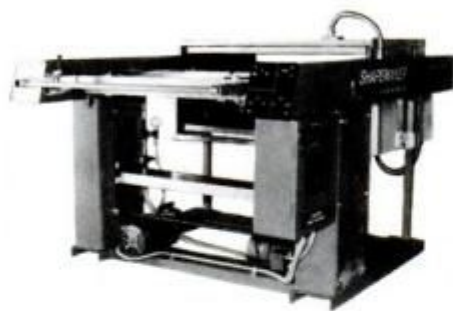
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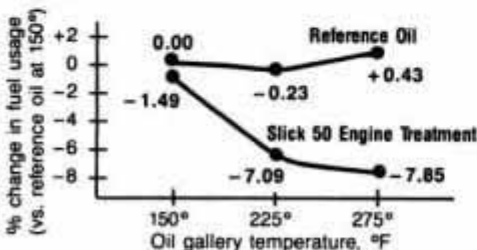
"Slick 50 does reduce engine heat and ordinary wear, and our informal tests indicated that it will improve gas mileage by about two or three miles per gallon . . . Slick 50 does exactly what Petrolon claims it does." *Consumer Digest* (Mar/Apr 1982, p. 35)

In 1989, the premiere engine and lubricant testing lab in the U.S. tested Slick 50. This EPA recognized lab conducted a strictly controlled experiment using industry standard ASTM procedures. Results showed Slick 50, compared to a standard reference oil, reduces engine wear by more than 50%. Be cautious of those Poly treatments that cannot back up their claims with such solid evidence.

In a fuel usage test conducted by this same prestigious lab, results showed that Slick 50 (compared to a standard reference oil at 150°) reduced fuel consumption in the test engine by 7.09% at an oil temperature of 225° and 7.85% at 275°. Once warmed up, most cars operate within the range of 225° to 275°.

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TUV, a prestigious German testing laboratory, tested Slick 50 and found substantial increases in both gas mileage and horsepower. The Space Shuttle Columbia uses the chemical "Poly" in its gears and bearings because it is the only chemical lubricant which can withstand the heat and corrosive elements of space.

The Cranfield Institute, known worldwide for its work in tribology (the study of friction), concluded a five-year study on Slick 50 in 1989. Results showed Slick 50 does indeed coat metal surfaces, dramatically reducing friction and extending the life of metal.

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3. Reduce operating temperatures, thus increasing the lubrication and life of the oil and engine
4. Minimize or eliminate costly overhauls by drastically reducing engine wear
5. Easier starting (important in cold weather)
6. Since lubricating lead is being removed from gas, and unleaded gas is poor in lubricating qualities, this extra lubrication of Slick 50 on valve systems and guides is a real bonus.
7. Slick 50 eliminates the "lubrication starvation" that all cars experience when you first

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